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FOOD PRODUCTION FOR A GROWING POPULATION OF FOUR BILLION

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One cannot realistically discuss world food production needs without also considering the present world population as well as anticipated population growth in the next several decades. Food requirements and population growth are of vital importance to all of us; they affect the quality of life and are intimately related to the future of world order. Without an assured food supply for the growing world population there will be increasing social and political chaos in the decades ahead.

World Population Growth

At the outset, before discussing current world food production problems, let us turn briefly to examine the history of human population growth so that we can better comprehend the magnitude of the problems that lie ahead.

Man (*Homo sapiens*) has not always had a population problem. During the many millennia - 3 million years, more or less - that man has roamed the earth he was generally an endangered species. He lacked control over his food supply, diseases, stronger animals of prey and had little ability to protect himself from the vagaries of the environment.

It was only about 10,000 to 12,000 years ago that agriculture was discovered, judging from the best archeological evidence available today - although there is some circumstantial genetic evidence that leads me to believe that agriculture may be considerably older than the present archeological evidence indicates.

I like to think that it was Neolithic woman that discovered agriculture and domesticated animals for it was she who had long gathered seeds, roots, fruits and nuts from wild plants. She was close to nature. Consequently when the wild herds dwindled and the man with increasing frequency failed to bring sufficient meat to the camp, she took action and became a farmer.

1) Vortrag anlässlich der Verleihung des Titels eines Dr. agr. h.c. der Universität Hohenheim.

Once the food supply appeared assured, nomadic hunter was able to settle down and build better shelter against the environment. Thus man's survival became secure. These two events were turning points in population growth. It began to multiply, slowly at first, then with greater and greater speed, especially after he began to gain some control over his diseases, which dates back less than 150 years.

Population probably did not exceed 10 million when agriculture began. Population had reached 250 million by the time of Christ. Since then, world population has doubled four times, or 16 fold. The first doubling from 250 million to 500 million, required 1650 years. The second doubling, from 500 million to 1 billion, required 200 years and was achieved by 1850, which was about the time the cause of infectious diseases was discovered. This event soon ushered in the era of modern medicine which reduced the death rate markedly and thus greatly accelerated population growth. The third doubling, from 1 to 2 billion required only 80 years and was achieved by 1930. Shortly, population growth rate was again accelerated by the discovery of sulfa drugs, antibiotics, and improved vaccines which further reduced the death rates. The fourth doubling, from 2 to 4 billion occurred in 45 years and was reached in 1975.

Now the world is on its way to its fifth doubling from 4 to 8 billion. If world population growth continues at its present rate, the fifth doubling will be completed in the year 2013 AD, which will be a 32 fold increase over the population at the time of Christ. This means that in the next 38 years 4 billion more people will be added to the current world population, which is 250 million more than the total population growth from the time of Christ through 1975. This gives a clear insight into the magnitude of the problems that confront the world in providing the basic necessities for a decent life for those who are born in the next four decades.

Currently there is a wide variation in population growth rate in different countries and regions. For example, while countries of Northern Europe will require 350 years to double at today's growth rate, those of South Asia and Tropical Africa will double in 32 to 27 years. Populations in a few countries will double in 20 years. At the other extreme, a few countries have very low population growth approaching the replacement level.

The relentless advance of the population monster casts an ever more menacing shadow over civilization as the time required for populations to double is shortened and the size of the population being doubled grows geometrically. These are explosive changes in a shrinking and ever more inter-dependent world, in which there is a growing scarcity of many non-renewable resources.

The basic necessities for a decent humane life

It is my personal belief that all who are born into this world have the moral right to the basic ingredients for a decent humane life. How many should be born into the world and how fast they should come on to the stage of life is another matter that I will explore with you in the next few minutes. If they arrive on stage too fast it will become impossible to provide them with the basic necessities for a decent life.

The basic elements necessary for a decent humane life include: 1) adequate food, 2) adequate clothing, 3) adequate housing to protect one from the elements, 4) basic education which will permit one to develop his talents, 5) employment to earn one's basic necessities - and since I am "old fashioned", I believe that constructive work is the best "medicine" God ever gave man -, and 6) medical care when one is ill. Satisfying the aforementioned six basic necessities, however, is very complex. It is necessary for government, private enterprise, or joint enterprises to develop the natural resource base and infrastructure required. This includes developing the raw material resources -- e.g. minerals, water resources, agricultural base, and systems of energy, transport, schools, hospitals, industrial factories and other basic services required to deliver them. It involves the investment of huge sums of capital in these systems and in a multitude of industries to provide opportunities for employment which in turn is capable of producing the basic goods required by a modern society.

Unless the world can provide the basic necessities for a decent life to those who are born into the world, there is certain to be continuing and even worsening social strife that will make peace impossible and even threaten world civilization. The social strife will sooner or later spread to all parts of the world. It will involve all systems of governments.

The importance of food production to mankind and world order

The right to food - is the first and foremost of human rights. Without adequate food the importance of the other human rights fade into insignificance. Whenever we consider food, we must consider it from three differenz points of view: 1) its biological importance, 2) its economic worth, and 3) its political importance.

The significance of food for biological survival should be self-evident to everyone. Without food we can live at most only e few weeks. Nevertheless, in the affluent nations virtually everyone - except those in the lowest income

group - takes food abundance for granted since most of them have never known hunger.

By contrast, in food deficit developing nations hunger and malnutrition are widespread and food shortages reach disastrous proportions in years when crops are poor. Unfortunately, since most of the political leaders in the developing nations come from privileged classes, they, too, have never known hunger and its degrading influence on life.

The economic worth of food varies widely from location to location and time to time. In a large part the prices people will pay for food depend upon how hungry they are and how long it is likely to be before they will be able to eat again. In an industrialized food exporting nation such as the U.S.A., where only 4% of the total population are engaged in food production, the average family spends a relatively small percentage of its income, after taxes, for food. In 1947 it was estimated to be 25% of the family budget. With consumer food prices relatively constant - in a large part because huge surpluses that depressed farm prices - and salaries and income rising, the proportion of the family budget spent on food had fallen to 16% by 1971. Nevertheless, when prices for food began to rise in 1972 and 1973 as a result of drastic depletion of reserve stocks to a level where the long dormant economic law of supply and demand began to function again, and worsened by the general inflation, there were indignant outcries from the urban consumers, who had become accustomed to cheap food. They had lost contact with agriculture and with the fact that it costs money to produce food. They had come to believe that food came from the supermarkets, and failed to recognize the investments and struggle required to produce the abundance of food and place it at their disposal in urban markets.

Contrast the food situation in the affluent nations with that in the food deficit nations of the developing world. In many of the latter in years when crops are good the average family spends from 70 to 75% of their income on food. In years when crops are poor and food becomes scarce, they spend all their earnings on food but they still are often hungry. For them there is a delicate poorly defined narrow zone between "adequate" food availability, hunger and even famine.

The political value of food cannot be evaluated in terms of monetary units under any system of government. It is directly linked to social and political stability. Peoples often show great patience with various types of abuse by their governments but when there is widespread hunger and famine, governments fall. Five of the governments in the Sahelian countries of Africa fell during the drought and food shortages of 1973 and 1974. Despite the time proven

fact that hunger leads to political instability, political leaders continue to give agriculture only a very low priority in development programs.

This neglect is particularly incomprehensible in the food deficit developing nations where generally 70 to 90% of the total population is engaged in agriculture and animal husbandry, generally at the subsistence level. Almost without exception agriculture in these nations is regarded as the lowest rung on the social-economic-political ladder. The budgeting and support for developing the agricultural sector is without exception inadequate, considering the vast proportion of the population that gains their livelihood from the land. Frequently government policies are such that they try to maintain prices for agricultural products and food at unrealistically low levels so as to pacify the organized minority group of urban consumers, at the expense of the vast unorganized rural sector. There comes a point, however, where such shortsighted policies contribute to the stagnation of agricultural production or even to collapse. In the long period of large food surpluses (1950 - 1971) in the food exporting countries, political leaders in the developing nations who used shortsighted agricultural policies were often saved from political ruin by obtaining large quantities of food as gifts or on easy long term concessional sales arrangements, to the detriment of their own agricultural development. The folly of such shortsighted policies becomes evident following the drastic reduction of world food reserves (surpluses) following the bad harvests of 1972, when concessional food sales were either greatly curtailed or discontinued, and when prices for food soared.

It is my contention that agricultural development and food production in the developing nations has lagged primarily because of inadequate, inequitable financial policies adopted by shortsighted political leaders who fail to comprehend both the complexities and importance of agriculture. Almost without exception over the past 25 years, rapid industrialization usually employing high capital intensive technology has received first priority at the expense of the agricultural sector. Capital investments in the rural sector have usually been only 20% of the total budget despite the fact agriculture produces 50% of the G.N.P. and contains 75% of the total population.

In my frustration of trying to encourage the adoption of more realistic policies that would stimulate food production during the food crisis of the past five years, I have stated that I believe the world would, almost certainly, have wiser agricultural policies and food policies with less hunger, famine and misery if the political leaders - including the heads of state, the economic planners, the ministers of foreign affairs, finance, industry, labor,

national defense, education, health, and agriculture as well as the top bureaucrats - were annually locked into a conference room without food for two weeks to condition them for beginning their debate to choose policies that would stimulate food production and facilitate food distribution to the hungry.

As one looks ahead at the magnitude of the problem of producing the food that will be needed to feed the world for the next four decades it becomes increasingly clear that the food needed to placate the population monster must be largely grown in the countries where the vast majority of expanding populations live. Vast international or bilateral food aid programs, except in emergencies, must be recognized as only palliatives. Similarly, international trade can only be an adjunct in attempting to remedy the food shortages, of the food deficit poor developing nations. Hundreds of millions of farmers must become involved - the great majority poorly educated with immense numbers completely illiterate - in transforming the world's agriculture. The idea that it does not take much intelligence, ability, skill and training to be a successful farmer must be eliminated. Many thousands of well motivated capable young men and women will need to be trained as scientists, extension specialists and teachers to assist the farmers. More than 100 governments will need to greatly increase support for agriculture and adopt agriculture policies which will provide economic incentives to farmers. Support must be continuous not an on-again off-again effort as food shortages wax and wane. And above all, we must always remember the magnitude of the problem of increasing the food production fast enough to compensate for population growth and hopefully to correct the deficiencies that exist today. To achieve this goal, during the next 4 decades food production must be increased by considerably more tonnage than it was increased in the 197 decades from the time of Christ up to 1975. At best the work on the agriculture and food production front is a holding operation to buy time, while others work on the educational and population fronts to slow population growth and tame the population monster. Unless a better balance is achieved between population growth and the world's ability to supply the necessities for a decent humane life to all who are born, the world will become more and more chaotic and the civilization may collapse.

There seems to be something basically wrong, in a more general sense, with the set of values being used by the world's political leaders. While hundreds of millions of the world's population remain undernourished and malnourished, the world's governments are collectively spending something approaching 300 billion dollars annually - in the name of national or regional defense - on armaments

while allocating only niggardly amounts to agricultural development, food production and distribution.

The food production base

Few people who have not been involved in either agricultural production, research, extension or education have much comprehension of the limitation of the world's natural resource base on which we depend for the production of food for the present population of 4 billion; and fewer still concern themselves with the future needs that will be required for a rapidly growing population. To most people the world (earth) is an enormous planet - and unfortunately to many still the center of the universe - with much unexploited land and water for increasing food production indefinitely as needed. The truth is that our earth is a medium sized finite planet - and apparently the only one with life as we normally characterize it - in our modest solar system, which in turn is only a "speck" in the universe as most of us observe but only vaguely comprehend as we glance upward on a clear moonless night and see the star-studded sky and the milky-way beyond with many "solar systems".

Our food production comes from three different sources: 1) the ocean and inland waters, 2) the land, and 3) indirectly from micro-organisms grown under artificial conditions. The latter is currently of very limited importance and will not be discussed in this presentation.

When we begin to examine the planet earth from the standpoint of food production potential, we realize that much of the surface is of little value. Approximately 79% of the surface area is water and only 21% is land.

Many people erroneously believe that the sea is a vast largely untapped reservoir of potential food production. The facts indicate differently. Although food harvested from the oceans and inland waters increased greatly during the 1950's and 1960's, as a result of expansion and improvement in fishing fleets, equipment and techniques, the total harvest seems to have leveled off, for the species now being utilized, at about 70 million metric tons; and in the past several years it has declined significantly indicating that a number of preferred species are actually being overharvested. Undoubtedly, the catch can be increased substantially by including species that today are not being harvested. Moreover, with the growing need for fish, mollusks and crustaceans there certainly will be an expansion in "aqua culture" of certain species in estuaries and lakes; but the total increase in food production from all of the foreseeable advances through these approaches will be modest when measured in terms of the total world food needs. In 1973 as is shown in Table 1 only about 2% of the total ton-

nage of world food production came from the ocean and inland waters as large essentially unexploited reserves for food production that can be readily drawn upon to feed the world when agricultural production can no longer keep up with the growing demand.

The land produces about 98% of the total tonnage of food at present. The total land area of the earth is approximately 13 1/2 billion hectares. However, the land area of the earth that is suitable for agriculture and animal husbandry is limited as shown in Table 2. Only about 11% of the total area is classified as arable land, suitable for agriculture or permanent non-forest tree crops, while 22% is classified as permanent pastures and meadows and another 30% is classified as forest and woodland. The remainder of the world land area, 37% of the total, is wasteland unsuitable or unavailable for agriculture and is made up of sub-arctic tundra deserts, swamps, rocky mountain slopes, sites occupied by cities and industries, highways, airports, railroads, etc. The aforementioned land classification is, at best, only a tentative attempt to classify the world's land resources. In land reform programs in different parts of the world I have seen the so-called "arable" land being distributed to peasant farmers which is incapable of producing sufficient food for a sizable population of locusts much less for a family of hungry people. Similarly, much land has been classified as valuable grazing land, but because of very low precipitation has a very low carrying capacity, and in a similar way vast areas classified as forest land are nothing more than xerophytic brushy vegetation. Consequently, we must recognize that considerable essentially worthless land has been classified as arable, grazing or forest land for political reasons, rather than because of their potential value for food and fiber production.

Moreover, we must recognize that each year millions of hectares of land, a great proportion of them suitable for agriculture, are being removed from production and converted to other uses, e.g. building sites, industrial sites, parks, highways, airports, etc. The truth is that currently few nations, if any, have a sound land use policy.

Since the beginning of recorded history there have been many recorded crises in food production leading to famines. There were almost certainly many more devastating famines that went unrecorded for in past centuries communications were poorly developed. Each crisis was precipitated by a drought, plant disease epidemic or insect plague at a time when the human population was approaching the carrying capacity of the land then under cultivation with the prevailing production methods being used. After each crisis, more land was rapidly opened to cultivation for then land was plentiful - to feed the growing populations. In those early dates when population growth was slow and good potentially

Table 1: 1973 - World Food Production

		Millions of Metric Tons	% Total Food Production (Tonnage)
I	From The Land (1)		
A	All Cereals	1368.15	42.0
	1. Wheat	377.02	
	2. Rice	320.71	
	3. Maize	311.78	
	4. Barley	168.26	
	5. Others	190.38	
B	All Root Crops - Potato, Yams, Cassava, etc.	581.28	17.8
	1. Potato	315.99	
C	All Pulses or Grain Legumes - Beans, Peas, Chickpeas etc.	43.84	1.3
D	All Vegetables and Melons	279.34	8.6
E	All Fruits	247.19	7.6
F	Nuts	2.91	0.09
G	Vegetable Oils	39.62	1.2
H	Sugar	78.92	2.4
I	Coffee	4.19	0.1
J	Cocoa Beans	1.36	0.04
K	Tea	1.54	0.05
L	Meat	109.75	3.4
M	Milk	414.14	12.7
N	Eggs	22.52	0.7
	Total Food From Land	3194.75	98.0
II	Total Fishery Catch from Ocean and Inland Waters (2)	66.10	2.0
A	For Human Consumption -	47.5=1.4%	
B	For Other Uses (Oils and Meals, etc.)	18.6=0.6%	
III	Grand Total Of Food From Land and Water	3260.85	100.0

(1) 1973 FAO Agriculture Production Yearbook

(2) 1974 FAO Yearbook Fishery Statistics

arable land was abundant this was an effective way to temporarily solve the food production problem.

Table 2: Land Resources of the Earth (1)

	hectares	%
Total Land Area of Earth	13,393,000	100
1. Arable Land Area (Annual and permanent crops)	1,457,000	10.87
2. Permanent Meadows and Pastures (Total Agricultural Land is therefore sum of 1 and 2 = about 33%)	2,987,000	22.30
3. Forest and Woodland	4,041,000	30.17
4. Other - (tundra, sub-arctic or antarctic waste, tundra, deserts, rocky waste, cities, etc.)	4,908,000	36.66

(1) 1972 FAO Production Yearbook

There are still opportunities for opening new land for food production by clearing forests and irrigating desert areas in some countries. But such opportunities no longer exist in some of the densely populated large nations where serious food shortages are present now and are likely to worsen and where "land hunger" is already great. Moreover, where the opportunities for opening new land do exist they are both time consuming and expensive and these approaches alone can not be brought into production soon enough to meet the growing demand for food as will be pointed out shortly. Moreover, there are many areas where the world must weigh the advisability of clearing or not clearing forest land for agriculture use or it will soon find itself faced with both a growing shortage of forest products and deterioration of watersheds and increased situation in irrigation reservoirs.

Thus it becomes evident that for the next two decades much of the increase in food production needed to feed the world must be grown in the food deficit developing nations where much of the present undernourished world population lives and ekes out a miserable standard of living on land of low productivity. Moreover most of the increase in production in these countries must be achieved on land currently under cultivation employing primitive production techniques which result in very low yields per unit of cultivated area. Most of this land is owned and worked by millions of small farmers, mostly with little education and often completely

illiterate. Most of the increase in food production on these farms will have to be achieved by the development and extensive application of suitable labor intensive high yield technology.

The food production requirements for four billion people

It takes a lot of food to feed four billion people. It is impossible to describe briefly either the great diversity of types or the quantities of all of the different kinds of food that enter into human diets. The total quantity of food harvested in the world in 1973, disregarding the differences in moisture content, caloric value and protein content was approximately 3,260 million metric tons. Of this total approximately 98% - or 3,195 million tons - was produced on the land.

Although the diversity of foods produced on the land is very great, without doubt the production (and reserve stock) of cereal grains is the best indicator of the world food situation at any time (Table 1). This, in no way, is meant to minimize the importance of potatoes, yams, cassava, sugar, beans, cowpeas, peas, lentils, chickpeas, soybeans, peanuts and other oil-seed crops, fruits, vegetables, nuts, meats, milk, cheese and eggs, all of which are important in the total food supply.

Cereal grains are singularly important from several points of view. Cereal grains collectively - wheat, rice, maize, barley, rye, oats, sorghum and millets, are sown on approximately 50% of the total cultivated land area of the world. Despite being low in moisture content when harvested, in contrast to vegetables, fruits, and tuber crops, they constituted about 42% of the total tonnage of the 1973 world's food harvest. They *directly* contribute about 52% of the calories to the human diet on a worldwide basis and constitute about 62% of the calories of the diets in the developing world. Cereal grains also *indirectly* contribute greatly to both protein and calorie intake in human diets since approximately 40% of the world's production of cereals is fed to livestock to produce meat, milk, cheese and eggs.

In order to provide some insight into the magnitude of the increment in food production that is needed to maintain current world per capita food consumption, I will use the case of cereal grains. The 1971 total world production of cereal grains, a year before the onset of the recent food crisis, reached what was then an all time record of 1,200 millions of metric tons. Most people cannot visualize a volume of grain of this magnitude. It can perhaps best be visualized as a highway built of grain that encircles the

earth at the equator. Such a World Pan-Equatorial grain highway would be 18 1/2 meters in width with a roadbed 2 meters in depth. That was the physical volume of the grain the world produced in 1971. However, since the world's population increases by approximately 75 to 80 million more each year, it will be necessary to increase grain production each year - by approximately 2% to compensate for population growth and then add another 1/2% to account for more affluent eating habits, including more meat and other animal products - by about 30 million tons. This means the World Pan-Equatorial grain highway must be reconstructed each year, for it is consumed in its entirety; moreover, construction must be initiated on a second highway of grain of the same dimension - 18 1/2 meters in width and 2 meters in depth of roadbed - and constructed at the cumulative annual rate of 1000 kilometers of new highway each year just to maintain per capita food production at the 1971 level. If the world is to attempt to increase production by this amount by solely increasing the land area cultivated to cereals, it must be increased by an additional 16.2 million hectares annually, using calculations based on the 1971 world's average cereal yield of 1850 kilograms per hectare. Moreover, to maintain per capita production of all other food would require a corresponding proportional increase in cultivated areas of each of these crops. This gives one a clear-cut picture of the magnitude of the food production problem. It also becomes evident that, with the shortage of suitable additional land that can be brought under cultivation in many of the densely populated food deficit nations, the main approach to increasing food production for the near future must be primarily by increasing per hectare yields on the land now under cultivation through the introduction of new high yielding technology - an expansion of the "green revolution" into many crops and areas of the world where low yields and primitive methods still prevail.

The food crisis of the past five years resulted from the world's inability to maintain the rhythm of expansion in cereal production as described above. In two of the past five years, production fell far below the consumption requirements. The shortfalls in grain production required to reconstruct and extend the aforementioned Pan-Equatorial grain highways on schedule were filled by drawing on stored grain reserves. Twice, within the past five years, because of unfavorable weather and poor grain crops, the Soviet Union and other centrally planned Eastern European countries, made large purchases in the international market. In each case, with reserve stocks at low levels, and the sizes of their purchases large, it exerted a destabilizing effect on the world market. Prices for grain on the international markets escalated, especially to the detriment of the chronically food deficit developing nations. Fortunately-

ly, the past two harvests in virtually all of the food deficit nations in North Africa, the Near and Middle East, South Asia and Latin American countries have been excellent. Some of these countries, notably India, have, for the first time, built sizable national reserve grain stocks as a temporary hedge against future inclement weather. During the past year, for the first time in the past five years, there also has been a sizable addition to the reserve grain stocks in the food exporting nations. International grain prices, reflecting this change, have fallen to pre-crisis level, after correcting for inflation. With the temporary easing of the food crisis, there is a danger and already some evidence that government officials in the food deficit countries and international agencies are already turning their attention to other things.

Food grain reserves

Hopefully, the food deficit nations, as well as the food importing developed nations, have learned something from the recent food crisis, about the importance of maintaining reserve grain stocks for buffering against the vagaries of weather which adversely affect production and results in wild gyrations in food prices. The question remains: do they have the political will to make the necessary investments to increase their own agricultural production and also finance and accumulate reasonable levels of national grain reserves?

It is my personal belief that all food deficit nations should build and maintain a reasonable national reserve buffer stock of grain as a hedge against bad weather and crop failures. Further, I feel, that all nations must join together - both developed and developing, both food deficit and food exporting - to find a way to jointly finance and build a strategic second level international grain reserve, that can be mobilized to meet threats of famine, wherever and whenever needed. If the nations of the world cannot agree on a reasonable policy on food grain reserves, as basic as it is to human survival, then there is little hope they can come to agreement on many other urgent matters that await solution.

Outlook for the next two decades on the world food front

There are two inter-related frustrating problems which must be considered in attempting to assure the world adequate food for the next two decades. One is production; the other is distribution.

Barring unanticipated major disasters, either man-made or nature-made, the world now has the technical capability to produce the grain that will be needed for the next decade, or even two decades; and it can be done at a level that would maintain present per capita grain consumption or even conceivably improve it modestly. But that does not solve the problem. At present, much of the potential for expanding production, in the near future, is in the current food exporting nations, whereas much of the growing grain deficits will be in the low income food deficit developing market economy countries, whose foreign exchange constraints will preclude the imports of much of the needed grain through commercial channels.

In most of the densely populated food deficit low income developing nations the main thrust toward increasing food production in the next two decades must be primarily through increasing yields per hectare on land now under cultivation, on which yields are currently very low. The approach must be a broad one based on developing a balanced package of improved technological practices, labor intensive insofar as possible, that has the capabilities of increasing current yields by 50 to 100%. Once the improved package of practices has been developed it must be demonstrated on thousands of farms. Government economic policies must be attuned to promoting the adoption of the new technology. To do so government must assure that the essential inputs are available at the village level at the proper time with an effective credit system that will permit farmers, and especially the small farmers, to purchase these inputs. Policy must also assure a fair price for the farmers product at harvest.

Without going into detail one must develop the package of improved technological practices on the basis of experimentation conducted in each of the major soil types and climatic zones for each of the important crops in a country. At the outset one must find out through research what nutrients have been depleted from the soil and determine what fertilizers must be applied and at what dosages on the different soil types to correct these deficiencies for all of the different major crops under consideration. When the soil fertility is restored it requires a different improved variety of crop plant that has the genetic make-up that will be more efficient in the use of fertilizer, and soil moisture; that will be, insofar as possible, resistant to the major diseases; and which because of these and other characteristics will be capable of greatly increasing grain yield per hectare when properly cultivated. In order to fully utilize the potential of the improved package of practices proper seed beds must be prepared, sowings made in the proper time and method to assure good stands of seedlings. Methods, either mechanical or chemical, or a combi-

nation of the two must be developed to control the noxious weeds. For when worn-out infertile soil is fertilized weeds, which were also previously weak and "starving to death", suddenly become aggressive and unless controlled can greatly depress yield. And so too with insects, they must be kept under control, with an integrated control insofar as possible.

During the past decade I have seen spectacular increases in yield and production in some crops in a number of developing countries. In the case of wheat Mexico, India, Pakistan, Tunisia and Turkey have made impressive progress. I had the privilege of seeing Indian wheat production increase from 11 million metric tons to 26 million tons in the short period from 1967 to 1972. During the same period Pakistan's wheat production also more than doubled. Although both countries suffered reduction in wheat production during 1973 and 1974, when there was a worldwide shortage in fertilizer and huge jumps in costs of petroleum, during the past two years record harvests have again been achieved. There are good possibilities of doubling wheat production again in both of these countries during the next two decades. But corresponding increases in production of all of the other major food crops must also be attained if these countries, and many other food deficit low income nations as well, are to produce the food that will be needed for their growing populations. The goal can be achieved if there is the political will and dynamic leadership that gives agricultural development the priority it merits.

The environment related issues world food production and the carrying capacity of the earth

The magnitude and complexities of producing sufficient food and the other amenities for a decent life for a rapidly growing world population, is being both confused and made more difficult by events and attitudes that are being fostered by elitists utopians and special interested groups in the affluent nations. On the one hand these groups during the past decade have made the general public in many countries, especially in the affluent nations, conscious of the importance of maintaining a healthful and pleasant environment, which contributes to improving the quality of life. These are positive and concrete contributions. On the other hand it is becoming increasingly more disconcerting that unbalanced political lobbying proposals and legislative action is sponsored by certain groups without weighing the benefits against the risks in attempting to arrive at the proper decisions in many of complex social-economic-environmental issues. Generally the views projected are based in favor of the affluent sectors of the society in

the developed nations and moreover, are judged from the short term rather than long term point of view. They are concerned with correcting the current obvious flagrant abuses of the environment, which is an admirable undertaking, but they ignore the relentless advance of the population monster which will make the short term gains meaningless unless the population monster is tamed within the next several decades. The lack of balance in the programs being promoted by these pressure groups have often added confusion rather than enlightenment to the issues under discussion and by so doing have confused the general public.

Among the groups that have been particularly active in exerting strong political lobbying pressures, in advocating new legislation and often in sponsoring legal action suits in support of their views are: organic food faddists, anti-chemical clubs, extremist consumer advocates, elitist and utopian environmentalists, "nature" groups and right to life groups.

Among the erroneous points of view that such groups have sponsored, which have confused the public are: how organically produced foods have better flavor and are more nutritious than food produced with modern technology; how chemical fertilizers are unnecessary and soil infertility can be corrected and maintained world-wide by the proper use of organic wastes of plant, animal and human origin; how the balance of nature has recently been upset by the use of agricultural insecticides, fungicides, and weed-killers, which now threaten the survival of many species, while ignoring the disappearance of many species in the geologic and historic past before the advent of synthetic chemicals, or in the former case before the emergence of man; how destruction of the habitat, as the result of increasing human population pressure, is ignored as the primary factors in reducing wildlife populations; how the solution to these problems is achievable by the dual approach of placing species on the endangered species list followed up by an aggressive campaign of lawsuits against all who disagree with their points of view, rather than seeking the solution through action programs to restore or improve habitats; how carcinophobia campaigns are being sponsored which visualize carcinogens in nearly everything we eat and drink and in the air we breath, while we largely disregard the danger of the best proven carcinogen of all the cigarette - which currently is consumed in the USA at the average per capita rate (by those above 18 years of age) of 211 packs per year; how the impression is given that the world is being poisoned into oblivion even though data show that people in the affluent nations today live a longer and more pleasant life than was ever dreamed of by their grandparents; how the world would have an abundance of food if the geneticists and plant breeders would get to work and

produce miracle grain varieties which would produce much more food with less water and less nutrients, and which would also be high yielding on the small farms and low yielding, with the same technology, on large farms so political leaders and economic planners would not need to concern themselves with the unpleasanties of equitably distributing the benefits of the new technology; and how the earth can (presumably now) easily support a population of 50 billion, even though it should be clear that no computer can predict reliably the carrying capacity of the planet, for it varies both with the technology that is available at any point in time for producing the basic necessities, including food, and also with the standard of living of the populations.

These views are all delusions! They encourage mankind to continue to increase his human numbers recklessly at a rate and to a point where civilization hangs on a precipice. They encourage ignoring the population monster. And time is already late! The world must face it, and tame it soon. For too long the world leaders - political, social, economic, religious, educational and scientific - have either unrealistically ignored or failed to recognize the growing evidence that world civilization is approaching a worsening crisis on a number of inter-related fronts including shortages of food, energy and non-renewable resources, accompanied by an accelerating deterioration of the environment.

In closing I make no pretensions of being able to see very far into the future in this complex interdependent world. To try to do so is more likely to add more confusion rather than enlightenment. The following quotation from the 1975 Agricultural Production Efficiency Report of the American National Academy of Sciences expresses my sentiments entirely: "Thus we believe our ability to foresee the future in this uncertain world is severely limited. While models and mathematics may be helpful in making explicit the implications of various assumptions, they cannot reduce the uncertainty of the future. Moreover they may deceive the unwary who often assume that numbers are somehow more accurate than verbal descriptions."

DIE AGRARPOLITIK IM SPANNUNGSFELD WISSENSCHAFTLICHER ERKENNTNISSE, POLITISCHER FORDERUNGEN UND PRAKTISCHER MÖGLICHKEITEN

Von Constantin Freiherr von Heereman

Schon die Formulierung des Themas "Die Agrarpolitik im Spannungsfeld wissenschaftlicher Erkenntnisse, politischer Forderungen und praktischer Möglichkeiten" macht deutlich, daß wissenschaftliche Aussagen, politisches Wollen und politische Praxis nicht deckungsgleich sind. Wird in der Öffentlichkeit nach den Ursachen für solche Spannungen gesucht, sind es in der Regel die Politiker, die Abgeordneten, die Minister, die Verbandspräsidenten, die schlecht dabei wegkommen. Ihnen wird meistens Kurzsichtigkeit bescheinigt.

Der Hinweis, die Politiker müßten an ihre Wiederwahl denken, ist dabei gleichzeitig eine Art Entschuldigung für deren Kurzsichtigkeit. Damit wird ein Teil der Verantwortung vom Politiker auf die Wähler und die Verbandsmitglieder gewälzt. Wähler und Verbandspolitiker, so meint man, laufen angeblich nur denjenigen nach, die ihnen am meisten versprechen.

Im Gegensatz zu den Politikern genießen die Wissenschaftler im allgemeinen einen wesentlich besseren Ruf. In der Politik ist es üblich geworden, Gutachten bei Wissenschaftlern einzuholen. Diese Gutachten werden um so eifriger benutzt, je mehr damit die eigene Meinung untermauert wird. Andere Politiker benutzen wissenschaftliche Gutachten anstelle des früher üblichen delphischen Orakels. Gutachten sollen sozusagen den Politikern die Entscheidungen abnehmen.

Diese Beispiele erwecken den Eindruck, als ob die Welt heute schon in stärkerem Maße, als viele Wissenschaftler und die Öffentlichkeit es glauben, von der Wissenschaft regiert wird. Trotzdem ist die Politik nicht leichter geworden. Der Grund liegt darin, daß trotz aller Fortschritte der Wissenschaft das Wesen der Politik sich nicht geändert hat. Politik hat es mit Menschen zu tun, bei denen Gefühle, Wertvorstellungen, Sympathien und Antipathien ebenso große Bedeutung haben wie rationales, sprich vernunftgemäßes Verhalten. Das ist übrigens bei den Wissenschaftlern oft nicht anders.

Auch bei Professoren sind manchmal wissenschaftliche Auseinandersetzungen wesentlich durch Antipathien der beteiligten Personen bestimmt. Der Bereich der menschlichen Wertvorstel-