

Karachi
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Santiago, Chile
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To: Haldore Hanson
Ford Foundation Representative
Karachi

From: Norman E. Borlaug
Wheat Consultant

Subject: Recommendations to Ford Foundation on next steps in the
Pakistan wheat improvement program

When I arrived in Pakistan November 4, you asked that I
prepare two reports at the end of my visit:

One to the Secretary of Agriculture, Lahore, which
would represent a progress report on the West
Pakistan Wheat Improvement Program, and recommend
actions within the jurisdiction of the Government.

One to the Ford Foundation, recommending how the
Foundation grant for wheat improvement should be
used.

This, is the second of those reports.

There are two new developments in the Pakistan wheat
program which I believe the Ford Foundation should consider, and on
which I will outline my views in this paper. These are:

1. Demonstration agricultural machinery units for wheat
production.
2. Team of consultants to outline research needed in
Pakistan to develop a new cropping pattern after
Pakistan reaches and passes self-sufficiency in
wheat.

1. I recommend demonstration agricultural machinery units for wheat production

Larger landowners of West Pakistan are rapidly introducing wheel tractors and implements at their own expense. I am told that over 5000 tractor units were added to private farms during the Second Plan Period, 1960-65.

In this process of machinery purchase, the Government is giving no leadership.

Introduction of agricultural machinery is a wasteful process in any country, including the United States, if the Government does not provide some leadership in experimentation, especially testing of the desirable size of tractor, type of implements, and how to maximize machinery use throughout the year. The Government also needs to take leadership in forcing machinery importers to provide workshops and spare parts. (Even the Governor of West Pakistan complained to me about the machinery importers not stocking spare parts).

This problem of machinery experimentation is much broader than the wheat crop, but we have already run squarely into the machinery problem in trying to improve wheat production on the larger land holdings, especially in the Punjab.

I propose that Ford Foundation authorize the International Center of Maize and Wheat Improvement, Mexico City, to import under the Ford grant three demonstration sets of machinery, one for each of the administrative regions of West Pakistan. This machinery should arrive by September 1966, and be used initially during the planting season of October-November, 1966.

Each set of machinery would include:

- 1 medium horsepower tractor (35-45 HP)
- 1 disk plow (not mouldboard, as most farmers presently purchase)
- 1 offset disk harrow (which breaks clods better, and leaves land more level, than the present harrows in use in Pakistan)
- 1 grain drill with fertilizer attachment
- 1 fertilizer spreader, separate from grain drill, to be used for many crops
- 1 small land leveller on wheels, hydraulically controlled, with blades front and back
- 1 bund maker (this enables the farmer to make his irrigation bunds mechanically, and thus encourages seedbed preparation in larger units. At present, the making of bunds is such a time consuming hand job that the landowner tries to keep his land permanently in small cultivation units roughly 100' x 100'. Machinery cannot be used effectively in such units)
- 1 toolbar tine attachment, hydraulically controlled, not on wheels, for cultivation across bunds
- 1 ditcher (V-shape, like a double mouldboard, for mechanical creation of tertiary irrigation ditches)
- 1 clodbuster (cultipacker), fairly light, needed especially on salty land, to shatter the crust
- 1 two-row corn planter, with fertilizer attachment. (Can be used for cotton also)
- 1 corn cultivator
- Syphons, probably of plastic which can be later made in Pakistan, to permit irrigation without cutting bunds
- Middlebuster shovels, to create shallow ditches between cropping rows, and thus permit slow continuous irrigation. This implement is used mainly for corn and cotton. It enables the wheat farmer to extend the use of his tractor throughout the year
- 1 truck capable of hauling tractor and all implements required for any given custom job
- Spare parts for all of above equipment
- Minimum shop equipment and tools to permit supervisor to do the more common repair jobs himself. Major overhaul of tractor should not be contemplated within the unit

One self-propelled combine should be provided for the Central Region only, probably for try-out in the Multan area where the larger wheat acreages occur. The other two regions are not ready for combining.

Let me expand and justify the above proposal with the following thoughts.

The above equipment might cost \$25,000 per unit delivered in Pakistan, and with spare parts and the combine included, a maximum of \$100,000. This estimate needs checking, but will serve for planning purposes.

Farm machinery adapted for irrigation areas is a specialty only of the southwest United States, and Mexico. The farm machinery companies which are importing machinery into Pakistan now are typically American mid-western companies (International Harvester, John Deere, Allis Chalmers, Massey Harris, Ferguson, Ford) or German (Mann, KSB, etc.). The present importers know little about irrigation, and many of the implements they are importing are generally unsuitable for irrigation agriculture.

Hit-and-miss experimentation with machinery by private farmers is a very wasteful process. Even though the Government is not investing money, this is wasteful of the Government's limited foreign exchange supply.

It would be more sensible for the Government to organize a deliberate try-out of machinery, selected specifically for irrigation areas. The Government should charge a nominal custom rate for the use of these experimental machines, but the demonstration units will lose money, because some machinery selected will prove unsuitable, and the Government will haul the machinery over uneconomic distances to demonstrate the equipment in different districts. These losses do not indicate that the proposal is a failure, because the

present system of hit-and-miss experimentation by private farmers is far more costly to the national economy.

I have considered the following questions about these units.

What Government agency can best manage these experimental wheel tractor units?

The present Agricultural Engineering Organization of West Pakistan, which reports to the Secretary of Agriculture, is engaged primarily in these activities:

- (i) Operating heavy earth-moving machinery pools, such as bulldozers and scrapers on a subsidized basis, for private landowners. Their job is to bring new land into production.
- (ii) Tubewell drilling for private farmers, with Government rigs and Government crews, at subsidized price.
- (iii) Operating agricultural machinery workshops, where private tractors can be repaired at cost, as well as the maintenance of public machinery. These workshops do some training of private tractor drivers and mechanics.
- (iv) Design and production of new implements, both for tractor and bullock. (I have not studied this work, but understand it is presently moving very slowly.)

Since our interest is to do an intensive experimental job for about three seasons, and then get out of the machinery business, I would favor assigning these experimental units to the wheat improvement project, which is under the research service.

What kind of staff should supervise the demonstration machinery units?

I would favor one irrigation agronomist and one agricultural engineer attached to each unit, plus tractor driver and mechanic. The agronomist is in effect a crop extension agent, who would accompany the unit on every job. His assignment is to study the adaptation of

machinery to irrigated cropping, to help the farmer understand the new methods, and to give advice about mechanical cultivation to private farmers who already have their own tractors. The engineer is also an experimental man, trying to devise machine maintenance procedures, tractor driver training, and re-design of implements when necessary, to adapt the machinery to West Pakistan's needs.

Who would pay the operating costs?

The West Pakistan Agriculture Department should pay local salaries and travel expense (agronomist, engineer, tractor driver), but I would hope the Ford Foundation would permit the Wheat Improvement Grant to pay the cost of POL for the operation, because petrol products in Pakistan are imported, and therefore represent foreign exchange costs.

What is our ultimate objective in machinery demonstration?

First, we are trying to speed up the purchase of tractors and implements by private landowners at their own expense, and get some of them into the custom rental business. We have no interest in Government machinery pools as a continuing practice. But the quickest and most economical way to get the information needed by the private landowner on size of tractor, type of implements, field methods of cropping with machinery, and best year-around use of tractors, is to operate one set of Government-owned equipment on a custom basis for about three crop seasons. We might set a target of 5000 hours of tractor usage by each machinery unit in a 3-year period, then go out of business, turning the machinery over to whatever Government research farm that the Secretary of Agriculture designates.

Second, we want to adapt the design of irrigation machinery for Pakistan's special needs, and get manufacturing started locally, either by private enterprise, or by the existing Government machinery shops. We have no interest in financing such manufacture. But we want to recommend design.

Third, we want the irrigation-agronomist to produce an extension bulletin or handbook on the best uses of machinery on private lands, or on Government farms. This includes the specification of tractor and attachments, the training of the tractor driver, maintenance procedures, average costs, etc.

Finally, we want to recommend to the Government a policy on issuing commercial import licenses for tractors and attachments, with "strings" attached, whereby the commercial importer is required to maintain adequate repair facilities in any area where a given number of his tractors have been sold, and to maintain in Pakistan an adequate supply of spare parts, directly related to the number of tractors he has imported. Judgment on such a policy will emerge from this experimental machinery program.

How should we train the supervisors for this machinery demonstration?

The three irrigation agronomists, who will supervise the machinery units, should be sent to the southwest United States, and to Mexico, for a few months of observation and direct experience in machinery supervision.

Combines

The entire wheat crop in West Pakistan (12 million acres) is now cut with hand sickles. Threshing is still done largely by treading out the grain with bullocks, and the chaff is removed from the grain by winnowing. It will become physically impossible with these methods, to complete the harvesting and threshing before the onset of the monsoon, once wheat yields per acre have doubled or tripled. Mechanized harvesting will become a "must". To my knowledge there is not a single self-propelled combine in West Pakistan at the present time.

Moreover the introduction of a medium sized self-propelled combine on the larger farms in the Multan area can directly contribute to reducing the problem of wind erosion, resulting from the hand cutting of wheat straw at ground level. This change will become feasible as soon as there is an excess of wheat straw production (which will automatically be forthcoming with proper fertilization) which is now widely used as feed for bullocks and buffaloes. A combine could leave an 8 to 12 inch stubble, thus reduce erosion, and contribute greatly to improvement in soil conservation.

I do not recommend going through the intermediate evolutionary stage of the stationary thresher in the harvesting operation.

Next step

I will investigate the specific machinery needed during a trip to the U.S. in January, and meanwhile, the Ford Foundation can consider whether it wants to get into this activity and also sound out the Government of West Pakistan.

Since \$60,000 is provided for equipment and machinery in the present grant, it is not necessary to change the grant at present, but only to draw down the grant at a faster rate than originally contemplated, and thus make a renewal grant in 1967, some months sooner than originally contemplated in the two year grant.

2. I recommend a team of consultants to outline research needed in Pakistan to develop a new cropping pattern after Pakistan reaches and passes self-sufficiency in wheat

I estimate Pakistan may reach self-sufficiency in wheat by the harvest in the spring of 1968 or at least by 1970, at the end of the Third Five Year Plan. Wheat farmers will then be trying to shift 4 to 6 million acres (out of the present 12 million acres of winter wheat) into other winter crops.

This is an enormous research problem. If research were started on an urgent basis today, it would not be possible to get more than superficial answers by 1970, and much of the shift in cropping pattern will of necessity be hit and miss.

Yet the answer to this shift from wheat to other crops, more than any other development, will establish the direction of the agricultural revolution in West Pakistan during our lifetime. That is why I attach so much importance to an orderly study of the problem.

Moreover, this is not simply a problem of examining substitute winter crops. With the addition of more irrigation water in West Pakistan, many farmers in the irrigated areas are already shifting to a summer-winter 2-crop system with no fallow, and the cropping patterns for the two seasons cannot be determined independent of the other. Therefore the answer to the question of shifting 4 to 6

million acres from wheat to other crops is in fact a question: What should be the pattern of major food and commercial crops, summer and winter, throughout the 1970's in West Pakistan?

I anticipated when we started work on wheat research that our efforts would cause a shake-up in the methods of the West Pakistan Research Service, on all crops. But my assumption was then based on diffusion of our methods.

I am now proposing that we use the wheat improvement program as a handle to bring into West Pakistan within the next 6-12 months a group of short-term consultants who would examine all major crop substitutes for the 4 to 6 million acres of wheat land which is likely to be shifted to other crops, consider how these substitute crops will combine with the major summer crops, and recommend to the Government, either in a series of reports, or in a consolidated report, a set of proposals on accelerated research during the Third Plan, 1965-70, on crops other than wheat.

This does not mean that Ford Foundation need involve itself in all crops in the same manner that it has in wheat. The Empire Cotton Growing Corporation of London, which specializes in cotton research, has already been invited by West Pakistan to assist in cotton research.

The East Pakistan rice breeding project, which Ford Foundation proposes to assist through IRRI, will be helpful to West Pakistan on rice research, at little extra expense.

Other collaborators can be found for major crops. This is not the immediate issue.

The need here is to draw up a 5-year blueprint for research on a new cropping pattern, which will enable the Government by 1970 to recommend specific crops, varieties, and cultural practices, when the time comes to reduce wheat acreage.

Let me expand my thoughts below on some areas of investigation and the possible personnel to make the studies.

Gram as human food and poultry feed

No effective aggressive research has been done on this crop anywhere in the world, to my knowledge, and it is presently used only as a catch crop in Pakistan, without fertilizer. Yet this crop alone could provide 80% of the protein needed for a poultry feed business, and (as discussed below) a large scale commercial poultry business is one of the most likely animal industry developments in Pakistan once the country has become self sufficient in cereals for human food and can consequently justify diverting some of the cereal grains to the production of eggs and poultry (meat) production. No one in the Rockefeller Foundation has covered this crop. I have recently told President Harrar that a gram and soybean specialist is one of the staff members that Rockefeller now needs badly. Increasing the production of plant proteins (legume crops) will become increasingly more important as world population mounts.

Soybeans

These could be grown as a winter crop in the southern region of West Pakistan, planted after the last killing frost, and harvested in late spring. There has been little research as yet, although I saw some growing at Tandojam and was told of some research at Peshawar.

There has been limited research on soybeans as a summer crop at Lyallpur. A vigorous breeding program is needed to develop varieties which will permit the establishment of soybeans as a major crop.

Potatoes

This is a logical and very profitable winter crop, but the problem of potato virus, and dependable source of potato seed has not been solved. I do not know what research has been accomplished in Pakistan. A potato man would need to make this review.

Sugar beets

This crop has only recently been introduced in the Frontier Region and deserves wider study. However, with the climate of Pakistan, sugar cane will undoubtedly continue to be the principal source of sugar production.

Winter vegetables

Carrots, peas, and onions can all be grown in late winter and spring, and harvested before a summer crop. A vegetable man would need to study what research has already taken place.

Berseem and other forages

This is a very promising use for much of the 4 to 6 million acres of wheat land, since most forage is converted to milk. All West Pakistan cities are short of dairy products, and every villager uses milk or its products as an important part of his diet. Hence the demand exists. Moreover, by growing and storing animal feeds in winter, land can be released in summer for valuable export crops. But a great deal of research would be needed on preferred varieties, cultural practices, and insect control. A forage man would be needed to review the present research and recommend next steps.

Tree crops

Fruit is expanding rapidly in West Pakistan and it is possible that some land now cropped for wheat should be shifted permanently out of crops, into horticulture.

Another tree crop is the production of eucalyptus and other fast growing soft woods for construction poles and fuel. In South-west Iran, I am told, there is now extensive cultivation of such softwoods on high priced irrigated lands, and the 7-year cycle of cutting has proved more profitable there than any existing row crop. This industry minimizes labor, and therefore must be studied for its effect on Pakistan Government policy to achieve full employment.

Summer crops

Among the major summer crops, which must be studied for their impact on the 2-crop cycle, are:

Corn
Sorghum
Cotton
Sugar cane
Beans

Corn

Among summer crops, Pakistan has already achieved acceptable hybrid maize varieties through almost 10 years work of US-AID, and the training of many Pakistani scientists in the U.S. The pieces of a new industry are all there on the experiment stations but so far no one has put these pieces together into an efficient production pattern on the farms. The varieties in Pakistan now should permit a yield three times the present average. Plant population is too low. Fertilizer use is inadequate (60 pounds of N instead of 120-160 pounds).

Weed control is poor. Control of corn borer is not understood. This is an extension problem, not research. I am glad to see the Third Plan calls for a 56% increase in annual corn production.

Sorghum

Sorghum is also an old summer crop in Pakistan, but has been treated as an "orphan" and never has been grown under conditions of high fertility, with good cultural practices. The varieties have never been selected for high yields. The revolution of dwarf and hybrid sorghums, which swept the U.S. in the last 10 years is almost unknown in Pakistan.

Maize and sorghum are the key carbohydrates for the poultry feed industry.

Rockefeller Foundation in Mexico and elsewhere is supplied with ample technicians in this field, either for short-term consulting or for residence in Pakistan. Sprague (corn) and House (sorghum), both of Rockefeller Foundation in Delhi, are outstanding men for short-term consulting, if their visits are politically acceptable to Pakistan.

Pakistan has several outstanding young scientists already trained in this field, including Bhatti, cereal botanist, Yusefwalla Maize Breeding Station, near Montgomery.

Cotton

Pakistan produces some excellent cotton, but by world standards the yields are inexcusably low. The basic problem is the local varieties, which have been selected for decades for insect resistance and fiber length, but never for fertilizer response and

high yield per acre. The cotton plant in Pakistan is very large, in relation to its yield. This permits fewer plants per acre than in other cotton growing countries.

The Delta Pine and Coker varieties of cotton, both developed by private U.S. seed companies and now widely grown in U.S. and Mexico, would permit 3 times the plant population per acre, compared to Punjabi cottons. Moreover, the earlier maturing Delta Pine varieties can be harvested in early November and thus permit a winter wheat crop in the same rotation.

Pakistan should shoot immediately for 40 maunds of cotton per acre, not 20.

Sugar cane

I have not studied the sugar cane crop in Pakistan. A specialist would be needed to look at the present research, the impact of sugar on the future crop rotation, and to what degree sugar beets should augment the cane crop.

Poultry industry

Experience in Mexico indicates that a poultry industry is an excellent way of utilizing "surplus" cereal grains as soon as the demand for cereal grains for direct human consumption has been satisfied, and when crop substitution becomes feasible. Poultry (both meat and eggs) is a favorite food of West Pakistan. There are the beginnings of a small modern poultry feed industry at Karachi but it will require a great increase in the supply of Carbohydrates (Sorghum and corn) and a similarly great increase in the protein crops (i.e. gram) to supply the feed which could convert the present

small poultry industry of a few 10,000 bird flocks a year into the millions that are needed.

The development of a poultry industry in the Ludhiana area of India, is less than 5 years, from no commercial sales to more than 3 million birds a year, is an indication how fast this development can happen, once the feed problem is solved.

Disease control is the other aspect of poultry industry on which help may be needed, but that is only a matter of good extension, not new research.

Possible consultants

My initial thinking on possible short-term consultants for this review of future cropping pattern in Pakistan includes the following:

Ed Wellhausen, Rockefeller Foundation Representative in Mexico, is probably the best general breeder and adviser on research programs. He is also a maize-sorghum specialist.

John Pino, who spent 8 years in Mexico and started the poultry industry there, is now with Rockefeller Foundation in New York. He could look at the requirements for a poultry industry in West Pakistan.

A Mexican scientist can help on potatoes. There are a number of first rate men in this field in the Mexican Government research service. Another adviser on potatoes would be John S. Niederhauser, a Rockefeller man.

Reginald Laird, Rockefeller soils man in Mexico, could be used as a generalist on any review of research programs in Pakistan.

Jose Guevera, Mexican technical director of research, and Alfredo Garcia, Dr. Gregorio Vasquez, and Dr. Jacobo Ortega, are all very good on problems of introducing new crops, and might be fitted into a team. I am sure the Mexican Government would welcome this opportunity to help in Pakistan.

Dr. Charles Krull, Rockefeller man in Mexico who now handles the Pakistani trainees, should visit Pakistan, either in connection with this cropping review, or separately under the wheat project.

The biggest gap in the above list of consultants is a specialist to look at gram and other legumes.

If Ford Foundation indicates that it is interested in a general review of cropping pattern, such as I have outlined here, I believe that we could recommend a panel of 3 or 4 men who could cover all the major cropping questions, and within three months put together a report that would outline what research should be undertaken during 1965-70 to find the answers for the shift in cropping made necessary by Pakistan's success in the wheat improvement program.

No additional funds are needed. You have already provided 12 man-months of short-term consultants in the grant, and you would not need to pay salaries on any men borrowed from the Rockefeller Foundation.

I will await the go-ahead from the Ford Foundation, and the Government of West Pakistan, before proceeding further on this team.