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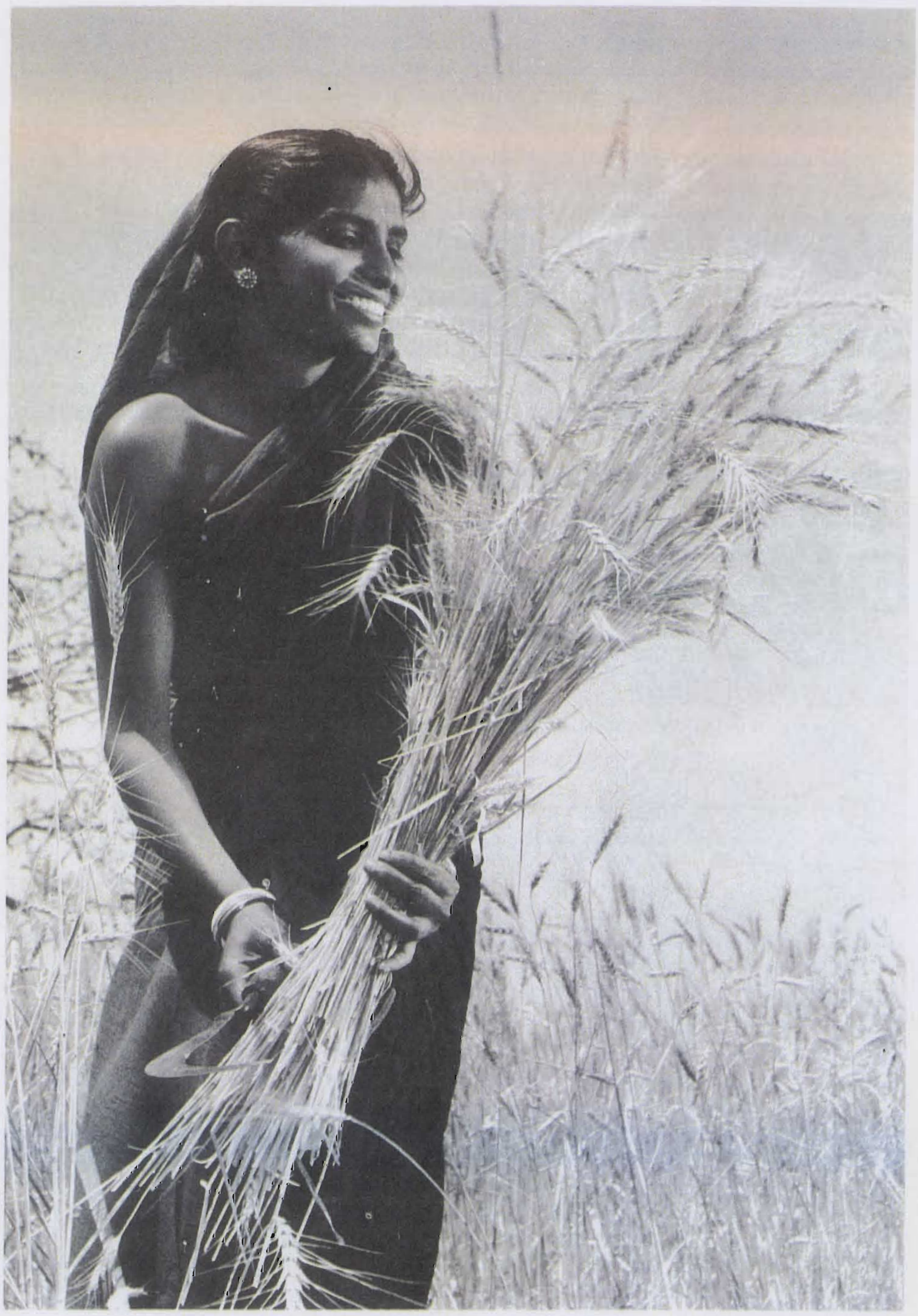

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Special Issue: INTERNATIONAL TRADE AND DEVELOPMENT

Minnesota Imports Finnish Landrace Sheep From Ireland

W. J. Boylan

The sheep population of the U.S. has been declining almost continuously since World War II. Yet on a world-wide basis numbers of sheep are on the increase and have been since the 1950's. The drastic U.S. decline from 50 million in 1942 to today's 21 million sheep has prompted some observers to speculate that the industry will soon be lost, for all practical purposes, as an important source of food and fiber in the U.S. Aside from the less "glamorous" status of sheep raising compared with cattle raising, the decline in the sheep population has been attributed to lower profits compared with other agricultural enterprises.

Genetic improvement of reproductive rates is a basis for increasing profits in the industry. Increased profitability could stimulate an increase in lamb and wool production. Raising ewes that produce five lambs at once rather than one could have a dramatic effect on profits. ⟶

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The Finnish Landrace, a native of Finland, has attracted international attention in recent years because of its high reproductive rate. Flocks averaging three, four, and five lambs born per ewe have been reported. The Finnish Landrace is almost unique in this respect among sheep breeds of the world. Most standard U.S. breeds average about 1 to 1.5 lambs born per ewe. The relatively large litters of the Finnish breed have an obvious practical advantage and also make it a scientific curiosity.

Animal Science researchers at Minnesota have been interested in importing the Finnish Landrace for several years. However, animal health regulations hindered import attempts. Animals could not be imported directly because Finland's livestock failed to meet the rigid health requirements for entry to the U.S. In order to import animals of the Finnish Landrace breed it was necessary to find a country where they had been established and also one that met U.S. animal health requirements for imports. Ireland was the sole country which had the Finnish sheep and could export them to the U.S. Even with Ireland a special requirement was imposed. Animals to be imported to the U.S. had to be second generation offspring. This resulted in a further delay.

In November 1968, a few lambs became available in Ireland and they were imported by the University. The importation became a joint effort with researchers of the USDA, Agricultural Research Service, who also became interested in the breed. Five ram lambs and one ewe lamb of the importation were brought to St. Paul.

The Finnish Landrace will be crossed with U.S. breeds to determine its potential contribution under U.S. conditions. Experimental crosses with the Suffolk and the Minnesota 100 breeds will be made at the Rosemount Experiment Station. A purebred flock will also be established. The performance of crossbreds and purebreds will provide a basis for making recommendations to the industry on the use of the breed.

The Finnish Landrace has a less desirable carcass than U.S. breeds. However, it has less subcutaneous fat than U.S. breeds, and this may be a distinct advantage. The quality of Finnish Landrace wool is not high, although in the past this breed was used for production of lamb pelts.

The breed is sometimes referred to in the broader classification as "Northern Short Tail" or "Rat Tail" sheep. This refers to their moderately short tail, which is partly covered with fine hair. This may be a bonus for American producers since it might eliminate the need for the docking of lambs.

The breed was brought to Minnesota primarily because of its high lambing rate. Though it is less desirable in carcass and wool qualities than U.S. breeds, these traits can be improved genetically with relative ease, but increased litter size is difficult to achieve in standard breeds.

The anticipated larger litters of this breed and its crossbreeds probably will require new systems of flock management. Intensive production, such as confinement rearing, may be the most suitable system for raising these new sheep. Management systems may even require artificial rearing of some or all of the lambs produced by a ewe. Improved nutritional knowledge and techniques make this a practical possibility. Even flocks with some improvement in litter size from introduction of the Finnish breed will benefit, although they may be raised by conventional systems of management. The genetic improvement of the latter flocks would permit a ewe to raise at least two lambs naturally, about double the present national average.

Although the use of the larger litter trait of the Finnish Landrace may not alter the present decline in the sheep population, it could have a lasting impact on the industry. It presents a major departure in sheep breeding and production, and with industry acceptance this new breed could contribute immeasurably to re-vitalizing the sheep industry.

Dr. Boylan holds a Finnish Landrace ram from Ireland. The breed has a white face free of wool, and both sexes are hornless. Note the naturally short tail.

Peasants Respond to Price Incentives

Vernon W. Ruttan

In modern industrial societies of the West the notion that changes in relative prices play an important role in changing producer and consumer behavior is firmly grounded in economic logic and is confirmed by observation and analysis. In most such societies, whether they are relatively free from state control or are rigorously socialistic, prices play an important role in guiding agricultural production decisions and directing the flow of commodities through marketing channels.

The response to price incentives has often been so powerful that programs designed to support the income of agricultural producers by holding prices above market levels have typically induced the production of substantial surpluses except where they have been accompanied by marketing quotas or effective restraints on resource use. As a result of higher product prices and relaxation of production controls, the U.S. is well on its way again to accumulating excess stocks of food and feed grains. And this occurred only a short time after a permanent end to surplus production had been widely proclaimed.

Traditional thinking about peasant response to prices

In the past a number of arguments have been advanced that anticipate that peasant producers would be unresponsive, or would respond negatively, to price incentives. It is frequently argued that the high value placed on traditional patterns of production and consumption weakens the response to price incentives. It is also argued that, under the conditions of extreme poverty which characterize large number of peasant producers, a rise in income is associated with more than a proportional rise in food consumption. Higher prices for food commodities would, therefore, result in producers retaining more of their production for their own use, resulting in a reduction of marketed surplus.

An important consideration in designing programs to achieve rapid growth of agricultural production in many underdeveloped countries is whether peasant producers in these countries respond to price and income incentives in the same manner as commercial farmers in industrial-

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This article is a revision of material prepared for the Sub-Panel on Production Incentives of the President's Science Advisory Committee (PSAC) study of *The World Food Problem* (Washington, US GPO, May 1967.)

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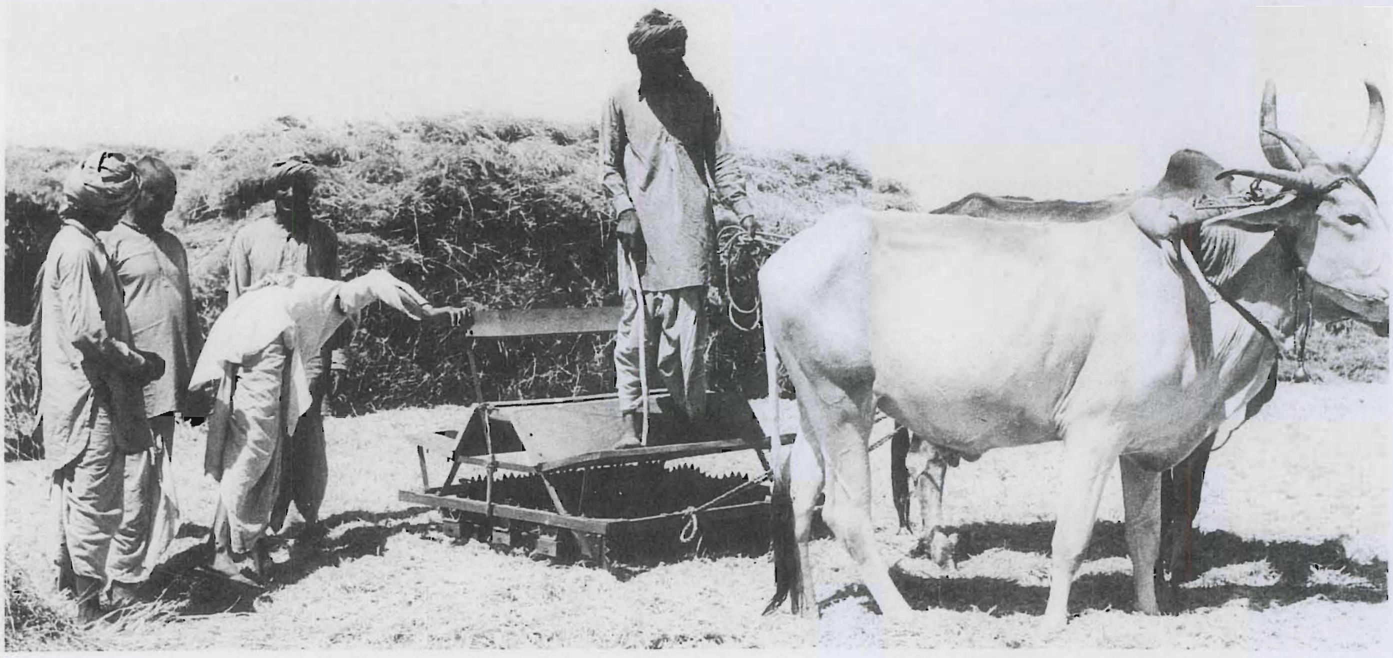

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ized countries. If peasant producers are unresponsive to price incentives, the efficient functioning of a free market becomes virtually impossible. And the effectiveness of price policy in achieving production or marketing goals in a planned economy is sharply reduced.

Policies based on unsound generalizations

Unsound generalizations about the importance of price incentives to farmers have frequently led governments in low income countries to adopt price policies solely on the basis of the impact of these prices on urban consumers, assuming that prices "do not matter" to farmers. Governments in a number of countries that export agricultural commodities impose substantial export taxes on basic food and nonfood commodities. In some cases the primary objective is to hold consumer prices below world market prices. In other cases the tax is employed primarily for revenue.

A number of governments require peasants to sell part of their production at substantial discounts. Other countries have used commercial imports or commodities obtained through food aid programs in a way that has held the prices paid to their own producers below the prices paid to the producers in the country from which the food aid was obtained.

Certainly, a country faces conflicting needs in trying, as it must, simultaneously to industrialize and to increase agricultural productivity. But one thing it cannot afford to do is to ignore the response of farmers to price incentives or depressants. New technological possibilities are becoming available. Technical inputs such as new seed varieties, lower cost fertilizer, more effective insecticides, locally adapted power equipment, and others are becoming available to many farmers even in the less developed countries. These new inputs differ from the traditional inputs in that they must be purchased from the nonfarm sector. One effect of this new biological, chemical, and mechanical technology is that peasant producers become more sensitive to prices.

Furthermore, the growth rate of demand for agricultural output in most developing nations today is far higher than the rate of growth in demand in the presently developed countries at a comparable stage in their development, primarily because of rapid population growth. The question must be raised, therefore, whether the required rate of agricultural output growth can be achieved in the absence of direct encouragement to producers through more positive agricultural price policies.

If a nation is to formulate a constructive agricultural price policy an attempt must be made to obtain reliable information regarding the effect of:

(a) relative changes in the prices of individual crop or livestock prices.

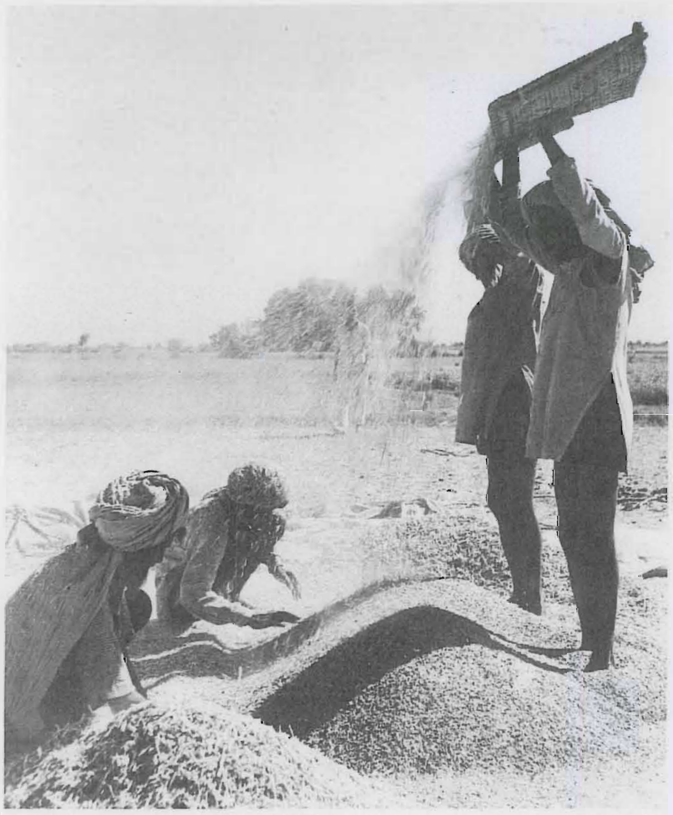
(b) changes in the prices of agricultural commodities relative to the prices of manufactured inputs and/or consumption goods purchased by peasants.

(c) price changes on the marketed surplus of food crops in countries where a large part of output is retained for home consumption.

Changes in prices of individual crops

Recently a substantial body of data has become available on the acreage response of individual crops to relative price movements for a number of major geographic regions or countries.

It is possible to draw a few generalizations from these studies. Most important is the fact that the peasant producers studied are reasonably responsive to change in the relative prices of individual commodities. Changes in relative price are, therefore, effective in determining land allocation among several agricultural commodities.



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A closer review of the individual studies also indicates that producers of crops normally grown for sale, such as cotton, sugarcane, and jute (commonly called "commercial" crops), are more responsive to price changes than producers of crops that are produced primarily for consumption by the farm families producing them. However, producers of these "subsistence" crops are typically more responsive to price changes in areas characterized by well developed irrigation, transport, and marketing facilities. In such regions the response of peasant producers to price incentives is of roughly the same magnitude as the response of commercial farmers in developed countries to similar incentives.

Attempts to detect yield responses to price changes in less developed countries have typically not been very successful. This seems to imply a less optimistic view of the role of price as a development tool than would be the case if it could be demonstrated that price changes have induced positive yield responses in addition to area shifts. Failure to find a positive yield response to price increases, coupled with data that indicate a positive acreage response, suggests that price incentives are effective primarily in localities where (a) the farm supplies and equipment necessary to increase output are physically available and (b) where marketing channels for farm products are adequate, and (c) where the many other influences affecting farmers' decision to adopt yield-increasing technologies, such as land tenure relationships, are favorable. In the Philippines, for example, peasant producers of rice are more responsive to price changes in the traditional centers of rice production in Central Luzon than in the newly settled areas of Mindinao.

Response of total farm output to price

Valid estimates of the response of total agricultural output to changes in the price of agricultural products relative to the prices of non-agricultural products are difficult to obtain. Furthermore, it is impossible to draw firm conclusions regarding the response of agricultural output as a whole from data on the response of individual crops. It is entirely possible that the studies of individual crop response merely indicate that the same total area of land may be reallocated by peasant farmers among different crops in response to relative price changes while total output remains essentially unchanged. Available studies support the view that increased use of traditional inputs tends to yield relatively low returns. In such situations the returns on a single new technical input, such as fertilizer, may also be low. At the same time, investment in a set of complementary new inputs — including irrigation, fertilizer, chemical weed and pest control — may yield exceptionally high returns when new crop varieties with sharply higher yield potentials become available. Recent experience in West Pakistan with the dwarf Mexican wheat varieties and in the Philippines with new non-lodging rice varieties are examples of such development.

Evidence indicates that prices of farm products, taken alone, represent relatively weak incentives for achieving growth in total output in densely populated areas characterized by a traditional agricultural technology. When higher prices of farm products are employed in combination with more efficient technical inputs, however, the increased incentive speeds up the adoption rate of the new technology and raises the level of agricultural productivity.

Price effects on marketed surplus

A complete evaluation of the potential contribution of price policy must consider not only the effect of prices on total agricultural production but also their effect on the quality of food that is made available to the non-agricultural sector — the marketable surplus.

Evidence indicates that the response of marketed surplus to price is typically positive and, under most conditions, greater than the response of output. Apparently even low income peasant producers have a sufficiently high demand for non-food items of consumption that higher prices for food crops typically induces as increase in both food production and food marketings.

Role of price incentives in development policy

The results of these more recent investigations of the response of peasant producers to price incentives have significant implications for agricultural and economic development policy.

First, it is clear that peasant producers of both commercial and subsistence crops are typically quite sensi-

tive to changes in relative prices. This means that the effects of price policies must be carefully considered if serious distortion in land use patterns is to be avoided. Export taxes on rice, designed to generate revenue or to hold internal food prices below world market levels, for example, clearly divert land and labor away from the production of rice and into the production of other food or commercial crops. The same consideration applies in evaluating the effect of PL 480 or other surplus food distribution programs. Except in situations where food shortages are sufficiently severe to cause the internal prices to turn sharply in favor of food grain producers, food shipments may discourage farmers from expanding production. Recent studies indicate, for example, that PL 480 shipments to India during the 1950's and early 1960's reduced food grain production. In the Philippines low rice prices resulted in a substantial shift of acreage to corn and commercial crop production.

Second, it is increasingly evident that the effective use of economic incentives to achieve agricultural development depends on the availability of technical changes, embodied in new capital and current inputs. In most developing countries, particularly the tropical and semitropical countries, the new biological and chemical technology, which would permit peasant producers to respond to price incentives, is only beginning to be developed locally. It cannot be directly transferred from the countries which have achieved high levels of agricultural productivity without substantial adaptive, and in some cases, basic research. Such research is usually highly specific to the location in which it is to be employed. By and large it must be conducted under the same environmental conditions in which it will be used.

This implies that the concept of technical assistance based on the transfer of agricultural technology from countries of high productivity to those of low productivity is not applicable. Instead, long term research and development directed toward production of modern biological, chemical, and mechanical technology that is adapted to the local ecology are required.

There is substantial evidence that peasant producers in most areas of the world are sufficiently responsive to economic incentives. So when highly productive new technology becomes available, price incentives can be used as an affective instrument to speed the growth of productivity and also serve as a sensitive guide to the allocation of resources into the production of alternative crops.

A variety of wheat susceptible to stem rust produced both groups of kernels above. The 25 plump kernels at the left represent the yield of a rust-free plot. The five shrivelled kernels at the right represent the yield of a plot infected with stem rust. Based on weight, the rusted plot produced only 6 percent as much as the rust-free plot.

Wheat Rusts— International Threat to Food Supply

L. Calpouzos, R. W. Romig, and M. F. Kernkamp

Rusts are the most important diseases of wheat and present a constant threat to production in all of the important wheat growing areas of the world. There are three rust diseases of wheat, each caused by a different species of fungus. These are stem (or black) rust; leaf (or brown) rust; and stripe (or yellow) rust.

Stem and leaf rust are likely to become epidemic in warm, moist seasons; stripe rust is likely to damage the crop in cool, moist seasons. Thus, stripe rust can be found, generally, in the Pacific northwest, northern Europe, and the highlands of Latin America, Africa, and Asia. Leaf and stem rusts, on the other hand, can be found in the Great Plains of the United States, in southern Europe, and in the lowlands of Latin America, Africa, and Asia.

With the right conditions for epidemic development, stripe and stem rusts can totally destroy the value of the crop. Losses from leaf rust usually are not as devastating; nevertheless, yields may be reduced by more than 40 percent (see table). An epidemic of any of these rusts can be a spectacular phenomenon, owing in large part to the suddenness with which the disease appears. Under ideal conditions, the disease may increase as much as tenfold in 3 to 4 days.

Rusts undoubtedly have plagued mankind since he began cultivating cereal crops. There are clear references to rust epidemics in the annals of ancient Greece and Rome. The Romans considered rust to be the greatest pest to crops and believed that the rust god Robigus destroyed grain as a punishment. Consequently, the Romans celebrated the ceremony of the Robigalia in the spring of each year, even well into the Christian era.

International grain trade is influenced by the wheat rusts, since they affect the supply of grain entering the market place. Mexico, for example,

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L. Calpouzos is an associate professor, R. W. Romig is an assistant professor (and also a research plant pathologist for the USDA), and M. F. Kernkamp is a professor and the department head.

was a country with low per-capita consumption of wheat and was a net importer of the grain until recently, when rust-resistant varieties were developed and grown widely there. As a result, the markedly increased supply of wheat in Mexico has permitted a sharp rise in local wheat consumption together with a shift in the marketing role of Mexico from an importer to an exporter.

The main strategy for controlling rust diseases in recent times has been by breeding resistant wheats. However, scientists were puzzled by the fact that wheat varieties which were resistant to rust for some years might suddenly appear susceptible. The reason for this change in resistance was discovered by Professor E. C. Stakman and his colleagues at the University of Minnesota. In a population of rust, a few new types of individuals may arise, through genetic recombination or by mutation, that are capable of attacking the "resistant" wheat. These new rust types, called races, may increase rapidly and in this way, a wheat variety resistant to the old population of rust becomes diseased.

To keep ahead of the new races, wheat breeders cooperate in an international network of rust nurseries where wheats from all over the world are brought together to form a collection which is planted at strategic locations in many countries and screened for resistance to the races of rust prevailing in each of these areas. In this way, the wheat is brought to the rust rather than the rust being brought to the wheat. This prevents the introduction of foreign races into new areas and thus safeguards local wheat production. The University of Minnesota participates in this international network of rust nurseries by contributing new kinds of resistant wheats and by growing one of the nurseries in a plot at the St. Paul Campus.

In a few instances, the rust is brought to the wheat plants. During the wintertime at St. Paul, the wheat varieties from the international nursery are tested in the greenhouse to individual races from the U.S. During the wintertime there is also a field test

A wheat variety susceptible to leaf rust produced these kernels. Those at the left represent the yield of a rust-free plot. Those at the right represent the leaf rust plot, which yielded only 56 percent as much as the rust-free plot.

in Puerto Rico, where many wheat varieties are screened for resistance against three or four selected races of rust that are potentially dangerous and are beginning to appear in small amounts in the mainland USA. Detection and selection of these races are accomplished in the Cooperative Rust Laboratory at St. Paul. Tests go on during both summer and winter to identify new disease-resistant germ plasm, which will be the basis for the development of future varieties.

Another strategy for the control of rusts is the use of fungicides on the new high-yielding wheats. The effective way of controlling diseases by a fungicide is to apply the chemical when an epidemic is about to develop.

Effect on yield by rust infection of spring wheat in Minnesota

Disease	Severity at harvest %	Yield bu/acre	Loss %
Leaf rust	100	21.3	44
	12	32.3	15
	Trace	37.9	—
Stem rust	100	2.1	94
	46	26.0	29
	7	35.5	3

Thus, prediction of epidemics is needed to tell us whether or not to spray and when to spray. Research concerned with fungicides that control rust and with the prediction of rust epidemics is being conducted at the University. We are relating the numbers of spores found in the air along with weather factors to the prediction of disease development. Results of these studies in the U.S. are also being evaluated in North Africa, the Middle East, and South Central Asia, where new high-yielding wheats are being grown for the first time.

The fight against rust needs a continual supply of young scientists trained in the latest methods of plant pathology and plant breeding. The University of Minnesota's St. Paul Campus has, for decades, been a leading center for educating pathologists and breeders. Today many of its graduates are among the world's leaders in combating food losses due to wheat rusts. The foreign countries in which some of these men are dedicating their life's work are Mexico, Columbia, Chile, India, Pakistan, and the UAR — countries that are becoming self-sufficient for the first time in recent years in wheat production.

Let's Profit From Europe's Forest Experience

In southeastern Minnesota we have a multiple-use public forest similar to certain public forests in Germany and England. We can learn from the centuries of forest-management experience of the Europeans.

L. C. Merriam, Jr. and T. B. Knopp

Henry David Thoreau was right when he compared the Rhine Valley of Germany and the Mississippi Valley of America more than a century ago. In many respects the two areas are similar. Even in Thoreau's time, of course, the Rhine and its banks had had heavy traffic for centuries. Our Mississippi, on the other hand, is fairly wild even now, particularly in Minnesota.

In 1961 the Minnesota State Legislature designated some 1,920,000 acres along the Mississippi in southeastern Minnesota as the Minnesota Memorial Hardwood Forest. This area honors both the pioneers and the war veterans of Minnesota. It includes parts of Dakota, Fillmore, Goodhue, and Olmstead counties and all of Houston, Wabasha, and Winona counties.

Diverse in ownership, the public and private lands that make up this Forest include 460,000 acres of woodland plus other land devoted to crops, pastures, and towns. Many agencies — federal, state, and county — are involved in its administration.

Concern for wildlife in the Whitewater Valley motivated Richard J. Dorer to lead in establishing the Forest. Today we can say that its purpose is to provide recreation, to improve wildlife habitat, to increase timber production, to control erosion, and to stabilize streams. That is, the Memorial Hardwood Forest is a multiple-use area.

Within the Forest are towns such as Winona, Red Wing, and Caledonia. Industry and commerce continue as always, and railroads and major highways carry travelers along the river and bisect the Forest east and west. Several major river systems flow into the Mississippi through the Forest — the Cannon, the Zumbro, the Whitewater, and the Root. All these rivers have recreation potential for canoeists and anglers, and all have caused flood damage and erosion of soils exposed by forest harvest or intensive agriculture.

Along the Mississippi River the land form is varied. Rugged scenic bluffs and valleys contrast with the surrounding prairie. Eight state parks, seven wildlife areas, and numerous historic sites lie within the Forest. It includes the old town of Forestville with its 1853 store, plus winter ski areas, private campgrounds, picnic areas, boat marinas, and tourist facilities.

A generally accepted objective of the Forest is improving the management of the 600,000 acres of woods and submarginal farmland while achieving cooperation between private owners, public, and quasi-public agencies at several levels. Some land acquisition by the state is recommended to achieve desirable conservation and management. Several counties and communities have their own recreation or resource plans, and some state and federal agencies have plans en-

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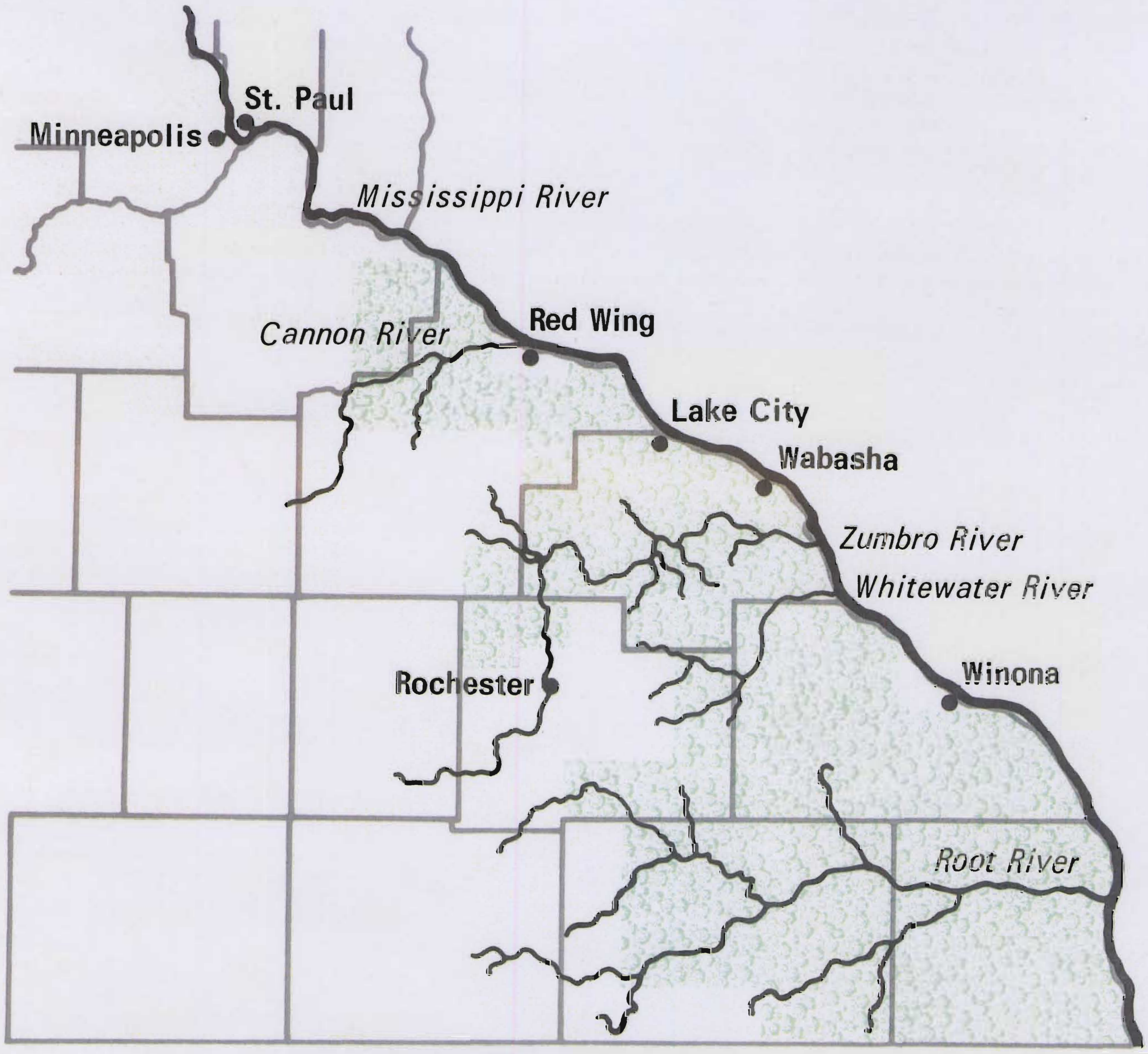
The authors are studying the Minnesota Memorial Hardwood Forest, and the senior author has studied forests in Western Europe. L. C. Merriam, Jr., is a professor and T. B. Knopp is an instructor, School of Forestry.



The Minnesota Memorial Hardwood Forest

compassing portions of the Forest. These plans can be coordinated to develop a wider range of opportunities for the recreationist, tourist, and, student of nature. Some form of land use zoning will be needed to achieve the goal of integrated resource use.

The typical user is not aware of the Forest as an entity; neither does he know the role of the state in coordinating management and planning. Also, the non-local user generally does not know of the variety of recreational environments and opportunities available in the Forest. Much use is tied to road systems and the river. Users range from auto-borne sightseers to walking fishermen, canoeists, and hikers, and from local people to foreign visitors.

Visitors to the Memorial Hardwood forest doubtless have typical American characteristics. In the United States we have a pattern of freedom of expression and individual direction comparatively unrestrained by governmental edict or tradition. We have often taken a cavalier approach to environmental development and control. Confrontation between organized groups and land administrators can often be direct and significant.

European experience is different due to long-established land-use patterns and to authoritarian church, class, and governmental control. Europeans accept their social class and role. They are more attuned to public transportation and walking. But in thinking of our Memorial Forest it may help to examine what older societies have done with their somewhat similar forest lands.

Populations are much greater in comparable land areas of western Europe. Minnesota, for example, with an area of 84,000 square miles is almost as large as Great Britain (89,000 square miles) and only 13 percent smaller than West Germany (96,000 square miles); but our 1966 estimated population was 3.6 million, compared to 54 million in Great Britain and 55 million in West Germany.

Germany's portion of the Rhine Valley has a particularly dense population, numerous large cities (Cologne, Mannheim, Dusseldorf), and industrial areas. Traffic on the Rhine and along its banks has been heavy for centuries. Despite its long and intensive occupation by man, the Germans feel concern for the natural environment, and they make plans to protect remaining natural landscapes.

Since 1956 the German federal and state governments have established natural parks in which forest production may be carried on while the public enjoys them as recreation areas. These parks vary in size from 3,400 to 432,000 acres. Some, such as Siebengebirge near Bonn, are on the banks of the Rhine. This small, state-owned river bluff park of approximately 10,370 acres contains a famous hotel, a famous castle ruin, farms, and many old developments. It is heavily used by local people.

The forest is harvested for products and has been extensively planted since World War II. There are trails, benches, and other facilities for visitors, who accept the primacy of timber management and the regulation of public access. An association for the park promotes its use and maintenance. But since some uses are competitive planners are concerned over the need for more thorough land use planning — not overemphasizing any one specialty.

Now let's look at Great Britain. Since 1949 national parks have been created on ten tracts of Britain's unspoiled countryside. Often these parks include mountains, forest, moorland, and lake country, frequently located near large metropolitan centers (for example, the Peak District National Park between Manchester and Sheffield). Such parks are not comparable to the Memorial Hardwood Forest in the forest production sense, but they do include towns, villages, farms, and the like, in which normal life goes on as before and land ownership is nearly all private.

Under British Parliamentary law establishing the advisory (non-administrative) National Parks Commission, park planning authorities are created for each park. They control development to preserve and enhance natural beauty, to promote outdoor recreation, and to provide countryside access. These park planning boards have local and nationwide representation plus professional planning and administrative staffs. Development plans are created for each area (like a national park master plan). All building design, land use, and development within the park are subject to planning board authorization. Access to or through land is subject to negotiation with the owner. Visitors must keep on paths, close gates, and abide by the British country code in respect to life of the rural areas.

In southern England near Southampton is the New Forest, an ancient royal hunting area established by William the Conqueror in 1079. The New Forest is controlled by the British (federal) Forestry Commission. Special acts of Parliament define the ancient right of commoners to graze horses on the Forest, and so on. The Forest consists of 67,024 acres of Crown (federal) land within a legal boundary that surrounds 92,758 acres, including farms, several towns, and private estate of Lord Montagu.

The New Forest is interesting because its management illustrates the importance of unchangeable tradition in Britain and the continuity of ancient laws, rights, and policies. The principal administrator is the Deputy Surveyor, who still must approve celebrations in local communities within the Forest as well as many other domestic matters. Though once primarily a royal forest for the hunting and preservation of game for the king, the New Forest now provides production of timber, protection of wildlife, grazing for animals of local residents, and the safeguarding of national beauty.

About two-fifths of the New Forest is wooded; the balance is open heath and grassland. It is divided into five main land-use zones:

1. The open forest, for local grazing and for public enjoyment.

2. The Inclosures (21,000 acres), primarily for timber production and protection of natural beauty.

3. The Ancient and Ornamental Woodland Areas, mostly of beech and oak (9,200 acres), maintained principally for natural amenity. They are open to the public with limited recreation facilities, and for commoners' animals, which graze even in the campground.

4. Freehold or private lands within the Forestry boundary, including estates such as Beaulieu Manor.

5. Outside Commons, usually National Trust or private lands subject to Forest bylaws.

Many people now travel to the New Forest and through it by road. Walking and horse riding on designated roads and trails are allowed, as is some forest camping. Strict regulations are imposed in visitor control and rigid enforcement followed, especially in poaching, littering, and vandalism offenses.

These European examples are but a few of many that could be given; none is wholly applicable to the Minnesota Memorial Hardwood Forest. But with a newer, dynamic society and less long-established tradition, we might experiment with some ideas from older societies under U.S. and Minnesota conditions before local problems become more acute with rising population, increased development, and more recreation pressure. Of particular concern for the Memorial Hardwood Forest are the following considerations: land zoning; use allocation and multiple product management; careful landscape planning to include many specialized fields, public interests, and environments; and interagency, community, and owner coordination in policy direction.

Rural Modernization — A Goal for Chile

Social, political, and technical changes are taking place in Chile. The problem is how to feed a rapidly increasing population.

Dario Menanteau-Horta

Chile is one of the Latin American countries facing the urgent challenge of rural reconstruction. This is a task which implies at least two major dimensions. One is the social and cultural transformation of the Chilean rural society, which includes over 30 percent of the country's population. The other, to increase agricultural production, is essential if the nation is to provide an adequate food supply for its people.

Both dimensions are interdependent. This article considers the following three points related to Chilean agriculture: 1) the discrepancy between potential and actual use of human resources; 2) The impact of a lagging agricultural output upon Chilean national development and its population; and, 3) the role of technical communication in increasing food production.

The Land and The People

The total area of Chile, about 300,000 square miles, is irregularly shaped on the southwestern corner of South America. Its average width of 109 miles and length of 2,650 miles limit the use of the land for agriculture. Approximately 37 percent of the total land area (68 million acres) is classified as farmland.

In spite of this small proportion, Chile has more than enough cultivable land to feed her population of about 9 million inhabitants. The nation has 1.8 acres of good land per capita, an amount close to the 2.2 acres available in the United States.

One of the most critical problems, however, is the misuse of this natural resource. Out of the total cultivable land (nearly 14 million acres), less than one-fourth is in general crops while almost 65 percent is used in natural grass and fallow. Furthermore, the natural conditions of climate and soil require the use of irrigation to a great extent. Although slightly more than 3.2 million acres are irrigated, almost one-half of them are in natural pasture. This represents one example of the discrepency between actual and potential use of natural resources, since between 5 to 20 acres are needed to feed one cow on pasture while only 2 to 3 acres of the same land could feed up to three cows.

The Chilean land tenure system also has been considered one of the major problems hindering both agricultural productivity and improvement of social conditions of rural workers. Large

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landholdings of more than 700 acres each represent about 5 percent of the total Chilean farms. They control, however, about 50 percent of the arable land. At the other extreme is the small property system, known as "minifundio," which includes 66 percent of small land-units (less than 50 acres) but accounts for only 2 percent of the arable land area.

Eight percent of the total agricultural population, is made up of landlords *(patrones)* who receive about 60 percent of the total agricultural income. Chile's rural underpriviliged group exceeds 420,000 families, including over 80,000 *inquilinos* or resident farm laborers, almost 200,000 transient workers, and others without land.

The land reform program initiated in Chile in 1964 is the first step toward agricultural reconstruction required by the nation. From it have already come some improvement of living standards of rural families and also some advances in transforming traditional patterns of land tenure.

Critical Lag in Food Production

Important efforts made by Chile toward industrialization and development have failed to bring about some necessary changes in the rural social structure and to introduce technological improvements for agricultural growth. Thus, over a period of 30 years (1930-1960) the industrial sector grew almost 400 percent, and general services increased 200 percent, but agricultural production increased only 84 percent.

This lagging agricultural output forces Chile to divert a substantial proportion of foreign exchange to food imports and thus threatens to curtail Chile's efforts to achieve a balanced national development. At the present time, Chile is importing about 170 million dollars in food products annually, of which less than 50 million dollars represents products which could not be grown in the country. This situation can be compared with 1939 when Chile enjoyed a favorable balance of trade in agricultural products, exporting more than twice as much food as she imported.

An additional problem is that Chilean agriculture has been unable to keep pace with population growth. During the last 25 years food production has increased at an annual rate of only 2.0 percent, while the population has increased at a rate of 2.3 percent annually. Population projections suggest that the present Chilean population of about 9 million people will reach 12 million by 1980 and may double every 30 years thereafter. Agricultural production, therefore, must be increased rapidly if the nation is to provide an adequate food supply for its population.

The problem of malnutrition is one of the most serious results of shortages in agricultural production. Today the average Chilean eats less than he ate 15 years ago, and a high proportion of the people eat less than the minimum amount recommended by nutrition experts. About 60 percent of the school-age population, constituting over one-third of the total population, is reported not to drink milk. Approximately 20 percent of these children are anemic, and a very high proportion (70 percent) show some symptoms of rickets.

Many other social problems can be easily visualized within a country affected by shortages in agricultural production. The poor performance of Chilean agriculture, however, should lead to a closer look at potentials for expansion of farm productivity as an important part of the rural reconstruction needed in Chile.

Diffusion of Technical Information

The diffusion of technical innovations is gradually coming to be recognized as a key factor in the process of agricultural development. Many years of research and of extension programs have revealed the positive impact of modern technology upon food and fiber production levels, in the United States as well as in other highly industrialized nations.

Rapid increases in Chilean agricultural production are quite dependent upon the structural changes being introduced by land reform programs. To be successfully implemented, however, social, political, and economic transformations should go together with the improvement of farm management and production techniques.

It is at this stage that communication and diffusion of modern agricultural practices become essential components of the rural reconstruction process.

The fact that less than 20 percent of the land under cultivation in Chile has been fertilized indicates that there is an under-utilization of agricultural technology.

Similarly, when the author recently studied three rural *comunas* of the central valley of Chile, among a sample of 244 farmers too few had adopted four recommended agricultural practices. Slightly over one-half of the farmers interviewed have adopted nitrate, only 36 percent were using certified seed, and less than a third of the farm operators have adopted the use of phosphate and herbicide.

Several social and economic factors related to this low use of recommended farm practices were education, size of farm, income level, and others. This study, which was sponsored by the Department of Sociology, University of Minnesota, also found that the lack of available agricultural communication media played a large part in this situation.

For the purposes of the study, technical communication was defined as the extension educational process, transmitting information and specialized knowledge to farm audiences. Four communication channels were selected (radio programs, farm journals, technical bulletins, and contacts with the Agricultural Extension Service), and farmer's exposure to these channels was analyzed.

The findings of this study revealed that only 3 percent of the sample population was regularly exposed to all four technical channels, and over one-half of the farmers interviewed indicated no use of these media. Less than one-third of them were listeners of agricultural radio programs or occasional readers of farm journals. Fifteen percent reported regular reading of technical bulletins, and only a very low proportion of the farmers were even aware of the existence of the local Agricultural Extension Service operating in the area. Approximately one out of ten farmers had received a visit from an extension agent.

For a large majority of Chilean farmers, informal associates, including relatives, friends, and neighbors, still are important diffusion agents and sometimes influential sources for innovation.

The fact that technical communication agencies and agricultural services are limited to a very low proportion of the Chilean farm community, especially to those large landholders with higher levels of income and education, suggests the need for an urgent revision of extension methods and expansion of research and action programs in this phase of agricultural development.

It is unfortunate that a technical assistance program launched 3 years ago by the University of Minnesota in agreement with Chilean Agricultural Agencies has failed to develop systematic research on diffusion and adoption of technical information among Chilean farmers. This is one important field where international cooperation could certainly be helpful in fostering and implementing the rural reconstruction so urgently needed in Chile today.

Two Summers a Year for Plant Breeders

J. W. Lambert

Minnesota plant breeders, with their counterparts elsewhere, have become impatient with the time commonly required to develop a new crop variety. They have been especially frustrated with the years that it takes to "turn over generations."

In a hybridization program, several generations must usually elapse between the time a cross is made and when the desired plant types are established and isolated. Moreover, when these types are isolated, additional generations are required to multiply the seed to amounts large enough to serve a significant number of commercial producers.

Plant breeders in the tropical and subtropical parts of the world have a distinct advantage in the race from cross to released variety. They can grow two or three crops per year in the field. In the temperate zones, on the other hand, breeders are held mainly to one crop per year. They have solved this problem partially through the use of greenhouses and controlled climate chambers. These are especially useful in the early stages of the breeding procedure, that is, for parental plants and for plants in the first generation from crosses. In later generations, however, space soon becomes a limiting factor. Cost per square foot in greenhouses and growth chambers is high.

To accommodate the winter space needs for the middle and later generations in a breeding program, many breeders have turned to geographical areas that enjoy warm weather during our temperate zone winters. In the thirties and forties experiment stations and seed companies established overwinter corn nurseries in extreme southern United States, notably in Florida and Texas.

These proved to be very useful and have been continued, even though there is a frost hazard nearly every season. To escape this frost problem some seed corn companies recently have established nurseries in Hawaii.

Certain areas in southern Arizona and California have been very useful for overwinter increases of new small grain varieties. One, and in some cases two years, have been cut from the time needed to multiply and release these varieties to farmers. Most successful and useful to small grain breeders, however, have been the overwinter nurseries established about 10 years ago in the state of Sonora in Mexico. These are operated cooperatively by the Mexican government, the Rockefeller Foundation, the Crop Quality Council, the U.S. Department of Agriculture, the Canada Department of Agriculture, and several state experiment stations, including the Minnesota Agricultural Experiment Station. In these fertile, irrigated fields located in the Yaqui Valley near Ciudad Obregon it is possible to grow several acres of experimental material at a relatively low cost and with very little danger from freezing temperatures.

Both the barley and wheat projects of the University of Minnesota have made excellent use of the Obregon facility. During the last couple of years an effort has been made to include oats in the Mexican program also, though there are greater problems in growing oats in the short Mexican winter days than in growing barley or wheat.

Another facility for overwinter work has been established in Puerto Rico. This has been particularly valuable in cereal disease studies. It has also been used by soybean breeders, though they have found they have to put auxiliary lights in the fields to make the days long enough for good seed production.

A different solution to the day-length problem has been worked out by the soybean breeding project at the University of Minnesota. We have taken our material down over the equator into the southern hemisphere where the seasons are reversed. In other words, July is winter, and January is summer. Planting can be done in Chile in November, after the seed is harvested in Minnesota. Air freight gets the seed down there in a couple of days and gets the Chile-harvested seed back to Minnesota in May. The crop grows normally in the summer climate of Chile and gives a good yield of seed. Since 1964 three new varieties of soybeans have received their initial increase in the irrigated fields of the Chilean Institute for Agricultural Research, the research arm of the Chilean Ministry of Agriculture. These varieties were Traverse, released in 1965; Norman released in April 1969; and a third one that is still in the advanced stages of increase.

Besides the increases, many hundreds of early generation plots have been grown every winter, starting with the 1962-63 growing season.

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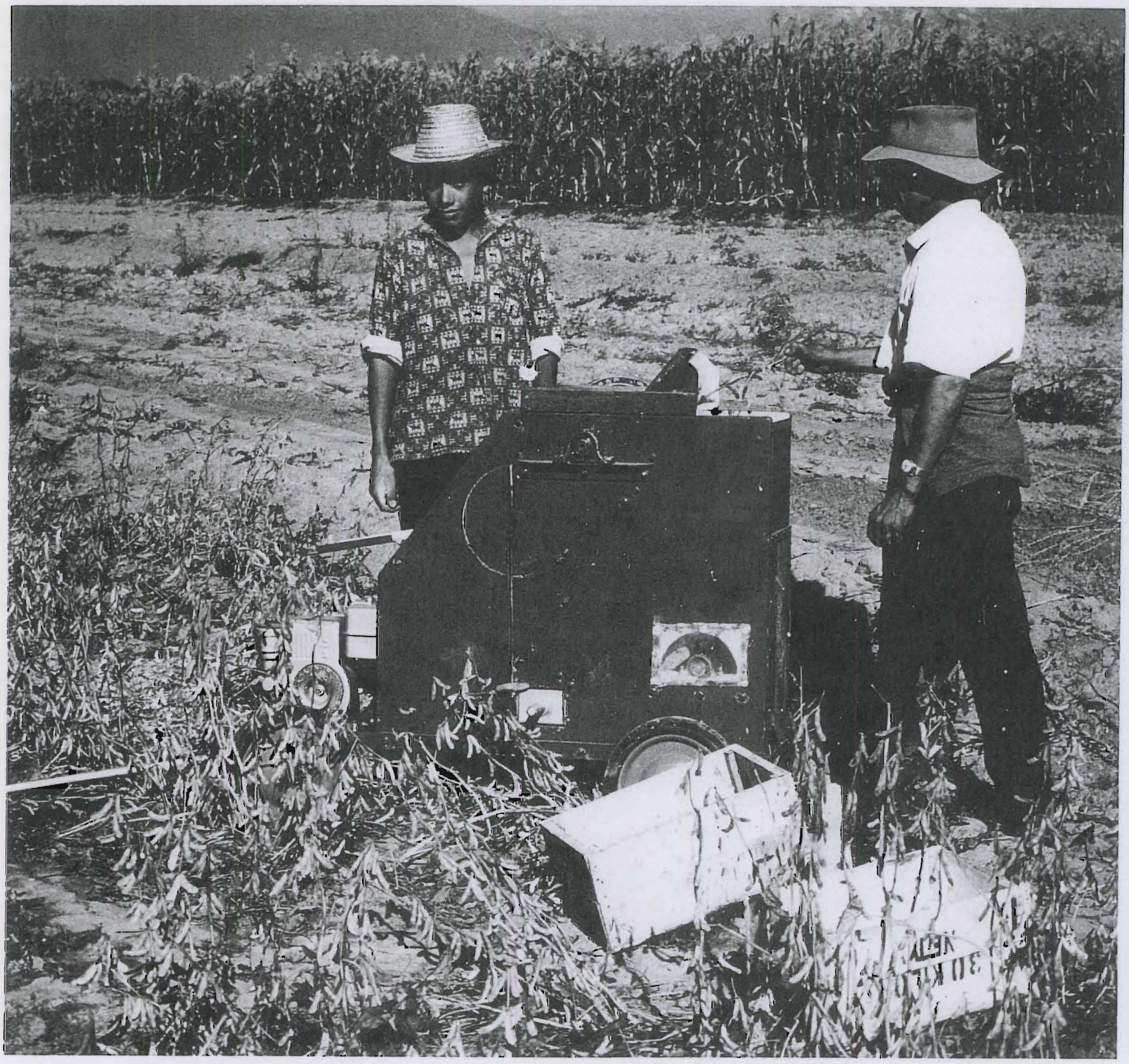
This has greatly accelerated the breeding procedure. For example, crosses made in February 1964 in Chile were grown in the first filial generation, or F_1, in Minnesota in the summer of 1964. The F_2 was grown in Chile, the F_3 in Minnesota, the F_4 in Chile, and the F_5 in Minnesota in 1966. The first yield trial was grown in Minnesota in 1967, 3 years sooner than would have been possible if all generations been grown in Minnesota.

The Minnesota soybean nursery has been important not only to Minnesota but to the Chilean Institute for Agricultural Research as well. Through the cooperative program the Institute has had access to the best varieties from the United States to help Chile get started with soybean production. Moreover, if the Institute eventually initiates a soybean breeding program of its own, the "two-summer" system will serve as well for it as for us.

To be sure, there are costs involved in conducting overwinter nurseries. Seed must be transported, labor hired, supplies purchased, irrigation water applied, and expenses incurred for travel. However, when compared on a cost-per-square-foot basis with greenhouses or growth chambers, the overwinter nurseries win hands down. They are the best solution yet to the problems of "generation turnover" and plant breeder impatience.



With the Andes mountains in the background, these Chileans are threshing out soybeans from one of the author's experimental plots. Growing crops in both the Northern and Southern Hemispheres doubles the speed of a plant breeding program.

U.S. Food Aid Export Programs

Since World War I America has been sending food to hungry areas. These aid programs have changed with the times.

Robert D. Hunt

Food aid exports stretch back to World War I. When war-ravaged Europeans were in danger of starving, the U.S. shared its abundance with them. Massive food and medical aid was also shipped to Russia during its famine of 1921. Food aid continued under the Marshall Plan when $2,994 million worth of food and feed was shipped. The Marshall Plan, with its aim of economic recovery through regional cooperation, resulted in a Western Europe stronger and more united than in any previous era.

With the onset of a serious U.S. surplus domestic agricultural production problem, the Agricultural Act of 1949 authorized overseas disposal by the Commodity Credit Corporation (CCC) of products in danger of loss by spoilage. These products could be disposed of at a substantial loss, since any payment at all would be better than losing the entire amount through spoilage.

But this left the U.S. government open to a charge of "dumping" surpluses on the world market, thus forcing down international prices of these products and passing the burden of adjustment for an entirely domestic problem on to the world at large.

These programs, while useful in themselves, were never meant to be long-term projects with multiple objectives. In the meantime, however, surpluses continued to build up at home, and the government needed to develop a constructive and long-term course of action to ease the surplus problem and to reduce criticism.

U.S. foreign aid programs have been administered by the Agency for International Development (AID) since 1948, and earlier by the International Cooperation Administration (ICA) and other predecessors. The Mutual Security Act of 1951 enabled AID to purchase agricultural products from the CCC with funds appropriated to it by Congress and to sell these products to other countries for non-dollar currency. Such money was used to finance development programs in these countries.

This continued until September 1961, when the Foreign Assistance Act permitted AID to drop the requirement that certain of its funds be used for foreign currency sales. This allowed the AID funds to be donated directly to the country, so that it could purchase its agricultural product needs on the world market when they did not coincide with the U.S. agricultural products which had been designated as surplus. In this way a foreign country's needs could be fulfilled rather than having to make do with whatever the U.S. had to offer. This also freed more U.S. surpluses for export to countries really in need of the surplus products.

Expenditures for exports of farm products under Mutual Security (AID) program have tailed off rapidly since the 1961 modification; but this was due principally to a cause other than the modification. Exports totaled $186 million in 1961 and $42.6 million in 1966, but in 1955 exports under this heading had totaled $450.6 million.

The main reason for the decline in farm exports under MSA was the passage of the Agricultural Trade Development and Assistance Act of 1954, best known as PL 480. This act removed the requirement that products stored by the CCC must be in danger of loss before they could be sold

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abroad, and it set up a program to dispose of surplus farm products in a number of novel ways. The aims of PL 480 as stated by Congress were:

(1) to expand international trade among the U.S. and friendly nations.

(2) to promote economic stability of American agriculture.

(3) to use surplus agricultural commodities in furtherance of the foreign policy of the U.S.

(4) to provide a means whereby surplus agricultural commodities may be sold through private channels for foreign currencies.

To this end the Act authorized three programs: Title I, sale of U.S. surplus farm products for foreign currencies. Title II, donations of surplus farm products to foreign governments for disaster relief and other assistance; grants of commodities to promote economic and community development. Title III, donation of surplus food to voluntary agencies for distribution, and barter of U.S. agricultural surpluses for foreign-produced strategic and critical materials needed for stockpiling government use.

In 1959 the law was amended to include yet another specialized program: Title IV, long-term dollar credits to facilitate foreign buying of U.S. farm products.

Title I is by far the most important of all four titles in terms of volume of exports. From exports totaling $263 million in 1955, the first full year of operation, it has almost steadily increased to a high point of $1,239.2 million in 1964 and declined to $819.6 million in 1966. Funds accumulated are known as soft currency, and the program provides for spending these within the countries of origin. The aim is to foster development programs and pay for goods and services consumed by U.S. government officials in the countries, and to lessen the balance of payments problem.

Principal recipients of food aid under Title I (in order of amount) are India, Pakistan, Egypt, Yugoslavia, Poland, Brazil, Korea, Turkey and Spain.

Title II shipments are principally for famine relief and aid in counteracting natural disasters such as earthquakes. Export levels are low relative to other programs — $55.8 million in 1955 and $79.7 million in 1966. The 10 largest recipients under Title II are Tunisia, Italy, the UN Relief and Work Agency (for the Relief of Palestinian refugees), Morocco, Pakistan, Algeria, Korea, Afghanistan, South Vietnam, and Yugoslavia.

Under Title III CCC surplus products are allocated to U.S. government aid and development agencies, to U.S.-based religious and charitable organizations operating in these countries, and to similar international agencies. These products are allocated only after domestic food assistance programs and other high point requirements have been met. Authority to use surpluses for barter also comes under Title III.

Acquisition of foreign-produced strategic materials for stockpiling by the U.S. government, and payment for services rendered to U.S. government agencies in countries not utilizing Title I concessions, are the principal uses of bartering in PL 480. It has the advantage of reducing the drain on U.S. gold and dollars that would otherwise occur. In 1955 donations amounted to $186.6 million, while barter transactions were $261.6 million. In 1966 the respective figures were $132 million and $260.4 million.

Title IV, added to the the program in 1959, has as its main objective stimulating and increasing the sale of surplus U.S. agricultural products by enabling sufficiently developed countries to become dollar customers of the U.S. In 1961, its first operational year, sales amounted to $0.8 million; these increased to $225.7 million in 1966.

During this time shipments were made to 27 different countries in all major world areas. The five largest were Yugoslavia, Chile, Taiwan, Greece, and Portugal. The U.S. negotiates with each country, approves the uses of local currency generated by sales, and assures that uses are coordinated with other U.S. development and assistance programs in that country.

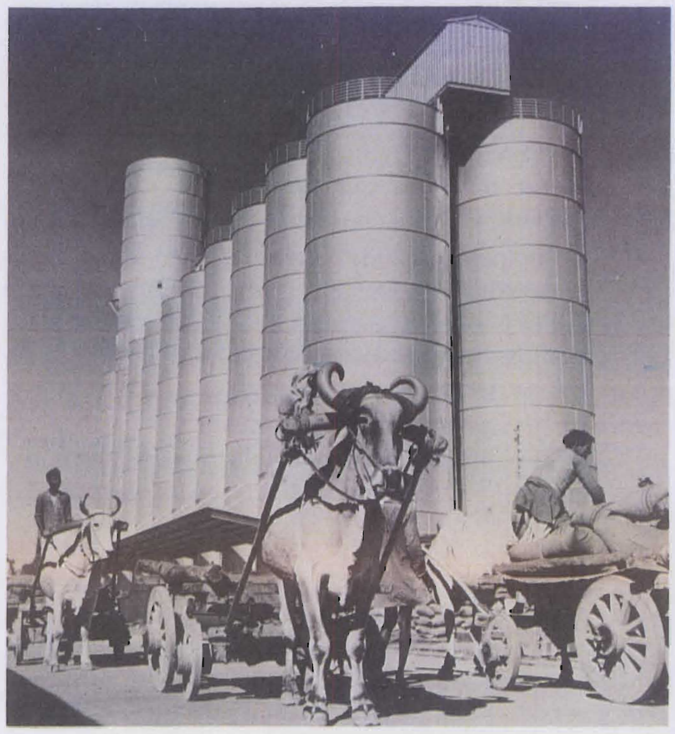
In November, 1966, Congress enacted the Food for Peace Act in which it amended PL 480 to accentuate the idea of self-help. While the self-help principle was always present in the past, now it was highlighted, and the entire food aid program was rewritten around it. The act specifies that each sales agreement entered into must describe the program which the recipient country is undertaking to improve its production, storage, and distribution of agricultural products. It also provides for termination of the agreement whenever the President finds that this program is not being adequately developed, and it requires that steps be taken to insure a progressive transition from sales for foreign currency to sales for dollars. This is done so that the country moves from aid to the trade arena as quickly as practicable, thereby fulfilling the first of the four congressional aims of PL 480 — expanding international trade.

Some title changes were also made. Title I now embraces all food sales; Title II contains all donations now; Title III involves barter transactions. The aims of the programs under the individual Titles, however, have not substantially altered from their position under PL 480, and soft currencies accumulated are still used principally for promotion of agricultural and economic development and trade.

The program has shortcomings, and while now every effort is made to insure that commercial markets will remain unhindered, it undoubtedly must have some effect on these, for much real as well as potential market demand is satisfied by it.

To fully appreciate the program you must put yourself behind the fence of a refugee camp in the place of a hungry orphan, or in the squalor of a slum, or in a hovel on an acre or two, always hungry, tired, and uncertain. Then you must watch the world turn away from you for the sake of a cent on the price of a bushel of wheat. Then and only then can we appreciate what our efforts mean.

Condition and Storability of Export Grains



C. M. Christensen

Since before 1900 the U.S. has annually exported large quantities of grains, especially corn and wheat; in 1966 this export trade amounted to 673,265,000 bushels of corn and 734,081,000 bushels of wheat.

Complaints of spoilage

There have been recurring complaints that many lots of these grains were damaged when they arrived at the foreign ports for unloading, or that they spoiled later. The implication has been that U.S. grain merchants were misrepresenting the quality of the grains being exported and that some of the lots were in poor condition when shipped, and prone to spoilage.

Two investigations of corn in ship transit from the U.S. to Europe between 1905 and 1915 indicated that, at that time, much of corn had moisture contents above 16 percent when loaded into the ships, and much of it underwent severe spoilage, either on the high seas or before the ships were unloaded at European ports. This occurred before specifications, including moisture content limits, were established by the USDA for different grades of different grains, and long before much was known about the cause and control of spoilage in stored grains.

Conditions are not the same now as then. In 1966-67 we tested 375 samples of corn taken as the corn was being loaded into ships at ports from New Orleans to Baltimore. As judged by moisture content, amount of damaged kernels, foreign material, germinability, degree of invasion by storage fungi, and fat acidity values, all of these samples were good average Grade No. 2 corn. Composite lots of these were stored for a year at 14.2 and 15.5 percent moisture content and 50 degrees F, and they did not change appreciably in any of the characteristics listed; that is, when kept for a year under reasonably good storage conditions they retained their original quality. None of this corn was "prone to spoil."

Grains and seeds perishable

Some lots of grain spoil in transit to or after arrival at foreign markets. Corn, wheat, and other grains and seeds spoil in shipment and storage *within* the U.S. too, including grains imported into the U.S. from other countries. So do lots of grain grown and stored in Argentina, Brazil, Canada, Mexico, or in any other country that produces grains and seeds in quantity. Grains and seeds, in other words, are highly perishable products, subject to damage by a variety of agents, principally insects, mites, and fungi.

In grain in commercial channels in the U.S., and in most of the grain in international trade, insects are very effectively controlled, and damage by them usually is slight. Damage from storage fungi, however, still is relatively common; heating, mustiness, caking, discoloration, and decay all result from invasion of grains by storage fungi. The conditions under which this spoilage occurs, and the conditions that must be maintained to prevent it, have been pretty thoroughly worked out; there no longer is any mystery involved.

Moisture content and spoilage

A major factor in determining whether grains in transit or storage will be damaged by storage fungi is moisture content. As emphasized in Extension Folder 226, *Maintenance of Quality in Stored Grains and Seeds,* the average moisture content of a given lot, as deter-

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mined on a representative sample, will *not* give any information as to the range in moisture content from place to place within the lot. This fact is disregarded by some grain merchants, which means that they probably do not know the moisture content of the grains they buy, sell, and store.

Much grain is harvested, stored, and transported by land and sea with an *average* moisture content only slightly below that at which storage fungi can grow and cause spoilage. Moisture will not be uniformly distributed throughout the mass of grain, but in some places will be higher than the average and in some places lower. Also, with temperature differences between different portions of the bulk, shifts in moisture occur, and sometimes these shifts are large and rapid. This is why spoilage may occur in bulks or parcels of grain that on the basis of average moisture content seem safe for storage.

Why not dry the grain to the same moisture content as is maintained in seed-grade corn or wheat, which would greatly reduce any possibility of spoilage? Chiefly because this is too costly. Economically it is preferable to subject the grain to as little artificial drying as possible and to accept some risk of deterioration.

Buyers can specify characteristics

Actually, a buyer for any grain firm can specify the characteristics he wants in the grain he buys. He can, for example, specify corn with the characteristics of Grade No. 3 so far as bushel weight, amount of foreign material, and damage are concerned, but with a moisture content of 13.5 percent. He can also specify corn of low invasion by storage fungi and high germinability, as some buyers do to obtain grain for special purposes. Naturally, he is going to pay more for grain of low moisture content and low storage risk than for grain of higher moisture content and higher storage risk. Presumably both he and his administrative superiors in the firm for which he works are experts who know their grains (or they would not be in the business), who know what characteristics they want in the grain they buy, and who know the degree of risk they are willing to take so far as possible spoilage is concerned. If they knowingly buy grain of high storage risk and low price, and if it spoils later, is the supplier of the grain at fault? This, by the way, is a problem not only in foreign trade, but wherever grain is grown, stored, and shipped in quantity.

Good grain may spoil in transit or after arrival at foreign ports

Corn or wheat can be sound and in excellent condition when loaded into a ship, and yet deteriorate rather rapidly in transit. Differences in temperature in different portions of the grain can result in rapid transfer of moisture, and if the moisture content becomes high enough in any considerable portion of the grain for fungi to grow, a self-perpetuating process of spoilage may develop.

As an example, in late May 1962, a ship was loaded with Grade No. 2 corn at New Orleans. When the ship arrived at El Salvador, 18 days later, much of the corn was spoiled, and the rest of it spoiled after it was unloaded. The ship owners claimed that the corn was of poor quality and "prone to spoil" when loaded.

Samples of the original corn were still available for testing, and they proved to be in excellent condition; germination was over 80 percent, invasion by storage fungi was low, and cracked and broken kernels and damage were low. What had gone wrong? Investigators found that the ship had kept its scoop ventilators turned into the wind throughout the voyage, and so air of high temperature and high humidity was constantly forced through the corn, as shown by the ship's log. Sound corn of the same type was obtained, and was stored in the laboratory under conditions that duplicated those to which the corn had been exposed in transit; after 18 days it had suffered severe spoilage. In this case, the ship was responsible for the loss, and the court so ruled.

It would be highly desirable to investigate the changes in condition of grain in ship holds during transit, especially in transit through the tropics, since cases such as the above are not uncommon, but so far this has not been possible.

Grain that arrives at foreign ports in good condition may be exposed to poor storage conditions before it is unloaded or during later transfer and storage. And grain that was of low storage risk when loaded into a ship at a U.S. port may be of high storage risk when unloaded at its destination, because of invasion by storage fungi resulting from increases in moisture in portions of the bulk during transit.

Evaluating storability of grains

During the last 20 years methods have been developed that make it possible to evaluate condition and storability of grains much more precisely than once was possible. Essentially these consist of taking samples from different portions of any bulk with a pneumatic probe and testing and examining each one separately for moisture content, storage fungi, damage, and possibly germinability. The tests for storage fungi tell a good deal about the past storage life of the grain, and also whether high-risk lots that already have undergone some deterioration (and thus are very likely to go out of condition) have been mixed with high-quality grain of low storage risk.

The practical value of these methods has been amply proved by their use by a number of malting, milling, and grain-merchandising firms in the U.S., Mexico, and Europe over the past 15 years. Combined with aeration systems to maintain uniform and low temperatures in bulk stored grains and to prevent moisture shifts, they have helped convert grain storage from a somewhat dubious art dependent on intuition into a science. More widespread use of these methods probably would result in greatly reduced losses of grains in local, national, and international commerce.

You're Only One Man

George R. Blake

Remember the Drudgery System of farming? Remember when hard work, early hours, sweat and muscle were the farmer's pride?

"Time has passed for that," most of us would say.

But it hasn't passed for the majority of the world's farmers who haven't been through the mechanization revolution.

"They should buy machines!"

Okay, okay. Let's focus in!

Suppose you're a Latin American farmer. You have 520 acres of fertile farmland. You grow wheat, sugar beets, barley, and rape. You are just learning about corn and soybeans and believe you could grow them. You have 30 milk cows, some dual purpose beef-draft cattle, a few pigs, and some young stock.

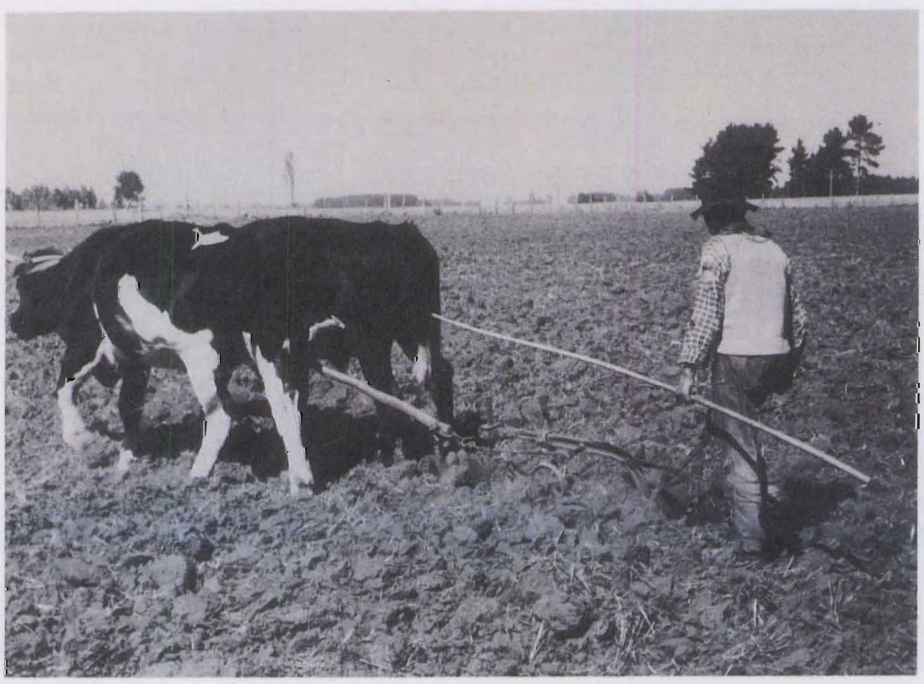
You also know about big tractors, combines, plows, and even rototillers. You have seen here and there in your state fine American makes, three German, some Argentine combines. A French, a Dutch, and two English partial lines of equipment are also imported.

But you also have 16 families — — "your people" — living on the farm. They milk the cows, repair the fences, plant the crops, weed and tend them. They disc the upper 80 over and over until you think the old grass pasture now being converted to a sugar beet field is sufficiently free of weeds.

You could keep two or three of the best families, then mechanize, sell the horses and oxen (you can put 20 yoke into the field at one time), and vastly improve your farm's efficiency.

But your people depend on you. Where would they go? There are no jobs in the city. Anyway, it's their home, too!

Okay, begin to mechanize anyway. Increase production and profit enough to more than pay for it.



One afternoon you drive 20 miles over dusty roads to town. There are three dealers, each handling a partial stock of farm equipment of five manufacturers from three foreign countries. In all, the three dealers have two tractors, four plows, one combine, and a few miscellaneous harrows, cultivators, and so on in stock. You like the combine but you find it is missing a pair of V-belts. They've been on order 7 months. "Can't predict when they'll arrive," the dealer says!

The "Morepower" tractor looks good to you, too. Bright, powerful. Even has power steering. "How much?"

"You must get an approval and a loan from FRFC (Federal Rural Finance Corporation). Foreign development fund sends them through FRFC. You have to pay them."

"I need the equipment for fall work in 6 weeks. Can I get approval from them by that time?"

"I doubt it. You have to get forms from the county office. The Zone director has to look over your farm and OK it, too. Then there's the Agricultural Allotment Board, the Ministry Office of Mechanization, the Bureau of Imports, the International Monetary Clearance Committee of the Federal Bank. Garcia got his application in 4 months ago."

"But he already has a tractor!" you protest.

"He needs a motor overhaul. His workers didn't know the radiator hose clamps were missing when it arrived, and they burned up the motor the second week he had it."

"What's he going to do?" you ask.

"Just have to wait. Don't stock parts, you know!"

"But this combine. How can you afford to keep it around when it only needs V-belts?"

"My money's not in it. It came on the American Loan Program. The government doesn't make me pay until I sell it."

You go home to think it over. You find the Agrarian Reform agents have been to look over your farm.

George R. Blake is a professor, Department of Soil Science.

"It's too big," they say. "Ought to be broken up and sold in 30-acre blocks to a dozen tenant farmers on government land loans. You can keep part of it."

You've seen that happen elsewhere. Tenant farmers aren't educated to be owner-managers. Takes time. Many planners think it's a good idea. They even arranged to have 45 of the American loan wheat combines sent to these "reformed farms" in this state. But then again there's no need for 10 farms if machines are brought in.

"How can a man plan? Have to wait the outcome of the planners' recommendations on expropriation."

You don't really care that they want to take your land. It's progress, as they say. And your men deserve a chance. But the men get dissatisfied when it's impending. They fight for favor from the planners. And they get nasty to you about why they have to pay for it. What they really want is to take over the big house. "They begin to act as if they hate me," you sadly admit.

And then there's your own work planning. Government decision on condemning the land could drag on for years. It could even be dropped if certain politicians are elected.

And there's food for hungry mouths. You worry about hungry people in the city slums. Your land is fertile. You have a good manager. If only you could mechanize. You know that you could at least double your output. It's not too large for three good men.

With influence you think you could get your permit. But when even a small but vital part breaks in the middle of seeding or harvest. What then? Neither seeding nor harvest can wait 4 to 8 months.

You think it over. You're making enough to eat and wear. And you have a comfortable house and surroundings. So you *could* produce it cheaper, and even more of it — maybe even 200 percent you think. But what's a man to do? Better wait and see. Maybe you should let well enough alone, anyway. Why buck the system? For what? Who cares?

You walk out to the barn to talk to the foreman. "Better kill a veal tomorrow. And have one of the men bring up some more wood for the fireplace. We need it these long cool evenings!"

As the quiet dusk approaches, and you walk toward the big house, you mull it over. Land Reform. Lack of export dollars. Development of industry. Production efficiency. Education of the 107 (more or less) children of "your people." Political ideologies. Twenty-eight and one-half percent inflation last year!

What can you do? You're only one man. And you're a farmer. You do the best you can.

You check the iron gate in the big rock wall surrounding the big house. You'll wait and see!

The Protein Gap — The Reality of World Hunger

Hank L. Stoddard

Those who have lived and worked with hunger during the past 15 years are feeling somewhat relieved. This is not because there is any foreseeable solution to feeding the world's millions of hungry inhabitants, but rather because of relief that comes in knowing that a serious problem has finally been recognized by a larger group of people who are in a position to do something about it.

The prediction — somewhat a cry in the wilderness up until now — that a crash course is charted between the world's rapidly growing population and the availability of food, has until recently gone unheeded or, at best, only received lip service from world planners and politicians. It seems to many of us that it has taken a long time for advanced nations of the world to appreciate the fact that, in one form or another, the problems of underdeveloped nations affect us all and will have to be dealt with.

Politicians are now devoting whole speeches to this subject. Books and published material voicing the broad spectrum of opinions about the food-gap have increased 10-fold during the past 18 months. Meetings that in the past gave one-speaker importance to this topic are now devoting full-time programs to the probability of widespread famine among the earth's population. An atmosphere of emergency, late in coming, now surrounds the expanding problems of hunger and malnutrition. The profound and far-reaching statement of the late President Kennedy — "Nothing, either on earth or in space, is so important as the need to conquer world hunger" — has only just begun to demand the attention it deserves.

Normal to any new and potentially disastrous situation, there is a wide range of opinion about this problem and its final outcome. Its novelty, magnitude, and associated variables make anyone's guess at this time as good as the next. The sobering thought of human beings starving to death, ironic in our technologically advanced society, has forged a synthesis of these opinions, focusing on how an expanding world population is to be fed.

The population explosion and world hunger

The crux of the problem is that during the past century success in increasing longevity has resulted in a rapid rise in the growth rate of world population. In 1850 the world's population was around 1 billion. In little more than a century the population has skyrocketed to 3 billion. Population experts estimate that if present growth trends continue, in the next 30 years — a few grains of sand in the hourglass of time — the world's population will more than double, reaching 7 billion by the year 2000. In simpler terms, during the time required to read this article, some 5,000 humans have been born, demanding to be fed.

Hunger in one form or another was related to nearly two-thirds of the 60 million human deaths on this planet last year, according to United Nations estimates. Furthermore, two-thirds of the earth's inhabitants, principally living in underdeveloped areas, are affected in some degree by chronic starvation and malnutrition. Projections for the world's future food demands reflect that simply to maintain the present unsatisfactory situation, food production during the forthcoming 30 years must be doubled. In order to slightly raise the world's standard of nutrition, present food production would have to be tripled.

Modern technology is placing in man's hands a broadening choice of methods to control population growth. Disease agents capable of causing widespread epidemics and death; toxic gases and lethal chemical compounds capable of destroying all life in large land areas; nuclear explosives and radioactive fallout so powerful that large sections of continents can be rendered uninhabitable; and simplified methods of birth control all represent solutions to an over-populated world. Finally, on standby if other methods fail, famine will decrease human numbers in those populations which cannot feed themselves.

Many on-the-scene observers of the numerous efforts to upgrade agricultural productivity in the have-not countries frankly do not believe the job can be done in time. Some are steeling themselves for the time when many millions of people in these poorer countries are going to starve to death before the eyes of the world.

In the past, food from the more advanced countries has been supplied to hungry countries in lavish giveaway programs or as temporary relief for an emergency. By and large, these handouts have not furthered the social and economic progress of recipient developing countries. Twenty years of trial-and-error experience in agricultural technical assistance and financial aid programs to underdeveloped countries have just begun to define the com-

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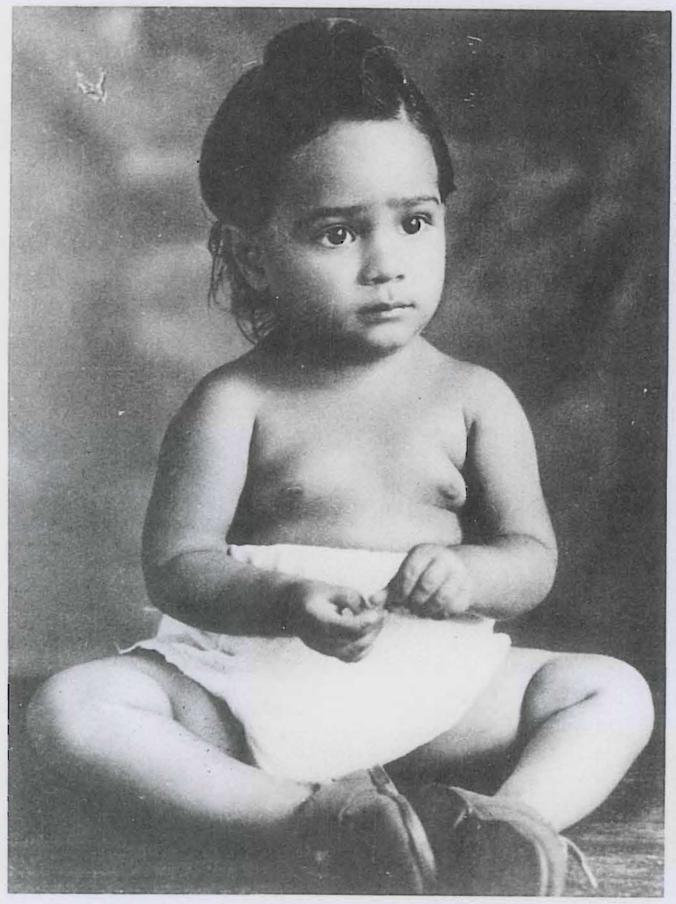


This is a 2-year-old South American girl. At the left she weighs 12 pounds and is suffering from severe protein starvation — the deadly world-wide disease usually called marasmus or kwashiorkor. At the right is the same girl after 10 months of treatment and supplementary feeding at a rehabilitation center. Photos from WHO via FAO.

plexity of this undertaking. Irrelevant to the results of these food give-aways, knowledgeable sources predict that the maximum agricultural production potential of the advanced countries will only support a world emergency food program for less than another decade. After that, if nations have not learned to feed themselves, decisions will have to be made regarding which societies will be fed and which will be left to starve.

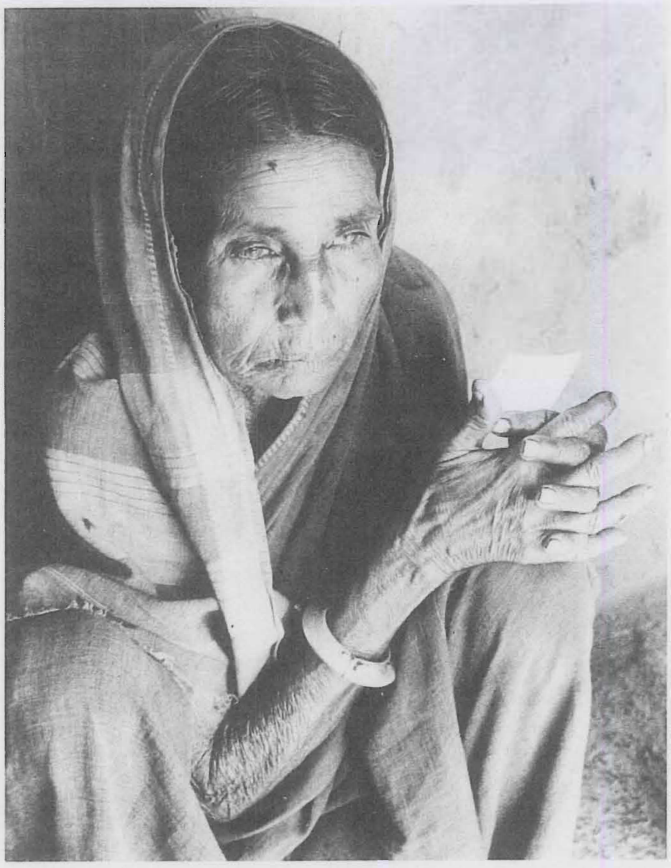
The protein gap

The shortage of proteins, and especially of high-quality proteins of animal origin, is the very heart within the anatomy of world hunger. Kwashiorkor, the protein-deficiency disease known by hundreds of other names, is an all-too-common syndrome in millions of children of the "have-not" nations. Small children with bloated stomachs, underdeveloped limbs, and listless eyes are living within a few hours of the abundant tables of affluent societies.

Kwashiorkor can be prevented, and it was once thought to be cured by one cupful of milk a day. It has been only recently that nutritionists have found that the aftereffects of chronic protein starvation in young children are more insidious and far-reaching. Field observations point out that when severely affected children recover from protein-deficiency disease, they are far less intelligent than other well-fed children of the same age.

Results from recent research in chronic protein starvation shed some light on one aspect of this disease. The amino acids that make up protein and determine its quality are essential for body and brain growth. Beginning about 4 weeks after conception and during the first 3 years of life, the human brain should accomplish 80 percent of its growth. By comparison, the body, competing equally for amino acids during this period, grows to about 20 percent of its adult size. If protein intake is inadequate during this critical growth period, nerve tissue may be permanently stunted, but the body survives.

In underdeveloped areas where the population growth rate is increasing more than 3 percent a year, it is not uncommon to find that at least 60 percent of these societies is made up of children under 10 years of age. The methodology is not at hand to guess how many of these children are slow learners as a result of protein-deficient diets. This situation becomes even more complex and ironic when the importance of education to social and economic progress is considered.



Like this woman of India, many millions of the world's people are undernourished. FAO photo.

The hope for a miracle

Many world planners are encouraged by promising progress in the technology for the use of nonconventional sources of protein for human food. Encouraging scientific advancements have been made recently in the use of oilseed meals, fish protein concentrate, algae, seaweeds, synthetic amino acids, and single-cell protein as sources of protein for human diets. But realistically, economic feasibility and technological limitations confine the hope of using these sources of protein to some indefinite future time.

Miracle grains, resulting from many years of research in high-yielding rice, wheat, and (to a lesser extent) corn, sorghum, and millet, are proving themselves in the "green revolution" of world agriculture. With proper care, fertilizer, and water, these cereals can markedly increase food productivity. Nevertheless, those who know the numerous limiting factors to agriculture in emerging countries — lack of technical know-how, fertilizer, insecticides, grain processing and storage facilities, investment capital, institutions to constructively serve agriculture — believe that there is still a wide gap beween field production and the mouths of the hungry.

Current technical and economic limitations that restrict the use of nonconventional sources of protein strongly suggest that a "technological fix" will not increase the per capita world food supplies in the foreseeable future. Protein still must be produced by conventional agricultural methods. Knowledge gained from experience with agricultural problems of emerging countries indicates that this will take time — in the opinion of many, too much time.

The importance of domestic animals

Traditionally, part of all protein has been supplied to the diet of the world's inhabitants by animals and animal products. Many underdeveloped countries depend heavily upon livestock for high-quality protein and badly needed foreign exchange earnings. Livestock in these areas convert grass into animal products for sale and consumption. This method of grassland farming is not competitive for other foods that form a part of the human diet.

Equally important, livestock is usually grazed on grasslands which have a marginal value for agricultural crops. Cattle and other types of livestock can be herded to market and do not depend upon capital-intensive road systems. Meat is stored on the animal until harvest. The increasing demand for livestock products, especially beef, distributes income to rural families in countries where most wealth goes to the privileged few. These merits of livestock agriculture to the economic and social progress of underdeveloped countries are obvious. Nevertheless, when compared with population growth in the underdeveloped regions of the world during the past 2 decades, livestock productivity has not increased. In fact, per capita production has decreased.

The population of the world's livestock is at least twice that of the human race. Still, yearly overall livestock growth is falling some 2 percent behind growth of human population. Throughout the underdeveloped regions of the world, billions of domestic animals whose sole reason for existence should be the alleviation of human hunger, are themselves half-starved and suffering from disease. Human indifference, nonproductive management practices, seasonal forage shortages, and livestock diseases reflect low livestock output per acre, per man, and per unit of capital investment in most of the developing nations.

The technology to increase livestock productivity exists. Its transfer to underdeveloped societies has proved difficult. The basic issues and problems curtailing livestock production and crop agriculture in emerging countries are well known and documented. Yet, politicians and world planners with sufficient courage and insight to change the unsatisfactory *status quo* are difficult to find. The requisites for social and economic progress in developing countries have been defined. Yet, societies confronted with a worsening food shortage hesitate to undertake social and institutional reform.

The dedicated continue their fight against hunger. It appears doubtful that the fruits of their work will be accepted in time to prevent famine in many areas of the world. And if not, the situation will require other courses of action.

Horticultural Research Spans the World

Leon C. Snyder

The exchange of scientific information between the U.S. and other countries is essential to progress in practically every phase of our research program. This is no more evident than in breeding programs to improve our horticultural crops.

Our present Horticultural Research Center, formerly the Fruit Breeding Farm, was established in 1908 to develop fruit varieties that would be hardy in Minnesota. Early records of the Minnesota Horticultural Society are filled with reports of failures in attempting to grow fruits. Development of the Wealthy apple by Peter Gideon in 1868 was one of the first successful efforts in the development of hardy fruits for Minnesota. This success prompted legislative action which led to the establishment of the Fruit Breeding Farm.

Early work at the station involved the evaluation of fruits from all parts of the world for hardiness and quality. South Dakota selections, which had resulted from frequent trips to Russia by the late Dr. N. E. Hansen, were included in our early trials and incorporated into our breeding program. Among the fruits brought back by Dr. Hansen were pears from Harbin, crabapples from Siberia, and apricots from northern Manchuria. These introductions were supplemented with introductions from the United States Department of Agriculture's Plant Importation Station at Glendale, Maryland, and introductions received directly by the Fruit Breeding Farm.

This exchange of fruit germ plasm continues. The Apple Breeders Cooperative, of which the University is a member, exchanges breeding lines between research workers in Canada, England, and the United States. In our strawberry breeding program we are using the South American species, *Frageria chiloensis*, from Chile and varieties from Germany, England, and Scotland. Although the cultivated blueberry is largely of American origin, we will be using breeding lines from Finland in search of greater hardiness.

In our vegetable improvement we have been equally dependent on germ plasm from other parts of the world. South American lines of sweetcorn, melon lines from India, and pea lines from northeast Africa are but a few examples of international dependence in our vegetable improvement efforts.

In our potato breeding program substantial use is being made of wild species from Central and South America. Six species from South America have been pooled, and selection is underway to develop adapted parents different in origin from those presently in use. Genes conferring field resistance and/or immunity to late blight have been incorporated into advanced breeding lines. An excellent source of germ plasm which will permit chipping directly out of cold storage has been identified in lines developed from a South American species. Initial data suggest that this character will not be difficult to transmit to commercially acceptable varieties. Resistance to scab in European cultivars is being incorporated into our advanced selections.

The role of the plant collector has been most important in the improvement of our ornamental plants. By far the greatest number of our woody and herbaceous ornamentals have their native home in some foreign country. The peony from Europe and the Orient, the tulip from Asia and China, the barberries from Japan and North Africa, the Regal lily from Korea are familiar examples.

In our present breeding program with azaleas we are using a species from Japan, a species from China, breeding lines developed in England, and several species native to the eastern parts of the United States. In our efforts to improve the hardiness of forsythia flower buds we are using species from Europe, Korea, and Asia. A variety of weigela from Manchuria is being used to incorporate hardiness into the garden forms of weigela. These and hundreds of other examples could be cited to illustrate our dependence on other countries.

At the arboretum we are building up a collection of ornamentals from all parts of the world. Over 2500 species and cultivars are in this collection. Already many of these have been introduced into our nursery trade. Today, Minnesotans can purchase hardy forms of plants that were once thought to be too tender for our climate. The Korean boxwood, Japanese azalea, the star magnolia from Japan, the dwarf burning bush from Turkestan, and the Sakhalin honeysuckle are but a few of the many plants from other parts of the world that are showing promise.

The interdependence with other countries is not so easily shown for research involving physiological and cultural studies. In our hardiness research we have benefited greatly from research in Japan, Russia, and northern Europe. Peat research going on in Ireland, Finland, and Russia is very important to our floriculture industry. The Malling and Malling-Merton rootstocks from England for controlling tree size in apples are being used in our stock-scion studies, both on apples and ornamental crabapples. We are just now starting to utilize techniques developed in Austria to study cell membrane permeability. These are but a few of the examples which show our interdependence with other countries for our horticultural research accomplishments.

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Changing Agricultural Policy Goals In Eastern Europe

Market factors are beginning to play a more important role in some socialistic countries.

Philip M. Raup

Until quite recently three words were taboo in the Soviet Union and its East European satellites: *rent, interest,* and *profit.* Land was the property of the state and assigned at no cost to the farms, factories, or housing authorities that used it. There was no calculation of economic rent, and no price on land.

In using capital, the rate of interest was not used in computing the relative cost and benefits of different investment opportunities. Ingenious alternatives were developed to measure the relative attractiveness of different projects. These were usually based on some variation of the "pay-out period," or the number of years it would take to replace the original capital at the anticipated annual rate of profit or benefit. But the rate of interest was not used. In this sense, there was no adequate "price on time." Capital could be tied up in half-completed projects for long periods of time, and there would be no mounting interest charge to spur completion.

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With no-price land (no charge for economic rent), and no adequate price on capital (which is to say, no good measure of the time-costs of production), the pricing policies of the USSR and its East European partners resulted in acute distortions of economic activity. Under Premier Khrushchev, agricultural prices were typically set at levels believed high enough to cover costs of production on average farms in each production zone. But with no charge for land, costs of production on the best lands, or on lands near cities, were understated. The result was that the most productive lands, and those with alternative uses for urban or industrial purposes, were used wastefully. "Prices must cover costs of production" was the Soviet farm price policy guide. But with land left out of the reckoning, there was no price signal to flash a warning when land was being misused. This was the situation up to 1968.

The lack of an interest rate has also led to distortions of production. For one thing, there was no adequate price signal to warn that farm mechanization in the USSR was going too far and too fast in the 1930's. Millions of rubles were invested in farm machinery at a time when there was excessive farm labor in the countryside and few alternative jobs. Capital has been "cheap" in the Soviet Union, due in part to this lack of an interest rate to use in computing depreciation. This has encouraged under-maintenance and misuse of equipment. And it delayed the realization that "time is valuable" in an economy shifting rapidly from an agricultural to an industrial base.

The goals set for farm managers have had similarly distorting effects. Throughout the war years and until the end of the 1950's the goal for farm managers in the USSR was to "maximize output per hectare (or per acre)." This was a physical goal, measured in kilograms, tons, and liters. It gave the individual farm manager no guidance in selecting among different products, and it was not intended to do so. Decisions on what to produce were made by the planning authorities. The farm manager was given a set of delivery quotas for different products, and it was up to him to use the available resources to meet these goals.

Up until 1958, most heavy field work (plowing, tillage, seeding, and harvesting) on collective farms was done under contract by the Machine Tractor Stations. A percentage of the crop was surrenderd as payment.

The Machine Tractor Stations were abolished in 1958, and collective farms were given the right to buy and own their own farm equipment. At this time a gradual change in management goals also occurred and the target of "maximum output per acre" was converted into a money equivalent. The new goal was financial; to "maximize gross output." It led to strange results.

For one thing, it favored the use of high-priced inputs, which would usually result in a higher "gross value of output." The farm manager had little incentive to pick the cheapest input that would do the job.

"Maximizing gross output" also led to an emphasis on high-valued products, at the expense of lower-valued products which might still be important as food staples (potatoes for example).

After 1966 a new management goal was introduced, the "maximization of gross income." In practice, this meant maximizing returns from farm product sales, minus the costs of inputs purchased. This was a Soviet version of "value added in production." This too led to strange results.

First, labor cost is the principal component of "value added." To maximize gross income, or value added, it might pay to use more labor rather than less. Spreading manure by hand, for example, would yield a higher "gross income" to the farm than spreading it by machine. The goal discourages economizing on labor. The manager is tempted to substitute labor for machines, and the laborers may favor this too, because it could lead to a greater total annual labor income.

Second, when prices fall, managers may try to increase output in order to hold gross income constant. But falling prices should be a signal that less of that good should be produced, not more. "Maximizing gross income" can thus lead producers to respond to price changes in a way that is the opposite of the responses needed to bring supply into balance with demand.

This was the situation in 1967-68. There was no price on land to permit the calculation of its "economic rent." There was no "price on time" (interest rate) to permit a realistic calculation of the marginal productivity of capital. And management goals were encouraging the use of labor at a time when labor was increasingly needed for non-farm jobs.

Prior to the Soviet occupation of Czechoslovakia in August 1968, the Czechs were attempting to control the use of labor by levying a tax on any increase in the "wages fund." If a farm had a wages fund of 100 and wanted to raise it to 110, a tax was levied on the 10 percent increase. This was a "payroll tax" designed to force the farm to economize on labor.

This combination of a management goal of "maximizing gross income" and a tax on increases in the wages fund, introduced a disguised form of "profit maximization," without using the hated word "profit." This was the point the Czechs had reached in August 1968.

The Russians control the wages fund by more direct methods. Central planning authorities set a limit on the wages fund for each farm. Within each farm, the management sets a limit on the wages fund for each brigade, or sub-unit. This increases the burden on management, and the rigidity of the system. But some control is needed to prevent farm workers from bringing pressure on the management to distribute all earnings as wage payments. An awkward form of profit maximization is being introduced as a management goal, but without mentioning profits.

A much more radical step is being taken with regard to land. On December 13, 1968, a drastic change in land legislation was enacted by the Supreme Soviet of the USSR which will take effect on July 1, 1969. This law provides for the valuation of land, sets up a national "cadaster" or register of rights in land, and makes it clear that compensation is to be paid for any land taken by the state. If land is taken from a farm for a highway, the farm is to be compensated. If a city expands and engulfs a collective farm, "city hall" or the housing authorities must pay for the land taken. Fifty two years after the "October Revolution," a price has finally been put on land in the Soviet Union.

The significance of this step is great. In the short run, it will enable the establishment of more realistic crop production and delivery targets by planning authorities. It will also provide farm managers with a better guide to wise use of land resources, especially in areas of encroaching urban uses. In the long run, the pricing of land may turn out to be the necessary step that had to be taken before true costs of production can be calculated by the USSR and its trading partners in the Council of Mutual Economic Assistance (COMECON). In this sense, pricing land in the USSR may be a necessary condition for the development of a freely convertible ruble in international trade.

If this is the consequence, it will mark a historic step in the development of the socialist economies of the Soviet Bloc. Realistic costs of production, permitting comparisons with world market price levels, will enable the Bloc countries to enter the trading world freed from the nagging doubt that they may be exporting the wrong products.

Prices that represent true production costs are the first requisite for freedom in trading negotiations. Trade can be left up to individual firms, freed from the rigid dominance of state trading authorities, only if prices are a reasonably satisfactory measure of the values being exchanged. With no charge for land rent in Soviet Bloc prices, it is clear that political decisions had to dominate foreign trade relations.

In practical as well as in symbolic terms, putting a price on land may well turn out to be one of the most important events in the history of the evolution of socialism in Eastern Europe and the Soviet Union.

Aerial Photos Reveal —

Ants Damage Argentine Range

Merle P. Meyer

From an altitude of 15,000 feet the anthill sites photograph as white dots; many form radiating or herringbone patterns. The 5700-acre study unit on this Argentine ranch is outlined in black.

A common grazing land management problem in many parts of the world is loss of herbage to ant colonies. Losses usually take two forms: (a) space occupied by anthills, and (b) plant material harvested by ants in adjacent vegetated areas.

Although aware of the problem, I had no real conception of its importance until, in 1964 and again in 1966, I served as aerial photo interpretation specialist on a United Nations (FAO) range livestock project in Argentina. The area involved was the prime range livestock region extending north from Buenos Aires to Paraguay and lying between the Uruguay and Paraná rivers. A number of study units, 30,000 to 70,000 acres in size, were selected in representative locations throughout the provinces of Corrientes and Entre Rios, and 8,000 to 15,000-foot (medium altitude) aerial photography was subsequently flown of them.

Since my initial task was to prepare vegetation maps of these study units by means of aerial photographs in conjunction with field reconnaissance, I soon became aware of severe ant colony infestations in certain localities. Figure 1 indicates their appearance on the aerial photographs and

Merle P. Meyer is a professor, University of Minnesota School of Forestry.

This anthill is about 25 feet in diameter. It is surrounded by a ring of bare soil 15 to 20 feet wide. Foraging ants make trails 3 to 4 inches wide and ¾-inch deep.

Figure 2 illustrates a typical anthill and the severe defoliation associated with it.

We had no idea what sort of forage losses were being incurred in these areas, but it was evident that the problem was sufficiently serious to merit some kind of useful estimate. Ground reconnaissance alone was out of the question because it was too slow, unreliable, and costly; as a consequence, an aerial photographic technique for accomplishing the survey was developed.

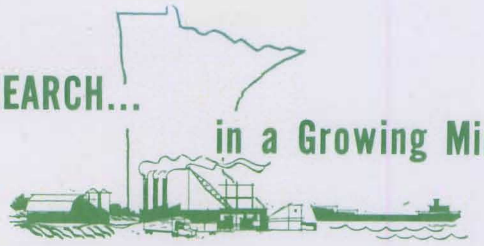
The test area (Fig. 1) was selected and those portions of it having anthills present were mapped on the aerial photographs. A whopping 59 percent (3,360 acres) of the 5,683-acre test area was found to be "infested," and a sample count of the anthill density showed an average of one anthill per 2.5 acres in the infested area. The diameter of the average anthill and its defoliated peripheral belt was found to be approximately 60 feet which, translated into total anthill ground area, meant that 299 acres of land were physically occupied by anthill sites. In short, 5¼ percent of this rancher's property was completely out of production due to anthills. Add to this the (as yet) undetermined ant-harvest of vegetation beyond the anthill sites, and some idea of the enormous loss of livestock forage over the area as a while becomes apparent.

Not all of the anthills were occupied by ant colonies, since control measures are sometimes applied; sometimes the colony dies out or leaves. It is not unusual, however, for abandoned anthills to be occupied by a burrowing animal (the digging is easy) similar to our raccoon, and known locally as the "vizchacha" (viz-kah-cha). Examples of their burrows and of healing anthill sites are shown in Figure 3. Although the vizchacha tends to keep the anthill unvegetated, he is not entirely without practical utility; i.e., when caught, drawn, skinned, cooked, and properly marinated and pickled, he becomes a tasty morsel, indeed — and I will vouch for that!

I do not wish to leave the impression that the use of aerial photographs in rangeland resource surveys is limited to looking for anthills — albeit ant colonies *are* a grazing land management problem in many parts of the world, including the U.S. On the contrary, their primary use is actually the classification of these rangelands on the basis of vegetation-soils-landform characteristics into so-called "land systems." These land system classes are directly related to productivity potentials and provide a base for improved management and development. This anthill assessment technique merely serves to illustrate the versatility of the aerial photograph as a means for solving difficult (local) resource analysis problems.

Ants have abandoned most of these sites, but a burrowing mammal, the vizchacha, has moved into them. Note the former sites that are healing.

RESEARCH... in a Growing Minnesota



Each year *Minnesota Science* devotes a special issue to a specific area of its research program. As we have indicated over the past few years, the research mission of the Agricultural Experiment Station is very broad and is not only in agriculture, but in forestry, home economics, and veterinary medicine. Our responsibilities do not lie just within the borders of Minnesota, since part of the support comes from federal and private funds which have regional, national and often world-wide implications. In this special issue we are calling to your attention that phase of our research program that has implications for international trade and development.

Economic growth and development as we know it in the United States had its beginnings over 100 years ago. In education and research the first significant impetus was in the establishment of the land-grant colleges and the accompanying agricultural experiment stations, and later the agricultural extension service. At the same time the land-grant colleges were established, the United States Department of Agriculture began a modest program of research. Today we find many developing countries of the world at the same point in development as we were 100 years ago. Perhaps at that time some of the more developed countries of Europe, which already were engaged in all types of research, including agriculture and forestry, took a somewhat tolerant and probably disinterested attitude toward the new developments in the United States. This country was, in fact, developing an educational and research system quite different from that in Europe.

Our early beginnings in research, which have implications for the developing nations, were concentrated on the training of scientists and the search for knowledge. There are few countries in the world where a Minnesotan can travel without meeting a graduate of one of the departments which are part of the Minnesota Agricultural Experiment Station. Many of these people have responsible positions in the governments of their countries and may not even be in the field of agriculture any longer. And so from this standpoint we can say that our principles of education, of research and even our way of life have been widely adopted by many developing nations.

While the economic and humanitarian benefits of "exporting" our agricultural science, technology, and educational methods to developing countries are familiar to Minnesotans, another aspect which brings benefits to us is little known. This is the matter of the exportation of Minnesota products to all parts of the world. The production of 1 out of every 5 acres in Minnesota finds its way into international trade.

Comparing Minnesota with other parts of the United States, the national growth rate in international trade during 1960-65 was 43 percent, while for Minnesota it was 75 percent. Thus we should have a keen interest in international opportunities, whether it is the export of food and fiber products or the export of better-trained young people returning to their home countries to assume roles in education and scientific research.

The articles in this issue address themselves to many different facets of our international interests. Recently the Institute of Agriculture established a division of International Agricultural Programs. Through this program we have active participation with the Ford Foundation in an extension development program in Chile. Through support from the Agency for International Development we are conducting an economic growth program in Tunisia. Individual staff members are taking part in various assignments with FAO, other governmental agencies, foundations, and private industry, which are offering assistance to the developing nations around the world. We look upon this as one of the responsibilities of the Agricultural Experiment Station which we must undertake without diminishing our attention to domestic problems. Service in terms of scientific discoveries and new technology to both domestic agriculture and to developing agricultural programs in other countries will surely expand the opportunities for Minnesota's economic growth on a scale hardly believed possible 100 years ago when it all began.

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