Agenda Item 3

PROPOSAL

FOR AN

INTERNATIONAL CROPS RESEARCH INSTITUTE

FOR THE

SEMI-ARID TROPICS (ICRISAT)

Report of the team commissioned by the Technical Advisory Committee of the International Consultative Group on Agricultural Research to study the feasibility and need for an institute for research on upland crops and farming systems of the semi-arid tropics and to prepare proposals for consideration.

Hugh Doggett
L. Sauger
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October 19, 1971

OUTLINE

Proposal for an International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)

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PROPOSAL FOR AN INTERNATIONAL CROPS RESEARCH INSTITUTE FOR THE SEMI-ARID TROPICS (ICRISAT)

1. Summary

The team recommends the establishment of an International Crops Research Institute for the Semi-Arid Tropics (ICRISAT - name tentative) hopefully to be located in India, which should serve as (a) a world center for the improvement of sorghum, millet, pigeon peas, and chick-peas; and (b) a center to promote the development and demonstration of improved cropping patterns and systems of farming which optimize the use of human and natural resources in the low rainfall, unirrigated, semi-arid tropics.

Other pulse crops, while of recognized importance in farming systems and as components of the diet of people in these regions, will not be given major attention initially in the work of the Institute but may be included in adaptive tests and as parts of the rotation systems employed, drawing upon the varieties and information on cultural practices developed elsewhere. If major attention is to be given by the Institute to additional crops such as groundnuts, additional resources above those proposed herein would be required.

The Institute should be developed on the general pattern and principles of the International Rice Research Institute (established in 1960)

with suitable modifications, including not only the provision of balanced multidisciplinary teams of scientists and supporting staff in the principal center, but being closely linked with strengthened regional and national research and action programs for these same crops and farming systems of similar ecological and cropping areas in other parts of the world, principally Africa, South Asia, and Latin America. Training, exchange of materials and information, improvement of communication among scientists with common interests and responsibilities, and mutual discussion and joint planning should be strongly emphasized.

The Institute (ICRISAT) should be governed by an International Board selected from among outstanding agricultural and scientific leaders of the host country, other countries of the ecological zones which the Institute is to serve, and from agencies providing major financial support. Its senior scientific staff should be drawn from among the best scientific talent available on an international basis.

After considering eleven areas in Africa and India as potential sites for the Institute and comparing them in terms of a common set of criteria, the team concluded that India would be the most appropriate country within which to establish the Institute headquarters if India could provide the necessary conditions for it to function effectively. The team was assured by appropriate officials of the Government of India that suitable conditions

will be provided to enable the Institute to function in a fully effective manner as an international body serving the whole world community, including provision for expeditious movement of (a) staff members into, out of, and within the host country as may be needed in conducting the Institute's program; (b) visiting scientists, administrators, and trainees from other countries who may need to visit or participate in the programs of the Institute (the above has been assured irrespective of the nationalities of the persons concerned); (c) seeds and genetic materials into and out of the country as may be needed in cooperative programs in any part of the world consistent with reasonable quarantine control to avoid introduction or export of serious pests and diseases (a quarantine unit associated directly with the Institute to permit prompt and expeditious handling of imports and exports of seeds and avoidance of unnecessary delays is contemplated); and (d) expeditious release and dissemination of research results and other information useful to cooperating programs.

In addition to its research programs, the Institute would be a center for training of relevant research and production staff, both through in-service training programs, collaboration of Institute staff with scientists of the cooperating nations, formal organized specialized courses, and in providing facilities for post graduate study and research in cooperation with universities. It would also strive to improve communications among the scientists

of the countries and regions concerned and bring them together in workshops designed to assess progressively the state of knowledge in this field of work and to improve planning for accelerated progress in the field.

The team has been assured that India will provide adequate quantities of land for the Institute, of appropriate quality and suitably located, and without cost to the Institute. While final site selection must await assurance of authorization and financial support for the Institute, the committee has inspected several sites, which could be made available and which appear to be worthy of consideration, in the vicinities of Poona, Hyderabad, Indore and Bangalore. Other sites in Africa could serve the needs reasonably well if, for any reason, a site in India could not be obtained under satisfactory conditions. For reasons discussed further elsewhere, it appears that sites near Poona or Hyderabad may more nearly meet the desired criteria. All these potential sites, as well as possibilities outside India, should be kept in view until more detailed studies can be made and all the necessary legal arrangements and other conditions necessary to the effective functioning of the Institute can be negotiated formally.

The team is suggesting a senior professional staff of approximately thirty-six persons at the central Institute headquarters (including the principal administrative officers) with appropriate support of junior scientific staff, technicians, clerical and administrative personnel, and service help.

Details of the resources and staff required for strengthening associated regional and national programs will have to be worked out progressively as the Institute's program gets underway and have not been specified quantitatively in the present study.

Estimated capital costs for bringing the core program of the Institute up to full operation are approximately ten to twelve million dollars. Recurring core costs, when the institution is fully staffed, are estimated at approximately $2,500,000 to $3,000,000 annually on the basis of present unit costs. If expansion of the program to include groundnuts were desired, substantial additional resources would be required. In order to get the Institute program underway, it is suggested that the overall proposal be endorsed, an interim policy board be created, and that an initial fund of $500,000 be made available beginning January 1, 1972 for initiating the development of the project.

The team is of the opinion that it should be possible to move expeditiously and to have the Institute ready to begin operations and development within a few months if the necessary authorizing and basic financing decisions can be taken promptly. It is suggested, however, that the various aid agencies might proceed immediately to investigate ways in which they could strengthen and improve the work on these crops at selected stations outside the main center, so that as the center is becoming operational, the

chain of out-reach effort can be developed simultaneously and linked with the Institute. An advisory committee of international scientists is proposed who could review the work which should be carried out at the center, and the work being done in the out-reach stations, so that the Institute develops a system of coordinated research effort. Such an advisory committee might be a permanent feature of the research efforts in semi-arid tropical agriculture.

2. Terms of Reference for the Team

The suggestion had been put forward from time to time by various agencies or persons concerned with international agricultural development that an international upland crops research institute be established which would serve as (a) a world research center for improvement of sorghum, millets, pigeon peas, and chick-peas,and (b) a center to develop and demonstrate improved cropping patterns and systems of farming which optimize the use of human and natural resources in low rainfall, unirrigated, upland tropics.

A meeting of heads of assistance agencies (Bellagio IV) held in New York, December 3-4, 1970, prior to the formation of the Consultative Group on International Agricultural Research, considered a discussion paper on the subject prepared by Dr. Clarence Gray and indicated its desire to have a detailed proposal prepared for its later consideration.

The Technical Advisory Committee to this Consultative Group, at its meeting in Rome, June 29-July 2, 1971, discussed this suggestion further. The Committee deferred a definitive recommendation on the subject but requested that a feasibility study be undertaken by a small team consisting of Dr. R.W. Cummings of The Ford Foundation, Dr. Hugh Doggett of the Overseas Development Administration of the U.K. and the Canadian International Development Research Center, and Mr. L. Sauger, Director, Centre de Recherche Agronomique du Bambey, Senegal, who is a staff member of IRAT (Institut de Recherches Agronomiques Tropicales et des Cultures Vivieres) and also a member of the Technical Advisory Committee. Mr. John Comeau of the International Development Research Center (Canada) accompanied the team on its field studies and was most helpful in the studies and in facilitating inter-language communication.

In undertaking this feasibility study, the team was expected to examine the research needs and requirements of these crops and of the agricultural systems of which they are a part in the various ecological situations throughout the world in which they are of actual or potential high significance. The areas in Africa and Asia where these crops are now extensively grown and where they form the basic staple food of the population was to receive particular attention.

In examining these various situations, the team was also expected to make suggestions as to whether there should be a single principal international

research institute to deal with these problems or whether there should be more than one center. Further, it was recognized that much of the adaptive research for applications to the various ecological situations will have to involve national and regional research organizations. Therefore, the committee was requested to provide suggestions to the Technical Advisory Committee as to the relative degree of emphasis which should be placed on the establishment of an International Research Institute with a staff and facilities competent to approach the basic problems with these crops and their farming systems in depth, as against the approach of strengthening of existing national and regional programs.

The report would be expected to reflect the team's judgment and recommendations to the Technical Advisory Committee as to the pattern, location, and conditions which would make most probable the attainment of the objective visualized for an effective international program in this field. These points were further elaborated in a letter from Mr. Peter Oram, Secretary to the Technical Advisory Committee, dated August 26, 1971 (copy attached).

ORGANISATION DES NATIONS UNIES POUR L'ALIMENTATION ET L'AGRICULTURE

ORGANIZACION DE LAS NACIONES UNIDAS PARA LA AGRICULTURA Y LA ALIMENTACION

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26 August 1971

Dear Dr. Cummings,

Thank you for your letter of July 28 concerning progress on your study related to the suggested upland crops institute. I am very glad that you managed to get a good insight into the programme of IRAT in West Africa since I do feel that this was a weakness in the original study produced for the Bellagio group on this subject.

I note your comments concerning the terms of reference and enclose a copy of the proceedings of the TAC meeting in the hope that this will guide you in your work. In fact, it was not stated at the meeting that the Secretariat would prepare specific terms of reference for your team (I have checked this very carefully against the verbatim record) so your request took me rather by surprise and unfortunately came at a time when the two key members of our Plants Division staff were out of Rome. It does, however, seem extremely important that your study should take into account :

1) the question raised at the TAC as to whether and where a breakthrough in developing high yielding varieties has taken place in certain key rainfed crops, particularly sorghum and millets; and - depending on this - whether the approach required by any international centre would have to be largely a breeding one or would have to be oriented more towards developing improved agronomy, appropriate rotations, and other measures (including the removal of socio-economic obstacles) to speed the adoption of high yielding varieties already developed, i.e. a largely systems approach;

2) what crops should be included in the programme of any such institute and in particular whether it should attempt to cater for certain of the food legumes as well as cereals; if so on which should its main effort be focused;

3) whether one main centre would be adequate to cover the rainfed crops in the sub-humid to semi-arid zones of both Africa and Asia and if so what would be the optimum location. Alternatively are two main centres needed, one for South Asia and one for Africa South of the Sahara, and where should these be;

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4) if main centres (one or two) are to be newly created or built up from existing stations with additional international support what other action is needed to create an adequate research network at the national or subregional level to support the work of these main centres. Alternatively, could the problem be covered adequately by building up an interlocking research network based on strengthening existing national stations without creating any new major centres, whether the latter are new or developed by greatly expanding an existing station;

5) what should be done to strengthen research on rainfed crops and/or multiple cropping in the wet monsoon areas of Asia (mainly South East Asia), the only ecological zone where the term "upland crops" is generally meaningful. Would you support strengthening the work of IRRI on upland crops in this zone with appropriate "outreach" programmes, or would you propose some alternative solution.

This still leaves open the whole question of what to do in the Near East and North Africa; but clearly this must lie outside your terms of reference, if only for reasons of logistics!

In making this review I know that you will take into account all existing research but I am not sure whether you will have been briefed on the recent proposal of Dr. Starnes, EAAFRO, for a major East African cereal and legume institute to be located in Nairobi; or on another proposal received from Ethiopia for a centre working on pulses to be based there. These two proposals to some extent conflict with each other and may also conflict with any ideas that you may have; in any case I would have strong reservations about locating a major centre at EAAFRO, both because of its somewhat atypical ecological conditions and because of its recent managerial difficulties. You will note that our Plants Division argue rather strongly on the merits of Ethiopia as a centre for sorghum and millets.

I hope these ideas will be of some guidance to your mission, and I would like to reiterate my previous request that if at all possible you and your team should travel through Rome on your way from Nairobi to Bombay in September. This would give us a chance to have a round-table discussion in FAO on your findings so far and to exchange ideas on the terms of reference which you have worked out.

I have sent copies of this letter and the TAC report to Messrs. Doggett and Sauger at the addresses indicated in your letter.

With kind regards,

Yours sincerely,

P. A. Oram
Secretary - TAC

Within this context, if the establishment of an International Upland Crops Institute were indicated, the team outlined the principles and objectives set forth below as those to be kept in mind in developing specific proposals. The International Rice Research Institute established in 1960 provided a model of the type of institution and mode of operation which has proven successful. The experience of CIMMYT, IITA, and CIAT, established more recently, were also helpful. It was assumed that the proposal would provide that:

1. The Institute should be a truly international institute, with an international board of governance, drawing its senior scientific staff from among the best scientific talent available irrespective of nationality.

2. Employment policies and conditions for the senior scientific staff would be on an international basis without discrimination as to nationality or origin or any consideration other than scientific and professional merit and performance.

3. The Institute would be set up and would function in such a manner as to strengthen and support national programs with the crops and topics concerned, both in the host country and in other nations, rather than compete with or replace national programs. It would expect to develop close linkages with national and regional programs in all parts of the world having a similar range of ecological conditions and in which these crops appear to

have high potential value.

4. The staff would be provided with the type of facilities and program support that would assure that they are able to make the maximum rate of progress, limited only by the parameters of the scientific principles concerned, and the imagination and ability of the staff.

5. Conditions would be established which would assure expeditious movement of (a) staff members into, out of, and within the host country as may be needed in conducting the Institute's program; (b) visiting scientists, administrators, and trainees from other countries who may need to visit or participate in the programs of the Institute; (c) seeds and genetic materials into and out of the country as may be needed in cooperative programs in any part of the world consistent with reasonable quarantine control to avoid introduction or export of serious pests or diseases; and (d) expeditious release and dissemination of research results and other information useful to cooperating programs.

6. In addition to its research program, the Institute would be a center for training of relevant research and production staff and thus should establish close relationships with educational institutions, preferably those which can provide a high quality of postgraduate degree work in the relevant fields.

7. The choice of the location of the Institute would include

at least the following considerations:

a. Proximity to a good agricultural university.

b. Within an agricultural area in which the above crops are of major importance.

c. At a latitude and in a climate which permits year-round cropping of the relevant crops, especially the sorghums and millets.

d. Adequate land of good quality for experimental work (at least 300 hectares of experimental land, in addition to that required for buildings, staff housing, and service facilities).

e. Availability of irrigation to at least a part of the land, so as to assure against hazards of losing valuable genetic materials in periods of extreme moisture stress.

f. Accessibility to an international airport.

g. Proximity to a population center which provided reasonable amenities to staff members and their families (shopping, primary and secondary education, entertainment, medical services).

h. A desire on the part of the host country to have the Institute located therein and willingness to provide reasonable tax and import concessions to the Institute and to non-national staff members and their families as may be appropriate to such an international body.

i. Probable availability of sufficient numbers of trained people to provide the required supporting scientific, technical, administrative, and clerical staff.

Within this context, the team made a study of the relevant areas

in West Africa (especially Senegal), East Africa, and India. In light of technical considerations indicating that India should be explored in greater depth as a potential host country, it enlisted the judgment and advice of the appropriate senior officials of India as to whether or not they would like to see such an institute established and, if so, whether they wished to have a location in India seriously considered as the site for such an institute. It also inquired as to whether or not or the extent to which the necessary conditions could probably be provided by India. The judgment on these matters being affirmative, the team visited areas in India which appeared worthy of consideration as possible sites for locating the Institute, in addition to the five areas in Africa previously studied, and inspected actual land areas which could be made available for the purpose.

3. Segment of Agriculture to be Served by the Institute

This Institute will direct its major attention and focus on the rainfed crops of the semi-arid tropical zones of the world. This ecological zone extends to all the tropical countries which are subject to a rainfall pattern with a limited duration of two to seven months per year (zones V3 and V4 of Troll's classification as shown in Gray's report).

Throughout this ecological zone the possibilities for irrigation are generally limited to a small portion of the entire area and affect but a small segment of the population while the total population density is frequently high and never negligible. Rainfed crops are therefore the essential

crop resources of the zone and constitute the base for agricultural development.

The ecological differences of importance to these crops which can be readily observed in this zone bear mainly on the amount and duration of the rainfall, and on the temperatures during the winter season, particularly the minimum temperatures. These differences in temperature sometimes vary considerably due to the differences in altitudes, and/or latitudes.

These differences combined with those of the soils - of which there are three main types: the black soils, the red soils, and the sandy soils - bring about, as far as the crops are concerned, certain differences as to their distribution, whereas the whole of the area is remarkedly homogenous. It is the nature of these differences which allow or prevent, as the case may be, a second crop in the post-monsoon period.

The importance of sorghum is clearly general throughout the entire zone. This is usually accompanied by a millet crop which may vary according to the amount of rainfall. The main types of millet are the pearl millet (Pennisetum typhoides - found throughout the zone visited by the group), and the finger-millet (Eleusine coricana) in East Africa and India. Other millets are also grown but they are of either a strictly national interest, as in the case of teff in Ethiopia, or of lesser importance.

In the case of food legumes found in association with these

cereals, it should be noted that food habits dictated by tradition must have been of greater importance than for cereals. The most important food legume in West Africa is cowpea (Vigna sinensis), although pigeon pea (Cajanus cajan) is widely grown in lesser quantities. In India the food legumes are very diversified and include chick-pea (Cicer arietinum), pigeon pea (Cajanus cajan); horse gram, field beans, black gram (Phaseolus mongo), green gram (Phaseolus aureus), soya beans, lentils, lathyrus, etc. Cowpea is mostly grown in India for its green vegetation as a vegetable or a forage crop.

East Africa is apparently transitional between these two, but it should be noted that the greatest area in food legumes is taken up by pigeon pea, cowpeas, and Phaseolus beans. In eastern Africa, the largest area in chick-peas is found in Ethiopia, principally at relatively high altitudes.

It appears that the Institute, for reasons of efficiency and means at its disposal, should concentrate, at least initially, on the two most important cereals - sorghum and pearl millet, and on the two most widespread legumes - pigeon pea and chick-pea.

The cowpea is probably the most important food legume grown in West Africa, both in the humid and semi-arid areas. The team noted that IITA will be giving major attention to the improvement of this crop. The semi-arid areas of Africa can look to IITA as a major source

of improved varieties and of information leading to higher levels of production. It will obviously be included in farming systems studies and some of the stations in the semi-arid areas of West Africa may also be able to offer assistance to IITA in the preservation and evaluation of portions of the germ plasm bank for this crop. Since it is of very minor importance in India, it would not for the present be expected to be included to any great extent, except in an observational way, in the core work of this Institute, especially if India becomes the host country.

Groundnuts are cultivated throughout this zone but mainly as an industrial crop rather than as a staple food. Although recognizing the importance of strengthening research on this crop, the team has not at this stage included it in the list of crops for which the new Institute will be responsible. It could be included if the necessary resources are provided.

Soya has also been acknowledged to be a potential crop for this zone and should be included along with cotton and groundnuts in the program of research on farming systems. The team suggests that the basic research work on this crop should be the responsibility of another institute, located in a zone with somewhat higher rainfall.

The countries concerned within the climatic zone studied by the group are: Senegal, Mali, Guinea (North), Upper Volta, Niger, Ivory Coast (North), Togo (North), Dahomey (North), Cameroon (North), and Chad

in Francophone Africa; Liberia (North), Ghana (North), Nigeria (North), the Sudan, Ethiopia, Kenya, Uganda, Somalia, Tanzania in Anglophone Africa, and West Pakistan and India in South Asia.

Other countries in Southern Africa and Central and South America and an important area of Australia would also fall within this ecological zone. These crops have a potential place in the agriculture of parts of Indonesia, Thailand, and the Philippines. The work of the Institute could also have an impact on rainfed agriculture in parts of the semi-arid areas north of the Sahara,as well as in parts of the Middle East.

Sorghums, in particular, are rapidly finding a larger place in the agricultural production patterns in the United States, Latin America, Australia, and other parts of the world. In the newer areas, it is grown largely as an animal or poultry feed grain, rather than for direct human consumption. This Institute can play a very significant role in providing the base for the varieties and production methods essential for its success in such regions.

4. Basic Objectives of the Institute

The Institute's primary goals will be:

1) to assist the various nations within the zones described above to increase their agricultural production and the real income of their farmers;

2) to provide the basis whereby the increasing populations may not only be able to provide the minimum food requirements for survival but at the same time improve the

nutritional quality and balance in their diets, and thus be able to be more productive members of society.

Throughout the ecological zones in Africa and South Asia relevant to the central thrust of the Institute, sorghum and pearl millet form major components of the farming systems involved and constitute a major staple food in the diet of the people. In the strictly cereal grain diets or those composed of cereal grains and root crops, the average protein level and the quantities of certain essential amino acids in the protein are insufficient for adequate nutritional quality and balance. Thus, a greater incentive for increased grain legume production, based on greater dependability in production and higher yields, must take a high priority.

While the ultimate objectives must aim at greater productivity of the total farming systems, the present yields and levels of productivity of these basic food crops are so low and their production is attended by so many hazards, that early attention must be focused upon the improvement of these respective major basic food crops. As advances are made with the major components of the farming systems, the total systems can be improved more effectively.

The major thrust initially will be centered upon improvement in the yield and quality potentials of the varieties of sorghum, millet, chickpea, and pigeon pea and in overcoming the obstacles, constraints and limitations, technological, economic, and sociological, which prevent the dependable

attainment of higher yield levels of these crops and of a satisfactory margin of return above costs to the farmers in their production.

This will require multidisciplinary teams of specialists who will seek to:

1) assemble the total range of world diversity of the crops under consideration, evaluate their characteristics, and develop gene pool combinations from which plant breeders in regional and national programs throughout the portions of the world to be served can select and develop varieties which will perform well and dependably in their areas,

2) help to develop the basic information necessary for solving the technological and economic problems which impose constraints and limitations on the levels of production and economical production of these crops,

3) promote the development and demonstration of improved cropping patterns and systems of farming adapted to the various parts of the zone, and which optimize the use of natural and human resources for a permanently and increasingly prosperous agriculture and society,

4) assist with the rapid strengthening of national research and action institutions through staff training programs and scientific counsel. In some cases, the Institute may be instrumental in supplying the leadership for national programs during the developmental stages.

The Institute would itself expect to do only a small part of the total work required for attaining its objectives. It would assemble the scientific talent and resources necessary for an intensive in-depth attack and concentration on the relevant problems. This implies a limitation in the scope of work so that the resources and talents available can be concentrated

sufficiently to make a real difference which would be difficult to achieve through other established institutions. It would bring together scientists from national and regional programs in workshops and planning sessions designed to focus attention on the higher priority problems and stimulate simultaneous and coordinated attack on these problems throughout the regions concerned, with a high degree of complementarity.

The Institute would develop, maintain, and make available services and research materials not generally available in individual countries, and which generally would be beyond country capabilities. In this regard the Institute would assemble a staff of resident scientists and consultants with unique and exceptional competencies to assist in the solution of regional problems. The Institute would stimulate and develop regional cooperation and provide facilities and services, including training, from which national programs could secure the best in the way of information, materials and services. In short, the Institute would provide needed support not otherwise readily available to national programs.

5. Justification for an International Crops Research Institute for the Semi-Arid Tropics

a) The need for international research effort on major crops and farming systems of the rainfed, dryland farming regions of the tropics

The tropical dryland farming areas occupy tracts of land between the more humid forest zones near the equator and the deserts of

the subtropics. Rainfall is often precarious and low, with long, hot, dry periods between rains or rainy seasons. The main cereal crops in these zones are sorghum and millets. Several legumes are grown, including pigeon pea, cowpea and various Phaseolus beans, with chick-pea (Cicer) important where there is a cool season. Groundnuts and sesame are grown as oil-seeds. Cotton is often cultivated as a fibre crop for sale. Large numbers of people live in these dry land areas, obtaining what is often only a bare subsistence from their farming operations. The existing agricultural systems were developed through long experience, and permit human survival at modest population densities. The steady decline in the death rate has put an increasing pressure on the agricultural system and the available land. For the majority of the people living in these semi-arid zones, an improvement in standards of living can only come from farming the land. There can be no doubt of the urgent need for improvement in the production efficiency of the major crops of the region, and for the development of new farming systems, making much more intensive use of the land, with greatly increased productivity per unit area. The achievement of this end will ultimately require a concentrated research effort on crop improvement, agronomic practices, crop protection and rotations. It is important that both the breadth of the disciplines to be covered and the extent and variable nature of the area to be served should be remembered in developing plans for research and improvement in crop production on these lands.

The distribution, area, production and yield of some of the major crops in the semi-arid zones are shown in Tables 1, 2, and 3. The sorghum and millet figures are not broken down, but at least half of the area shown is planted to sorghum. Pearl millet shows an overwhelming predominance in the areas with somewhat less dependable moisture conditions. Detailed figures for the miscellaneous pulses are not available. Other important crops for these areas show a world total of 33 million hectares for cotton, and 5.7 million for sesame.

TABLE I

Area and production of sorghum and millets combined.
(1968 figures from F.A.O. 1969 Production Yearbook, Col. 23)

REGION	AREA in 100 ha.				
	Sorghum and Millet	All Cereals	Sorghum/Millet as percentage of all cereals	Mean yield, q/ha.	Production 1,000 tons
Europe	161	73,216	0.2	27.3	440
North America	5,663	83,030	6.8	33.2	18,789
Latin America	2,733	46,700	5.8	16.3	4,452
Oceania	237	14,319	1.6	18.5	438
Sub-total A) mainly stockfeed)	8,794	217,255	4.0	-	24,119
Near East	2,693	34,098	7.9	10.6	2,854
Far East	39,961	170,177	23.5	4.6	18,435
Africa	27,627	60,425	45.7	6.4	17,638
Sub-total B) mainly human food)	70,281	264,700	26.6	-	38,927
World total	111,171	711,275	15.6	7.7	85,084

Notes

1) The World total includes Russia and Mainland China.

2) India has a total of 37,767 x 10^3 ha. of sorghum and millet, representing 38.2% of its total cereals acreage (98,822 x 10^3 ha.)

3) The total areas of sorghum and millet in Africa divide as follows:

	West Africa		East Africa	Rest of Africa
Nigeria	10,200	Ethiopia	3,600	
Niger	2,300	Sudan	1,800	
Upper Volta	1,975	Tanzania	1,300	
Chad	1,047	Remainder	1,728	
Senegal	1,036			
Remainder	2,334			
Total	19,003		8,418	196

4)
4) Assuming that 1 metric ton of grain feeds 5 people for 1 year, then in the Near East, Far East and Africa some 200 million people depend on these crops. The World figure would be 400 million. These are likely to be low estimates.

5) The area of maize in the Near East, Far East and Africa is 32,823 x 10^3 ha.

Table 1 summarizes the data available for the area of production of sorghums and millets. Table 1 has been divided into two main groups--areas where the sorghum is grown largely for stock feed (subtotal A), and areas where sorghum is mainly a human food (subtotal B). The differences between these two groups in the table are striking. In Europe, America and Oceania sorghums and millets form only four per cent of the total cereal acreage, and the average yields vary from 16 quintals per hectare to 33 quintals per hectare. In the areas where sorghum and millets are used for human food, these cereals together form 26.6 per cent of the total cereals grown, and the yields vary from 4.6 to 10.6 quintals per hectare. Present knowledge indicates that in areas having 1,000 mm. and more of rainfall per year, production of 5 metric tons or more of sorghum grain per hectare should be possible. This gives some indication of the scope for improvement if the tools of modern science can be effectively applied to this segment of agriculture. Production figures are disturbing. The area grown for human food is eight times the area planted for stockfeed; yet the total production for human food is only 60 per cent greater than the total production for stockfeed. In world terms, including Russia and Mainland China, sorghums and millets form 15.6 per cent of all cereals grown. Subdividing the table further, the main component of the Far East is India, which has $37,767 \times 10^3$ hectares of sorghum and millet out of the Far East total of

39,961 X 10^3 ha. This represents 38.2 per cent of all India's cereals acreage. Sorghums and millets are also extremely important in Africa, with an average of 45.7 per cent of all cereals grown. The subdivision of the Africa figures shows that West Africa has more sorghum and millets than East Africa. Nigeria has the largest portion of any country in West Africa and Ethiopia has the largest in East Africa. It will be noted that the area of sorghum and millets in India is greater than the acreage of these crops in the whole of Africa by some 30 per cent. The sorghums and millets grown in the Near East, Far East and Africa occupy more than double the area under maize. It seems certain that sorghums and millets are supporting at least 200 million people in this particular region of the world and in the world as a whole the figure is probably at least 400 million.

Table 2 summarizes the data on chick-peas and pigeon peas. It will be seen that virtually all the world's chick-pea acreage is found in the Near East, Far East and Africa zone, while India has 76 per cent of the world's chick-pea acreage. The pigeon pea situation is very similar. Virtually all the pigeon pea is being grown in the Near East, Far East and Africa regions. India grows the greatest area,constituting 92 per cent of the world's pigeon pea acreage. Taking the FAO world total of all pulses, which include dry beans, dry peas, dry broad beans, chick-peas, lentils, pigeon peas, cow-peas, vetch, lupins and miscellaneous pulses, we find that chick-pea and

pigeon pea together occupy 21.9 per cent of this whole total.

The picture that emerges from this examination of the available figures is very clear. In the regions of the Near East, Far East and Africa, as defined by FAO in the FAO Production Yearbook, millets and sorghums are of great importance, occupying some 26.6 per cent of the total cereals acreage. India has by far the largest acreage of these two crops, occupying some 38 per cent of its total cereals acreage, while West Africa shows up as an area where millet and sorghums are also extremely important. The chick-pea and pigeon pea picture is biased even more heavily in favor of India, which grows the greatest area of both of these crops, which together constitute nearly 22 per cent of all pulses grown in the world.

From a dietary standpoint, the chick-pea and the pigeon pea may be even more important than sorghums and millets. Protein deficiency is a critical factor in the hungry world, and where the production of the grains has begun to increase, as is the case in India, the production of the pulses has tended to fall. The figures quoted to the team in India show a fall of some 16 per cent in the production of these vitally important legumes. It is therefore most necessary that high yielding types should be developed and methods of farming improved so that the legumes can again become profitable to the farmer, and it pays him to redress the balance in the proportions of legume to cereal in his fields.

Table 2

Areas of Chick-peas and Pigeon peas, 1968 (FAO Production Yearbook, 1969)

	Chick-pea		Pigeon-pea	
	Area	Production	Area	Production
Near East	227	206	-	-
Far East - India	8,257	5,972	2,665	1,741
Far East - Remainder	1,282	586	86	19
Africa	505	316	100	38
Total	10,271	7,080	2,851	1,798
World Total	10,844	7,445	2,895	1,829
World total, all pulses	62,700	42,700		

Notes

1) Chick-pea and Pigeon pea together occupy 21.9 per cent of the whole world area under pulses.

2) India has 76 per cent of the world's chick-pea acreage, and 92 per cent of the world's pigeon pea acreage.

While groundnuts are grown principally as an oil seed crop for marketing off the farm rather than for direct consumption as a staple food, this crop is important as a food source and is a vital part of the farming systems of the areas in which sorghums and millets are the major basic food staples. The position of groundnuts (Table 3) shows a rather similar pattern to that of the other crops. Most of the acreage is concentrated in the Africa and Far East

zones (77 per cent), the whole of India accounts for 84 per cent of the Far East total (exclusive of China), and 70 per cent of the African total is found in West Africa. There would be much logic in favor of including this crop as a part of the concern of the International Crops Research Institute for the Semi-Arid Tropics. It is not so provided for in the following proposal and its inclusion would necessitate additional resources above those estimated here.

b) The method of application of an international research effort

The extent of the area to be covered, and the close local adaptation of most farming systems, make it clear that the research results have to be tested in many places, and many of them must be derived from different places. Thus a single research center, unlinked to outside points of effort, could not adequately serve the needs of such a broad and varied zone. Three possible international approaches were considered by the team, namely (i) increased support to existing local research efforts; (ii) the development of two or more centers of research, either as fresh stations or through strengthening of existing stations; (iii) the development of one main, central research center or institute, linked by an "outreach" system to research effort throughout the region to be served. The three systems are not mutually exclusive.

Table 3

Area & Production of Groundnuts

Region	Area in ha.x10^3	Yield, q/ha	Production, tonsx10^2
North America	581	19.8	1,153
Latin America	1,083	11.5	1,246
Oceania	27	11.9	32
Near East	372	7.8	292
Far East (not including China)	8,412	7.0	5,869
Africa	5,225	8.1	4,219
World total/mean	17,620	8.5	15,034

Notes

India, with a total area of 7090 X 10^3ha. accounts for most of the Far East production, and 40% of the total world area.

African groundnut areas (principal producers) are as follows

West Africa		East Africa		Rest of Africa	
Cameroons	168	Sudan	328	Malawi	190
Chad	145	Uganda	250	S.Africa	340
Congo Republic	200				
Gambia	140				
Niger	320				
Nigeria	1,314				
Senegal	1,191				
Upper Volta	207				
Total	3,585		578		530

Areas in the African countries not listed above total 532X10^3 ha.

The provision of increased support for existing work without any effective central coordinating mechanism seems unlikely to be very effective in obtaining rapid advances. Some sort of close coordinating system would need to be set up. All developing countries are deeply concerned with solving their own problems and cannot give very much attention to their neighbor's needs. While each nation would strive to meet the needs of its own area to the extent available resources permit, it would be difficult for anyone to provide the necessary concentration of resources to serve the basic research needs on a broad international basis. Further, it would not only be difficult for any one nation to orient its program so as to serve effectively the needs of other nations, but the acceptance of any one national center as the premier international center is more difficult than would be an international center of which all are direct participants. There could well be strongly conflicting views within countries on the crops to be worked upon and the type of work needed. A further defect in such an arrangement is that it results in a dispersal of effort over a wide area without any major concentration on the basic problems to be solved.

The establishment of several separate major research centers suffers from fewer of these weaknesses, but would be expensive. At least four types of situations would be required in Africa alone, as discussed later, to cover the West African Guinea zone, West African Savannah zone, East

African Savannah zone and Ethiopian Highland zone. Research on the improvement of the crops, and all the related practices, requires a multi-disciplinary approach with a concentration of effort and facilities. With modern communications, it would not seem necessary to repeat this concentration at several centers. Dispersing the concentration of staff effort over several centers could well result in much slower progress at all of them. Estimates of what is believed to be the minimum staffing and budget requirements for one international research center or institute are given. These serve to underline the expenditure which might be involved in establishing more than one main center.

All the evidence indicates that the most effective form of international support for research into the development and improvement of crops and farming systems in the semi-arid tropics will be to establish one main research center or institute in an area where the crops concerned are of major importance. This institute would, however, be closely linked to all regional and country programs on these crops, and much increased effort on these crops could be channeled to these programs through the institute in a variety of ways. The institute would be there to serve the regions, the countries and their programs. The International Rice Research Institute has demonstrated that a very effective pattern can be built up in this way. We think that IRRI and CIMMYT with their concentrations of research effort coupled with flexibility of outreach provide the most appropriate models known to us on which an

international effort on the crops and farming systems of the semi-arid tropics should be based.

6. Name of the Institute

The team has considered a variety of names. Obviously, the name should be self-explanatory and descriptive of the program of the Institute. It should preferably be reasonably short and hopefully provide an acronym which is easily pronounceable. Hopefully the name or the acronym should carry a favorable connotation. The name "Upland Crops Research Institute" did not meet these criteria. None of the names considered by the team were thought to be entirely satisfactory. Tentatively, the team suggests: "International Crops Research Institute for the Semi-Arid Tropics" (ICRISAT). Some other possible alternatives considered were:

Crops Research Institute for the Semi-Arid Tropics (CRISAT)
International Research Institute for Semi-Arid Tropical Agriculture (IRISTA)
International Research Institute for Crops of the Semi-Arid Tropics (IRICSAT)
International Semi-Arid Tropical Crops Research Institute (ISATCRI)
International Sorghum, Millets, and Pulses Research Institute (ISOMPRI)
Center for Research on Rainfed Crops (of the Semi-Arid Tropics) (CRRC)
Et cetera.

7. Scope of the Program

a) Research on:

(1) Crops

A sharp focus in objectives and a high concentration of effort are necessary to insure rapid progress. For the initial effort sorghum, pearl millet, pigeon pea, and chick-pea have been selected for concentrated attention on the grounds that all of these occupy large acreages, and all are of basic importance as human food. However, it is recognized that other crops must be included in farming systems for the area. It is believed, however, that substantial improvement in the farming systems of these regions will require basic improvement in the production technology for these major crops.

The process of yield improvement involves the improvement of the crops by plant breeding coupled with better agronomic practices and protections against insects, diseases, birds, and rodents. These aspects go hand in hand. A better understanding of the physiological responses to stress is required. And, of course, the considerations of grain quality, in terms of physical and chemical characteristics and nutritional value must be kept in mind. It is true that sometimes a major "breakthrough" occurs, as the result of a spectacular advance in the genetic materials, or a revolutionary new practice. However, it is much more likely that an advance in genetic material supported by improved practices is required, and that the effectiveness of each will be dependent on advances in the other. This has certainly been true in the case of recent spectacular gains in the technology of wheat

and rice production.

While some advances have been made in developing more efficient plant types and in identifying male sterile lines for sorghum and millet in recent years, this has done little more than to indicate the directions and give some idea of the extent to which further improvement may be possible. The new improved varieties and hybrids which have been developed still have many deficiencies in grain quality, disease and insect resistance, and in range of adaptation. A portion of the world range in genetic diversity has been collected and partially evaluated. There is an urgent need to bring together the full range of world germ plasm of all these crops through a more thorough exploration and collection program, to evaluate and classify this material, and to develop gene pools of material from which varietal selection and improvement programs can systematically put together more productive varieties which eliminate weaknesses in present varieties and which can perform well in the variety of harsh environments in which they must be grown to supply the food requirements of the people therein.

While there is great scope for improvement with the cereal grains of this region, the scope for improvement of the grain legumes is even greater and the need even more acute. The people of these regions are already short in both quantity and quality of protein in their diets and this imposes serious limitations on their physical and mental performance. The

grain legumes, so important in this respect, have been neglected in the past and have been poor economic competitors with the cereals in their farming systems. Improvement in the production of the selected grain legumes will assume a very high priority in the Institute's program.

Workshops would be anticipated as an early activity in the Institute's program formulation so as to enlist the assistance of the best and most experienced scientific talent available to identify the most critical and important problems and constraints limiting the productivity of the crops and farming systems under consideration and the best approaches to their solution. For all of the crops concerned, it seems obvious that consideration must be given to such characteristics as the most efficient plant type, time of maturity in relation to rainfall patterns, photo period response, grain type and quality, protein content and amino acid balance, resistance to insect attack (for example, the shoot fly, stem borer, and grain midge are especially serious on sorghum and in some areas on pearl millet), resistance or tolerance to striga (witch-weed), response to moisture and other environmental stress, resistance to leaf, root, and grain diseases (ergot, and downy mildew are examples), weed control, cultural practices, and food technology.

(2) Farming Systems

The traditional agricultural systems in the dryland tropics were developed over long periods of time, through experience. They were

not designed to give high economic returns, but were rather evolved to give an adequate and secure harvest with the available tools and labor. They represent a part of the life of the people, and are involved in all aspects of village life.

Each modern agricultural system required to replace the traditional way of life must be worked out and proved as a unitary, integrated series of practices matched to the available tools, labor and resources. It must be shown beyond doubt to be profitable, and to maintain or improve the fertility of the soil. The distribution of the labor effort must be so adjusted that no excessive peak demands occur. Further, any new system must take cognizance of established customs and social habits, and of the timing of other demands, such as cutting thatch and repairing houses.

The method of introducing new agricultural systems also requires study. It may well be necessary for the changeover to be relatively gradual, and it is important that each step in the process of changeover should also match the available tools, labor and resources.

Basically, much of this work needs to be done individually for each area, involving as it does agro-socio-economic research at the village level. Some work of this kind has already been undertaken, notably by IRAT in Senegal, but much more is required as the successful transfer of better crops and practices from the research station to the farmer is dependent upon it.

A team at the Institute will concentrate on the development of farming systems in selected experimental but real situations, will undertake basic studies, and will keep the workers in the country localities fully informed on methods and results obtained elsewhere, attempting to relate their particular problems to other parts of the world in which similar situations may have been encountered. This implies the organization of seminars and workshops bringing scientists concerned with this problem from throughout the region together periodically for exchange of experiences, discussion of ongoing programs, principles, and objectives, and for joint planning. The Institute will not attempt to develop the wide range of specific farming systems for the various parts of the zones under consideration but will act as a center to stimulate and promote consideration and serious attack on this problem by scientists throughout the regions concerned.

b) Training:

An important aspect of the work of any effective research program is the acquisition, discovery, and dissemination of knowledge. The Institute's program will involve visits of varying length by visiting scientists, thereby bringing the staff up to date with the latest work, at the same time the latest research results will be imparted to the visitors. Provision will be made for all categories of students, to do advanced thesis work or other levels of practical study and research. Courses will be organized to teach

the latest techniques and applied knowledge to visiting scientists, agriculturalists, and technicians from other countries. The holding of workshops for workers from all parts of the world has already been mentioned, and does form an important aspect of the training program to the mutual benefit of those involved.

c) Communications:

A prime function of the Institute will be the dissemination of knowledge and information to all research workers in the appropriate field, and the making available to all areas results obtained in any one. A literature service will be operated, in which title pages of the important scientific journals will be circulated, and xerox copies supplied of any papers requested.

8. Location or Locations for the Institute

In consideration of the segment of agriculture to be served by the Institute, it appeared to the team that the belt across Africa, south of the Sahara and north of the equatorial wet zone from Senegal on the west to Ethiopia, Kenya and Tanzania on the east and the Indian subcontinent embraced a major portion of the most concentrated areas within which these crops appear to be central to agriculture and where they produce the major staples in the diet of the people. The individual crops are important in a number of other parts of the world but, in the other parts, these crops, especially the cereals, are more frequently grown as a source of animal feed. Thus, in considering suitable sites for the Institute, the team confined its study to this region.

The following criteria were kept in mind as desirable features:

a) proximity to a good agricultural university,

b) within an agricultural area in which the concerned crops are of major importance,

c) at a latitude and in a climate which permits year-round cropping of the relevant crops, especially the sorghums and millets,

d) availability of adequate land of good quality for experimental work (at least 300 hectares of experimental land, in addition to that required for buildings, staff housing, and service facilities),

e) availability of irrigation to at least a part of the land, so as to assure against hazards of losing valuable genetic materials in periods of extreme moisture stress,

f) accessibility to an international airport,

g) proximity to a population center which provides reasonable amenities to staff members and their families (shopping, education, entertainment, medical),

h) desire on the part of the potential host country to have the Institute located therein and willingness to provide reasonable tax and import concessions and other privileges appropriate to such an international body,

i) probable availability of sufficient numbers of trained people to provide the required supporting scientific technical, administrative and clerical staff.

The following specific locations were considered and are described below in terms of these criteria:

Bambey, Senegal
Bobo-Dioulasso, Upper Volta (not visited by team)
Samaru, Nigeria (not visited by team)
Alemaya, Ethiopia
East of Nairobi, Kenya
North of Kampala, Uganda
Morogoro, Tanzania
Bangalore, India
Poona, India
Hyderabad, India
Indore, India
Varanasi, India (not visited by team)

The proposals which had been put forward for the establishment in Ethiopia of an International Center for the Study of Pulses and for an East African Cereal and Legume Institute (EACALI) were brought to the team's attention. Also the team was provided copies of the working paper by L. M. Roberts on the Food Legumes.

None of the cities in Africa quite met the team's requirements. There was excellent work being done at Bambey, and it was near enough to Dakar for good amenities and air services. However, round-the-year cropping would be difficult owing to strictly limited irrigation water, which is rather saline. There is the possibility of obtaining a second generation at Richard-Toll in the Senegal River valley to the north, but this is quite a distance away from Bambey. The main crop in the area is pearl millet, and there is some sorghum, but no pigeon peas or chick-peas.

Bobo-Dioulasso and Samaru are both in the Guinea zone, where long season sorghums and millets are grown. These have limited usefulness in other ecological zones. The rainfall distribution is such that the short-term sorghums and millets grown in other ecological zones are very difficult to grow in the Guinea zone.

The site at Alemaya, Ethiopia is pleasant, and there is a great deal of sorghum in the area, with some chick-pea, a little pigeon-pea, and virtually no pearl millet. This site is basically suitable for high altitude sorghums and millets. It suffers in distance from large population centers which could provide appropriate staff amenities.

The Kenya site appeared to be reasonably suitable, ecologically. However, there is very little sorghum and millet in the area and no chick-pea. Sorghums and millets occupy relatively low priorities in the national development plans for the country.

The Nakasangola area in Uganda appeared reasonably satisfactory ecologically, but again, no pearl millet or chick-pea are currently grown in the area.

The Morogoro situation is a little uncertain. The nearest big town, Dar-es-Salaam, is 120 miles away and there is little millet in the area. Sorghum and pigeon pea are important in the area.

The statistics contained in Tables 1, 2 and 3 of this report make it quite evident that the main acreage of sorghum, the main acreage of pearl millet, the majority of the pigeon peas and the majority of the chick-peas grown in the world are in India. Therefore, with full assurance that the Indian Government feels able to offer hospitality to a research institute, the team felt strongly that the main central effort should be located in India. Indeed, the team could think of no good reason for suggesting a preference for its location in any other country. In India, the number of farmers who would make immediate use of the Institute's results would be very great, and the extension services and developmental services are already in existence to utilize the research results, to confirm them, and to get them across to the local farmers.

Five sites had been suggested in India as meeting many of the requirements. One important stipulation was the need to obtain at least

two generations of each crop each year: on this count, Varanasi appears unsuitable because it is too cool for sorghum in the winter months.

A second important stipulation was that the site for the Institute should be fairly representative of areas where the main rain-fed, dryland crops are grown. On this count, Bangalore has serious limitations, since it is a ragi area with only negligible quantities of sorghum and pearl millet within 50 miles. It has some eight months of well distributed rainfall and is not usually subject to acute drought stress. As a city, Bangalore is one of the most attractive ones considered and the possibility of a site adjacent to the agricultural university would be quite appealing.

Indore grows very little pearl millet, and no rabi sorghum, as minimum temperatures are rather low in winter. However, the team was assured that successful sorghum crops can be grown there if planted between December 15 and January 15. The team was impressed favorably by the sites and facilities available, but the city itself is only moderately well served for international connections by air. Irrigation facilities may be satisfactory but would require checking. These factors, taken in conjunction with the absence of pearl millet and regular rabi sorghum crops, led the team to put this site, for the present, in about third place among the Indian sites considered.

The choice between Poona and Hyderabad is more difficult to make. Both have very similar climates, which are typical of large

sorghum and pearl millet tracts. Both have soils representative of wide areas under sorghum. Communications are good at both places and there are good residential areas,with fair schooling and medical facilities, in both cities. The primary and secondary educational facilities are superior in Poona to those in Hyderabad. There is an international community at both centers, with well developed facilities for sports and recreation.

Hyderabad has several desirable features: it is the center of the national coordinated sorghum, rice, and dryland farming research programs, with a general University in the city, an agricultural university some 10 miles away, and it is also the site of several important laboratories. The site near Hyderabad which was inspected and considered by the team as most suitable for the purposes of an institute has an ample clear area of approximately 3,000 acres available. Two important soil types are represented at this site. The irrigation position needs to be checked further. It has a large irrigation tank covering about 350 acres, but this has been breached, and a proper survey will be required before it can be stated with certainty that sufficient irrigation water will be available at all times. One possible objection to the Hyderabad site is that very little pearl millet is grown in the immediate area.

Poona has a university, and a virus research laboratory, and an agricultural college which is a branch campus of the state agricultural university. The site proposed at the Manjri farm school is near the city, and has excellent permanent irrigation available from a perennial river.

It consists of several parcels of land, and some site clearing and development would be required to dispose of old buildings and to consolidate the several parcels of land now operated separately. The amount of land available is not unlimited in amount.

It will not be easy to obtain much more than 500 acres of suitable land in the immediate vicinity of Poona. However, land on the suggested site is carrying good crops. It is on a side of the city which is not likely to be troubled by industrial development in the near future. One advantage of Poona lies in the fact that substantial quantities of sorghum and pearl millet are grown, while the amount of chick-pea is double that found in the Hyderabad area, and the acreage of pigeon pea is similar to that for Hyderabad. Poona is an area where all the crops proposed for this institute grow, and grow well. Poona is only a few hours away from Bombay by road or rail, in addition to its daily air service, which would bring advantages both for international communications and for maintenance and repair services. It is conveniently placed for access by road and air to Madhya Pradesh with its large areas of sorghum(3068×10^3ha.), chick-pea (1600×10^3 ha.), and pigeon pea(420×10^3). From the climatic standpoint the site is also interesting. The East-West road out of Poona, where the proposed site is located, is in the rain shadow of the Western Ghats, so that along a rather short stretch of road a steadily decreasing gradient of rainfall is found, declining to very low levels. This gives interesting scope for crop testing. On the western side of the Ghats the rainfall is more plentiful. It seems probable that sites could

be selected where varieties might be tested against disease susceptibilities, and where an assessment could be made of quality characteristics liable to be impaired by wet conditions.

The team has some uncertainty as to the superiority of Hyderabad or Poona. The land situation at Hyderabad is better than at Poona, with plenty of clear land available, on two main soil types. The merits of Poona are to some extent counterbalanced by the cut-up nature of the site, and the amount of site development which may be required. It is recommended that more detailed studies should be made of these two sites before a final choice is made. It appears evident that suitable sites can be found and that the Government of India will take the necessary steps to assist in obtaining a suitable site and in providing the other conditions necessary for successful operation of the Institute.

Description of Locations Considered as Possible Sites for the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)

(See chart at end of report.)
(Pages 82 and 83.)

9. Extension and Outreach

A basic premise of this proposal is that the Institute should be set up and should function in such a manner as to strengthen and support national programs with the crops and topics concerned, both in the host country and in other nations, rather than compete with or replace national programs. Further, it would expect to develop close linkages with such national and regional programs in all parts of the world having similar ranges of ecological conditions and in which these crops appear to have high potential value.

The team wishes to emphasize these principles strongly and to suggest that the trustees and staff of the Institute keep them prominently in view as the Institute and its programs are established.

In recommending the establishment of a single major institute, the team recognizes that this can meet the needs effectively only if it is closely linked with, serves, and maintains close working relationships and communication with a series of regional and national programs throughout the relevant areas of the world. The International Rice Research Institute (IRRI) provides an excellent model of how this can work. Without going into detail, suffice to say that very close working relationships have been established with national programs in the Philippines, Korea, Japan, Vietnam, Indonesia, Republic of China, Malaysia, Thailand, East and West Pakistan, India, and Ceylon. Some of these national programs have been linked formally to IRRI by contracts between IRRI and foundations or government agencies providing direct support to

some phases of the respective country programs. In other cases, the relationships have been less formal. In all cases, however, these countries have had free access to all the genetic materials in the Institute which they wished for and could use. They have sent trainees to IRRI and their scientists have participated in IRRI workshops and seminars. There have been frequent and numerous visits of IRRI staff members to these countries for consultation and of national program staff members, administrators, and program leaders to IRRI.

Outside Asia, other international research institutes (CIAT and IITA) have added rice speicalists with experience at IRRI to their core staffs to assist in developing regional rice improvement programs in their respective regions (Latin America and Africa), being able to draw upon IRRI's resources in materials, staff, and training facilities for support.

Recently, the West African Rice Development Association has been organized, with FAO and UNDP support, to facilitate regional cooperation in rice production research and improvement in West Africa. Again the materials, staff resources, and training facilities of IRRI can be drawn on for support to this regional program.

Links with other national and/or regional programs are being established. A similar outreach program is being developed by CIMMYT for wheat and maize growing countries. It is visualized that ICRISAT will take advantage of this experience in developing close linkages to

regional and national programs in the various parts of the world it is designed to serve. Success is due in large part to flexibility of organization, coordination of effort, and the conduct of the applied stages of the research in the areas where the crop is actually to be grown.

It is suggested that the system which has come into being in association with IRRI may be regarded as a reasonable model for ICRISAT. It is suggested that the main center should concentrate on the basic problems and assure that the full range of genetic materials of these crops is made available to all stations desiring them. Unless such a chain of stations is associated with the Institute, its effectiveness will be very restricted. It is therefore recommended that, parallel with the establishment of the Institute, support be given for strengthening associated research activities on selected government stations or university sites throughout the belt of the dryland tropics. Such a strengthening of local effort appears vital to the full success of ICRISAT. In order for this effort to be most effective and in the interest of assuring the closest possible coordination, the Institute could well be the medium through which additional resources for strengthening national and regional programs could be channeled. This could take the form of grants or contracts with the Institute to provide for support to specified regional or national programs. While providing a certain amount of money to the basic support of the Institute, at least some of the assistance agencies may also wish to initiate and to be responsible for such specific projects in individual countries.

Africa has several regional programs for work on sorghum and millets. In West Africa, Bambey serves the Savannah zone for short term sorghum and millets, while Samaru under project 26 with STRC/OAU serves the whole region. Its logical ecological region, however, is the guinea sorghum belt, where the long term varieties of sorghum and millet are grown.

In East Africa, the EAAFRO/USAID project at Serere serves the East African States, and could contribute to the lowland Sudan areas, although there is at present no machinery for doing so. In Ethiopia, sorghum work is being developed at Alemaya which is typical of wide areas of the highlands where sorghum, millets and some grain legumes are grown. Ethiopia could well serve a key role in the plant exploration and assembly of the world genetic collections of the sorghums, millets, and some of the grain legumes.

The pattern of help given by the USDA/ARS through US/AID at Serere in East Africa illustrates one method which would be appropriate for the outreach work of the Center. There has been a relatively strong sorghum breeding program at Serere. US/AID/ARS complemented this work by providing a plant breeder for the millets and an agronomist and an entomologist to cover both cereals. All officers were fully funded. Later, as improved plant material became available, 2 trial officers were appointed, one each in Tanzania and Uganda, to look after the testing trials in these areas and also to stimulate the interest of the country extension services in tne new varieties, hybrids, and improved

farming methods. The mechanism by which this aid was given was by a contract between US/AID and the East African community. Other funds going into the Serere program came from the Rockefeller Foundation and from ODA, and these were also channeled through the East African community.

In preparing plans for more effectively linking the various regional centers to ICRISAT, the desirable staffing and additional required support at each regional or national center could be reviewed. The Consultative Group may wish to provide contract funds through ICRASAT for such support, or this support might be arranged through individual donors. Contracts with individual countries can be arranged as desirable, the participation of the Institute assuring that efforts are complementary rather than overlapping, and that full services and information relating to the subject throughout the tropics is available to all participants. Evidently where and when fully trained professional staff are available in the country or regional centers, the additional needed support may take other forms. Where staff are employed on such contracts through the Institute, it is expected that the training of counterpart staff will be a part of the program.

In addition to the actual servicing of outreach contracts, two other functions of the Institute will be very important in serving the cooperating programs. These are (1) the arrangement of regular workshop conferences where the workers are gathered together to exchange ideas, information, experience, and (2) the arrangement of training programs and training courses of long or short duration at the Institute.

West Africa

Outside of India, a significant portion of the sorghums and millets (Pennisetum millet) to be found in the ecological zone of concern to ICRISAT, is grown in West Africa.

Important work is actually being carried out in that part of the world, in Senegal, and Niger, by IRAT on short-term millets and sorghums (80 to 100 days), and in Nigeria through the joint project no. 26 and in Upper Volta again by IRAT for the long-term millets and sorghums (120 to 150 days). The first group is principally located in ecological zone V4 (2 to 4½ months of rainy season) and the second group in zone V3 (4½ to 7 months of rainy season) as described in Gray's report.

The mechanism outlined earlier for East Africa could very well be adopted in this area although several factors peculiar to this region would have to be taken into account:

-firstly, a great number of countries are involved, some being anglophone and others being francophone;

-secondly, there already exist networks of research for the same crops extending over all of these countries. One of these is provided by IRAT in francophone countries within the framework of the needs as they are defined by the different governments and through joint financing by the countries concerned, by France and by other agencies. The other is joint project no. 26 of the OAU which is financed by USAID and which is concerned with cereals

within the countries of that part of Africa;

-thirdly, certain programs which would normally be the responsibility of the new Institute because of their general scope are already being intensely pursued in this zone and care should be taken to avoid their duplication or suspension. This is the case for basic studies on the physiology and genetics of cereals or on soil sciences, as well as for studies of a more practical nature such as agricultural engineering and production systems.

It should then be agreed:

-on the one hand that the programs of the Institute take into account research now being done in these countries in order to avoid duplications, with the understanding that there would be a free exchange of research results;

-on the other hand that the outreach programs of the Institute be channeled through the network of existing research programs, one for short-term cereals, the other for long-term cereals. This constitutes an advantage for simplifying linkages rather than having to deal with each country separately since the dialogue would be engaged with two regional organizations; that represented by IRAT and the other by joint project no. 26.

The Bambey center in Senegal, thus associated to the International Institute, with its secondary stations, would be the relay station for

short-term millets and sorghums. Senegal in this respect has the advantage of providing across a North to South distance of 500 km., at less than 300 km. from Bambey, the entire range of rainfall from 300 to 1,500 mm. This allows for the selection of the best combinations of varieties, of cropping patterns and of production systems to be recommended for the zone. The possibility of envisaging year round irrigation at Richard-Toll should be considered as a favorable asset in expediting the research work. Dissemination to other countries could be rapidly achieved due to the existing network. Samaru would serve as a relay to Bambey for the anglophone countries concerned with short-term cereals.

The Samaru center in Nigeria would be similarly associated to the International Institue for long-term millets and sorghums and the dissemination would be provided through the existing joint project no. 26. Bobo-Dioulasso in Upper Volta would serve as a relay to Samaru for francophone countries.

None of the grain-legume crops chosen for ICRISAT are now extensively grown in West Africa although the same allocation between Samaru and Bambey, based on the ecological requirements, could apply as well for those which are important to the region.

The same principle applies to the study of farming systems which will have to integrate these different crops in addition to cotton, in varying proportions according to the ecologies, the soils and the social customs.

The outreach suggestions above have not included Oceania or the New World. In both areas,much of the production of crops under consideration

is for livestock feed. However, similar outreach arrangements can be envisaged for the West Indies and Central and South America (Northeast Brazil, for example, would seem to merit special attention in the outreach program) while there would certainly be close collaboration and exchange with the work at Puerto Rico and in continental U.S.A. Plant breeding programs in Puerto Rico will be of great importance to the work of the Institute, and this island might well become a regional center for the Institute's activities in the New World.

10. Structure and Governance

The Institute shall be administered by a Director selected by the Governing Board (the first Director may be selected by the Interim Development Advisory Board), who shall be responsible for the internal operation and management of the Institute and for assuring that the program and objectives for the Institute are properly developed and carried out. He shall be a member and shall serve as executive secretary to the Board. The Board shall be responsible for development and/or approval of the policies under which the Institute operates, shall be responsible for selection and employment of the Director, shall approve the appointment of the senior scientific staff members, on recommendation of the Director. The Board shall review and approve the budget estimates for the Institute.

Interim Development Advisory Board

An Interim Development Advisory Board of 5 to 7 members may be designated by the Consultative Group to serve for a period of one year or until the Governing Board can be fully constituted.

Governing Board

The Governing Board may consist of no more than fifteen members selected as follows:

3 representatives of the host country to be chosen from among such persons as:

- Secretary or Minister of Agriculture
- Chairman or Deputy Chairman of the National Planning Commission
- Director General of the Indian Council of Agricultural Research
- Vice Chancellors of state agricultural universities

3 representatives of agencies providing financial assistance

6 or more representatives from among scientific, agricultural and educational leadership of the countries or areas being served

1 Director of the Institute, Executive Secretary

The Consultative Group shall be responsible for constituting the initial Board and designating its chairman. Two of the six non-ex-officio members shall be appointed for one, two, and three year terms respectively. Thereafter, the Board shall designate successors to those non-ex-officio members whose terms shall expire as well as for those who leave the board for other reasons before their terms have expired. New appointees shall be appointed for the remainder of the term of the member who is being replaced or for three years in case of those appointed to fill vacancies occurring as a result of expiration of the term of a member.

The host country representatives will be ex-officio. The representatives of the agencies providing financial assistance may be designated by agreement among the group of such agencies

participating. The Director shall be selected and appointed by the Governing Board.

Panel of Technical Consultants

The team suggests that a panel of technical consultants approximately 7 to 10 in number be constituted, consisting of outstanding scientists competent to assess the quality of work in the respective scientific disciplines and applied programs, upon whom the Director and the Board may call from time to time to assist in reviewing the scientific programs of the Institute, assessing their quality, degree of adequacy, strengths, and weakness and for advising as to how these programs should be altered, strengthened, or changed to meet the changing needs of the agricultural sector served by the Institute. This might be a standing panel, with each member designated to serve on call for a three-year period. Appointments to the panel could be renewed or changes made as desired as individual terms expire.

11. Staff

The basic programs of the Institute on sorghums, millets, chick-peas, and pigeon-peas and on the production systems will be developed and carried out by teams of scientists and specialists from selected disciplines and specialized fields deemed useful and necessary for the development of improved, superior crop varieties and to the solution of major production problems. These teams will be provided with appropriate support from other scientists, administrators and specialists. The

exact composition of the staff will depend upon the Institute's programs as they are finally developed. The Director should be given considerable latitude to develop internal organizational patterns and methods of program administration to get the highest productivity from the staff and budget provided.

A suggested staffing pattern is proposed. It is based on expected programs and will provide an approximate guide for planning and estimating personnel and related requirements. Using the program headings presented in the preceding program section, the following would be a reasonable senior staff to initiate the programs and activities of the Institute:

Administration

Director
Associate Director (Resident Research)
Assistant Director (International Cooperation)
Treasurer-Controller
Administrative Officer

Crop Improvement

4 Plant breeders (sorghum, millets, Pigeon peas, and chick-peas)
2 Botanists (collections - cereals and pulses)
2 Geneticists (cereals and pulses)
2 Physiologists (cereals and pulses)
2 Entomologists (cereals and pulses)
2 Pathologists
2 Agronomists
1 Microbiologist (nitrogen fixation)

Production Systems

Agronomist
Agricultural Engineer (machinery)
Agricultural Engineer (soil and water use)
Soil Scientist (chemistry and fertility)
Agricultural Meteorologist-Climatologist

Other specialists supportive to all the Institute's programs and operations can be provided under the Associate Director for Resident Research, including:

2 Economists (agricultural economics, marketing, socio-anthropologist, etc.)
1 Information officer/editor
1 Librarian
1 Training Officer
1 Biochemist
1 Food Technologist
1 Statistician/Biometrician
1 Experiment Station Manager

The proposed senior staff will be supported by an appropriate regular complement of assistant scientists and specialists, research assistants and aides, and laborers. In addition, provision should be made for liberal use of visiting scientists and postdoctoral research investigators (at least two of each category each year) to augment and extend the work of the regular staff. Further, the scope and variety of research activities and the productive output of the Institute's staff could be increased significantly through planned use of long-term trainees (those in residence for six months or more). For example, with an expected average of five on-the-job type trainees per senior scientist, a hundred or more of such trainees would be in residence at all times and could help expand substantially research and research-related activities. Thus it would be highly desirable and in fact expected for the Institute to program as many long-term trainees as the staff and facilities can accommodate. Table 4 presents the kinds and numbers of staff, trainees and others by program areas that conceivably might be engaged in the Institute's programs.

TABLE

INTERNATIONAL CROPS RESEARCH INSTITUTE FOR THE SEMI-ARID TROPICS

ILLUSTRATIVE CONSOLIDATED STAFF AND TRAINING PROJECTIONS

FOR RESEARCH AND RESEARCH-RELATED PROGRAM AREAS

(Numbers of individuals)

Program Area	Scientists and Specialists[a]	Research Assistants and Aids[b]	Visiting Scientists & Specialists[c]	Postdoctoral Scientists & Specialists[c]	Scholars & Trainees[d]	Sec'y.-Clerical	Laborers and Helpers
Sorghum & Milleta	8	32	1	1	32	3	4
Chickpeas & Pigeonpeas	9	36	1	1	36	3	4
Production Systems	5	20	1	1	20	2	3
Economics	2	8	1	1	8	2	
Communications	2	12			5	4	2
Training and Demonstration	1	6			45[e]	3	2
Chemistry Labs	1	7			4	1	1
Food Technology	1	5			4	4	4
Experimental Statistics	1	4			4	2	
Experiment Station Operations	1	5			4	2	60[f]
Totals	31	135	4	4	172	26	80

[a] All "senior" scientists/specialists

[b] Younger, less experienced personnel at B.S. and M.S. level

[c] Numbers and assignment to program areas scheduled on basis of need and availability of individuals and funds. Numbers are illustrative.

[d] Represents training capacity on basis of four long-term trainees (6 months or more per scientist/specialist). Actual numbers programed on basis of available funds and trainees.

[e] Extension-type trainees. Established on basis of 3 groups of 15 each per year. Approximate duration of training period: 6 weeks.

[f] Established labor-pool requirement.

INTERNATIONAL CROPS RESEARCH INSTITUTE FOR THE SEMI-ARID TROPICS

ADMINISTRATIVE AND SUPPORTING SERVICES STAFF

(Numbers of individuals)

Program/Office/Section	Officers	Executive Assistants	Technicians	Secretarial - Clerical
Administration				
Office of Director	3	1		6
Office of Treasurer-Controller	1	1		
Payroll and Disbursement				2
Accounting and Bookkeeping				3
Office of Administrative Officer	1	1		1
Travel and Conference Arrangements				
Inventory and Supplies		1		
Purchasing				1
Supply				3
Inventory				2
Property Superintendent		1		3
Instrument Repair			3	
Refrigeration			1	
Plumbing			4	
Carpentry			4	
Painting			3	
Electrical Repair			4	
Motor Pool			15	1
Building and Grounds			3	1
Janitorial			2	1
Security			20	1
Personnel		1		1
City Office (if required)		1		
Mail and Records; Electronic Communication		1		4

Program/Office/Section	Officers	Executive Assistants	Technicians	Secretarial - Clerical
Administration				
Office of Food and Dormitory Services		1		1
Cafeteria			10	1
Dormitory			1	1
Staff and Guest Housing			2	1
Totals	5	9	72	34

PROJECTION OF PHASING OF SENIOR STAFF

Program Area & Officer/Specialist	Agreement Signed	Land Acquired	Date of Land Acquisition Plus Year			
			1	2	3	4
Administration						
Director	1					
Associate Director		1				
Assistant Director			1			
Treasurer-controller		1				
Administrative Officer	1					
Sorghum & Millets						
Plant Breeder (Sorghum)		1				
Plant Breeder (Millets)			1			
Geneticist				1		
Physiologist					1	
Entomologist				1		
Pathologist				1		
Agronomist				1		
Botanist (collections)			1			
Chickpea & Pigeonpea						
Plant Breeder (Pigeon Pea)		1				
Plant Breeder (Chickpea)			1			
Geneticist				1		
Physiologist					1	
Pathologist				1		
Microbiologist					1	
Entomologist				1		
Agronomist				1		
Botanist (collections)			1			

TABLE 6 (Cont.)

Program Area & Officer/Specialist	Agreement Signed	Land Acquired	Date of Land Acquisition Plus Year 1	2	3	4
Production Systems						
Agronomist		1				
Agr. Engineer (Machinery)				1		
Agr. Engineer (Soil & Water)		1				
Soil Scientist (Chemistry-Fertilizer)				1		
Agricultural Meteorologist						1
Economics						
Economist		1				
Economist				1		
Communications						
Information Officer/Editor			1			
Librarion		1				
Training & Demonstration						
Training Officer			1			
Chemistry & Biological Labs						
Biochemist			1			
Food Technologist				1		
Statistics						
Statistician			1			
Experiment Station Opns						
Exp. Station Superintendent (Agr. Eng.)	1					
TOTALS	3	8	9	12	3	1

12. Recruitment and Employment Policies

Employment policies and conditions for senior scientific staff will be on an international basis without discrimination as to nationality or origin or any considerations other than scientific and professional merit and performance.

Junior scientists, technicians, and clerical, administrative, and operational support personnel will be drawn largely from the host country and will be employed under terms and conditions established or approved by the Board of Trustees. Conditions of employment for such personnel would more nearly approximate accepted norms of the host country, with such modifications as may be necessary to assure availability of well qualified staff and a high quality of performance.

13. Facilities Required

Based on a probable location in India, it is expected that a self-contained, self-sufficient crop research and training center (complete with research, administrative and service buildings; a field research station with irrigation on a reasonable portion of the land; dormitories and senior staff living quarters including recreational facilities; and supporting utilities, water lines and service roads) will have to be built and/or developed. Given an expected location adjacent to a major national institution, the required physical plant and facilities will likely be similar to those required for the establishment of the International Rice Research Institute (IRRI), Los Banos, the Philippines.

Using the IRRI model, the following estimate of space and building requirements can be projected in general terms:

Administration Building

This building would accommodate the principal administrative offices; public areas (reception, seminar-conference and auditorium); Office of Communication, including the library; Office of Economics; central files and mail and records.

Research Building

Biological research requires certain standard utilities and facilities, i.e., water, gas, electricity, laboratories, apparatus, machines and equipment. Some requirements are peculiar

to particular lines of research and other requirements are common to all. In the first instance, requirements have to be designed and provided for individually, but in the latter case they can be pooled and provided for centrally. To meet diverse and common research requirements, it is proposed that major research programs of the Institute - sorghums, millets, pigeon-pea, chick-pea and production systems - be housed in a research building with central chemical, biological and other laboratories, including apparatus and equipment rooms, located so as to facilitate central use and service.

Training Building

This building will provide offices for the training and demonstration program staff and appropriate instructional rooms and facilities to be used mainly for short term, extension subject matter training.

Plant Materials Building

A suitable facility will be required for carrying out operations with regard to threshing, handling, processing, storing and shipping of experimental seed. The building will (1) house the germ plasm collections of sorghum, millets, chick-peas and pigeon-peas, (2) provide handling and storage space for experimental seeds and other dry or refrigerated plant materials, (3) areas for preparation and storage of certain plant/seed materials for analyses, and (4) provide receiving and in-processing and out-processing

and packaging facilities for incoming or outgoing shipments of experimental quantities of seeds and other plant materials.

Field Research Services Building

This building will house the Office of Experiment Station Operations for work areas in crops, agronomy and soils, and plant protection in direct support of field plot research and for farm supplies storage, mixing and storage of fertilizers and chemicals, and storage areas for farm machinery and equipment. It will include also lockers, showers and other service facilities for the Institute's labor pool.

Engineering Services Building

This building would house and provide space and facilities for property maintenance shops and personnel, building and grounds maintenance, inventory and supply, general work area, vehicle garages, and agricultural engineering research.

Plant Growth Facilities

Suitable structures and facilities - greenhouses and screened plant growth chambers, head houses and service facilities - will be required to conduct controlled research in genetics and cytogenetics, plant physiology, weed control, soils (chemistry, fertility, microbiology), plant pathology and entomology.

Student Dormitories, Cafeteria and Recreation Building(s)

Suitable resident quarters will have to be provided for long term and short term students. Accommodations for up to _____

long term students and _____short term students should be provided based on projected training capabilities of the Institute. Such accommodations should include an appropriate dining facility and recreation rooms and lounges.

Staff Housing

It is probable, based on experience in establishing similar international institutes, that staff housing will have to be provided for the senior staff and selected junior staff, especially female clerical and technical personnel. In the case of IRRI, a staff dormitory has been provided for many of the secretaries and clerical staff.

It can be planned that a director's house, a minimum of _____ detached, single family houses, _____ multiple family houses, one staff dormitory for _____persons and one guest house will be required. Associated with these staff quarters should be living quarters for servants and recreational facilities for adults and children.

At certain of the potential sites,housing for senior staff could probably be arranged on a rental basis in the city, rather than relying on construction of such houses on site.

14. Preliminary estimates of budget requirements

a) Recurring Costs of Care Program

1. Staff: Table 7 presents illustrative projected phasing of staff personnel by categories and

estimated costs at several stages of development. The estimates of phasing and costs are based on experiences of existing institutes such as IRRI, CIMMYT, CIAT, and IITA.[1] They can be only approximated at this stage. A better estimate of personnel costs and expected rate of employment will be possible when the Institute is authorized. Based on the estimates in Table 7, total permanent personnel costs when the Institute is fully staffed after a period of four to five years would be approximately $1.8 to $2.0 million. To this should be added approximately $110,000 to $125,000 for special, temporary staff members (visiting scientists and post-doctorals).

2. Operating Costs: Based on a rough estimate of U.S. $10,000 per senior officer/scientist/technician for research and logistical support (supplies, equipment, housing, utilities, official travel, and administrative costs), annual operating

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[1] IRRI: International Rice Research Institute, Los Banos, The Philippines

CIMMYT: Centro Internacional de Mejoramiento de Maiz y Trigo, Mexico City, D. F.

CIAT: Centro Internacional de Agricultura Tropical, Cali, Colombia

IITA: International Institute of Tropical Agriculture, Ibadan, Nigeria

expenses would be of the order of $300,000 to $350,000.

3. Training Costs: Table 7 summarizes the estimated kinds, numbers, and costs of trainees. Travel, cost of living stipends, and incidental expenses to provide for 100 long term scholar trainees would be approximately $260,000 annually, estimated at current levels.

b) Capital Costs

1. Land: It would be expected that the host government would make a suitable area of land (not less than 500 acres and preferably 1,000 acres or more) available either free or at a low nominal cost.

2. Buildings, Equipment, and Utilities:*Costs for these items can be expected to be between U. S. $9.0 and $12.0 million. This is based on the experiences at IRRI, IITA, and CIMMYT.

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* These estimated costs are based on the space requirements at the following prevailing construction rates:

1.	Residential Buildings (does not include land and external services)	70 Rs/sq. ft.
2.	Dormitory and International Hostel	70 Rs/sq. ft.
3.	Laboratories	50 Rs/sq. ft.
4.	Service Buildings	40 Rs/sq. ft.
5.	External Services	5% of cost
6.	Contingencies	5% of cost
7.	Architect's Fees	6 to 11% of cost

TABLE 7

ILLUSTRATIVE PROJECTED PHASING AND ESTIMATED COSTS FOR STAFF PERSONNEL

SCHOLAR - TRAINEES AND OTHERS

CATEGORY	AGREEMENT SIGNED		LAND ACQUIRED		DATE OF LAND ACQUISITION PLUS YEAR							
					1		2		3		4	
	No.	1000 $	No.	1000 $	No.	1000 $	No.	1000 $	No.	1000 $	No.	1000 $
Senior Scientists - Specialists-Administrators	3	96.0	11	352.0	20	640.0	32	1,024	35	1,120.0	36	1152.0
Executive Assistants	1	4.0	3	12.0	9	36.0	9	36.0	9	36.0	9	36.0
Research Assistants & Aides	-	-	-	-	18	54.0	70	210.0	100	300.0	126	378.0
Technicians	2	4.0	9	18.0	35	70.0	55	110.0	65	130.0	72	144.0
Secretarial	3	6.0	7	14.0	35	70.0	45	90.0	50	100.0	54	108.0
Laborers & Helpers	-	-	4	2.4	35	21.0	50	30.0	65	39.0	79	47.4
TOTAL PERMANENT STAFF	9	110.0	34	398.4	152	891.0	261	1,500.0	324	1,725.0	376	1865.4
Special Staff, Scholars and Trainees												
Scholar-Trainees					2	4.8	30	72.0	65	156.0	100	240.0
Extension Trainees											30	24.0
Visiting Scientists											4	80.0
Post Doctorals											2	30.0

SUMMARY OF ESTIMATED COSTS	U. S. Dollars 1,000's
Recurring Costs	
Permanent Staff	1,800 to 2,000
Special Staff	110 to 125
Operating	350
Training	260
Capital Costs	
Buildings, Equipment and Utilities*	10,000 to 12,000

c) Costs for Strengthening Regional and National Programs linked with the Institute's Major Objectives

It is not possible to prepare detailed estimates of the requirements for strengthening the various regional and national programs concerned with the field of work which is the concern of this Institute. This should be kept under continuing review and study so as to develop the arrangements and levels of support needed in each particular case. The general pattern for such cooperative effort is set forth elsewhere.

15. Host Country Relationships

a) Legal Status

The Institute must be provided appropriate legal status by the host country adequate to enable it to function effectively as a truly international institute. The team has been assured by

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* See footnote on previous page

the officials of India that this will be examined thoroughly and that necessary measures will be taken. The team is of the opinion that specific legislation, worked out in consultation with the Interim Development Advisory Board, should be given very careful consideration to the end that clear and direct authority and legal status to the Institute and its program are assured.

b) Arrangements and assurances for expeditious movement of:

a) Staff members into and out of the host country. Visiting scientists, administrators, and trainees
c) Seed and genetic material exchange
d) Release and dissemination of research results

The team has been assured that there will be no restrictions on the appointment and posting of staff and of the entry to India and participation of scientists, trainees, and other visitors concerned with the Institute's program on the basis of nationality of origin, irrespective of whether or not India may have active diplomatic relations with the country concerned in any individual case. This will be subject only to the normal checks and clearances required for security purposes.

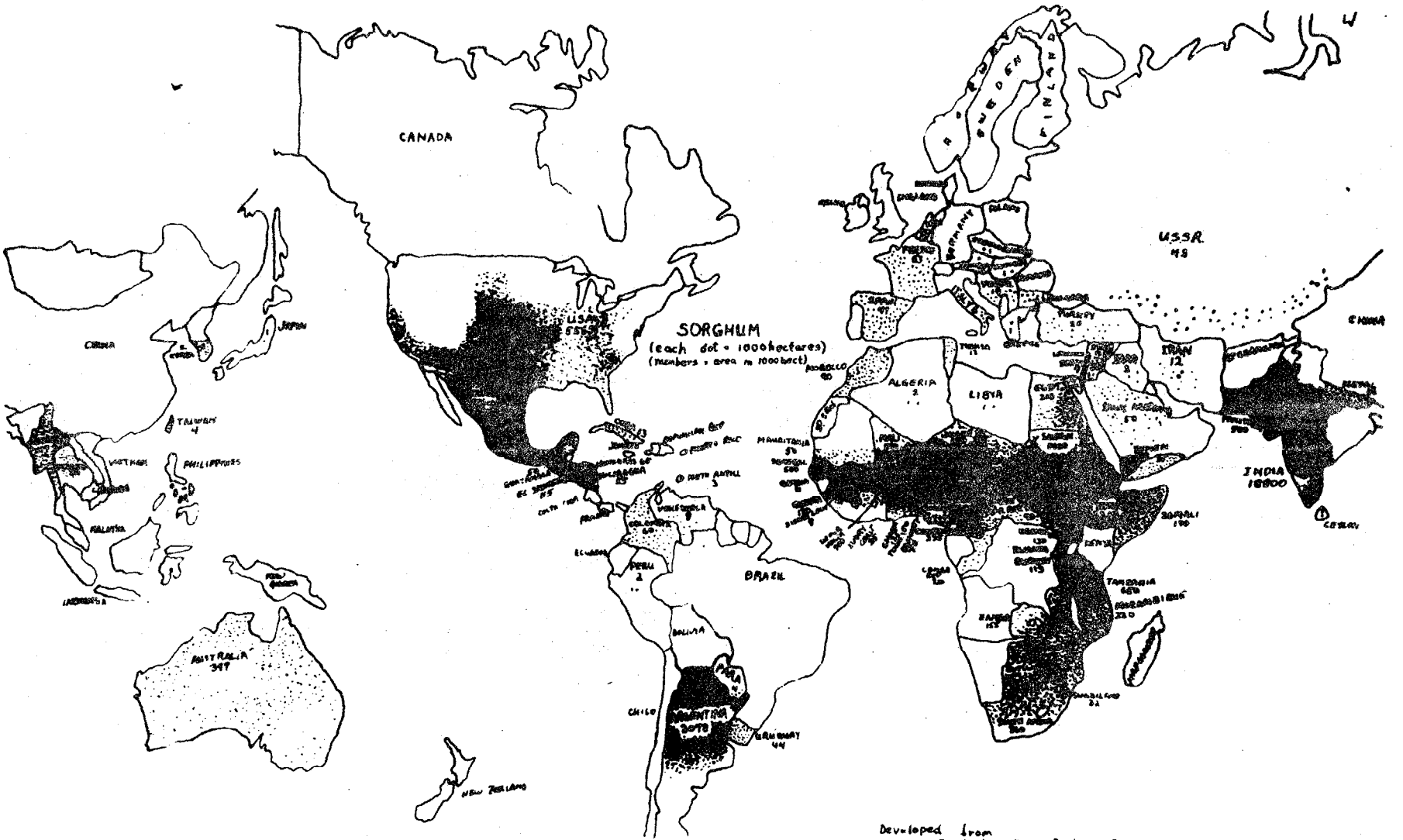
The government proposes to establish a quarantine unit in direct association with the Institute to assure prompt and expeditious examination of incoming and outgoing seed shipments and thus avoid any unnecessary delay in seed movement. In principle, no restrictions are anticipated other than the examination necessary to assure the avoidance of import or export of diseases and pests which might pose

a threat to the agriculture of the host country or to others to which seeds may be sent.

Every effort possible will be made to expedite communication among the cooperating countries and to make the results of research available to all potential users as rapidly as possible.

c) Tax and import provisions for the Institute and for non-national staff

The Government of India has given assurance to the team that reasonable provisions will be worked out to extend income tax exemptions to non-national staff members of the Institute, and for expeditious handling and import tax exemptions to the Institute and for its non-national staff members. The Government wishes to be appraised of the specific concessions which have been provided to the other international institutes already in existence and any additional provisions which the experience of the other institutes has shown would be required for smooth and effective operation of the program, as a basis for their working out the necessary arrangements.



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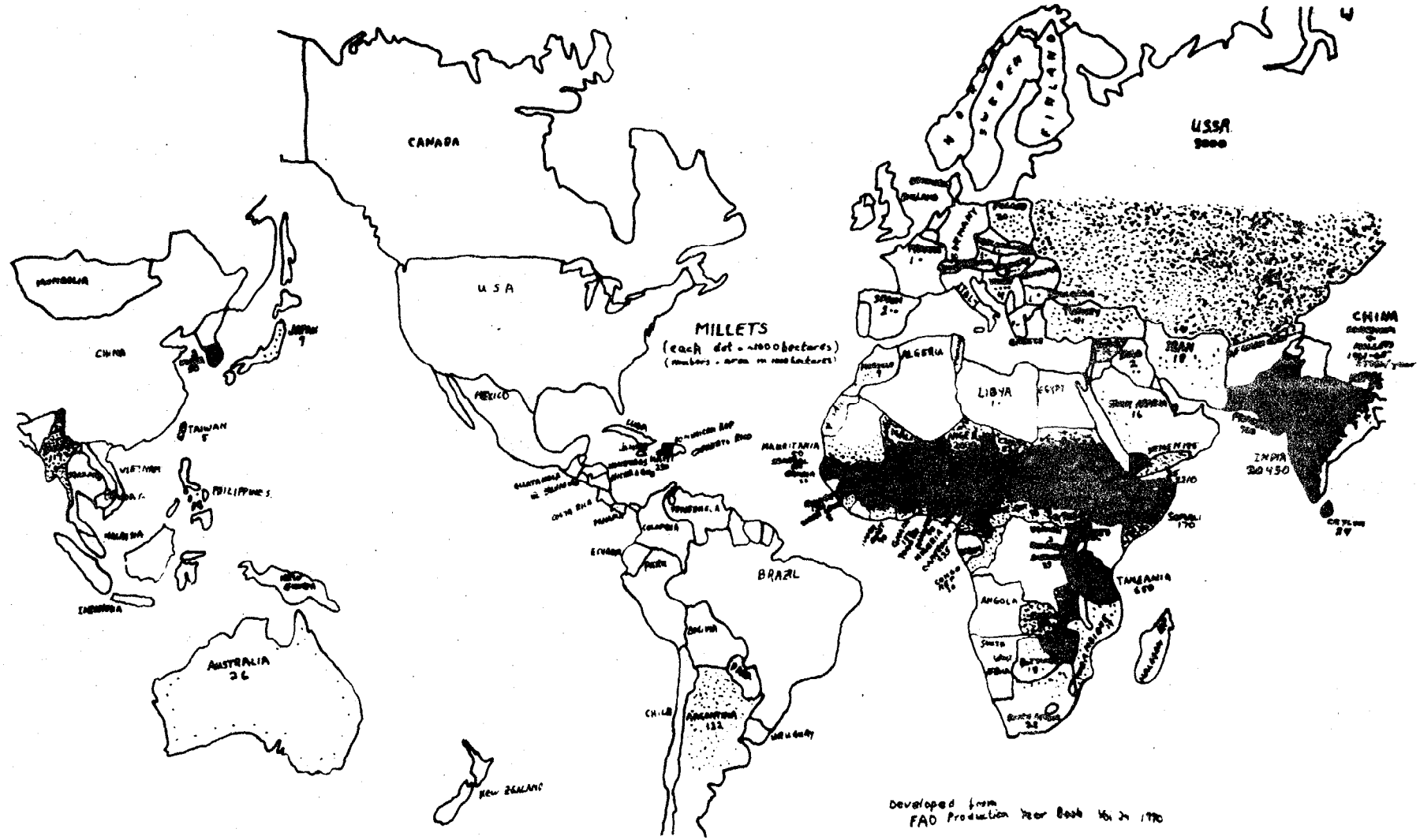
MILLETS
(each dot = 1000 hectares)
CANADA
U S A
MEXICO
BRAZIL
ARGENTINA
AUSTRALIA
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CHINA
INDIA
NIGERIA
LIBYA
ALGERIA
TANZANIA
ANGOLA
IRAN
TAIWAN
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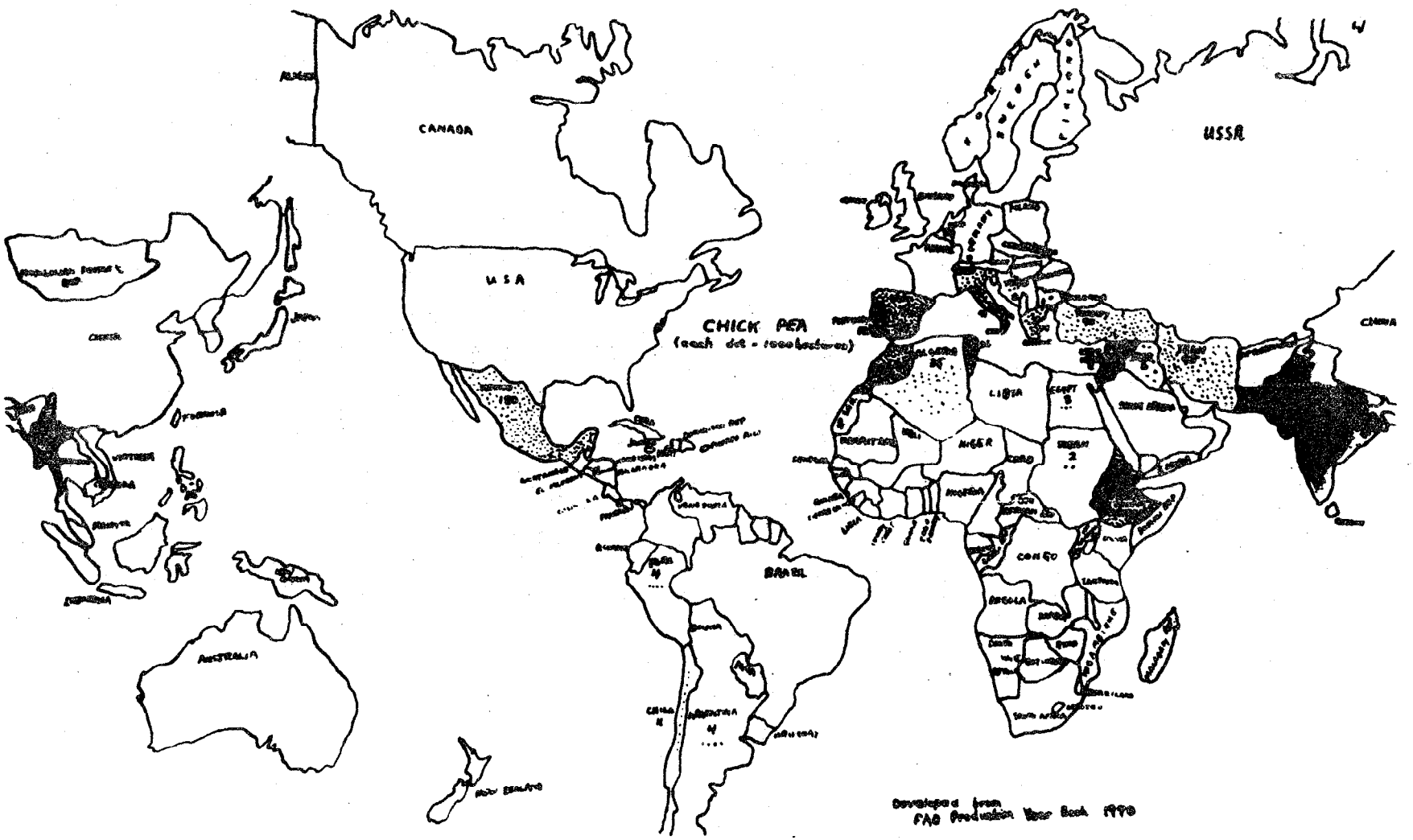
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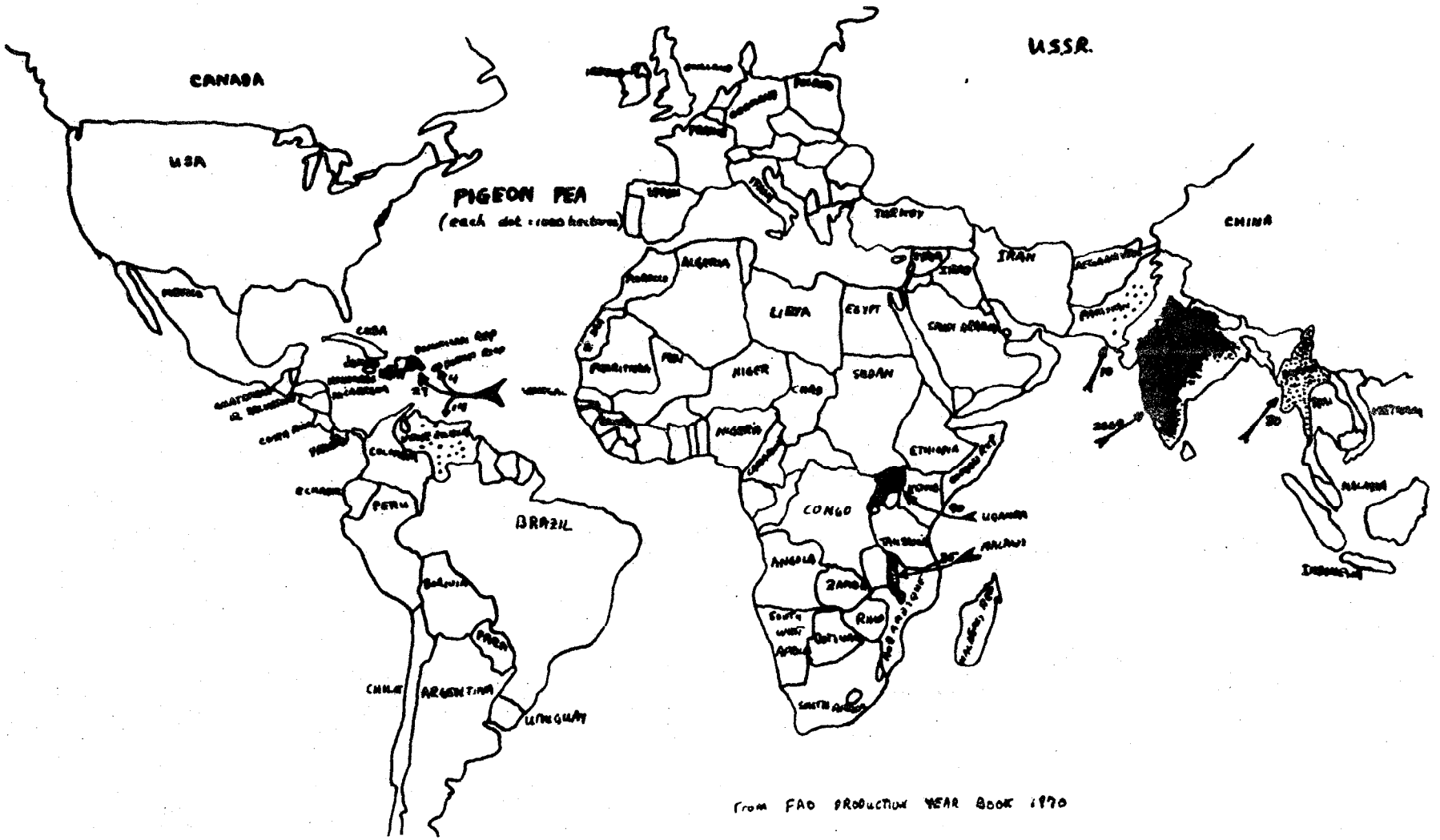
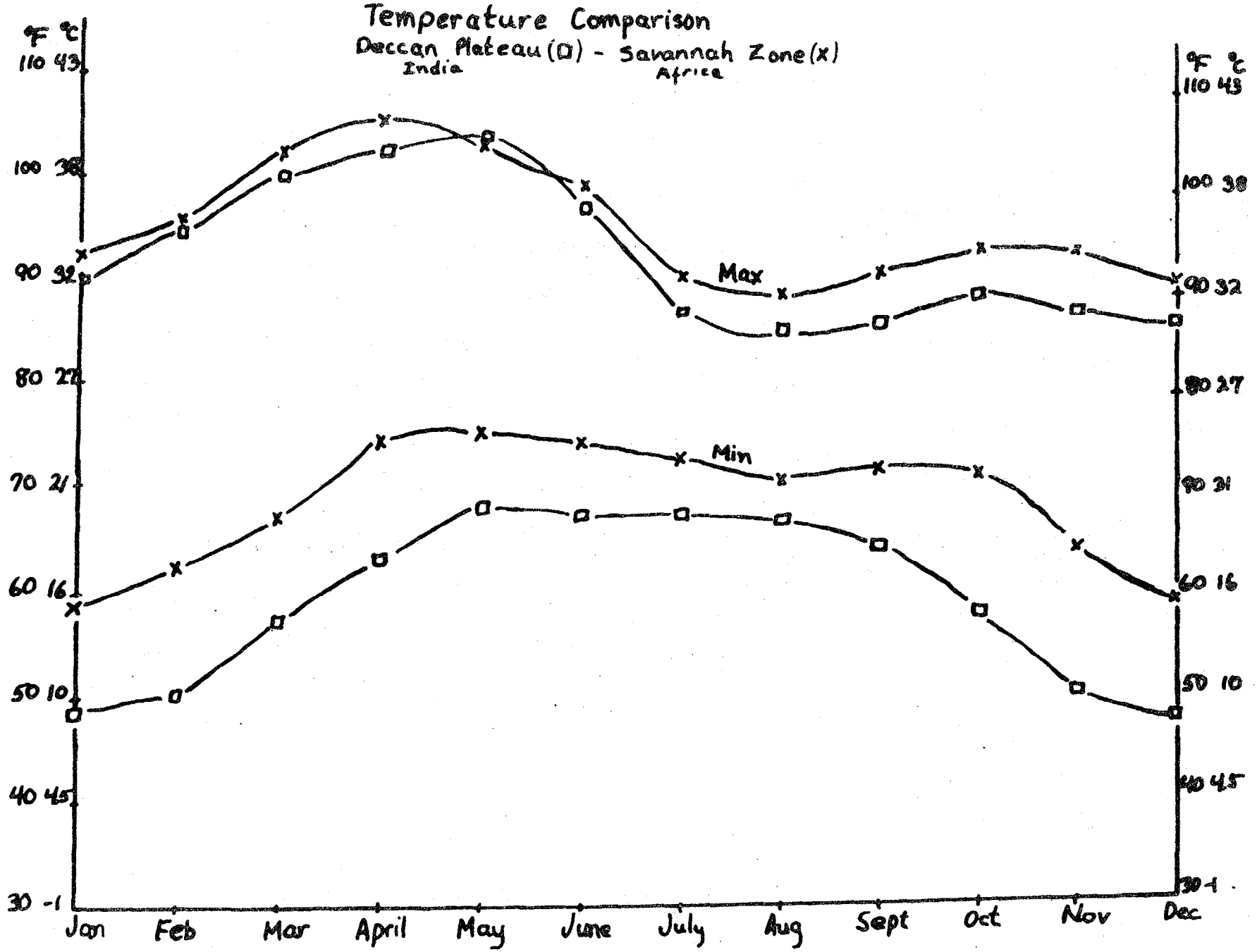
developed from
FAO Production Year Book 1979



From FAO PRODUCTION YEAR BOOK 1970


Temperature Comparison
Deccan Plateau (□) - Savannah Zone (x)
India
Africa
°F °C
110 43
100 38
90 32
80 27
70 21
60 16
50 10
40 45
30 -1
Max
Min
Jan
Feb
Mar
April
May
June
July
Aug
Sept
Oct
Nov
Dec

	(a)	(b)	(c)	(d)	(e)	(f)	(g)					(h)	(i)
							Characteristics and Facilities of Population Center						
Location	Proximity to a good agricultural university	Suitability of agricultural area	Suitability of latitude and climate for year-round cropping	Land availability and quality	Irrigation possibilities	Accessibility to international airport	Population	Shopping	Education: Primary & Secondary	Entertainment	Medical	Attitude of host country	Availability of trained personnel for support staff
1. Bambey, Senegal	No agricultural university within country. General university in Dakar - 100 km. distant	Primary crops: millet groundnut, sorghum	Latitude satisfactory. Rainfall limits cropping to four month period - late June to early October	Quantity land on "Centre de Recherche Agronomique du Bambey" satisfactory. Soil sands, topography level to slightly rolling - drainage good	Very limited-shallow well provides enough water for only one to two hectare nursery in dry season-deeper water said to be saline	Fair. Int'l airport at Dakar approx. 85 km from Bambey - connecting roads good	About 5,000. Nearest pop. center Thies or Dakar.	Poor, except at Dakar	Primary (French med.) on station. Other schools primarily at Dakar	Staff club on station, otherwise Dakar	Dakar	Not determined but presumably satisfactory	Very limited
2. Bobo Dioulasso, Upper Volta (not visited)	No	Primary crops longer season millet, sorghum, groundnut. Maize to limited degree	Latitude satisfactory	Presumably satisfactory	Could probably be arranged	Internal connections to Abidjan, etc - accessibility internationally only fair	Medium-sized city, of about 100,000.	Fair	Fair. Poor	Fair	Unknown	Not determined but presumably satisfactory	Very limited
3. Samaru (Zaria, Nigeria (not visited)	Good. Adjacent to Amadu Bello University	Primary crops longer season sorghum and millets, maize, cotton, groundnuts	Latitude and climate reasonably satisfactory. Some cool periods in mid-winter.	Satisfactory	Probably satisfactory	Internal air connections Int'l airport at Kano (100 miles) Lagos.	Medium-sized city about 40,000	Fair	Fair	Fair	Fair	Not determined but presumably satisfactory	Somewhat limited
4. Alemaya, Ethiopia	Fair/Good. Could be adjacent to college of agriculture, HSI University. Good undergraduate agric. college, but not yet ready for graduate programs	Crops primarily sorghums and groundnuts, with some pulses. Altitude about 6,000 feet	Not satisfactory. Altitude of approx. 6,000 ft. & above limits cropping to one season per year-would be especially useful for high altitude sorghums also perhaps chick-pea and pigeon pea, very little pearl millet grown.	Satisfactory. Land adjacent to College of Agric could be obtained college owns large tract in Dacata Valley about 40 km. to south of Alemaya.	Probably satisfactory	Poor. Airport at Diredawa 45 km. from Alemaya and approx. 95 km. from Dacata Valley, connecting to Djibouti & Addis Ababa by daily flights. Int'l. conn. from Addis Ababa. Good roads from Alemaya to Diredawa.	Small center	Fair. Poor	Fair. Poor	Limited	Limited	Not determined but presumably very favorable	Limited
5. Tikka-Machakos area, Kenya	Poor. Newly created agri. faculty in Univ. of Nairobi approx. 60 km. distant	Unsuitable. Sorghum may have considerable potential for area but not now grown. Area relatively undeveloped. Some chick-pea grown	Very close to equator, but altitude 4,000/5,000 ft. Probably satisfactory but only limited amount of relevant crops in area to provide observational evidence.	Fair. Area rolling in topography. Suitable tract of land could possibly be found.	Could probably be developed, but site selection would require that this be kept in mind.	Fair. Nairobi would be about 60 km. away	Rural	Poor. Only at Nairobi	Poor, although fair at Nairobi	Poor except at Nairobi	Good at Nairobi	Poor. No real interest of gov't. in crops concerned	Very limited

	(a)	(b)	(c)			(f)	(g)					(h)	(i)
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6. Morogoro, Tanzania	Fair/Good. Recently established Faculty of Agriculture, Univ. of Dar Es Salaam (undergraduate) at Morogoro. Research Institute could probably obtain land in close proximity	Fair. Sorghum and pigeon pea important crops of area - very little millet or chick-pea	Satisfactory	Satisfactory	Probably satisfactory	Poor. Air strip at Morogoro but no regularly scheduled service. Int'l. airport at Dar Es Salaam about 135 miles away.	Small city. Estimated about 8,000	Fair/Poor	Poor	Poor	Poor/Fair	Unknown	Very limited
7. Poona, India	Fair/Good. Important agri. college of state Agri. Univ. with graduate training - one of oldest in India - at Poona - Headquarters Campus of Univ. 100 miles distant. Site about 10/12 km. from campus of Agri. college	Excellent - all principal crops important in area	Good	Good/Excellent. 413 acres choice land in hands of government available. Could obtain 300 acres more nearby. Not all continuous tract. Ample land with agri. univ. main campus 100 miles away	Available and already installed. Lift from perennial river	Good. Daily air service to Poona - 125 miles to Bombay int'l. airport. Good road and railroad connections to Bombay	About one million	Excellent	Good	Good	Excellent	Excellent	Ample
8. Bangalore, India	Excellent, especially if site adjacent to campus Mysore Univ. of Agri. Science selected	Fair. All crops can be grown although finger millet now principal crop of area. Some pigeon pea, little sorghum or pearl millet, very little chick-pea.	Good. Temperatures avoid extremes. Suitable for year-round cropping but summers cooler and winters warmer than most other locations	Satisfactory. Two sites in hands of Forest Dept. Now best site would require purchase - gov't. assures possible.	Doubtful - ground water supplies limited. No perennial stream. Tank doubtful.	Good. Excellent air and rail connections to Madras, Delhi, Bombay	About 1.4 million	Excellent	Fair	Fair	Excellent	Excellent	Ample
9. Hyderabad, India	Good. Agri. Univ. at Rajendranagar (Hyderabad) about 25 km.	Excellent. All principal crops grown in area, though chick-pea to lesser extent	Excellent	Excellent 3,000 acres on main highway about 25 km from city already available in gov't hands.	Probably ok. Will have to check on dept. land dependability of large surface tank/s on land. Some repair required	Good. Excellent air/rail connections to Delhi, Bombay, Madras, fair to Calcutta	About 1.8 million	Excellent	Fair/Poor	Fair/Poor	Excellent	Excellent	Ample
10. Indore, India	Good. Very close to second-rank campus of state agri. univ.	Good. Sorghum, pigeon pea, groundnuts, cotton principal crops. Some chick-pea, little pearl millet	Fair. Slightly far north. Winter temperatures marginal though limited experimental evidence indicates second crop can be grown with late December plant	Excellent. Black regur soils - three available sites shown very close to city - 800 to 1400 acres each	Probably ok - would need to be checked out. Stream adjacent to two sites said to be ok.	Fair. Air/Rail/Highway connections to Bombay and Delhi, although distance considerable	About 0.6 million	Fair	Poor	Fair	Fair/Good	Excellent	Ample
11. Varanasi, India	Good. Could probably obtain site near Banaras Hindu Univ. with good agri. faculty	Fair/Good. Sorghums largely of fodder types - important area for pearl millet, pigeon pea and chick-pea.	Poor. Too far north. Winter temperatures too low - would probably only grow one full generation annually with limited off-season plantings.	Not investigated thoroughly.	Probably satisfactory. Good ground water area.	Fair. Daily air/rail connections to Delhi and Calcutta. Distance substantial.	Large city	Fair/Good	Fair	Fair	Good	Excellent	Ample