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ABSTRACT

In the 1960s it was predicted that famine would strike India because the country lacked the necessary resources to feed its rapidly growing population. Yet, in the 1970s and 1980s new agricultural developments occured that have helped abate the crisis. These developments comprise what is now called the Green Revolution. India's food/population crisis and the elements of the Green Revolution are outlined in this student handout that accompanies a teaching unit about agriculture in a cultural geography course. The development of new varieties of food grains; the heart of the Green Revolution; the changes in agriculture that have resulted from the revolution; and the changes that remain to be made are analyzed. Three tables and an 11-item bibliography are included. (DB)

INDIA AND THE GREEN REVOLUTION

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For my Fulbright project, I have developed a teaching unit in agriculture for my cultural geography course. I discuss various economic strategies, including traditional agriclture and agribusiness. The enclosed paper is one of the three handouts the students receive for this unit. I disucss shifting or slash and burn agriculture, peasant agriculture, and modern agriculture. Then I disucss the changes that have occurred in agriculture in India since the advent of the Green Revolution. The background material for this section came from a few interviews while I was in India last summer, and from materials I purchased there. The students also have similar materialss on the changes that have taken place in the People's Republic of China since the successful conclusion of the communist revolution, and materials on the characteristics of agribusiness in California. To illustrate agriculture in these settings I show a set of slides, some that I have purchased, and many that I have taken, including a set from last summer's visit to India.

INDIA AND THE GREEN REVOLUTION

To some, it appeared that Malthus was right. Many felt that humans would, unless they showed restraint, reproduce themselves to death. Thomas Robert Malthus stated that while human ability to reproduce proceeds geometrically (1,2,4,8,16,32), human ability to increase food supply progresses only arithmetically (1,2,3,4,5,6) (10). William and Paul Paddock certainly agreed. In their book, Famine 1975! America's Decision: Who Will Survive?, published in 1967, the authors said it all. Their first chapter is entitled "The Population - Food Collision is Inevitable: it is Foredoomed". In it they lament the widening gap, in developing countries, between birth rates and death rates. Death rates in the less developed countries were dropping rapidly; birth rates were not. Mortality rates, the Paddocks believed, would continue their downward rush until checked by famine. They felt that the world's capacity to produce food would not, could not, keep pace with the world's capacity to produce babies. Starvation would result.

The following table is from their book (11, p. 55):

Table One - Future Food Requirements of the Hungry World

	Population At Current Rates of Growth (millions)		Additional Food Production Needed (percent)
	1965	1975	
East Asia	867	1,040	20
South Asia	975	1,250	28
Africa	311	404	30
Latin America	248	335	35
Total	2,400	3,000	26

"Thus, simply to maintain today's inadequate dietary levels, the hungry nations must increase their production by 26% " in the ten-year period between 1965 and 1975 (11,p. 55). This, the authors felt, these countries simply could not do.

India was thought to be a good example, one that clearly supported their conclusions. "It (India) is the bellwether that shows the path which the others, like sheep going to the slaughter, are following." (11, p.56) The hungry nation today that refuses to heed India's history, they said will be condemned to relive it. The food crisis in India in the mid-1960s had been officially predicted in 1959. In that year the Indian Government, with the help of the Ford Foundation, said "We have reached an inescapable conclusion that a rapid increase in production is India's primary problem over the next seven years..." (7)

The Paddocks despair of India's ability to feed her people. "By 1974 India will have increased her population by 120 million. India cannot, literally cannot, feed that many more mouths." (11,p.60) They continue by saying that grain imports from the United States cannot make up the increasing difference between food demand and food availability. There is a solution, at least for the United States. We should, the Paddocks believe, do the responsible thing, the greatest good for the greatest number of people. We must, like military doctors in time of battle field crisis, perform triage on the nations of the world. We will need to divide them into three categories:

1) those which can be saved by immediate attention;
2) those which can survive regardless of whether or not help is received; the "walking wounded";
3) those in such serious need that they cannot survive regardless of the help given, the "can't be saved".

India falls into the last category. "Today India absorbs like a blotter 25 percent of the entire American wheat crop". (11, p. 217) India's agriculture was too antiquated to inaugurate long-range agricultural development programs. The annual population gain of 10-15 million would overwhelm all efforts. India could not be saved.

There was cause for concern. As the twentieth century progressed, death rate in India declined; crude death rate was lowered from 47.2 per thousand in 1911-1921 to 15.0 per thousand in 1971-1981. Birth rate dropped also, but not nearly as rapidly. The result was that population increased, and at an increasing rate.

Table Two - India: Population and Population Growth

Year	Pop(million)	Pop Increase(million)	Change (%)
1931	278.9	27.7	11.0
1941	318.5	39.6	14.2
1951	361.0	42.5	13.3
1961	439.1	78.1	21.6
1971	548.2	109.1	24.8
1981	688.6	140.4	25.6

The pessimism of the Paddocks seemed to be well founded. Production of food grains in India had increased between 1931 and 1981, but not as rapidly as had population. Perhaps Malthus was right. But changes, important changes, were about to occur. The sum total of these changes, and they include both new plant types and a new so-called "management package", is called the Green Revolution. The Green Revolution hasn't been equally applied throughout India yet, but where it has been introduced, it has brought very important changes, very great increases in agricultural production.

The heart of the Green Revolution is the development of new varieties of food grains, first of wheat, then of rice.

In the late 1940s and early 1950s, research at the Borlaug Institute in Mexico led to the development of a high yield dwarf wheat. A pilot program in India in selected optimum production areas led to the conclusion that this wheat variety had the potential to lead to significant increases in food grain production. Dwarf rice research started in Asia in 1962 and successes in the development of new varieties were reported in 1965. These two new crops did have the potential to dramatically change the food situation in India, but many other changes than just the development of new plant varieties were required. The Green Revolution was a package deal. The major elements of the Green Revolution in India included high yielding varieties of wheat and rice seeds, increased use of fertilizer, a controlled and increased water supply, liberal use of insecticides, and expanded use of mechanized equipment. But other changes were required, even before field operations could begin.

First of all, land consolidation had to occur; in fact, a major cause of low agricultural productivity in India had been fragmentation of land holdings. Typically, peasant farmers worked small farms fragmented into a number of very small plots. This situation resulted in wasted land and wasted effort, and, in addition, made it difficult to introduce other improvements. Even though progress in land consolidation has made important progress, particularly in

the states of Punjab and Haryana, much more needs to be done. Some states haven't even begun the process of land consolidation.

Land ownership patterns also need to be overhauled. There has been too much of ownership of agricultural land by absentee landlords; this situation does not generate much enthusiasm for making improvements in traditional Indian agriculture. Improvements have been made in this area since independence in 1947. In 1961 the Census of India reported that out of 100 cultivators, 76 were owner cultivators, 16 were owner-cum-tenant cultivators, and only 8 were pure tenant cultivators. Unfortunately there has been much backsliding. There is still the need to prevent land acquisition by wealthy and powerful absentee owners.

Despite the importance of the factors mentioned above, the basis of the Green Revolution remains the development of new high yielding seeds. The new seeds are much more responsive to the application of fertilizers than are the older seeds; they also have a shorter maturing period and, since they eliminate photoperiod sensitivity, they are no longer tied to planting at just certain seasons. The new seed varieties allow the possibility of double cropping.

The new varieties are also responsive to increased irrigation, but here difficulties arise. The expansion of irrigation requires not just the provision of increased of

water but also very large investments in reworking the land: land shaping, land leveling, construction of water courses, and the development of drainage systems. In addition, increased use of fertilizers and water help not only crop growth, but also lead to an increase of pests, weeds, and diseases. So increased use of insecticides and pesticides is an additional element in the Green Revolution package deal.

In all of these new developments, one need becomes particularly important, the ready availability of credit. Other inputs, for instance new seeds, new technology, increased use of irrigation water, fertilizer, pesticides, and machinery, all depend on the availability of credit. Credit for many farmers is not merely another needed input; it is absolutely necessary to allow them to participate in the Green Revolution at all.

The list of needs goes on and on. Rural electrification is necessary to lift water and for processing and preserving agricultural produce. The construction of rural roads is needed, not only to allow farmers to move increased surpluses to market, but also for the supply of all of the other needed inputs.

More agricultural mechanization is needed, both during pre-harvest and post-harvest, as well as during harvest itself. To maximize the benefits of the Green Revolution, double-cropping and even multiple-cropping are necessary.

Now the farmer is fighting against time as never before. To be ready for the next sowing he must hasten his operations. To accomplish this, not only labor but mechanization is needed. This doesn't displace the existing labor force, because new jobs are available in the repair, maintenance, and running of the additional machinery.

The amazing thing is that, despite the complexity of these new developments, despite the scale of needed change and the number of elements that make up the Green Revolution, significant progress has been made, particularly in Punjab where these changes first occurred.

Table Three - Change in Agricultural Production in Punjab and India (Base: 1950-1951 = 100)

Crop		50-51	55-56	60-61	65-66	70-71	75-76	82-83
Rice	Punjab	1.00	1.00	2.14	2.73	6.43	13.52	38.75
	India	1.00	1.34	1.68	1.49	2.05	2.37	2.26
Wheat	Punjab	1.00	1.11	1.70	1.87	5.02	5.65	8.96
	India	1.00	1.36	1.70	1.61	3.69	4.46	6.52

Source: 2

Between 1965-66, about the time the Green Revolution really began, and 1982-83, rice production in India rose sharply. This increase was due to expansion of the area devoted to rice cultivation and to the substantial increases in yields per hectare. Wheat production also rose sharply during this period. The increase in production of food grains in India since the Green Revolution began has more

than kept pace with increase in population. Huke, however, feels that a solution has not been found for the problem of providing adequate food for a rapidly growing population (8). An optimist might point out that the greatest strides toward increased agricultural production have been made in only a few parts of India, most notably in the states of Punjab and Haryana, and that if the results of the Green Revolution could be spread more widely throughout the country, the potential for even greater increases in food production could be realized. A pessimist might say that, in the long run, these increases in food supply will be futile unless the developing countries of the world, India included, can control future population growth. Malthus may yet be proven right.

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