FOOD AND AGRICULTURE AND THE USE OF NATURAL RESOURCES

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Summary

For tens of thousands of years the search for food has helped to shape the development of society. The agricultural revolution in the Neolithic period about 10 000 years ago made it possible for human populations to grow rapidly. It was a time when crop plants and animals were domesticated and when a shift from a nomadic to a more sedentary lifestyle was achieved.

The human race has had an overwhelming excess of arable land for almost all of recorded history, and now within a generation or so, we may be forced to deal with a sudden and serious shortage. Modeling of the outcomes of increasing human populations and the concomitant reductions in the area of arable land per capita predict rather gloomy outcomes for the twenty-first century and beyond.

Human capacity to alter the environment has changed rapidly since the Industrial Revolution, and the rate of resource degradation has accelerated. This is in part a function of population growth and in part a result of technological change. These two factors are closely related (Figure 1). It was the development of more rapid transport systems that enabled populations to gather into large conurbations and to be fed from even larger farms. Land degradation, environmental pollution, and other symptoms of mismanagement place food production at risk at a time when more food is required.

There are interactions between environmental, population, and development variables that transcend geographic boundaries. Figure 1 shows the characteristics of land within the major climatic regions and outlines the nature of resource degradation from overuse.

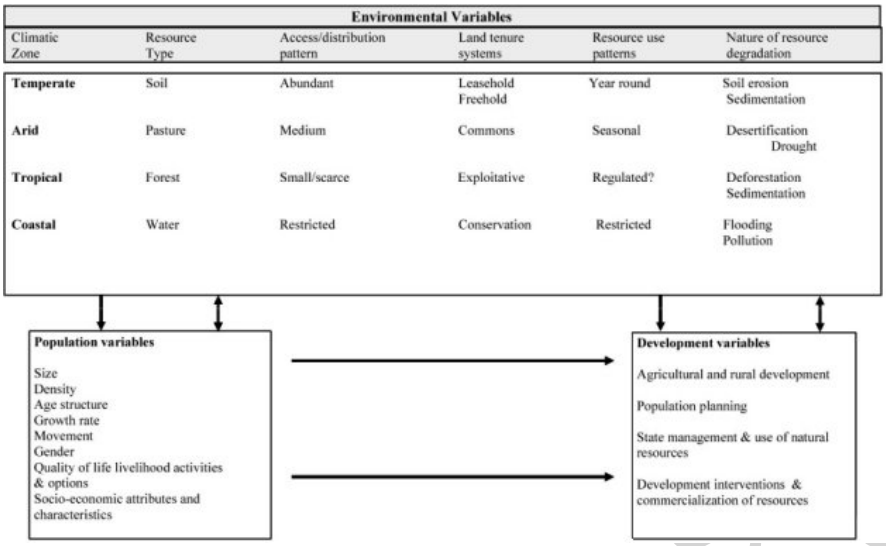

Figure 1. Land characteristics of major climatic regions and resource degradation from overuse

The capacity of science and technology to overcome the constraints imposed by land degradation, a diminishing supply of arable land, climate change, environmental pollution, and various other trends is not a foregone conclusion. Many commentators express concern that acute food shortages will inevitably occur. If these predictions prove to be true, a few years of famine could mean death to millions of people, and permanent brain damage for many of those who survive. Optimists believe that the food future is satisfactory. If the output of food grains can be trebled while the population merely doubles, and if scientists can produce a sufficiency of manufactured protein and other nutrients, there would be no real problem. The simple fact is that either the pessimists or the optimists could be right. But is also a fact that the present situation of rising populations and a diminishing resource base presents a challenge to scientists, technicians, and policymakers. And the challenge will have to be met in the first half of the twenty-first century when world population will reach 7 billion (double the number in the early 1970s).

The dilemma for policymakers in the twenty-first century is to reconcile the needs for more food with the science and technology to produce and distribute it and also take into account the social issues involved. The social forces are likely to prove as decisive a factor as the scientific advances.

1. Introduction

The twenty-first century is here, and world population continues to increase. The world's population reached 6 billion in October 1999. It is likely to reach 7 billion within the next 30 years or so (see *Projections of Global Carrying Capacity*). This situation brings with it almost impossible demands on the world's natural resources. The challenge is to avoid squandering and ruining the natural resource base while satisfying demands, and ensuring that the world remains a good place to live. One of the criteria for deciding whether the world is a good place to live is that food should be available and accessible in sufficient quantity and of a quality that sustains life for every

person (see *Socioeconomic Policies and Food Security*). There is a real need to balance both economic and ecological imperatives. Ironically enough it has always been so. Early in human history the supply and continuity of food supplies kept the population in check. It has been estimated that in 3000 BC, after 7000 years of farming, the world population was poised to explode from about 3 million to more than 100 million. Agriculture made the difference. Once humans learned how to grow food, domesticate livestock, and preserve the surplus, the balance between food production and population was racked up a notch or two (see *Historical Origins of Agriculture*).

2. A Brief History of Food—Gathering, Production, and Storage

Although there is comparatively little actual evidence about conditions in the world before about 10 000 years ago, archeologists have excavated sites and found tools and food residues which provide a picture of the diet of prehistoric humans. It has been claimed that in the earliest days of human evolution food helped to make modern human society. In about 11 000 BC the ice began to retreat and the climate mellowed. Vegetation patterns began to alter. In the 2000 years after the retreat of the ice, the deliberate cultivation of plants and the domestication of livestock began. The first villages were established.

The Neolithic revolution, the change from a primarily hunting-fishing-gathering existence to one in which humans became settled farmers and stock raisers took place at different times in different places in the world. For example, in the Near East it is believed that the new and abundant fields of wild grains, which flourished in the milder climate as the glaciers retreated, provided an opportunity for people to settle in villages. Initially settlements were on the edge of fields of wild grains. By almost imperceptible stages, the gathering of seeds developed into cultivating them.

The fields of wild grains that sprang up in the Near East 12 000 years ago did more than help to feed humankind. They also attracted a number of those smaller animals that had begun to multiply in the open shade around the margins of the forests. Sheep and goats, in particular, competed with humans for food, but by a process of domestication a solution to some food problems was obtained. Domestication had the advantage of ensuring meat and grain supply.

Slowly and irrevocably, knowledge of plant and animal domestication spread throughout the Old World (see *Development and Domestication of Plant Cultivars*). In the early millennia of the Neolithic, agriculture itself was concerned simply with taking all that it could from the soil, and gave nothing in return. The Neolithic revolution laid the foundations, not only of modern civilization, but also of many of the pressing ecological problems that bedevil twenty-first century humans.

In the millennia between 3000 BC and AD 1000 many developments took place in food and diet. The agricultural revolution that converted humans from meat-eaters to grain-eaters had far-reaching consequences. It tended to immobilize large numbers of people, to keep them tied to the land they farmed. It also coincided with an era of conflict between the settled farmers and the more mobile herdsmen. The meat-eaters, full of protein, commonly won in these skirmishes.

Food preparation methodologies changed. The discovery of fermentation, bread making, oil extraction from fruits and nuts such as olives and ground nuts, and so on, and the use of spices all contributed to the greater satisfaction that could be obtained from food. Trade was also fostered.

Food preservation methods were also found: dried and salted fish and meats, dried fruits and vegetables, pickled fruits and vegetables. Dry storage of grains and cold storage of hardy vegetables such as cabbage, turnips, and other root crops provided for needs over the winter months. Butter and cheese making preserved milk. The development of ghi (ghee), a clarified butter that unlike fresh butter can be kept for months in a hot climate, also preserved milk.

From the fifth century AD until the Industrial Revolution, 90% of the population of the whole world was directly engaged in agriculture. The Industrial Revolution changed the pattern from the agricultural revolution in most of the world. In many developing countries the proportion of people living in rural areas exceeds 80%. Most of them are directly involved in agriculture.

The moment when prehistory ended and history began is an arbitrary distinction from region to region and country to country. Many of the technological innovations that enabled human communities to manipulate their environment were developed in Europe. The Greek and Roman civilizations wrought considerable environmental change.

The Romans practiced two broad types of farming: dry farming and wet farming. Dry farming predominated in the Mediterranean zone, with its hot dry summers and warm wet winters. This involved arable crop production in lowlands, mostly coastal regions and alluvial plains, with vine and olive cultivation on the less productive slopes. Summer pastures, mainly for sheep, were provided in the cooler uplands. In contrast, the northern provinces with a cool, wet climate were suited to wet farming.

Arable and mixed farming dominated the lowland areas, and stock raising on pasture prevailed on the upland zones. The agricultural practices, settlements, mining and smelting operations, and communication networks of the Romans changed the character of landscapes. For example, many wetlands were drained during Roman times, with far-reaching consequences.

As populations expanded and empires crumbled there were several waves of invasions and injections of new ideas and technologies. History shows the important effects of the Roman, Greek, and Byzantine empires and the impact of Mongols, Arabs, and other groups. The plunder and pillage and the destruction of towns and cities all had their effect on the population. Many people fled the cities and towns and sought refuge in the countryside.

Deforestation to provide timber for ships, for smelting of ores, and for other military operations was a factor in soil erosion and land degradation in many countries, especially around the Mediterranean basin. Trade routes opened to supply the basic raw

materials (unprocessed food) but more important the spices and condiments that were adjudged to be so essential.

The changes in diets that followed a major invasion are also significant. The greater dependence by the north European tribes on dairy products led to the expansion of cattle herds in places such as northern India where Aryan tribes invaded in the second millenium BC. The nomadic Central Asian invaders brought a greater dependence on sheep and goat meat. Religious influences led to shifts in diet habits. For example, the principle of vegetarianism was promoted by Buddha and Mahavira (the Jains). This principle is widely observed by their followers. Even today there are large differences in the food habits of peoples from the various regions. Many of these food habits involve prohibition on the use of certain foods or unique methods of food preparation. In some cases, local indigenous knowledge allows certain potentially poisonous plants and animal to be used as food.

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Biographical Sketch

Dr. Victor R. Squires is an Australian. He has undergraduate qualifications in Agriculture, Botany, and Ecology and a Ph.D. in Range Ecology from Utah State University, US.

He is a retired academic from the University of Adelaide and currently an Adjunct Professor at the University of Arizona, US. He is a consultant to UN agencies such as FAO, UNDP, and UNEP, and has consulted for the World Bank and the Asian Development Bank in Africa, the Middle East, and Central Asia.

Dr. Squires was a researcher with the Australian government research organization CSIRO for 22 years before taking up the post of Dean of the Faculty of Natural Resources at Roseworthy Agricultural College (later merged with the University of Adelaide).

During his time at the University of Adelaide, Dr. Squires was Head of the Division of Land Resource Management and, later, Director of the National Key Center for Dryland Agriculture and Land Use Systems. He is the author of more than 100 scientific papers and three books.