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Lesson Plan
Who Will Feed China?
Lester Brown
World Watch Institute, 1995

Introduction

The inspiration for this unit came from reading Lester R. Brown's book *Who Will Feed China? Wake Up Call For a Small Planet*, copyright 1995, by Worldwatch Institute. Much of the content text of this unit is taken directly, or paraphrased, from the book. The content is organized by the book's chapter titles to allow teachers and students to check the data for themselves.

Students are encouraged to focus on a current international situation: the pressures placed on physical resources by a growing population and political and economic policies, which aim to integrate China into the international economy. Specifically the issue is supply and demand of grain for China's 1.2 billion (and growing) population.

Students are encouraged to use the geographic frame of reference, or model, included in the unit as an intellectual tool to categorize and organize data and as a mechanism to identify relationships. The unit also encourages concept development and as identification of generalizations with transfer value. Of course, the unit is multidisciplinary and may be used in social studies, history, science or language classes.

Additional references are provided for those who wish to pursue a more in-depth study. *Who Will Feed China?* can be ordered from Worldwatch Institute, 1776 Massachusetts Ave. NW, Washington, DC. 20036 or by calling 1-800-555-2028, or wwpub@world_watch.org. along with other books and resources that can be valuable to teachers interested in studying international resource issues.

Why Is This A Geography Lesson?

Because it focuses on a major problem of one specific place, China. The lesson looks at selected physical and culture characteristics and shows how they are related in this place. It also shows how this place (China) is related to other places. In studying a specific place related problem (food shortage in China) it involves aspects of both regional and systematic geography.

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Teaching/Learning Objectives

Cognitive:

To understand that:

1. Geography, as a discipline, is concerned with the location, arrangements and relationships of physical and cultural data in place.
2. As the human population of a place increases, additional pressure is placed on the physical and cultural environments and on the resource base.
3. As the level of technology of a population increases, that additional pressure will probably be placed on the physical and cultural environments and on the natural resource base.
4. An increase in per capita income tends to encourage a people to make decisions that will place increased pressure on the physical and cultural environments and on the natural resources base.
5. As increased pressure is placed on the physical and cultural environments and on the natural resource base social and political changes will occur and suggest the establishment of governmental policies.
6. As land is changed to industrial and urban uses, agricultural uses usually diminish.
7. As agricultural land diminishes in area total agriculture production is lowered unless technological or procedural practices are changed to increase output.
8. Means to increase agricultural production per unit area are finite.
9. Land, to be agriculturally productive, must meet minimum level of fertility, have access to water and have locational attributes that are positive in relation to access to markets.
10. The loss of a needed agricultural product will necessitate its import from an outside place, which, in turn, requires payment in cash, goods or services.
11. The nation of China wants to industrialize in order to advance in the world's economic structure and to increase the per capita income of its people.
12. As China's population gains in income, changes will involve a more complex diet and the use of modern machines and household appliances.
13. Lifestyle changes in China will be initiated unevenly over the nation's spatial expanse.

14. If China enters the world trade market as a large importer of grain, the price of that product will increase. This is true of all food products.
15. China does not have the option of obtaining dietary protein from seafood to the degree that will develop in Japan, Taiwan and other countries because that would require more than the fish catch of the entire world.
16. Until the 1990's China's population obtained 70% of its dietary calories from grain products, primarily wheat in the north and rice in the south.
17. The official reaction to a food crisis in China has been mixed.
18. Some experts feel that China's dilemma is an example of other countries that are pursuing demographic and economic policies that are environmentally unsustainable.
19. Some experts feel that people should not be overly concerned about world food shortages because scientific advances will solve the problems.
20. Virtually all experts agree that there is a problem with worldwide food distribution, if not the supply, but they do not agree on solutions.

Affective:

To appreciate:

1. The size and diversity in China's physical characteristics and human population.
2. The reality of a population of 1.2 billion people and the impact of their basic needs on resources and the physical environment.
3. The difficult political task of trying to meet the basic needs of the Chinese people while attempting to integrate the nation into the world economy.
4. The synergistic forces that operate in a complex society as it changes from an agricultural to an industrial mode.
5. The basic physical and cultural/population character of the nation of China and the primary differences in the north, south, west, interior and coastal regions of the country.
6. The desire of those Chinese people, whose income is increasing, to want to diversify their diets and to own cars and larger, more modern homes.

7. The attributes of geographic methodology to describe and contribute to the solution of spatial problems.
8. The importance of investigating the various aspects of a problem including the consideration of the views of different knowledgeable people before you make your decision.
9. The fact that national policy decisions in the 21st century world economy may impact average citizens around the globe.
10. The importance of protecting farmland and water resources around the world to help ensure a food supply for all of its citizens.
11. That a food crisis in a strong nation could instigate a dangerous military conflict.

Psychomotor:

To develop skills in:

1. Reading maps, charts, and graphs.
2. Structuring a problem to encourage analysis through looking for spatial patterns and relationships.
3. Using a geographic model to aid in problem solving.
4. Using the World Wide Web to locate data in order to solve, or at least better understand, a problem.
5. Research and integrate data from multiple sources as an aspect of problem solving.
6. Developing the skill of organizing and analyzing an on-going problem so that its study may be continued.

Sample Concepts and Generalizations

Concepts

Production

Consumption

Hectare

Industrialization

Economic sustainability

Environmental sustainability

Import/export trade

Import/export balance

National population policy

Multiple cropping

Water diversion project

Biotechnology

Unequal distribution of resources

Population supporting potential (carrying

capacity)

Generalizations

- If countries become densely populated before they industrialize, they inevitably suffer a heavy loss of cropland.
- If industrialization is rapid, the loss of cropland quickly overrides the rise in land productivity, leading to a decline in the production of crops such as grain.
- The same industrialization that shrinks the cropland area does increase income, and with it the consumption of animal products and therefore, the demand for grain.
- Strong international demand for a product has an impact on local prices for that product.
- A rise in per capita income has an impact on personal life choices and on resource use.
- Increases in national levels of living create competition for a country's resources.
- Animal food sources are less efficient in the net calorie ratio between production and consumption than are vegetable sources.
- An increase in a family's per capita income increases their per capita use of water.
- Food shortage can be the motivation for military aggression.
- The capability to be self-sufficient in food production is an important aspect of national security.

Who Will Feed China?
By Lester R. Brown
SELECTED CONTENT

Introduction

- Editor's note states that *Who Will Feed China?* does not aim to point a finger at just one country and say future world's scarcity rests on decisions made there. The goal of looking at China's food prospects for the next several decades is to highlight the unsustainability of many national economic and population trends.
- If countries become densely populated before they industrialize, they inevitably suffer a heavy loss of cropland.
- If industrialization is rapid, the loss of cropland quickly overrides the rise in land productivity, leading to a decline in the production of crops such as grain.
- The same industrialization that shrinks the cropland area does increase income, and with it the consumption of animal products and therefore, the demand for grain.
- Before China, three countries, Japan, South Korea and Taiwan were densely populated before they industrialized. (Fig. 1.1)
- These three countries can be used as a guide to see what is likely to happen in China. Within thirty years each of these countries has gone from being largely self-sufficient in grain to importing most of their supplies.
- *The Times of India* quoted a Chinese official as saying, "we are giving priority to agricultural productivity. Our family planning program has been very successful. Science and technology and economic growth will see us through." Some Chinese officials have said in answer to the question "the Chinese people will feed themselves."
- In 1995, reports from China begin to change. One official indicated that the question regarding feeding China was "sounding of alarm bells," said another, "the task is a very hard one." President Jiang "warned that lagging agricultural growth could spawn problems that would threaten inflation, stability, and national economic development." He further stated "that some developed coastal areas where industrialization was particularly rapid had suffered a precipitous drop in the amount of acreage under cultivation," and added that this is "a trend that must be reversed ... this year." Another official indicated that China had to pay more attention to the sector (agriculture) they had neglected in their effort to industrialize.

- China, a county of 1.2 billion people, continues in the year 2000 on its path of rapid industrialization.
- The question regarding the feeding of China is a part of the world trend that is “now on a demographic and economic path that is environmentally unsustainable” – Lester R. Brown.

Overview: The Wake-Up Call

- China may soon emerge as an importer of massive quantities of grain – quantities so large that they could trigger unprecedented rises in world food prices.
- The shortage of grain worldwide could parallel the shortage of marine resources as higher technology has allowed fisherman to deplete, and in some places threaten extinction, to several varieties of food fishes.
- An international demand for grain could drive up prices that would greatly affect bread, cereal, and all other grain food prices in the United States as well as the rest of the world.
- China is only one of scores of countries in this situation. It just happens to be the largest, and by an accident of history, the one that tips the world balance from surplus to scarcity.
- The demand for food in China could climb dramatically as industrialization accelerates and incomes rise.
- Rapid industrialization inevitably leads to a heavy loss of cropland, which can override any rises in land productivity and lead to an absolute decline in food production.
- The examples of Japan, South Korea, and Taiwan show that the conversion of grain land to other uses, combined with the decline of multiple cropping in these countries over the last few decades, has cost Japan 52% of its harvested area; South Korea, 46%; and Taiwan, 42%.
- Possible partial solutions would be to increase the effectiveness in grain yield per hectare. However, this is questionable because China has made considerable gain in this area in the last twenty years.
- The fact that China’s grain production might fall is not the result of agricultural failure, but of industrial success. China’s record in agriculture is exceptional. Between 1950-94, grain production increased nearly four-fold. (Fig. 1.2)
- Another possible part of the solution is to be more effective in protecting its croplands from change to industrial, residential, recreational and transportation

uses. Nevertheless, building the thousands of factories, warehouses and excess roads that are an important part of industrialization process inevitably mean sacrificing cropland.

- Much of China's cropland is dependent upon irrigation water, and industrialization also provides competition for that water. This is important when half of the cropland is irrigated and nearly four-fifths of the grain harvest comes from irrigated land.
- Even with 1.2 billion people China in the late 1990's is not facing starvation.
- As incomes rise, one of the first things that low-income people do is diversify their diets, shifting from a monotonous fare in which a starchy staple such as rice supplies seventy percent or more of the calories, to a diet that includes meat, milk, and eggs. As consumption of beef, poultry, eggs, and milk, and other livestock products increases along with income, grain prices rise rapidly because animals compete with humans in the consumption of grain.
- In Japan, the increased demand for grain driven by prosperity combined with heavy loss of cropland caused that country to import 72% of its total grain consumption in 1994. These same forces are now at work in China. However it is one thing for a nation of a 120 million people (Japan) to turn to world market for most of its grain. But if a nation of 1.2 billion moves in this direction, it will quickly overwhelm the export capacity of the United States and other countries, driving food prices up everywhere.
- Small increases in grain prices are desirable to China's leaders in order to keep farmers on the land due to increased profits. However, they do not want an increase of so much that it creates urban unrest that can lead to political upheaval.
- As China's industrialization proceeds, factory workers incomes increase much more rapidly than those of farmers. This causes farmers to leave their small, and in some cases marginal land, to go to the city to make more money. As hundreds of thousands of small farmers leave small plots, grain output decreases.

Another Half-Billion

- Predictions are that by 2017 China's population will be 1.5 billion, equal to the world's entire population in 1900. Its growth is expected to peak at 1.66 billion in about 2045, after which it should start to decline slowly. (Figs. 2.1 & 2.2)
- Asia has many more people per hectare of grain land than Europe does. The grain land per person in China in 1994 was roughly half that in France, and the land is inherently less fertile. Western Europe's smaller population occupies more productive land and its population growth has stopped. That region's population

demands on its land and water resources have stabilized. In the late 1990s Europe actually exports some grain(Shen, 1998).

- China is about the same size as the United States, but the big difference is that the Western half of China is largely inhospitable to human habitation due to a lack of basic life supporting soil and water resources.
- Historical Background – After World War II China was able to feed itself (500 million plus people). In the late 50s, during the Great Leap Forward program millions of farmers were diverted to large construction projects, including roads, huge dams, and backyard steel furnaces. The movement of this labor from agriculture caused a massive food shortage. Official records now show that nearly 30 million Chinese starved to death between 1959 and 61. The demographic affect of the famine extended far beyond these deaths. In 1960 during the heart of the famine, deaths in China actually exceeded the number of births. This has left an indelible imprint on China’s national psyche.
- China has been faced with the problem of encouraging families to have more children in order to have more workers for industry, while at the same time fearing a repeat of the 1959-61 famine. History shows us that when Europe became over populated, or if people became unhappy, they moved to the New World. Today, there is no place for the Chinese to go. The sparsely settled western part of the country is just not habitable and the lifestyle and culture of many of the people in far western China is oriented toward the Muslim West rather than the Oriental East. By 1979 Chinese leaders opted for a policy of one couple/one child. This policy ran into heavy resistance. One source of difficulty was that in China the strong preference for male children lead to widespread female infanticide. This illustrates that political conflicts can develop within a society that is overrunning its human carrying capacity. If China could sustain this one child family policy its population size could stabilize sooner rather than later, and fall short of the projected 1.66 billion people. Although the one-couple/one child policy was rescinded there was a call in 1995 to renew it because at the present time (1995) the population growth rate of China is 1.1%, roughly the same as that of the United States. That is a very low growth rate. However, there is the potential for it to increase significantly. President Jiang pointed out that “the rapid increase in big population base has a direct bearing on the problems of food, jobs, education, resource destruction, environmental protection, and an imbalance ecology.”

Moving Up The Food Chain

- As Chinese diversify their diet to eat more beef, pork and poultry etc. they need to take more land out of grain production and put it into animal feed lots. In the United States a major share of US beef production comes from grass. China, however, does not have vast range lands and therefore its animals, sheep, cattle or pigs, are keep in feed lots where they are fed grain that could be used to feed

people. More meat means more grain loss for humans – 2 kilograms of additional grain for each kilogram of poultry, 4 for pork, and 7 for each kilogram of beef added in the feed lot. Government policy encourages production of chickens because they convert grain into meat more efficiently than do pigs or cattle. (Figs. 3.1, 3.2. Table 3.1)

- For China, it would be tempting to turn to the oceans for its animal protein as population pressure on the land intensifies, as Japan did. However, with the population pressure throughout the world on ocean resources at the present time argues against China's following Japanese lead. If China, with a population that is ten times larger than Japan, were to turn to oceans for a similar dependence on seafood for animal protein, it would need 100 million tons of seafood, an amount that matches the world's total fish harvest in 1994.
- Future growth and the demand for fish would have to be satisfied largely by fish farming. This, in turn, increases the demand for grain by roughly 2 tons of grain for each ton of fish produced, putting yet another demand on the country's shrinking grain fields. Rising grain prices, combined with the need to use scarce land and water resources for fish farming, will constrain the growth in fish consumption.
- As the Chinese diversify their diet they are also acquiring a taste for beer. It is sobering to think that to provide just one beer for each adult takes an additional 370,000 tons of grain.
- The improvement in the diet of the Chinese population demands the use of more vegetable oil. This in turn takes more land out of grain production for the production of soybeans. The same is true with China's very rapid increase in its consumption of sugar.
- With the cropland base shrinking and with water shortages spreading, much if not all of the growth in demand for food in China translates directly into imports. Given the scale of China's projected needs, this would put pressure on world supplies, affecting food prices everywhere.

The Shrinking Cropland Base

- In 1984 the shrinking cropland base caused the government of China to issue a directive restricting the use of traditional burial grounds because that practice consumed too much scarce land. Instead, Beijing encouraged cremation of its dead.
- China is a large country, but only 1/10th of its land is cultivable. Most of this land is in a strip along the eastern coast.

- Not only is the cropland area per person one of the world's smallest, it is shrinking rapidly. In 1995 the *Economic Information Daily* of China said that "a land crisis is approaching...if farm land loss continues at present rate, China will suffer a serious problem of lack of food by the beginning of the 21st century." Compare with Japan, South Korea and Taiwan (Figs. 4.1, 4.4)
- In countries that are densely populated before industrialization begins, at least four distinct trends affect the grain-harvested areas. One is the conversion of cropland to nonfarm usage, including the construction of factories, housing, and roads. Second is the abandonment of cropland that is marginal either because its fertility is too low or because plots are too small. Third is a decline in multiple cropping. And finally, as income rises it drives up the demand for, and prices of, fresh fruits and vegetables. Farmers shift land from grain production to these more profitable crops.
- Creating industry and jobs requires land. Shifting 100 million workers from the farm labor force to the industrial sector means building 1 million factories. Each factory needs warehouses, access roads, and homes for the workers.
- Another consequence of rising affluence means an increase in living space per person resulting in larger homes.
- Another trend of the Chinese population, and supported by government policy is to have people with money trade in their bicycles for cars and developing an automobile industry is a major goal of the government along with telecommunications, computers, and petrochemicals. The increase of the number of cars in China by twenty times to 22 million by 2010 will require millions of hectares of land for roads, service stations, and parking lots. The Chinese government is now launching a highway construction program that includes four trunk routes that span the country in different directions. From northeastern Heilongjiang province to the southern island of Hainan. The second will go from Beijing to southern Guangdong province and a third will link Jiangsu province on the East Coast with Xinjiang in the far northwest. The last one will link Shanghai, to Sichuan province in the southwest. A short super highway linking Hong Kong and Guangdong is a self-financing, toll road (\$13-per vehicle) and consumed a broad swatch of cropland, including some of China's most productive riceland.
- In addition to factories, housing, and roads, farmland is also being claimed by shopping centers, tennis courts, golf courses and private villas. An estimated forty golf courses have been built in the newer affluent Pearl River Delta Region in Guangdong province. Concern about this land use has encouraged the land bureau to cancel the construction of all golf courses planned but not completed.
- Closely associated with growing affluence is a growing demand for fresh fruit and vegetables. This is especially true in booming coastal provinces in the south.

Spreading Water Scarcity

- Water is a resource demanded by successful agriculture. Water use has increased by six fold – due to population growth, irrigation expansion, rising affluence, and industrialization. One hundred Chinese cities are in very short supply of water. In large areas of North China, demands are being met by depleting aquifers.
- China had more irrigated land than any other country in the world.
- As in several areas of the world, increased irrigation from ground water will deplete the ground water supplies totally. In a move that works against the production of food, the government banned farmers around Beijing from using water from reservoirs from which they drew their irrigation supply. These farmers have converted to less intensive rain-fed farming which results in much lower yield than the irrigated farming. The pumping of under ground water in large areas in Northern China is exceeding the recharge rate of aquifers. A rise in income not only diversifies the diet, but it leads to building homes with indoor plumbing and the acquiring of modern kitchens which include appliances which have a high demand for water.
- Some have suggested the movement from Northern China to Southern China of the water intensive industries. This would encourage the loss of more agricultural land.
- Another suggested solution is to build an 860-mile canal that will bring water from the South to the water-deficit North. The cost of this project would be enormous and the environmental challenge would be almost impossible because it must cross 219 rivers and streams including the Yellow River in route to Beijing. Another partial solution to the water resource problem is to try to eliminate the waste in China's use of water. As in most of the world, water is supplied free or greatly under priced and therefore is used inefficiently.
- Water rationing is also a potential policy to save water however such policies work against the encouragement of multi-national corporations, leisure hotels for tourists and housing developments which China is encouraging.

Raising Cropland Productivity

- An increase in the yield per hectare of rice, wheat and corn can contribute marginally to meeting the grain crisis. Rice and wheat of course, are the two national staples in China's diets with rice dominant in the South and wheat in the North... Some corn is also consumed as food, but most of that harvest is now feed to livestock.

- Some governmental reactions to the food crisis are met by indicating that increasing yield will help solve the problem. However, many of the steps to increase yields have already been taken, such as providing land reform and giving farmers long-term leases. This gave the workers incentive and between 1977 and 1984 they enjoyed a 50% increase in grain production. During this same period a dramatic rise in use of fertilizer took place and those benefits cannot be repeated. Finally the use of irrigation, which could improve yield, tends to be on a decline rather than increase. Some increases in yield may be made in the production of rice due to the breeding of new seeds. (Table 6.1)
- Wheat yields per hectare fluctuate due to agricultural practices, supply and demand, weather, plant disease, etc. (Fig. 6.2)
- Some increase in yield may be developed through biotechnology when research goals are achieved to increase insect and disease resistance in plants.
- Soils in China tend to be low in organic matter simply because crop residues-straws corn stalks, and so on –are typically removed from the field and used either for forage or fuel.
- As non-farm wages climb, workers have left agriculture reducing the amount of multiple cropping.

The Growing Grain Deficit

- In 1950 Japan depended on grain from other countries for 25% of its total. By 1985, this had risen to more than 70% where it has remained through the 1990s. China in the mid 1990s may now be where Japan was in the early 1960s. (Fig. 7.2)
- There are several key reasons why China's grain deficit could grow even faster than that of Japan. One is the lack of seafood option, the second is the fallen water table under much of Northern China, and third, China does not have the opportunity to increase production to the same degree as Japan did.
- In light of the above, one way China might help decrease its demand for grain is to discourage any further rise in the per capita consumption of animal products. A second scenario assumes that the population makes the decision to slow their move up the food chain to a more western diet. This will include changing a social policy that would increase the consumption of 400 kilograms of grain by the year 2030 from the present 300 kilograms. This can be compared to the US per capita grain use of more than 800 kilograms per year.
- Even if China's booming economy produced no gains in consumption per person of animal products, a projected 20% drop in grain production would leave a short fall of 207 million tons-roughly equal to the world's entire 1994 grain export.

- But, if China's newly affluent population does not forgo increase consumption of livestock products, and per capita gain in grain consumption reaches 400 kilograms in the year 2030, total demand for grain would cause China to import nearly twice as much grain as it does in 1999. (Fig. 7.5)
- The head of the Chinese Academy of Sciences observes that the failure of China to recognize the possibility of a grain deficit could lead to a global food crisis.
- With increasing grain prices the government fears inflation and they are reluctant to either ration food or to have a policy to depend on imports.
- It is generally accepted as fact that China cannot continue to industrialize and remain self-sufficient in food.

Competition For Grain

- China has developed a political policy to build an auto-centered transport system, which will claim a vast amount of additional cropland.
- If China follows such policies, will it have enough foreign exchange to import the grain it needs? Secondly, will the grain be available?
- China's non-agricultural exports are growing by leaps and bounds. Many products from cloth wears to electronics are being fabricated in China because of its vast pool of cheap labor.
- In the mid 1990s, China had a very large trade surplus with the United States. China could buy all of the US grain imports it produces even if grain prices doubled. This however, would increase prices in the U.S., and it would keep grain from more than 120 other grain-deficit countries.
- In the mid 1990's China exported over 62 billion dollars of goods to the United States while importing only 13 billion dollars of goods from the U.S.
- Assuming China's grain output diminishes and it depends on imports, which would add to the competition for grain worldwide, the question is who could supply grain on this scale? The answer: no one. In the economic world, the price of grain will rise, reducing consumption and imports by stimulating production and exports until a new balance was reached. Many poor, hungry nations will be forced to do without grain.
- By 1990, North America dominated the world export grain trade, lesser players were Western Europe, Australia and New Zealand. Many developing nations, not just China, will need these exports. (Tables 8..2, 8.3)

- In 1990 North America exported 110 million tons of grain. Western Europe, 27 million tons and Australia/New Zealand, 14 million tons. Of these sources, only in North America is it possible to increase the supply to any significant degree.
- Within Latin America the country of Argentina is a traditional grain exporting country. However, like Canada, Argentina faces a conflict between growing grain and soybeans for vegetable oil.
- Other possible sources of grain export include Eastern Europe and Russia (wheat), and Thailand for rice.
- Producing more wheat in the United States provides another irrigation problem. Much of the land that had been taken out of grain in the central and southern Great Plains depends on water from the Ogallala aquifer, which in some places has already been depleted and is in a general state of depletion. In the United States, water demand in cities such as Los Angeles, Phoenix, Denver, Las Vegas and others will further reduce the water available for irrigation in the southern Great Plains and the southwest due to urban growth.
- A second constraint on the growth of US production is the common problem of the loss of cropland due to non-farm usage.
- There is a question as to what possible long-term climate changes will do to grain production. Most considerations for change will lower grain production due to less rainfall.
- Competition to China for world grain supplies will be enhanced due to the projected tripling of populations in countries like Iran, Nigeria, and Ethiopia among others.
- A point of consideration is that competition for grain imports in the years ahead is likely to intensify dramatically even without China's emergence as a massive importer.
- It appears that the grain market is to be changed from a buyers' market to a sellers' market, which will limit the availability of grain for some people and raise the price of grain worldwide.

Facing Scarcity – Entering A New Era

- As we move into 2000, an age of relative food abundance is being replaced by one of scarcity. As the one-fifth of humanity who live in China seek to join the affluent one-fifth already living high on the food chain, the transition in the new era will be accelerated.

- “Why do China’s leaders stoutly maintain that they will never become dependent on imported grain? Perhaps they genuinely believe that the phenomenal rises in land productivity that followed the economic reforms of 1978 will somehow be sustained indefinitely into the future. Or it could be they are simply practicing a form of denial. For the Chinese who barely survived the great famine, it must be unbelievably difficult to accept the insecurity that is associated with becoming heavily dependent on the outside world for food”.
- As China’s grain imports rise, they are likely to drive prices upward, making it increasingly costly to import on the scale projected.
- China can reduce its growing dependence on imported food in a number of ways. One is to stabilize population. Two, they can alter their industrial policies in a way that will save cropland. They can change from a policy of an automobile-centered transportation system that will inevitably consume vast amounts of cropland to a modern national rail transport system. This will encourage a bike-to-train commute system that works in Japan and the Netherlands. Three, in terms of saving water they can charge the full cost of supplying water which will tend to eliminate waste. Four, the country can officially adopt a policy that will slow the population moving up the food chain.
- In summary, major problems include diminishing response of crop yields to additional fertilizer use, the growing scarcity of fresh water, the shrinking back log of unused agricultural technology, the social disintegration that occurs when great numbers of people move and change their jobs and the heavy loss of cropland.
- Since 1990, there has been a small decrease in the world grain harvest as well as in the world fish catch.

Priorities In An Age Of Scarcity

- The earth’s capacity to produce enough food to satisfy our expanding demand is now emerging as the overriding environmental issue as the world enters the 21st century.
- Whenever demand outruns supply in the economic marketplace, prices rise, reducing demand while encouraging additional supply. From a purely economic stand point the market does a good job of balancing demand and supply but from a social point of view, rising prices can quickly become life threatening to the world’s poorest people.
- Expanding food production will be difficult unless there is an unforeseen discovery of a new policy or agricultural technology to expand crop yields.

- It is possible that food shortages could be the basis for military aggression in some parts of the world.
- On the back cover of *Who Will Feed China*, these words summarize the justification for studying this problem. It states, “In an integrated world economy, China’s rising food prices will become the world’s rising food prices. China’s land scarcity will become everyone’s land scarcity. And water scarcity in China will affect the entire world. China’s dependence on massive imports, like the collapse of the world’s fisheries, will be a wake-up call that we are colliding with the earth’s capacity to feed us. It could well lead us to redefine national security away from military preparedness and toward maintaining adequate food supplies.”

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WHEN Chairman Mao promised his fellow Chinese an "iron rice bowl", he was appealing to something deep in the national psyche. Throughout its long history China has known many famines. Even today many ordinary people do not take it for granted that they will always have enough to eat. In large part, this is because Mao failed to make good on his promise. The worst Chinese famine of all, claiming as many as 30m lives, began on the Chairman's watch in 1958 and remains a vivid, painful and formative memory for anyone aged 40 or more.

The memories of that famine may also account for official China's preoccupation with the notion of national self-sufficiency in food. While many economists argue that such a preoccupation is not necessarily rational-it might make more sense for heavily populated China to buy the grain it needs-the idea of China relying on foreign suppliers of grain remains heretical in government circles.

Chinese anxiety was stoked two years ago when Lester Brown, of America's Worldwatch Institute, predicted that future increases in Chinese grain demand would be so steep that, by 2030, neither China's own production nor global surpluses would suffice. Many academics in the West have attacked Mr Brown's thesis as alarmist; and some Chinese officials have labelled him as just another prejudiced westerner, out to bash an increasingly powerful and prosperous China.

But in some circles in China, Mr Brown's thesis was well-received. Experts writing in specialist publications have thanked him for issuing "a wake-up call". While not necessarily agreeing with his conclusions, they accept some of Mr Brown's raw projections, and credit him with posing valid questions.

In the immediate future, however, China has no real problem. Last year grain output hit a record 490m tonnes; and this year it should exceed 484m tonnes, despite problems with the weather in the north-east. Grain reserves are said to be at a record high-although their precise level remains a state secret.

None of this, however, is likely to shake China's tendency to equate food security with self-sufficiency. Zhang Xinmin, an agricultural official with the State Statistical Bureau, argues that dependence on foreign suppliers would impose a burden on the Chinese government and the world market. There is another reason to emphasise national self-sufficiency, which often remains unstated. Officials fear that if China becomes dependent on grain imports, it would be vulnerable to a grain embargo at times of international tension, perhaps led by the United States. At the UN World Food Summit in Rome last November, Li Peng, China's prime minister, said that his country will not only remain self-sufficient in grain production, but will also make "new contributions to food security worldwide"-ie, export.

Quietly, however, some Chinese academics are beginning to criticise the official line on food security. Feng Lu, a scholar with the China Centre for Economic Research at

Beijing University, has criticised the tendency of policymakers to equate food with grain. China, he says, enjoys a competitive edge in the production of other, more valuable agricultural products. The country should import more grain in order to raise more livestock, and devote its own land to the more profitable business of growing cash crops for export.

Dr Feng counters fears about a grain embargo, by pointing out that any land used in other food production could fairly quickly be re-converted to grain in an emergency. Other economists note that allowing farmers to devote their labour and their land to more lucrative crops would help solve one of China's most pressing structural problems: the vast discrepancy between urban and rural incomes. Obligated to meet all of the nation's grain demand, Chinese agricultural workers are condemned to poverty. Even when the government buys their output at above market prices, as it often does, that premium does not provide enough incentive to stay on the farm.

One obvious option open to struggling farmers is to protest their plight; another is to move into the cities. The government is not keen to see them take either course. But the best way to head off these unwelcome developments may be to allow farmers to diversify out of grain, into more profitable products.

Two months ago, 180 scientists from 15 countries gathered in north central China to exchange information on soil erosion and dryland farming. The location of this gathering, Chinas Loess Plateau in Shaanxi Province, was highly significant -- a region that had been cropped for 6,000 years and terraced, in places, for 3,000 years; and now half of which has been degraded in nearly equal proportions by wind, water, and freeze/thaw action.

The plateau is girded by the Yellow River, described as "clean" back in 200 BC, but now receiving 30 times the sediment of the Nile River and 98 times the sediment of the Mississippi River. Half of all the sediment in the Yellow River comes from Shaanxi Province, and although the province is only one of 30 provinces and subdivisions in China, it accounts for 20 percent of all the soil loss in the country.

Sustainable? From a soils perspective, one has to concede that, having lost all topsoil many years ago, and with the removal of annual residue for fuel and feed, the surface soil is about the same as the soil many feet below the surface, and on that basis erosion can continue for generations without affecting soil productivity. Gullies formed by erosion present no problem to efficiency of farming practices, since there is little mechanization used in planting, fertilizing, cultivating, or harvesting. Of course, the gullies eat away at arable land and diminish potential production, but the biggest effect is downstream -- sediment carried and deposited. One estimate is that the river bottom of the Yellow River is rising by almost 4 inches a year. On the positive side, in the view of some, much of the sediment settles out above small reservoirs on tributaries, creating additional high quality farming areas in this region.

So the biggest motivator toward conservation practices is not likely to be the prevention of sod loss nor the reduction of non-point source pollution. Rather, it is the reality of increasing yields by conserving water. Rainfall averages from 18-24 inches per year on most of the plateau and is concentrated in a few summer months. Loess sod can absorb substantial amounts of moisture if rainfall is "harvested" rather than allowed to run off the land. Converting slopes to terraces and benches facilitates holding the rainfall, and underground cisterns allow the collected water to be stored for irrigation uses later. Plastic film and other mulches facilitate water conservation by slowing evaporation of soil moisture.

Several demonstration projects in the region have shown remarkable success, including a 70 percent reduction in erosion, grain production per acre tripled, permanent vegetative cover increased two and a half times, and a five fold increase in per capita income. The projects follow a strategy of managed land use: retain rain, raise grain crops on tablelands, plant wood and fruit trees in gullies, and cover hillsides in grass and shrubs.

The need for outside investment and time for practices to take hold are two of the biggest factors affecting more widespread adoption throughout the plateau. Research and

extension stations believe it will take 30 years or more to show the kind of progress one would call success.

In the meantime, the world waits to see whether a country with 22 percent of the world's population can feed itself with just 7 percent of the world's land, and 70 percent of that land too hilly or too dry to farm. Lester Brown of the Worldwatch Institute skeptically asks, "who will feed China?" He anticipates a major change in diet in China based on continuation of the economic growth experienced in that country over the last 10 years, and that a change in diet will cause world food prices to rise. He discounts the possibility that food productivity will continue to, increase at the rate it has in the past, though he notes that productivity increases since 1950 exceeded the productivity increases in the previous 10,000 years. (I don't know who kept the data 10,000 years ago; that's before there were grants, journals, and tenure tracks.) It is probably true that we will not see the productivity gains through fertilizer that we did in the first 60 years of this century; and we are stretching, if not exhausting, our ability to increase productivity through irrigation. But we are just beginning to see the gains from biotechnology, and there is much room to increase productivity through adoption of basic, sound farming, land use, and conservation practices in China and most other parts of the world.

USDA/ARS scientist John Laflen, the assembled scientists in China last September, had one answer to Lester Brown's question. "Who will feed China? China will" replied Laflen. Based on the advances I have seen in land management, conservation, and farm income in China I tend to agree.

Suggested Teaching Strategies

NOTE: These suggested teaching strategies emphasize student participation in the learning process. The strategies, while in a logical order, are not in a required sequence, nor are they individually self-contained. Strive to create learning situations in which students use geography methodologies testing for areal distribution (density, pattern, diffusion, dispersion), spatial interactions and clear place description. Remember to ask, within reason, “where” questions.

- Decide how many days or weeks should be spent on the unit. Remember, the longer time spent should include more time developing the broader objectives, those that have transfer value. Review the objectives to set the logical organization of the study.
- From step one above make a preliminary list of concepts and generalizations you wish to teach in the unit (see examples, p.5). Review these with the students and instruct them to add to the list as they go over the study material. Generalizations can be used in both the deductive approach by testing a given generalization with the existing data and the inductive approach where generalizations are developed from observed data.
- Understand the use of the “Model for Studying a Place” (Appendix A). This should be understood before beginning this unit as a learning objective of the geography course. If not already studied it could be a preliminary activity to go with this unit. Explain or review how the Model can be used to organize data, to suggest questions, to develop concepts and generalizations, and identify relationships. Show how the problem, “Who Will Feed China?” can be used to drive the model.
- Discuss, without the benefit of research, what the students know about China. Have wall map(s) or overhead transparency map(s) for reference. Use the headings of the model to guide the discussion. Direct the students, if necessary, to comment on a unit topic, “Who Will Feed China? or Sometimes Being Number One Can Be A Problem”.
- Have each student find China on a globe, on a flat map of the world and then in an atlas for more detail
- Make overhead transparencies or copies of atlas maps of physical and cultural topics for the students. They should be able to identify facts and, develop generalizations about areal distribution, density, patterns, dispersion and spatial relationships between and among physiography population, climate and agricultural and economic zones. . Using the first three pages of the CIA World Factbook (Appendix C), discuss what information can be verified from the maps and what cannot. Then, using the Model, make notes from this data on what the students feel would be relevant to the unit topic.

- For class research and homework, have the students as individuals, or by committee, use the unit book “Who Will Feed China?,” the CIA World Factbook (Appendix B) on China and any other data the teacher chooses to organize information they feel is important under the Model headings. Some data, facts and interpretation may fit under more than one heading.
- Divide the class into eleven groups of 2-4 students and assign the Introduction and one chapter content section to each group. Have them summarize the material and identify the points they feel are most critical. On which points do they understand fully, where do they empathize with the Chinese people and leaders and with which points do they have trouble understanding or questions?
- When discussing unit content, use the Figures and Tables provided from the text to discuss questions such as those suggested.
- List the various possible solutions to the Chinese food problem and evaluate each one for practicality.
- Note how the Chinese food problems affect the rest of the world, i.e., United States, poor hungry nations, wheat-producing nations, others.
- Some have said that *Who Will Fed China* is an “alarmist” book, one that causes unnecessary worries and fears. Discuss The Economist and the Journal of Soil and Water Conservation articles. Are those articles alarmist? Explain.
- Ask the question – Do you think that the thesis and supporting data in this book (lesson) is alarmist? How should American students and the U.S. government react to the situation? The United Nations? Is this an example of a world problem that will continue for some years and deserves constant examination?
- Look into the predictions of Thomas Malthus and discuss how technology and migration overcame many of his dire predictions. Also research the reaction of the nuclear power industry in the late 1950’s when warned that “we don’t know how to dispose of radioactive wastes safely”. Their answer was, “Oh, well, science will solve that problem shortly.” Fifty years later, science has not solved the problem and radioactive waste is a major national/world problem. You might also investigate the “Club of Rome” Report of the 1972 with the dire predictions as well as *The Year 2000* by Herman Kuhn, and Anthony Wiener (1967). It is interesting as a “speculation on the next thirty-three years” and the role of both the physical (technological) and social services in problem creation and solution. The State of the World 2000 is a reference published in 2000 that gives the Worldwatch Institutes’ assessment of “progress toward a sustainable society as the twenty-first century begins. How should citizens react to such choices?

- Review the utilization of the Model for studying a place and its problems and prospects. Discuss its transfer value for studying other place-related topics and the value of geography as a discipline for the 21st century.

National Standards: Geography for Life

This unit includes content from the following content standards in GEOGRAPHY FOR LIFE.

The Geographically informed person knows and understands...

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

Standard 3: how to analyze the spatial organization of people, places, and environments on Earth's surface.

Standard 4: the physical and human characteristics of places.

Standard 6: how culture and experience influence people's perceptions of places and regions.

Standard 9: the characteristics, distribution, and migration of human populations on Earth's surface.

Standard 11: the patterns and networks of economic interdependence on Earth's surface.

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.

Standard 18: how to apply geography to interpret the past.

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