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AGRICULTURAL RESEARCH CORPORATION
WESTERN SUDAN AGRICULTURAL RESEARCH PROJECT

REPORT OF VISIT TO SUDAN TO REVIEW THE ORGANIZATION AND DEVELOPMENT OF RESEARCH SUPPORT FOR THE WSARP EXPERIMENT STATION

WSARP PUBLICATION No. 21 FEBRUARY 1983

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THE GOVERNMENT OF SUDAN
UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT
THE WORLD BANK
CONSORTIUM FOR INTERNATIONAL DEVELOPMENT
WASHINGTON STATE UNIVERSITY

REPORT OF VISIT TO SUDAN TO REVIEW THE ORGANIZATION AND DEVELOPMENT OF RESEARCH SUPPORT FOR THE WSARP EXPERIMENT STATION

Ernest W. Nunn

Consultant, Station Development
and Operations
ICRISAT

WSARP PUBLICATION No. 21

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WESTERN SUDAN AGRICULTURAL RESEARCH PROJECT

Report of Visit to Sudan to Review the Organization and Development of Research Support for the WSARP Experiment Station --
Report by Station Development and Operations, Consultant, Ernest W. Nunn
November 24 - December 11, 1982
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4 February 1983

Dr. Dafalla Ahmed Dafalla
Director WSARP
P.O. Box 5141
Khartoum South
Sudan

Subject: Consultancy for the Organization and Development of Research Support for the WSARP Experiment Station (November 24 thru' December 11, 1982)

Dear Dr. Dafalla:

At your invitation I arrived in Khartoum on the afternoon of November 24, 1982.

The Introduction and Terms of Reference for the Consultancy conveyed by Dr. J. J. Riley through Dr. L. D. Swindale were as follows:

PURPOSE AND ROLE OF EXPERIMENTAL FARMS AND FACILITIES

The Experimental Farms, Grounds and Facilities at the WSARP Research Stations are considered to be a vital part of the Research Support Program. Consequently, they are to provide a suitable, functional and well maintained environment conducive to the performance of high quality agricultural research.

The land under the supervision of the WSARP should be managed in a manner such that it serves as an example to others in applying good agronomic land, soil and water conservation practices.

TERMS OF REFERENCE FOR CONSULTANT ON:

EXPERIMENTAL FARM DESIGN AND OPERATIONS

To visit Kadugli Research Station and review physical layout and plans for experimental farm with resident staff.

To draft land utilization plan and layout of Kadugli experimental farm.

To prepare suggested plan for operations and maintenance of station materials and equipment (including suggested staffing pattern, background and training of farm staff).

To review plans for facilities, labs and experimental farms at other WSARP Research Stations for the purpose of making recommendations regarding construction, layout, staffing, operations, etc,.

It was a pleasure to meet and work with you and your dedicated and gracious colleagues.

My report, which I trust will be of value, is attached.

Sincerely yours,

Ernest W. Nunn
Station Manager

/mp

INTRODUCTION AND GENERAL INFORMATION

To date, very few references are available on the objectives, organization and description of the research support services required at the Research Institute and/or Experiment Station Level. Therefore, in the way of an introduction to this report the following information and concepts are provided.

It is estimated that the world expenditure for agricultural research exceeds five billion dollars annually (World Bank 1980). Some research institutes spend more than fifty percent of their budget for the support of research, while others spend a major portion for scientist and top management remuneration, leaving very little for their support services.

Developed countries and developing countries alike are dedicated to the task of finding a solution to the world food crisis that will soon be upon us, if the world population continues to explode as predicted (Wortman and Cummings, 1978). Most of those involved in agricultural research are aware of the urgency and are giving full attention to research and its results. At experiment stations one can see crop, animal, and laboratory experiments that attest to the efforts of the scientific community. Not so obvious, however, are the research support staff and facilities so vital to the conduct of meaningful and efficient agricultural research.

When one looks beyond the obvious, that is, beyond the research experiments and data compiled therefrom, at the long chain of interconnected ideas, people, activities, and support functions that must be organized in order to produce significant agricultural research, one all too frequently finds that scientists, whose mandate, training, and interest are research, spend a considerable portion of their time obtaining facilities and managing support staff.

The inadequacies of research support facilities and their management are high among the major restraints to research in many countries.

Vast expenditure and much effort have gone into the establishment of an international network of agricultural scientists who must lead the way to find solutions to the threatening world food shortages.

Without adequate research support, agricultural scientists cannot utilize their full potential, nor can they be expected to make substantial progress in the conduct of research while, spending a large portion of their time securing and superintending their support services.

Productivity is increased, at little or no extra cost, when a cooperative, supportive atmosphere is maintained in which scientists, administrators, research support managers. and their staff, work together with the common interest of achieving the mandates of the institute. Therefore, only after organizational, managerial, and psychological aspects in a research organization are properly blended, can full utilization of its monetary and physical facilities be achieved.

As stated by Moseman (1970), "The inadequacy of research facilities - laboratories, field stations, and scientific instruments is a general handicap and frequently one of the most difficult to assess," The availability of adequately trained and motivated administrators, managers, and support staff to supply, operate and maintain these facilities, is likewise a major restraint and even more difficult to assess.

The manner in which Research Support Services are organized within a research institute, and the types of services required, depend on many factors. Therefore, it is extremely rare to find any two institutes organized in an identical fashion. Some of the factors are:

1. The research mandate of the Institute.

2. The personalities and capacities of the staff providing the services, and of those utilizing the same.

3. The judgement and experience of management.

4. Adequacy and priority of funds.

5. Availability and capacity of local establishments.

6. The history of the development of the Institute.

Regardless of the types of support services sustaining a particular institute and the way in which they are organized, they can usually be classified in four general categories:

1. Administrative Services.

2. Research Services.

3. Physical Plant Services.

4. Farm Operations/Services.

A brief list of some of the functions under each category is as follows:

(A) Administrative Services
- administration
- personnel
- finance
- secretarial/clerical
- purchase and stores
- transport

(B) Research Services
- analytical
- library
- statistics
- economics
- computer
- etc.

(C) Physical Plant Services

- mechanical maintenance
- electrical maintenance
- civil maintenance
- electronics
- etc.

(D) Farm Op./Services

- tilling
- planting
- irrigating
- seed processing
- plant protection

In addition to the four categories of Research Support Services, there are a number of pursuits in most Agricultural Research Institutes that cannot be clearly classified either as Research, or Research Support.

These are departments which disseminate knowledge in the form of printed and verbal information, data, improved practices, etc., and also disseminate the material products of research, such as improved seed, plants, machinery, and even animals, fish or poultry, depending on the mandates of the Research Institutes.

Such departments, which may be covered by the appellation of "Augmentation Services," do not give direct support to the research in their institutes, but are universally found in most of them. They deal with the "products" - material and otherwise - resultant of scientific research, and assist institutional management in the dissemination of information, etc.

Some of the Augmentation Services are:

1. Information Services

    a. Editing
    b. Language Interpretation
    c. Layout and Art
    d. Photography
    e. Printing and Binding

2. Training

3. Multiplication of Improved Products

4. Extension Work

5. Visitors' Services

6. Liaison

7. etc.

A brief description of the four Research Supported categories and their role in the support of research are as follows:

ADMINISTRATIVE SERVICES

The administrative services of a research institute are those which manage numerous business-type aspects of the institute resembling those required in any other organizations of similar size. The managers of the administrative units, personnel, finance, purchasing, vigilance, travel, etc., must be qualified professionals. However, in addition to their professional competence, they must be aware, and appreciate, that the management of an agricultural research institute differs from that of the management of a business organization in that data and results, not profit, are the primary objectives of the institute. Therefore, the straightforward application of standard business, or the bureaucracy of government practices, may not adequately serve research.

It is rare that administrative, as well as other service personnel joining an agricultural research institute, will have had previous experience in such an organization. Complete orientation is essential as to the work performed, and administrative support required, by research disciplines and sister service units of the organization.

Administrative units of the institutes, due to their professional interest and background, tend to become isolated from the mainstream of research activities. Therefore deliberate and continuous communication must be sought between all facilities of the institute. Attendance at research seminars by administrative, as well as other service supervisors, should be encouraged, if not made mandatory. Likewise, service units, on occasion, should be encouraged to present short seminars to be attended by both research and service staff.

Every member of the institute, regardless of his status, must project a positive cooperative attitude which contributes to high morale. The administrative services, as the service arm of management, has a leading role to play in the espirit de corps of the institute. Fisher (1980) states, "As long as employees believe: (a) management is trying to do the right thing, (b) the system for decision-making is fair and equitable, and (c) those at the top are working diligently in the organization's interests, morale will likely be high."

RESEARCH SERVICES

Research services are those which directly support research. They may be considered as research partners, as some of them may, on occasion, conduct research directly related to the mandate of the institute.

Depending on the institute's area of pursuit, some of the functions considered as research services in one institute are in others full-fledged research disciplines.

An example is Economics, which, in many institutes, is a research discipline conducting original inquiry towards the accomplishment of the institute's primary mandate. In others, it compiles information through the conduct of routine surveys of market flows, market integration, etc. utilizing established methodology.

Research services units, at times, have a secondary research component, in that they conduct a quest in their own technical field in order to provide the required services to the research discipline concerned. For example, if Biochemistry is required to furnish a new basic biochemical analysis, it will be necessary to develop and perfect new analytical techniques. Likewise, Engineering Services may be required to design and develop specialized equipment for the support of research.

In each research program there are usually a number of staff who do not perform or direct research as per se, but provide direct in-program support. The services performed by some of these staff are so closely related and interconnected with the research conducted that it is often difficult to identify the point at which support becomes research or vice versa. A general "rule of thumb" that may be used is; if the task performed is inventive in the accomplishment of the program's research mandates, it is research; otherwise, it is research support.

PHYSICAL PLANT SERVICES

Physical Plant Services, known as Engineering Services in some institutes, in general provides engineering and maintenance services for the entire institute. The major sections of Physical Plant Services (PPS) are:

1. Mechanical Engineering and Maintenance
2. Electrical Engineering and Maintenance
3. Civil Engineering and Maintenance
4. Electronic and Scientific Instrument Engineering and Maintenance

FARM OPERATIONS OR FARM SERVICES

The title is self-explanatory, as this service group supplies and manages the field support operations, etc. necessary to support field-oriented research.

In addition to field support, the farm operations group, in many institutes, also operates plant growth facilities, such as glass houses, screen houses, constant temperature and humidity growth facilities, etc.

The operations and services performed by the farm operations unit vary from institute to institute, depending on the research mandate. For instance, in a livestock-oriented research institute, a major requirement would be the provision of feed, pasture and perhaps animals for research; whereas, in a plant breeding institute the services required are primarily agronomy-oriented.

A competent Farm Manager, given appropriate status, is the key to successful farm operations, the success of research, and the accomplishments of the research staff.

He must be a generalist and placed at a level in the organization equal to that of research department heads.

Years ago, the practice of some countries was to establish the position of Farm Manager as a sub-professional skilled worker. It has now been realized that he should be a practical professional manager. Today the position is being upgraded to that of management, and as the older Farm Managers retire, qualified professionals, to be active members of the station management, are being recruited. New equipment stations being organized should not place the Farm Manager at a level below that of research department heads.

Dr. Lloyd Johnson, sometime ago, stated "At present, a Farm Manager is considered a sub-professional in an isolated, dead-end position. No wonder, then, that we don't get large numbers of qualified young people lining up for the job.

We must make these generalists full partners in the experiment-station operation. Right now they feel that rather than participating, they are being used.

There are some strong historic reasons for this bias against the generalist: a century ago, the major emphasis was on practical farming ability; lack of scientific training was not a limiting factor. To correct this, the scientific method was stressed and eventually overstressed. Scientists now have far too little contact with practical farmers; nor do they wish to be considered good farmers. Scientific training is highly rewarded, practical skills are not. Yet, now it is the lack of practical skills that is limiting."

Some points, with reference to the position and duties of an Experiment Station Farm Manager, are as follows:

1. The Manager must be precise in all his activities, as he is managing a Research Farm.

2. He must be a good steward of the land, and husband the resources of the station to preserve them for future research.

3. He must monitor and keep records on the use of insecticides, fertilizers, herbicides, and all other operations carried out on the farm; particularly if they are operations which will leave any sort of residue affecting future research experiments.

4. He should be familiar with the research being conducted, and have the capacity to anticipate future requirements.

5. It is desirable that he should possess good technical knowledge, be inventive and innovative, and keep up-to-date on new equipment and services which may be required by researchers.

6. As his first requirement is to supply research support services, he must be prepared to accept that there is a fundamental difference between commercial farming and field-oriented support research.

7. He should be familiar with local farming practices, but it is essential that he maintains communication with other research farm managers.

8. Opportunities should be given for him to exchange ideas and information with his colleagues in farm management.

9. The views of scientists and other managers in his profession should be considered.

10. He should have an accountant and/or secretary to assist him with financial and other record-keeping, as there is a great deal of paperwork involved.

11. It is difficult to do a job when commercial requirements compete with research support for his attention and farm facilities. Therefore, any commerce is to be closely examined in the light of its competition with research for time and resources.

12. It is essential that he be assisted in difficult logistic decisions by a helpful Chairman or Station Director.

13. Relatives and friends of local politicians or senior staff of the institute should not be imposed on the Farm Manager at the time of recruiting (hiring) personnel.

14. The Farm Manager must have authority to manage, equal to his responsibilities.

TOUR REPORT - OBSERVATIONS AND RECOMMENDATIONS

From the 25th to 27th November 1982, discussions were held with Drs. G. Owens, J. Riley, J. Kearns, J. B. Henson, J. Noel, D. Higgins and Mr. H. P. Bergman.

The WSARP Work Plans (1982-1985) were studied and discussed in order to estimate the requirement for research support facilities and staff.

Minutes and Comments

On the 28th of November, a meeting was held to discuss land development and research support requirements, etc. A copy of the minutes, as recorded by Dr. Riley follows:

Time: 10:00 - 11:00 a.m.
Date: 28 November 1982, Monday
Venue: WSARP Director's Office

In attendance:

D. Dafalla	WSARP Director
G. Owens	WSARP Deputy Director
J. Henson	WSU Campus Coordinator
J. Noel	WSU Campus Deputy Coordinator
H. Bergman	Senior Project Architect
D. Higgins	Project Engineer
J. Riley	Senior Advisor ARC
E. Nunn	Station Manager and Head of Physical Plant Services, (ICRISAT) Main Hyderabad Center

J. Riley opened the meeting, introduced the topic and explained the need for urgent planning of station support activities, facilities and staff.

E. Nunn briefly described the layout of the ICRISAT Farm and the planning which went into developing it. He distributed a map of the ICRISAT Farm and an outline of information required to plan a station properly (both are appended to the Minutes).

E. Nunn pointed out that to lay out a station, you need to prepare a land-use plan and map which requires basic information on the characteristics of the farm land (i.e. relief map with 1-meter contours, soil classification map with representative profiles, an aerial photo-mosaic of entire station area).

E. Nunn circulated one copy of type of soil profile information that is required. It has been duplicated and appended to the Minutes.

Thought must be given, he said, to the purpose of the station and the types of activities to be conducted on the farm, in the labs, workshops, offices and other support facilities. For example, small watershed water harvesting is thought to be a potential intervention on small farms in India. So, a portion of the ICRISAT Research Farm has been developed to evaluate the feasibility of this technology.

It was suggested that we look into the feasibility of having the Sudan Survey Department do the surveys required. H. Bergman said it was his experience that the contour surveys they prepared for the building sites were not particularly accurate.

E. Nunn said that it has been his experience, elsewhere, that private surveyors would do the job quicker, at about the same cost, as Government sections. In India a simple survey, as is needed here, would take the Government survey section more than one year to complete.

H. Bergman said that there were regional survey offices in Kadugli, El Obeid and El Fasher, and another in Nyala which might be able to assist in surveying Ghazala Gawazet sites.

E. Nunn observed that, in his opinion, we were behind in the land development of the research farms. He suggested that plans be made to gather the needed data and, when it is assembled, he could return to help us with the planning exercises. H. Bergman said that the Survey Department's airplane is flying again and could be contacted in regard to making aerial photos of our stations.

Dr. Dafalla raised the question as to the need of the contour maps, if land levelling and irrigation were not anticipated on the WSARP Experimental Farms.

E. Nunn assured him and the group that the surveys mentioned in the meeting were the minimal requirement for planning roads, land use, drainage routes, etc.

The following information about the Kadugli Station was brought out in the meeting:

Farm area	1800 Feddans (approx. 1800 acres)
Relative use	1/4 Crop research
	1/2 Livestock research
	1/4 Forestry research

Water Requirements for Annual Maintenance of Livestock Herd	4,000 gallons/day

The possibility of an irrigation requirement to maintain or multiply germplasm was raised. Dr. Dafalla said that this could be better handled in Wad Medani or Shambat.

With regard to the facilities at Kadugli and El Obeid, E. Nunn said that from the blueprints the plumbing and carpentry workshops looked small. He asked about plans for machine shop, welding area, farm machinery maintenance shop, electrical applicance and equipment repair workshop, electronic workshop and workshops to repair air conditioners. To assess the needs in these areas, he asked to know the number of air conditioners, desert coolers, refrigerators, autos, trucks, tractors, etc. planned for each station.

E. Nunn pointed out the necessity of having at least two persons on duty in the powerhouse at all times and the desirability of having an electrical workshop overlooking the generators, so that the operators (who should be qualified electricians) could be doing some repair work while watching over generators. From the lists of projected functions, staff and equipment, it can be ascertained whether sufficient and appropriate space has been alloted in the buildings or on the farm.

Due to the necessity for E. Nunn to leave on December 10, Dr. Dafalla suggested that we try to get him only to El Obeid and Kadugli on this trip.

H. Bergman noted that construction of many of the facilities are in an early stage, so that desired changes can be incorporated rather easily.

It was agreed that E. Nunn would visit Kadugli Station on Monday, November 29, and El Obeid later in the week, when H. Bergman went there to supervise roofing installation.

Individuals assigned to oversee items I through VI on the Information Desired List have been added to the list appended to the Minutes.

JJR/28 Nov 82
/ps

COMMENTS (By E. Nunn)

The requirements for rainfall data, as to duration and intensities for the last several years, were not discussed in the meeting. This information, along with the contour map, is required in order to design waterways, terraces, rain-water storage tanks and drainage structures, road culverts, etc. If someone could obtain this data for the four stations for which farm land-use plans are to be developed, it would be most helpful.

Once all information required for the development of land-use plans is assembled, I would be prepared to return to Sudan (with my Director General's concurrence) for several weeks to assist in the development of these plans.

In the meantime, I believe, it would be helpful if Dr. Higgins and others, who are to be involved in and responsible for the development of the four research farms, could spend a week, or more, here at ICRISAT reviewing the different concepts and practices utilized in the development of this station.

Alternately, or in addition to a visit to ICRISAT, a visit to a station now being developed by Mr. Chitti Babu in Tanzania could be informative.

Mr. Chitti Babu is an agricultural engineer who worked with me during the development of ICRISAT and a number of other experiment stations. He is now in the final stages of completing the Ilonga Experiment Station near Kilosa, Tanzania.

A copy of his recent report on the development of this station is attached for your information (Appendix 1).

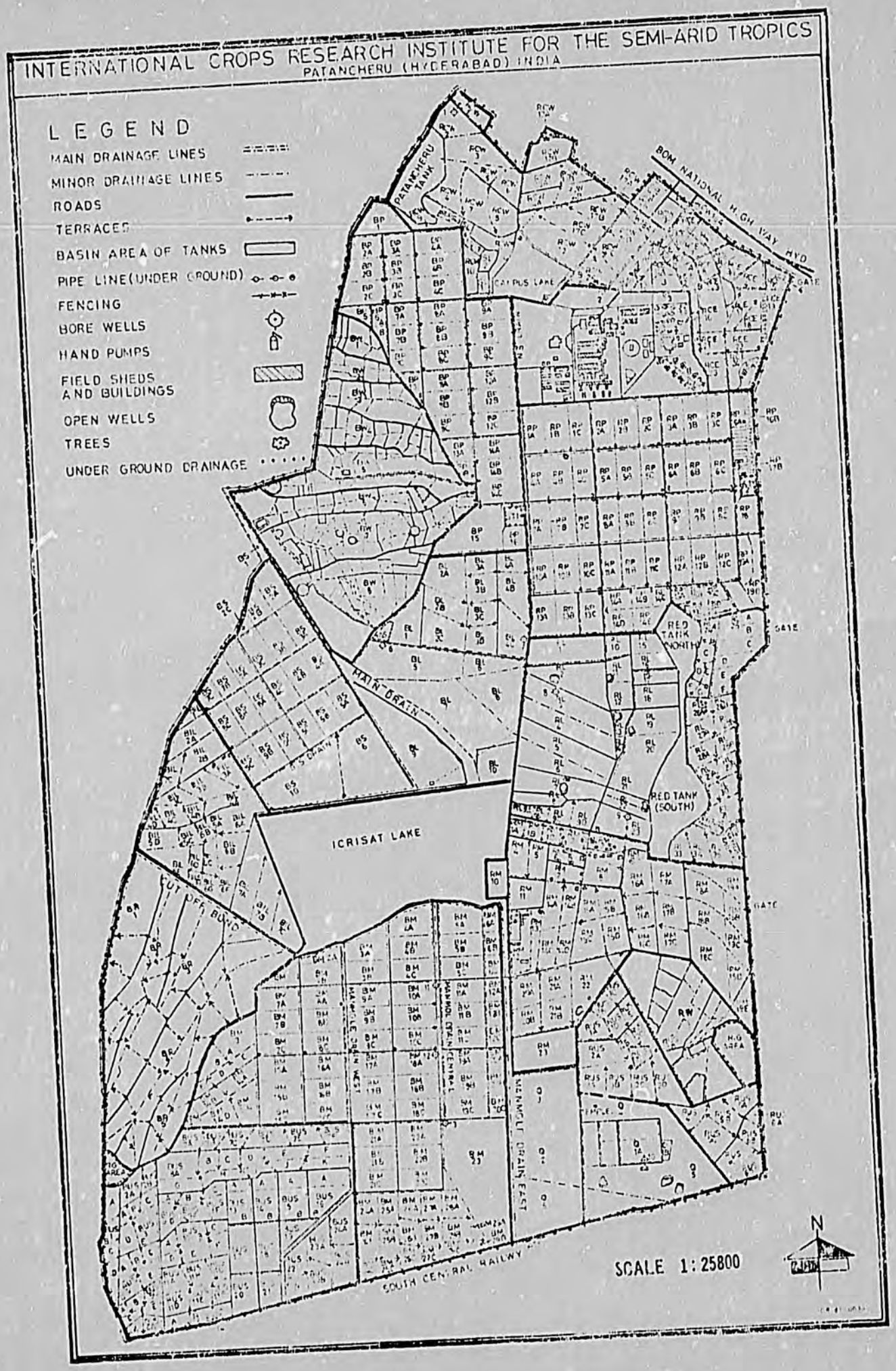
His address, in the event you desire to contact him and arrange a visit there, is: Mr. Chitti Babu, Agricultural Research Institute, Ilanga, Private Bag, Kilosa, Tanzania.

INFORMATION DESIRED

(List appended to Minutes of Nov. 28 Meeting)

Responsible Party		
Higgins/Bergman	I.	Maps
		1. Contour Map of Station on 1m Intervals
		2. Soil Map-Soil Profiles, etc. (Gingrich to assist in supervision)
		3. Aerial Mosaic-Survey Department Plane
Riley	II.	Farm-Size and Area Required for:
		1. Animal Experiments
		2. Crop Experiments
		3. Forestry Experiments
		4. Other
Bunderson/Gingrich	III.	Irrigation Requirement for:
		1. _____
		a. Crop Production
		b. Life Saving (Germplasm)
		c. Disease Promotion, etc.
		d. Livestock
		2. Type of Irrigation
		a. Furrow - border
		b. Sprinkler, etc. (needed for plant pathology studies)

Henson/Noel	IV.	List of Equipment On-hand/or On-order/or In-Plans to Order 1. Farm Tractors and Equipment 2. Workshop Equipment a. Mechanical (auto and tractor) b. Fabrication, Welding and Machine Shop Eqpt. c. Electrical Maintenance d. Electronics and Instrumentation
Dafalla/Henson	V.	Budget Available for Upgrading Support Facilities
Henson/Noel	VI.	Staffing Pattern-Scientists, Technicians and Support Staff.


INTERNATIONAL CROPS RESEARCH INSTITUTE FOR THE SEMI-ARID TROPICS
PATANCHERU (HYDERABAD) INDIA
LEGEND
MAIN DRAINAGE LINES
MINOR DRAINAGE LINES
ROADS
TERRACES
BASIN AREA OF TANKS
PIPE LINE(UNDER GROUND)
FENCING
BORE WELLS
HAND PUMPS
FIELD SHEDS AND BUILDINGS
OPEN WELLS
TREES
UNDER GROUND DRAINAGE
PATANCHERU TANK
BOM NATIONAL HIGH WAY HYD
CAMPUS LAKE
RED TANK NORTH
RED TANK (SOUTH)
MAIN DRAIN
ICRISAT LAKE
CUT OFF BUND
SOUTH CENTRAL RAILWAY
SCALE 1:25800
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Considering the number of Scientists projected for each of the four stations, and their research objectives, the building facilities and the dearth of local agencies to supply support, the quantity and types of skilled support staff proposed appear insufficient, in some instances.

Suggestions for the number and types of support staffing are not included in this report, as this can best be handled through group discussion at a later meeting, when more information is available as to the amount and types of equipment to be serviced, and the availability of services from other agencies, such as government units and local firms.

Sample job descriptions, for most farm operations and Physical Plant staff positions, have been forwarded under separate cover to Dr. Riley. These job descriptions are those used by ICRISAT and may not, in some cases, be entirely appropriate for WSARP.

The building plans were briefly reviewed with Mr. Bergman and later with Dr. Henson. During the discussions with Dr. Henson, a number of modifications and additions were suggested to provide facilities for workshops, crop work areas, plant and soil sample preparation (dirty work areas), laboratories, and seed storage.

Sketches of suggested modifications and additions are provided with this report, with the notes on each station. These sketches are, in some instances, a little different from those made during discussions with Dr. Henson, as a result of on-site visits and information gained later concerning actual requirements.

The indicated additions and modifications for workshops are only suggestions, as, at this time, the exact amount of equipment to be maintained is not known. Likewise, in the current staff projections, staff for the utilization of some of these facilities are not at present provided. In

view of the potential for the provision of additional service staff and how these services are to be organized, a decision is to be taken as to additional space requirements.

EXPERIMENT FARM DESIGN

Some concepts, with reference to experiment stations and research-farm planning and development, are given below:

Prior to the development of a Land-Use Plan, detailed planning is to be completed as to exact requirements, to include the amount and type of land required for the support of immediate research objectives. So, also, there should be an estimate of requirements for 10 to 20 years in the future. After this time, the present research objectives may have been completed, or, at least, evolved beyond those currently envisaged.

In other words, the research farm design should not only meet current requirements, but should cater for the future as well.

The Farm Plan and Land-Use Planning

A complete Experiment Station Plan (Research Farm Plan and Campus Plan) is based upon objectives of the station, anticipated activities and operational methods, the climatic conditions of the area, the soils and topography of the farm (and, for certain considerations, the areas adjacent to, and affecting the farm), and the local situation as related to availability of outside support.

The Land-Use Planning deals more specifically with fitting anticipated activities, most advantageously, into the soil and topographic situations. The Research Farm's Development Plans are then made to follow the Experiment Station Master Plan, fitting the various requirements of research fields, roads, drainage, water storage facilities, etc., into the areas, or land categories, suggested by the Land Use Plan.

The design of a research farm, to no small extent, determines the operational procedures of an experiment station. Only after the research farm is designed, can realistic estimates be made as to the size, shape and locations of precision, arrable and irrigated (if required) fields.

These factors directly influence:

a. The quantity and type of field research to be conducted and supported.

b. Operation decisions as to who will do what, and how and when, do what in the numerous complex interrelated activities required in the operation of the experiment station.

c. The quantity and types of equipment and labor required. For example, a large farm with numerous poorly designed, irregular-shaped fields will require more time, more small equipment, and perhaps more labor to operate, compared with large, properly designed and shaped research fields.

All of the above factors, station development, equipment, facilities, and number of staff, have a direct influence upon the Capital and Operational Budgets of the research organization. These requirements cannot be fully determined until the plans for campus and farm have been developed and implemented.

Only after five to ten years of operating the newly developed experiment station (or research organization), can a full realization of equipment, staff, facilities, operational procedures and, therefore, budget requirements, be determined. Planning, in the initial stages, should take this into consideration and provide budget for the necessary modifications and changes in both staff and facilities at years five through ten, after the full development of new research organizations.

Decisions concerning an Experiment Station's Master Plan, Detailed Campus and Farm Plans should be made at an early date so as to allow the orderly progression of developmental work. These decisions should include the establishment of development by phases and priorities, so that farm development coincides with campus development and staff recruitment.

The four WSARP Campus Plans (part of the overall Station Plan) have been completed, with the exception of, possibly, some additional service facilities.

It would appear that the development of the Kadugli Station is somewhat out-of-phase, as the Campus (Physical Plant facilities) are virtually completed, and are now being occupied, while the major portion of the research farm is yet to be planned and developed.

KADUGLI - 29 November 1982

A meeting was held in the new conference room, with most of the staff available on-site at that time. I first explained that the purpose of my visit was to review the existing facilities and to obtain as much information as possible for the development of a farm plan, and research support services.

Dr. Gingrich explained that the research farm, which consists of approximately 1800 feddans, is approximately 3kms. from the campus. It is not, however, possible to reach the research farm directly, as there is a swamp between the farm and campus. It is, therefore, necessary to travel several miles by a roundabout route to reach the farm.

The major soil-type of the farm is vertisol (black cracking soils). A very urgent requirement is the construction of an all-weather road from the campus to the farm in order that agronomy research and other experiments can be started as soon as possible. It was not possible to conduct agronomy experiments on the farm last year, as the fields were not accessible during

the rains. If roads are not constructed prior to this monsoon, it is unlikely that it will be possible to conduct experiments on the site this year, also.

Drs. Cook and Moham manage two research herds of cattle, one of which is continuously on-station. The second herd is nomadic, and is maintained as a control herd, utilizing traditional local practices. For the maintenance of the on-station herd, additional buildings and facilities are required on the research farm. There are currently a few temporary structures, such as a large, round, night-barn constructed in a traditional manner, and temporary corrals made from coconut-tree trunks.

The buildings and other facilities required on the farm for livestock are as follows:

1. A pole-type barn to provide protection from sun and monsoon rains. The barns should be equipped with facilities for tying the cattle, when required.

2. Permanent corrals.

3. Office space with a refrigerator and an evaporative cooler.

4. Storage facilities for feed and equipment.

5. Living quarters for herdsmen.

6. Regular power supply or generator current.

A decision should be taken, based on initial and long-term operational expenses, as to whether power is to be supplied from a generator on the farm or through a power line from the campus generators.

Dr. Cook indicated that requirements for the cattle shelters had been discussed with the Review Team, but their entire needs had not been explored in depth. It was suggested that they make lists and sketches of their estimated necessities as a first step in the process of designing the buildings, and for procurement of funds. These sketches should be submitted to the architects and management for further development and financing.

After the meeting, we reviewed the newly constructed laboratory building, which consists of two wet labs on either end, with an instrument store between them. The space available for refrigerators, centrifuges, ovens, incubators, glass storage and other apparatus appeared to be insufficient. Apparently the only place for these items is in the instrument store. The number of electrical outlets is insufficient. The quantum needs to be increased and the amperage rating of each checked against required loads.

The fume hoods in the wet labs are exhausted through a PVC pipe which makes a right angled-bend just below the ceiling. The normal procedures for the exhaust of acid and hot chemical fume hoods is straight up through the ceiling and roof with an exhaust fan, preferably connected to an air scrubber, on the outlet. The specifications for one type of air scrubber are attached (Appendix 4). Space is required for a scientific instruments maintenance and repair technician, as also, for the storage of chemicals, glassware and apparatus.

A review of the remaining support buildings indicated a requirement for modifications or additions, as previously discussed with Dr. Henson.

Discussions with the Maintenance Officer, Mr. Antonio (Tony) Cenidoza, indicated that the maintenance of vehicles is a problem, in the absence of adequate tools, spare parts, and skilled mechanics. Tony did not know what tools and workshop equipment had been ordered, but did indicate that some of the tools previously ordered had been lost in transit.

After returning to Khartoum, an extensive list of tools and shop equipment for automotive maintenance, welding and fabrication, electronics, electrical, carpentry, plumbing and refrigeration services was marked in the Sears & Roebuck Farm and Ranch Catalog and the McMaster Carr Catalog. These were the only two catalogs available at the Khartoum Office, and do not necessarily indicate the best firms from which to make the purchases. The "Request for Purchase" was being typed by Mrs. Bergman at the time I departed from Khartoum. It was not possible, therefore, to obtain a copy for this report. However, a list indicating the catalog page number, a general description of the item, and, in some cases, the part number, is shown in Appendix 2. The exact description, part number, quantity, etc. were marked in the concerned catalogs.

The items and quantities suggested in this list should be checked against equipment already on order or on hand, in order to avoid duplications. The items suggested in this list, and particularly those of farm and seed processing equipment, are only suggestions for one of the main stations (El Obeid/Kadugli). Likewise, unless workshop space and craftsmen are to be provided for the utilization of welding, electronics, air conditioning, machine shops and other maintenance equipment and tools, the purchase of many of the items suggested would be a waste of funds. The list is by no means complete and, in some cases, (electronics, a.c. and electrical) is only the basic minimum necessary to begin work.

The extent of the farm equipment currently available on the station consists of the following:

1. A tractor, of Russian origin with a German air-cooled engine, is in running condition. However, the starter is missing, and the tractor is push-started.

2. A Ford 3000 series tractor.

3. An International Harvester tractor.

The latter two are inoperative, due to lack of tires. If the tires were provided, and the fuel pump of the Ford serviced, they could both be utilized.

The fuel injection pump of the Ford was being taken to Khartoum for servicing at the time of my visit.

In addition to the tractors, there were a number of vehicles also in the shop waiting for spares.

Another item of farm equipment was a three-disc Massey Ferguson Plow. The coulter of the plow is broken and badly worn. The coulter arm-pivot pin is also badly worn. One other item was a back-fill blade, which also requires extensive repairs.

A hand-written list of equipment previously requested for the station was provided by Dr. Patrick. It was not known, at that time, if the equipment had been ordered. Drs. Noel and Henson were to check on the position of this equipment on their return to Washington State University.

As a supplement to Dr. Patrick's list, I recommended some additional equipment to Drs. Noel and Henson (Appendix 3).

Farm Tour

The perimeter fence of the farm is almost completed. The alignment and workmanship are very good. Several pasture improvement plots within the farm have also been fenced, and experiments are underway.

The proposed agronomy and crop improvement areas were visited. They are in the flatter portions of the station, located on the deep vertisols (cracking soils). The fields are currently covered by numerous accacia trees and shrubs, and were, last season, planted by local farmers. Mature

sorghum crops were in the fields and were slowly being harvested. The striga infestation was quite high. Some portions of the farm had recently been burned.

RECOMMENDATIONS: KADUGLI

The farm land-use planning can begin as soon as contour maps, soil maps and climatic data are available. However, it is recommended that the construction of a connecting road between the farm and campus be immediately undertaken, and that an internal perimeter road around the farm started. It will be necessary to construct a number of culverts. As to culvert size, without adequate contour maps and rainfall data to indicate the runoff through the low areas, these can only be estimated and may, at a later date, have to be enlarged. The perimeter road, in addition to providing easy movement around the farm, will serve as a fire break.

SUGGESTED BUILDINGS MODIFICATIONS AND ADDITIONS:

1. Laboratory - A sketch is provided suggesting additional space. As two maintenance personnel are projected for office and scientific equipment (first two years at Khartoum and later at El Obeid), it is assumed they will make periodic service trips to the other station. If so, they will require shop space. This is shown in the extension suggested.

2. Machine Shop, Welding and Fabrication - If the new agricultural engineering shed at Kadugli is to be used as a farm equipment research center, it is suggested that the same welders, machinists, etc. could also do the necessary maintenance of the farm equipment, etc. If this is feasible, additional staff, machinery and space is not required. If this is not possible, then additional space, staff and equipment is required in the workshop buildings.

3. Due to fire hazards, the carpentry shops should be separated from other shops. Likewise, the welding shop should be separated from other shops by a wall or screen to prevent eye-damage from electric arc flashes.

   It is suggested that another bay (4.95 x 7.10 m) be added to the workshop for carpentry. See attached sketch.

4. Crop Work Area, Fertilizer, Farm Chemicals and Seed Storage - A building similar in size to the agricultural engineering shed is required for the above. A suggested floor plan is attached.

   It is assumed that fertilizer and chemicals, as they are to be imported, will be ordered and stored in bulk. Fertilizer and chemicals should not be stored in the same area as seed and equipment. Therefore, separate areas are required. If seed is to be stored for some time, an air-conditioned and de-humidification room is desirable.

5. Farm Buildings - As the Kadugli Farm is located some distance from the campus workshops and other facilities, it will not be practical to make numerous trips each day during the land preparation, seeding, growing, and harvest season with the tractors, vehicles, etc. Therefore, some on-farm buildings appear necessary for the temporary storage of equipment and farm supplies, and for occasional shelter for staff during the monsoon rains.

   It is suggested that a building similar to the crop work area, suggested above, be constructed at a well-drained (high) point on the farm, central to the agronomy fields.

It is desirable to have electrical power available at this building for the operation of crop threshing, and, if necessary, seed drying equipment. The building should be surrounded by a large hard-surfaced area for crop work and drying.

The construction of a power line from the main generators to the farm and to the livestock buildings would eliminate the need for two additional generators. This would also exclude transport of fuel, maintenance services and additional power.

6. Electrical and Refrigeration Maintenance - An additional bay of 3.5 x 6 meters is suggested at the power house. This area may, at first sight, appear rather large. However, after a few years when electrical, air conditioning, refrigeration, evaporative (desert or swamp) coolers begin to require continuous repair, this space will seem small. The time-consuming import of spare parts for this equipment will most likely result in a number of bulky items being stored in the shop at one time. Any overflow may be stored in the warehouse.

7. All stations will require a farm tractor and equipment storage shed.

It is suggested that the generator operators be qualified electricians and that two or more of them have additional qualifications in refrigeration maintenance. As a safety precaution, a second person (helper or laborer) should always work with an electrician.

After refueling the plane and a short stop in El Obeid to unload passengers, we returned to Khartoum just after dark. The next few days at Khartoum were spent in preparing shop tools and equipment list, as previously mentioned. The construction of a road across the swamp to the site was discussed with Dr. Higgins as also the construction of a four-thousand

gallon per day water-storage facility on the farm for livestock maintenance. This is to be supplied from the existing bore well, or from another bore well yet to be installed.

The 4000 gal/day is Dr. Cook's water requirement for livestock maintenance. There are certain to be, over the years, additional water requirements for the crop and other research activities.

EL OBEID - 6 December 1982

Dr. Cook, Mr. Bergman, Ms. Michaels, Tom Mills (Pilot) and myself flew from Khartoum to Kadugli, unloaded passengers, refuelled and left for El Obeid, arriving there about one o'clock in the afternoon.

Most of the buildings in El Obeid had come up to the roof stage. The contractor had almost run out of work, as roofing material shipped from Post Sudan about two weeks earlier, had not arrived.

Mr. Bergman and I reviewed the building plans, paying specific attention to the workshop and laboratory designs. There did not appear to be any space specified for the maintenance of electronic and scientific instruments, unless one of the 5M x 5M room labeled "Technicians" space on the ground floor of the research building can be made available.

Likewise, space is not provided for machine and welding shops. The plumbing and carpentry shop is a covered space 5 x 15 meters, with both ends open.

The seed fumigation room, provided in the plant pathology lab does not appear to have adequate ventilation. It was suggested that a 100% fresh air supply and exhaust be provided, which could be operated as and when required. Acid waste and drainage treatment facilities have been provided.

A storage area for volatile chemicals and pressurized containers was not indicated. This storage area should be a well-ventilated space some distance from occupied buildings.

The bricks and cement being used in the construction of the exterior walls of the buildings appeared to be crumbly and there is concern that continuous wind and sand blasting over the years will erode the unplastered exterior walls.

We next visited the research farm, the boundaries of which have not been clearly defined. It is understood that Dr. Higgins is in the process of obtaining the materials for construction of a fence around the site. Maps, as well as the exact figure as to the area of the farm, were not available. However, it was estimated that the farm which joins the campus area is approximately 600 acres. The entire farm appears to be deep sand, with occasional accacia trees. There was almost no grass cover. Numerous borrow pits have been dug at random locations through the farm.

After the farm tour, we made a round of the local markets in El Obeid. A large number of open-air vehicle maintenance shops were seen. The machine and hand tools available appeared to be limited. This is an indication that some mechanical ability is available in the immediate area, from which mechanics may be recruited for work on the station after further training.

RECOMMENDATIONS: EL OBEID

1. Vehicle Maintenance - The inspection pit is wrongly located and its requirement is questionable. Most vehicles today require little chassis maintenance (lubrication). Oil change and inspection can be accomplished through the use of small portable ramps, or two hydraulic hand-operated bumper jacks. The pit does not appear to have a drain. Pits are almost impossible to keep clean, and occupy expensive maintenance space. The locations of this pit right in front of the office, means tools and spare parts stores

will be a constant hazard to be walked around or jumped over. It is recommended that the pit be filled and concreted over and that bumper jacks or portable ramps be purchased similar to those suggested in the attached equipment list. Two maintenance bays for vehicles and farm equipment would appear insufficient for a main station. It is suggested that the space between the warehouse and maintenance buildings be covered to provide an additional bay.

The north side of the maintenance bay should be closed, and, if possible, sliding or roll-up doors provided on the south. Otherwise, the area may become a "wind tunnel" during the windy season, with the result that dirt and sand will be driven into open engines, transmissions, etc.

A work bench should be provided along the north wall, with windows in the wall for light.

A "clean room" (dust free) is required in sandy arid areas for the overhaul of engines, fuel systems, hydraulics and transmissions. The room should have adequate lights and air conditioning, or evaporative cooling, with overhead fans; otherwise, it will be difficult to get the mechanics to make proper use of this facility.

An auto electrical maintenance area or work bench is required; as also, a battery refill and recharge area. The battery maintenance area should be well ventilated and preferably in a separate lockable room with an acid-proof floor-level sink for battery filling.

The parts room is too small for the storage of automobile and farm equipment spares. The overflow can, perhaps, be accommodated in the warehouse stores; which are also thought to be quite small.

2. Fabrication and Machine Shop - Space does not appear to be available for welding, metal fabrication and machine shops. A welding and fabrication shop is essential for the support of a modern experiment station and a small machine shop is most desirable, unless adequate facilities are locally available close to the station.

3. Crop Work - Space is required for a crop work area to include a large covered area for threshing and processing the crops; plus a special grinding room or dirty work area, seed storage, etc. A structure similar to that suggested for Kadugli is recommended. One possible location for this building could be between the maintenance building and power house in Cluster "A."

   This location is fairly close to the lab building and offices of those who will supervise the area. However, placing it in the maintenance compound will create a messy (crop residue) situation and is a problem for access from the field. A better location might be next to the workers' canteen. This places the Crop Work Area near the farm, but some distance from the main building complex.

4. Wash Facility - A washing facility for insecticide equipment and showers for those applying insecticides is suggested. The water from these areas should be conducted through a closed drainage system to an open-top shallow evaporation tank which does not leak/seep.

   A similar facility may be desirable at Kadugli and other stations, depending on the amount of insecticides and weed control chemicals used.

The design of the maintenance building, with toilets and showers on the west and warehouse on the east, does not facilitate easy expansion. If construction, at this time, is too far advanced to permit the expansion of this building by three bays to the west, an additional building may be required.

EL FASHER - 7 December 1982

We left El Obeid at approximately 8:30 a.m. and flew west to El Fasher, arriving there about 10:30 a.m. The experiment station covers approximately 200 hectares in area, being 2 km. long and 1 km. wide. A portion of 2.5 hectares is reserved in the south-east corner for the Campus.

The soils are deep sand with almost no ground cover. A long ridge or sand dune running from east to west covers a large portion of the northern side of the farm. This station is yet to be fenced, and it does not appear that any cultivation has taken place on the site in recent years. However, the Chinese construction labor are growing excellent kitchen gardens, using sewage and bath water effluent.

El Fasher Buildings

The administration building, laboratory and a number of the residential houses have come up to roof level, and the foundations are in place for other buildings, including the workshops. The buildings are being constructed by a Chinese contractor. The quality of workmanship and the speed of construction is very good.

As the buildings and presumably the research activities at El Fasher are similar to those of El Obeid, the same comments apply as to support requirements, etc.

However, due to the smaller size of the station, and thus less equipment, etc., to be maintained, the space requirements may be somewhat reduced, keeping in view the fact that a certain minimum space is required for each activity or support function.

GHAZALA GAWAZAT - 8 December 1982

We arrived at Ghazala Gawazat by air at about 11:00 a.m. This site consists of approximately 20 square miles of grass and scrub trees. This is an old station, started by the Russians about 12 to 15 years ago. A number of poorly maintained buildings are already on the station.

The water for this station is supplied from two deep-bore wells. The pumps are of the Sucker-rod types, powered by diesel engines.

The site was previously fenced, several years ago, into pastures of one square mile each. All the fencing seen was down, but the wire itself was still in good condition. It appears that it was previously constructed with wooden posts, which have since been devoured by termites.

Approximately 100 cows and several bulls are maintained on the station. The animals are in excellent condition.

In a small room adjoining the herbarium/office, a number of spare parts of an old Russian bulldozer were found. The parts include gaskets, hydraulic pumps, track components and other miscellaneous items. In the mechanical maintenance area, a bulldozer of Russian origin, equivalent in size to that of a D8 Caterpillar bulldozer, is stored. It was indicted that the dozer has not been in operation for more than 7 years. A very brief inspection indicated that it had not been used very much and could, perhaps, with minor repairs, be put back into service, if required, for some of the land development activities.

One Russian farm tractor (estimated at 30 horsepower) was in operation and is understood to be used for trips to the fields in the rainy season. Two other farm tractors of similar design, plus a fairly new John Deere tractor are inoperative, due to shortage of spare parts.

There are a number of existing buildings, the floor plan and condition of which were not examined. It is assumed that many of the support functions such as crop work requirements and maintenance shop can be accommodated in these buildings.

Their suitability to accommodate support functions as described for Kadugli and El Obeid is to be examined in view of the research and staff to be supported at Ghazala Gawazat.

The electrical power for the station is generated by one diesel generator of approximately 100 KVA capacity. A second identical generator at the same location appears to be quite new. However, it has been canabalized for spare parts, such as radiator, fuel pump, etc.

After visiting the building site we went to the meteorological laboratory, which is located on the station, to review the rainfall data for the past several years. The average rainfall was about 500 millimeters a year. Some yearly records were missing, and others appeared to be in error, as, for example, the figures for 1976. The register indicated that only 8 mm of rain was received in 1976. The record available for 1981 was only up to March and indicated that only a "trace" had been noted during that year.

The record for 1982 up-to-date (8 December 1982) indicated 280 mm of rain.

From Ghazala we flew southeast to Kadugli where we refueled and departed for Khartoum, arriving there about 6:00 p.m. (after dark).

The 9th of December was spent in the WSARP office with Tony and others reviewing vehicle spare parts orders. To date, the office has not been successful in obtaining parts books for some of the vehicles, and have only maintenance manuals from which to request parts. The service manuals only list major component groups and, therefore, it is difficult to order individual parts for carburetors, distributors, water pumps, etc. as required.

(B1.43)

APPENDIX 1

REPORT ON MASTER LAND USE PLAN
FOOD CROPS RESEARCH INSTITUTE, ILONGA
(IITA/USAID/TANZANIA PROJECT-107)

By B. CHITTI BABU

BACKGROUND:

On the recommendation of Dr. J.C. Davis, in his capacity as the Associate Director, ICRISAT, my services were offered to Dr. S.V.S. Shastry, The Director of Research IITA, as a consultant for 2 months period to start the implementation of the Land development Project, ARI, Ilonga, Tanzania, under the auspices of USAID, Agri. Research Project. Thereafter I was contacted by IITA to implement the Land development Project, by joining as a staff member of IITA. Thus I started, serving IITA/USAID/TANZANIA PROJECT and execution of The Land Development Project, ARI Ilonga.

The directive given me by IITA was to work as a Technical Officer, ILONGA station Development to develop the station on the basis of ILONGA DEVELOPMENT REPORTS BY D.C. COUPER AND CRAIG.

Information for the final development design and implementation of The Proposed Research Station come from the following individuals and/or reports:

1. Report on the development of the Ilonga Research Station, Agricultural Research Project 107 IITA/USAID/TANZANIA Project 12-10-79 by Mr. D.C. COUPER, FARM MANAGER, IITA and Mr. John H. Craig, Asst. Director and Head of the Physical Plant Services Division IITA, NIGERIA.

2. Reports by Mr. J.A. STEWART, Farm Manager, CIMMYT, MEXICO.

3. Mr. D.C. COUPER

4. Dr. P.C. DUFFIELD

5. Mr. J. ANANIA

6. SCIENTISTS AND LAND DEVELOPMENT STAFF OF NATIONAL FOOD CROPS RESEARCH INSTITUTE, ILONGA.

7. E. MLAY - M.S. THESIS, Development of the new Research site of The Ilonga experiment station KILOSA, TANZANIA.

8. Report by Mr. STERLING DAVIS, P.E. Irrigation & Drainage Consultant, P.O. Box 353, CAIRO, EGYPT.

Going through the references above my thoughts were basically focussed to as follows:

1. To produce a land use plan for physical development ofthe total Research Farm considering the objectives of the Institute, a good land utility, and of the Principles of soil and water conservation. The map to show the areas to be used for specific purposes such as irrigation, dry land experiments, Building Areas, necessary access roads, Drainage and water sources.

2. To develop an irrigation system, suitable to the Farm considering the station requirements, source of water supply, soil climate and topography, crops to be grown, availability of materials and staff to install, operate, and to maintain the system.

3. To modify the list of the machinery and allied equipment for Farm Development, operation of Farm, and maintainance of the station facilities considering:

(a) Farm Development:

1. Execution and quality requirement of the end product.
2. Time schedule
3. Availability of Funds
4. Local Technical Staff available.

(b) Farm Operation and Maintenance:

1. Research requirements and crops to be grown
2. Extend of mechanisation.
3. Size of the individual operational unit
4. Total area of the Farm for each season
5. Staff available to operate and to maintain.

4. To establish a land development and operational Division (FDO) as a research service support unit.

5. To establish a Farm development Committee to consider and recommend the Farm research Committee recommendation to FDO division, to review the Farm Development plans designs and schedules. To approve the implementation of plans and designs of Development.

6. To identify and establish a better communication links, between FDO services users and FDO staff.

7. To identify means to establish good workshop, stores and office and procurement of staff for FDO.

DESCRIPTION OF THE FARM:

1. LOCATION, ALTITUDE AND ACREAGE: The station is situated approximately 10 Km (6 miles) from Kilosa on the Kilosa - Rudewa all weather thirt road adjacent to CCM, Ilonga, and at 6° 46's of equator and 37° 02's East of GREENICH. The altitude is 506M above sea level (1650 ft.) . The proposed area to be developed for Food Crops Research is approximately 160 Ha. (400AC). The station comprises approximately 1066 Ha. of which about 700 Ha. are potential for agriculture development.

2. SOIL TYPES:Soils are variable, but in general, the soils are sandy clay loam. These are fertile soils formed from recent alluvial and colluvial deposits brought down by floods from the nearby Ukaguru hills. The top soil depth varies from 45 to 60 cm. depth. The table showing the values of Infiltration (10mm/H.) and (10m) of water holding capacity (0.35 cm) attached.

3. TOPOGRAPHY:The area is a sub-basin with two main catchment areas. One comprises the Northern of the Farm with outlet at North-East corner of the Farm. The other is south of the Farm and with main outlet towards south-east.

The Farm is gentle and rolling with slopes 1 per cent to seldom exceed 2.5 per cent. The Farm slopes lead into two main drainage lines.

4. CLIMATE: (SEE ATTACHED APENDICES). The average rainfall is approximately 1073 mm and falls mainly in 3 months duration (Feb., to mid. May). The frequency of rainfall intensity over short durations are not available. Estimate 3 inch/hr. intensity storms for short periods of 15 to 20 minutes are experienced. The temperature ranging from 15°C to maximum mean of 35°C.

The hot months are Nov. to Feb. The cool months are June to Sept. Evaporation is estimated to be 1820 mm per annum and is maximum during October, November and December.

5. VEGETATION: The vegetation in the farm falls within the savana ecological region in tropical Africa. The sub. region is Dry Savana (Acacia tall grass savana). The area is covered with tall grass of 1 m to 2 m high with scattered trees with 6 INCH to 3 FEET dia trees. The common grass spp. are Hypershenia, Andropogon and Heterpogon. The main spp. of trees are Acacia, but broad leved trees too occur.

6. EROSION:Erosion has been more intense than at first realized, with much evidence of surface erosion caused by exposure of soil due to burning of grass and moderately high erodability nature of soils by high intensity rainfalls during early land preparation time. Gully erosion caused by the existing Drains reveal that soil erosion structures will be required to stabilize the drains to non eroding grades.

7. POTENTIAL WATER SOURCES: Sufficient data was collected from the nearby 2 to 3 Km. vicinity village bore wells, to estimate the quantity and quality of water available from the Farm area. Two bore wells of 220 ft. deep were dug. The log of the bore wells are attached. The yield of the each bore well is approximately 3500 gal. per hr. The quality water for irrigation would appear to be satisfactory. The quality test results are awalted from MAJI Morogoro. Sufficient water taping from the deep wells would appear to be very expensive proposition to supply irrigation to 50 Ha. of Farm located

North West Corner at the rate of 8 mm per day. Approximately 15 to 18 bore wells of 220 ft. or deeper wells would be required to support irrigation. The estimated drilling cost alone per each bore well by MAJI, Morogoro is approximately Sh. 250,000 to Sh. 3,000,000 (US $ 31,000 to $ 37,500).

Though there is no sufficient data collected to give the flow rates of the Ilonga river, but according to latest records, the minimum flow rate in the river during the driest months is about 1585 USg pm. The station is allowed to draw about 475 USg pm. for domestic, irrigation and livestock. So, it is obvious that pumping direct from the river to irrigate the 50 Ha. is not practical.

I would suggest to build a DAM and collect the water by diverting from the River during the high stream flowland reserve it to irrigate the 50 Ha. area during dry season. From the topographical map, it appears to be possible to build a reservoir at North East corner of the farm of capacity approx. 650 AC/ft. by constructing an earth dam 3960 ft. long. The details of the LAKE ILONGA are provided in the later part of the report.

It is assumed that the domestic water for the campus will be obtained from the tube well dug in the campus area if the quality is satisfactory.

8. THE POLICY AND OBJECTIVES OF THE INSTITUTE: The policy and objectives of National Food Crops Research Institute (NFCRI) is set up as a national research center for TANZANIAN Agriculture, with main objectives of producing better quality, higher yielding varieties and develop better farming systems of Maize, Sorghum, Millet & Legumes (such as Beans, Cowpeas).

The genetic research and plant Breeding operations as well as agronomic research will require an adequate Hactarage of irrigable land both for speeding up breeding programmes and for simulating differing rainfall quantity and distribution regimes. A net amount of 125 AC (50 Ha.) has been agreed upon as adequate for this purpose and set near by campus area which has better drainage and uniform deep soils.

An amount of 150 Ha. of developed land has been agreed upon for research, on rain fall pattern and for bulking up of seed from newly proven varieties.

9. LAND USE PLAN: A suggested specifications of a layout plan:- A layout plan was drawn on the topographical map. As a means of shortening slopes within the unit boudries as defined by road and drainage line, a system of broad based 0.3 to 0.5 per cent graded terraces be used with a length of 110m and a vertical interval between terraces of 2 to 2.5 m, with a length of 220 m.

Thus dividing the entire area, by 110m X 220m rectangular blocks, The criteria apart from the soil conservation aspect are :

1. To have uniform field sizes for conducting field experiments and large enough to accommodate large experiments and multiples of small experiments.

2. To have easy management and efficient mechanised field operations.

3. To have uniform 5m wide by 200m long beds. These beds are uniformly separated by one meter allcys.

4. To achieve uniform irrigation by limiting the length of run into 100m long.

5. To minimize the earth movement to achieve a 0.3 to 0.5% irrigation slope. As the entire plot is divided by ridges and furrows in 100m long direction to facilitate furrow irrigation, the cross slope could be kept to its existing slope.

6. The fields are divided from all sides by roads for better excessibility from all sides.

7. There are provisions for tractors turning places at the headlands, surface drainage and for gated pipe transport movement.

8. The drains should not cause any hindrance to the mechanised operations and field machinery movements.

The designed profiles reveal that the suggested layout is one of the best layout could be possible to meet all the above requirements.

The layout plan was layed out on the ground by marking the roads and drains.

The earth work was computed for several individual plots (attached). The earth work ranges from 600 cu.m. to 200 cu.m. with an average maximum cut of 20 to 30 cm.

An area of 220 x 220 sq.m. is earmarked at the high spot for Physical Plant Facilities.

An area of 13,000 sq.m. is earmarked for Two Service Reservoirs at the high spot near Physical Plant Facilities In the plots.

A land use plan is attached.

* * *

APPENDIX 2

Page No.	Description	Part No.

SEARS 1982 FALL AND WINTER CATALOGUE

Page 754	Jacks	
	Creepers	
	Ramp in place of inspection of pits $54.97 per set	
765	Transmission jack	
1037	Point spray gun & air accessories	
1036		
1726	Oxygen acetylen track kit	
1027	Arbor Press 2 ton	

SEARS 1982 FARM AND RANCH CATALOGUE

Page 47	Chain saws and equipment	
65	PTO Power Seed and Ferterlizer spreader	
64	Boon crane with category II - 3 point hitch	
56	Box scraper F 32AF 78171N for Cat II, 3 point hitch	
	Note: This appears to be tight duty - a heavy duty scraper is required.	
53	Seed cleaner with Bagging attachment	
	Note: For the above order a 1/2" Electric Motor 220V single phase with 5/8" shaft - Sears No. (page 1027 - 9H2223C (1982 Fall & Winter Catalague)	

NOTE : In Dr. Higgins' copy of the McMaster CARR Catalog, (1) items checked ✓ were on RFP dated 29 Nov 1982 for Antonia (2) items marked with heavy red mark appear to have been previously requested for Kadugh

Items suggested by Mr. E.W. Nunn are marked in Yellow.

SUGGESTED TOOL AND WORK SHOP EQUIPMENT - McMASTER CARR Supply Company as per page marked -

540 - 541	Stencil sets and brush
290	Jacks
297	Jacks
298	Jacks
23	A.C. Service kit
1225	Volt ohm Ammeter 0 to 600 vots
1221	A.C. - testing kit 100 to zero volts
1222	A.C.-D.C. testing milliameters
297	Crane
334	Boom crain
434	Grease guns
436	lube and grease bucket
438	Accesseries
441	Grease fittings
466-468	Drafting table and equipment
1166 & 1168 & 1169	Puller
1196	Battery chargers
1232	Crawlers for electric motor testing
1246	squares
1248	squares
1249	calipers
1250	Dial calipers
1253	Micrometers
1281 (page 2)	Bench Press and accessory set
1289	Anvils
1291	Tube flaring tools 45° on order
1293	Pipe cutters
1295	pipe threads
1302	Tap and die set
1315	Extraction
1316	Screw extractors

McMASTER CARR

1335	Drill sets
1336	Masonery
1362	Drill press
1365	Drill checkers and tools & keys
1644	3/4 Drive to refix wrench
1645	1/2" Drive Torque wrench set
1620	10pc 1/4 & 3/8 Drive tool kit set
1623	13 pc metric 1/2" Drive socket set
1623	33 pc 1/2" drive socket set
1625	25 pc 3/4 Drive socket set
1332	Drill set 1/2" shank set 9/16" to 1" - 2 sets
1332	Drills 1/2" shank sizes 1¼, 11/18, 1¾, 1½ one each
1687	COMPRESSOR, PISTON RING
1954	Cock sheets
1954	Packing sheets kit
1687	Piston ring compressor
1687	Piston ring groove cleaner
1687	Piston ring expander
1751 & 1752	Hex cap screw natia large assortment -
	If these are required as they come in pockets of
	100 each one packet should be divided between 4 stations
1753	Assortment of nuts washer etc (one per station)
1803	Corse and fine nuts
1466	table saw
1467	Power Hack saw and blades
1824	Flat washer
1833	lock washers
324	Double Ratchet Puller
326	Chain Hoist
324	Boon crane
423	Tow chains
546	stamp dies 1556 7390 and 15567210
621	Inspection Minoses for Mechanics
961	Fuel pumps
990	Air compressor
993	portable air tank

1196	Battery chargers
1259	Feeler gauges
1268	- 18" level
1414	punch set
1415	chisel set
1429	snips - - - - - - part Nos. 3895A2
1431	cutters 3771A13
1437	nipper and cutters 3738A3
1439	Pliers & cutters
1438	cutters
1440	glass cutters
1451	plain
1461	wood chisels
1462	Band saw wood
1468	Band blades
1475	circular wood saw blades
1476	circular wood saw blades
1479	Hack saw
1480	Hack saw blades
1480	Hand saw, wood
1481	Buck saw for position improvement project " " blades 20 nos.
1482	Files
1483	Files
1501	Bench grinders
1532	6" Electric Hand sander - grinder 230 volts (see sears for 6" model 110V) also order supply of blades as shown on page 1493 of M.C. catelogue 6" reinforced resin straight abrasive wheels also need adapter and nuts for mounting wheels
1536	C Clamps 2 each per station
1550	Vice
1560	Pliers
1574	screwdrivers
1575	screwdrivers
1580	Hex key set
1591	metric Hex key set
1592	Pipe wrenches

1594	Chain wrench	
1595	Vice grips	
1596	adjustable wrenches	
1632	carpenters tool kit	
1634	Electricians tool kit	
1633	Sr. Mechanic tool set	
1649	Pinch bar	
1656	AXE	
1657	Sledge hammer	
1689	Engine test equipment	
1691	tire tools	
1690	Oil filter wrenches	
1697	picks and mattack	
1965	O-Ring cord kits	
339	chain binder	
1473	7¼" circular power saw	
1472	Jig saw and blades	
1365 *	Drill press	*(Type on seperate RFP)
1365 *	Drill chuck and jey	
1366 *	chuck key nos K3	
1366 *	chuck key nos K4	
1366 *	Taper chuck arber for above chuck	
1367 *	Drill sleeve	
	(TYPE ON SEPERATE RFP the following parts)	
1387	12' metal working lathe Pedestal Model No.3191A2 with specifications and equipment as attached photocopy attachment for above lathe	
1387	3/4 HP 208/220/400 moter No.3191A6	
1387	Steady Rest No.30201A3	
1387	Tool post toal set no.3370A14	
1392	Lathe chuck 3 jaw 6" dia with 1½ - 8 threads 3230A5	
1392	6", Four jaw independant chuck 3232A12	
1393	9 pc Lathe tool Holden set 3369A25	

1393	Tool Holders for carbide bits	
1393	Straight shank 3297A11	
1393	Offset shank L.H. 3297A24	
1393	Offset shank R.H. 3297A17	
1393	Extra cutter for threading tool	3310A22
1396	Medium duty line center	3259A11
1402	Tool bits type	
1403	Mashal	
1686	Glaze Breaker complet	6678A12
	set 3 Replaceable stone	6678A13
1686	Engine cylinder hone complete	6673A12
	Fine grit stone	6673A13
	Medium grit stone	6673A14
	Coarse grit stone	6673A 16
1693	Break cylinder hones	
	standard complete	6713A12
	Replacement stones	6713A14

APPENDIX 3

To : Dr. J. B. Henson

From : Ernest W. Nunn

Notes on Farm Tractor and equipment on order and suggested additions.

1. A Industrial type front end loader for 65 H Tractor which can be easily removed and installed would be most useful.

2. The two wheel trailor should be a dump bed type equipped with hydraulic dump cylinder and hose pipe with hose connectors for tractor ordered.

3. A two row planter is required. The specifications should be written around the John Deer 7100 Maxi-emerge planter.

- double disc furrow openers
- Rubber semipneumatic disc scraper gague wheels which maintain contact with the disc furrow opener.
- 2 rubber rimeel seed press wheels per row assortment of seed plats for seeding sorghum, millet, cowpeas, corn and grass seeds if available.
- 3 point category II hitch
- ferterlizer hoppers etc,.

4. Spray - equipment tractor mounted barrel and booms with pump etc (Hudson, John Blue Co or others.

5. Seed processing equipment single head or single plant plate thresher.

6. SEED DRYERS? Smallbed type

Fisher Scientific Company

International Division

52 Fadem Road
Springfield, N.J. 07081
Telephone: (201) 379-1400
Cable Address: Fishersci, Springfield, N.J.
Telex Number: 138287

Overseas Branches

Mexico City
Halley No. 29
Mexico 5, D.F.
Telephone: 545-88-11

Puerto Rico 00908
P.O. Box 13557
Santurce
Phone: (809) 783-5858, 5985
Telex: 365397

Europe, Africa and Middle East
Zeltweg 67
8032 Zurich
Switzerland
Telephone: (01) 32 29 92
Cable Address: Fisceurico, Zurich
Telex: 55496

West Germany
Imhofstrasse 3
8 Munich 40
Telephone: (089) 361 53 43

OUR LOCAL DISTRIBUTOR IS:

LABCONCO SWIRLAWAY

The Labconco Swirlaway® fume scrubber is an efficient, compact and easily installed unit designed specifically for use with laboratory fume hoods.

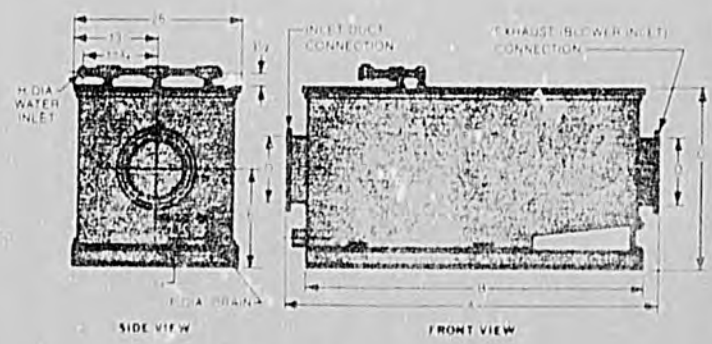
It is lightweight, self-contained and frequently may be used with the existing blower and ductwork. When connected to the exhaust system, Swirlaway® removes particulates and other contaminants so that clean, dry air is exhausted to the atmosphere. Its performance has been proven on water soluble materials including commonly used laboratory reagents, and hard to handle materials such as perchloric acid, as well as other chemicals.

Swirlaway® has no moving parts so it is virtually maintenance free. The durable PVC construction and low profile make it ideal for roof mounting.

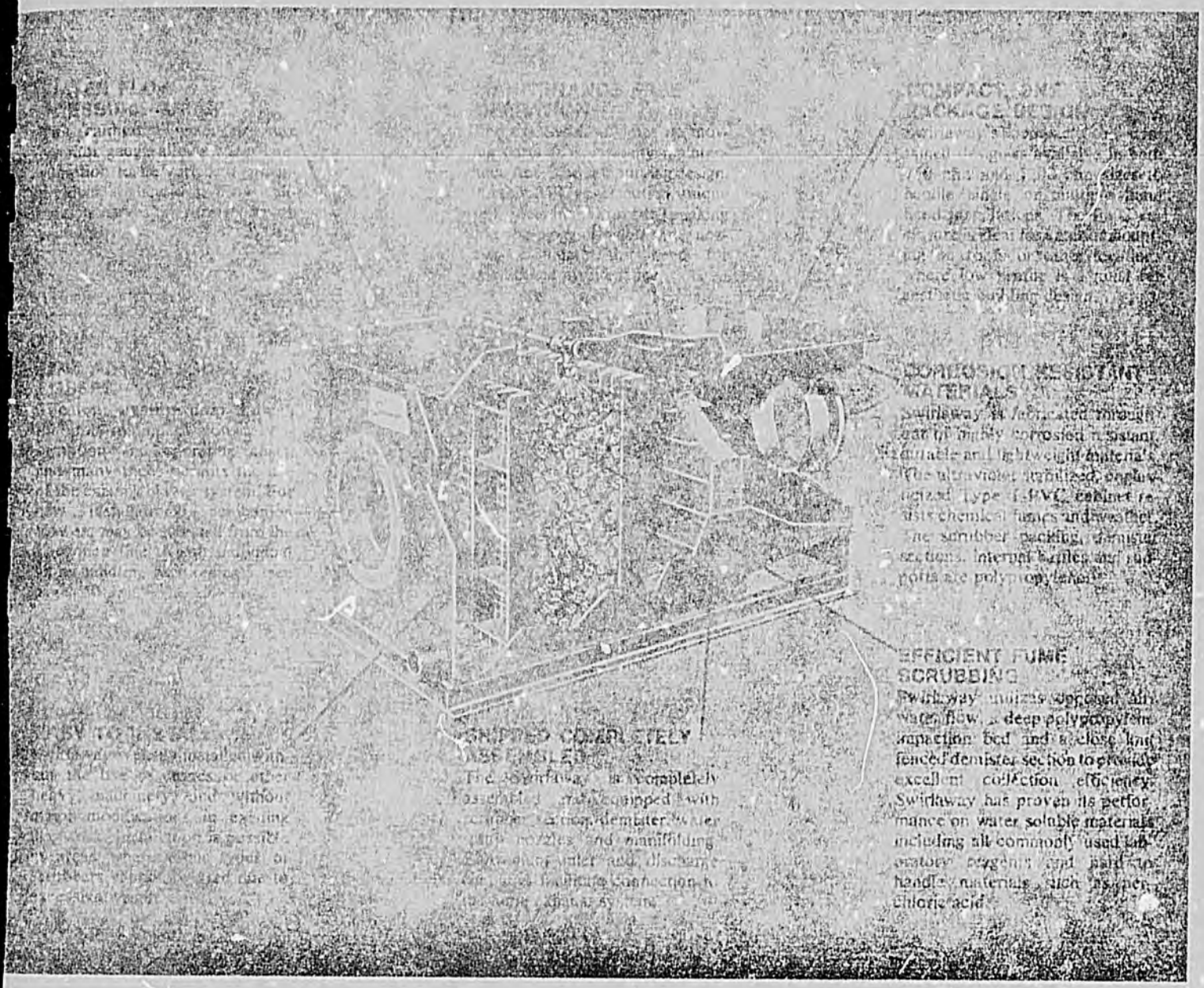
It provides maximum collection efficiency and performance capabilities and is an effective method to maintain environmental safety around your lab building.

DIMENSIONAL DATA

CATALOG NUMBER	A	B	C	D	E	F	G	H
56215	57¾	51¾	27¾	10	12¼	2⅝	1[illegible]	1
56216	76¾	70¾	39¾	12	18	3½	1¾	1½



SWIRLAWAY® FEATURES



SPECIFICATIONS

Catalog Number	Rated CFM	Internal Static Pressure Drop At Rated CFM	Water Usage – GPM	Nozzles	Ship Wt. lb
56215	750	.75" H_2O	1.3 GPM optimum @ approx. 2 psig*	3 – each rated .71 GPM @ 5 psig*	250
56216	1200	1.4" H_2O	2.8 GPM optimum @ approx. 3 psig*	5 – each rated .71 GPM @ 5 psig*	400

*Working pressure indicated on integral pressure gauge.

TYPICAL SPECIFICATION

This specification includes typical data for ordering a Labconco Swirlaway laboratory fume scrubber.

No. 56215 – SWIRLAWAY LABORATORY FUME SCRUBBER Completely assembled with scrubber/demister section and water spray system, rated for 750 C.F.M. with .75" H_2O internal static pressure drop. Cabinet to be ultraviolet stabilized, unplasticized Type I PVC. Internal scrubber packing, demister section, internal baffles and supports to be polypropylene. Shipping weight, 250 pounds.

ACCESSORIES

COMPLETE BLOWER SELECTION

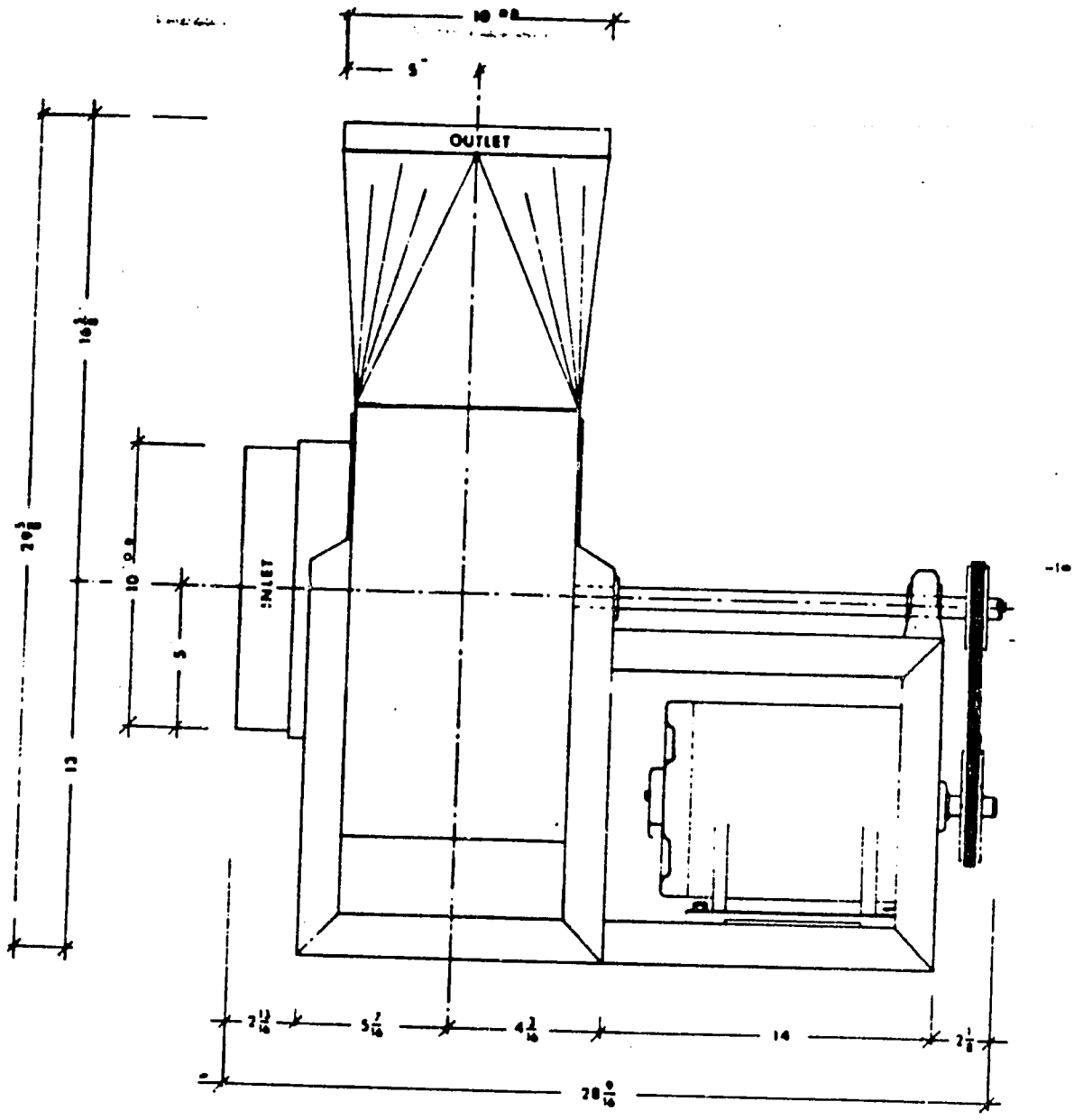
Labconco fiberglass and coated steel blowers for use with the Swirlaway Fume Scrubber may be found on pages 48-57. Blowers with standard or explosion-proof motors and in a full range of cfm capabilities are available.

DUCT AND FITTINGS

Labconco offers a complete selection of thermoplastic duct and accessory fittings for use with your Swirlaway. See pages 56-57.

ENGINEERING ASSISTANCE

Labconco offers engineering assistance to help you in the selection of Swirlaway and related equipment. Contact your nearest laboratory supply dealer.



Performance Characteristics

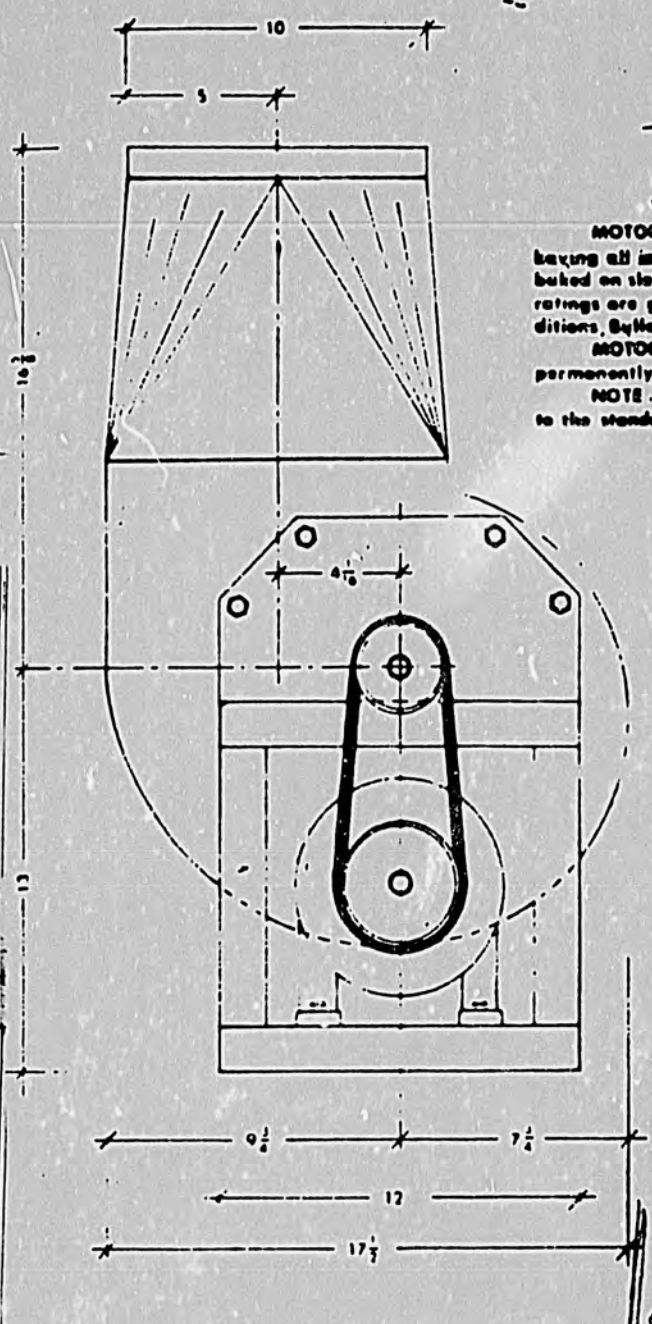
Motor Data

CATALOG NUMBER	WEIGHT	HP	RPM	VOLTAGE	PHASE	HZ	AMPERES	ROTATION
93-8504	100 lbs	3/4	1460	220V	1	50	5.54	CW

Air Delivery (CFM at Stated Static Pressure)

INCHES of WATER	1/2"	5/8"	3/4"	7/8"	1"	1 1/8"	1 1/4"	1 3/8"	1 1/2"
CUBIC FEET per MINUTE	2000	1875	1735	1609	1550	1485	1425	---	---

HP	Horsepower
RPM	Revolutions per Minute
HZ	Frequency (Hertz)
TEFC	Totally Enclosed Fan Cooled
CW	Clockwise



Specs:

93·850M V-BELT DRIVE

MOTOR BLOWER assembly.. shall be spark proof, having all interior and exterior surfaces coated with a baked on slate grey acrylic epoxy enamel finish. Blower ratings are guaranteed accurate under AMCA test conditions, Bulletin 210, Figure 4, Type A.

MOTOR shall be capacitor start type, ball bearing, permanently lubricated, totally enclosed, fan cooled.

NOTE . . . to order an explosion proof motor, add an "E" to the standard catalog number. . . EXAMPLE 93·850E

NOTE . . . . A painted steel weather cover is available on catalog number 93 859

Request for Installation & maintenance manuals.

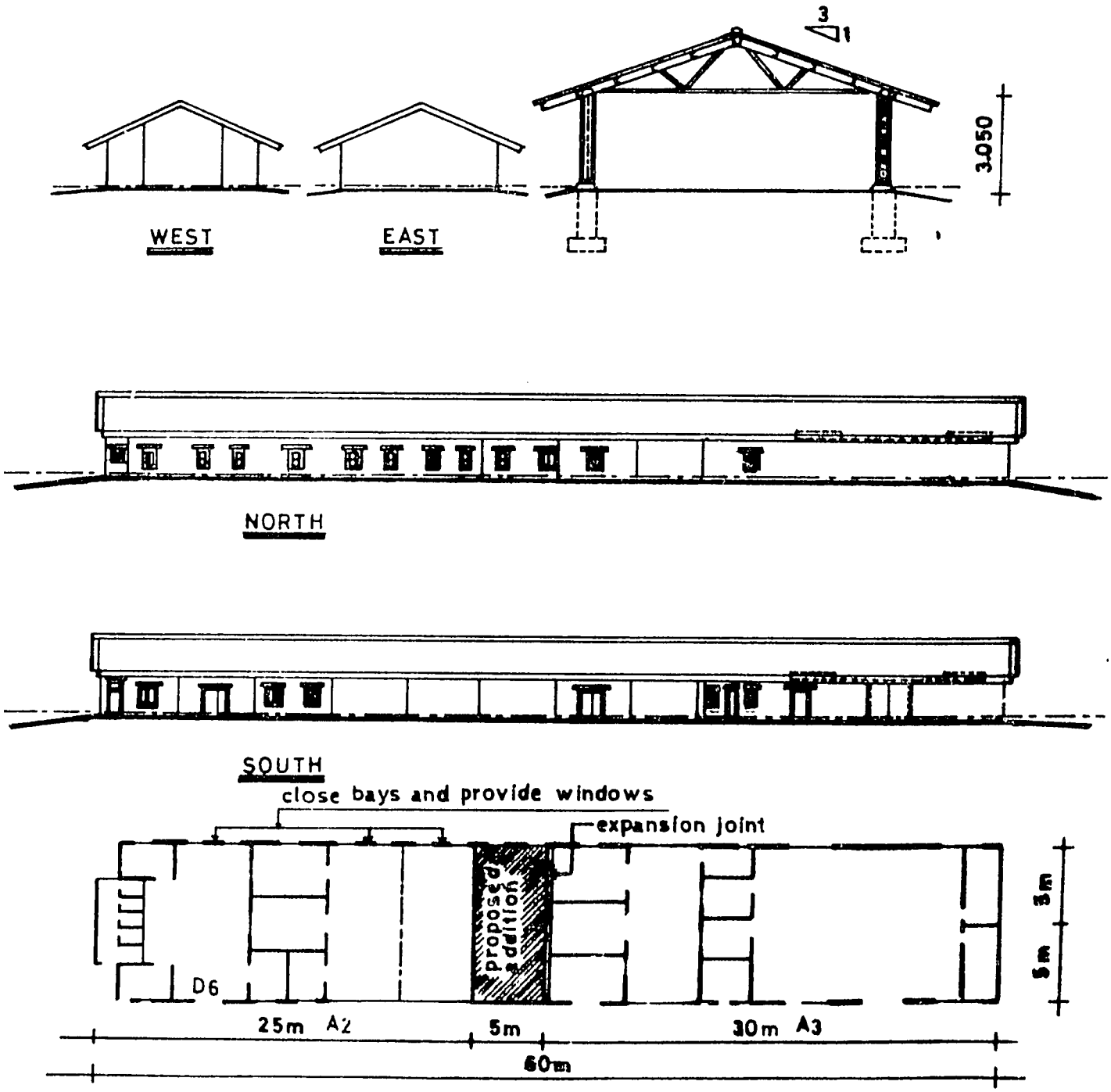
To order with all necessary accessories including fiberglass [illegible] cap, etc.

M = 220V/50HZ/1 Phase.

ORDERED 9 Nos.

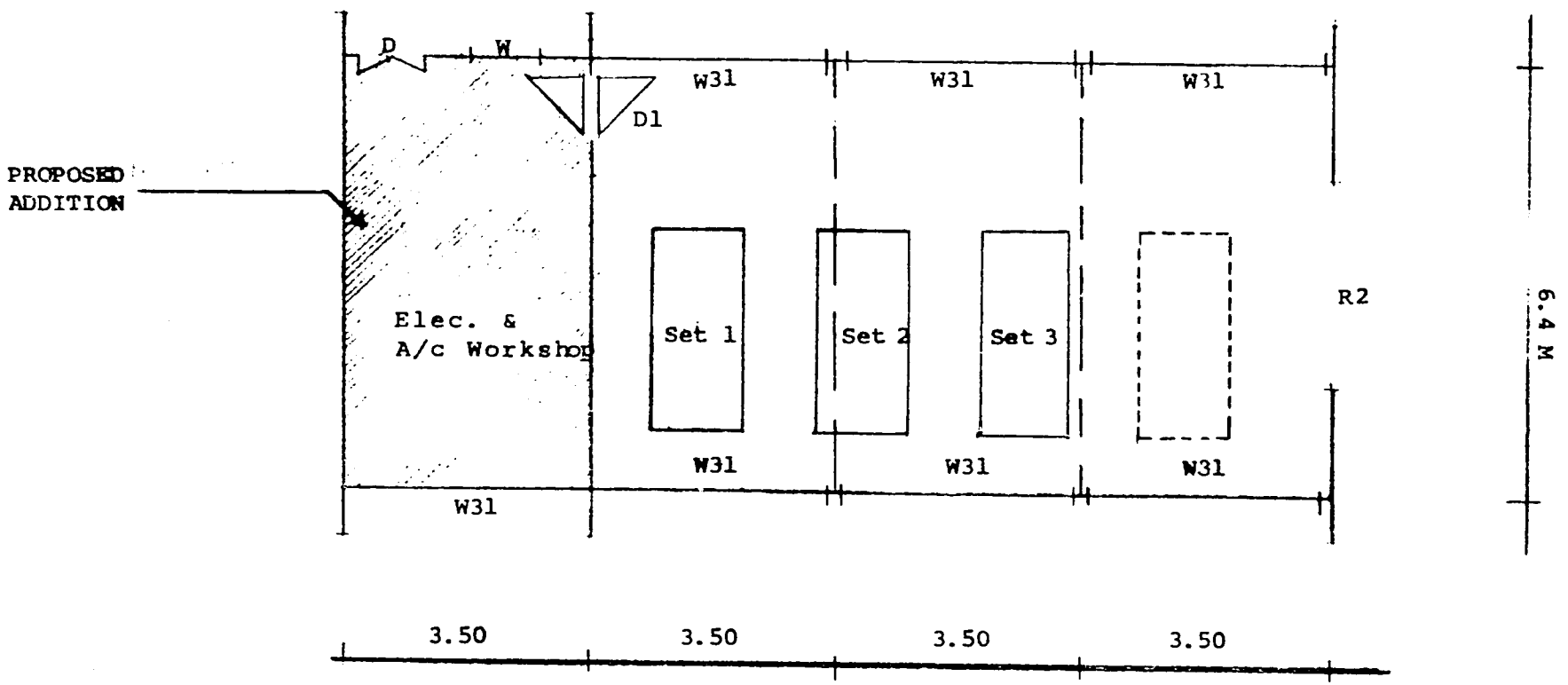
FISHER SCIENTIFIC COMPANY LABORATORY FURNITURE DIVISION			
93·850M V-BELT DRIVE MOTOR BLOWER UNIT			
DRAWN BY [illegible]	DATE [illegible] JUNE 97		SCALE [illegible]
REVISION	DATE	DESCRIPTION	
DRAWING NUMBER INT 0029			SHEET NUMBER 2-2

54



MAINTENANCE AND WAREHOUSE BUILDING Scales 1:400
1:200

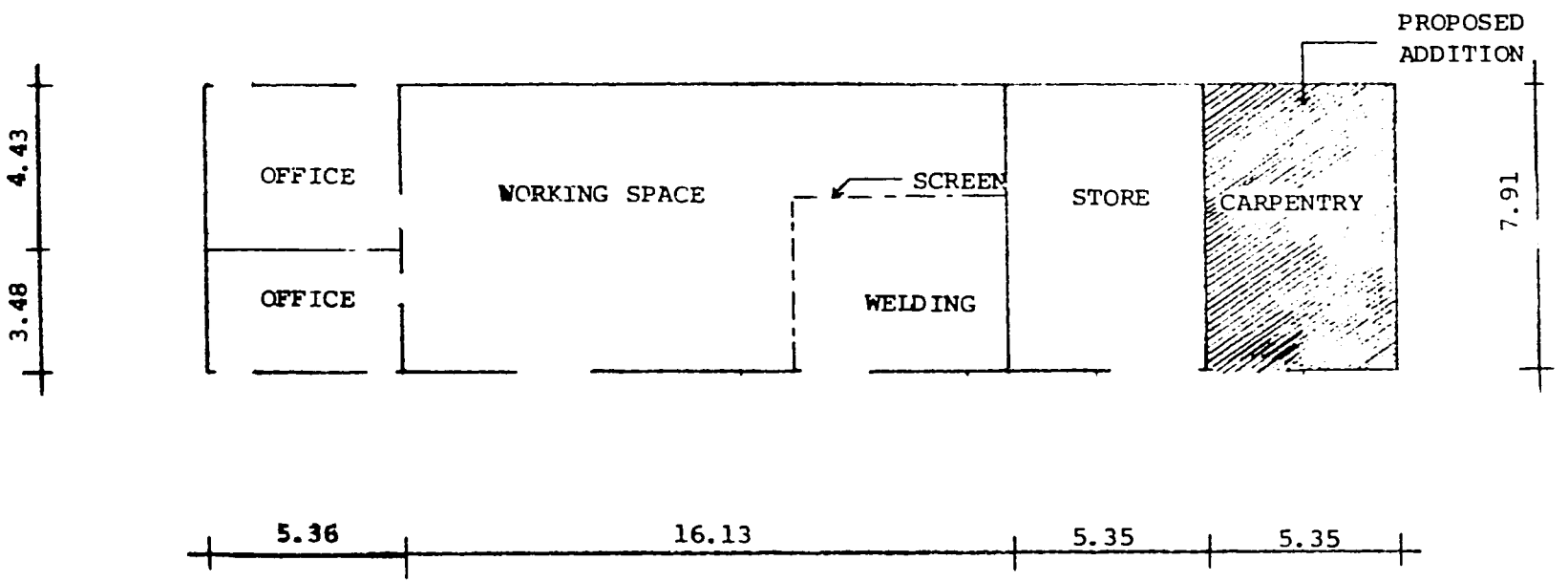
EL Obeid



D - Double leaf
shutter 1.5 m wide

D1 - Double door

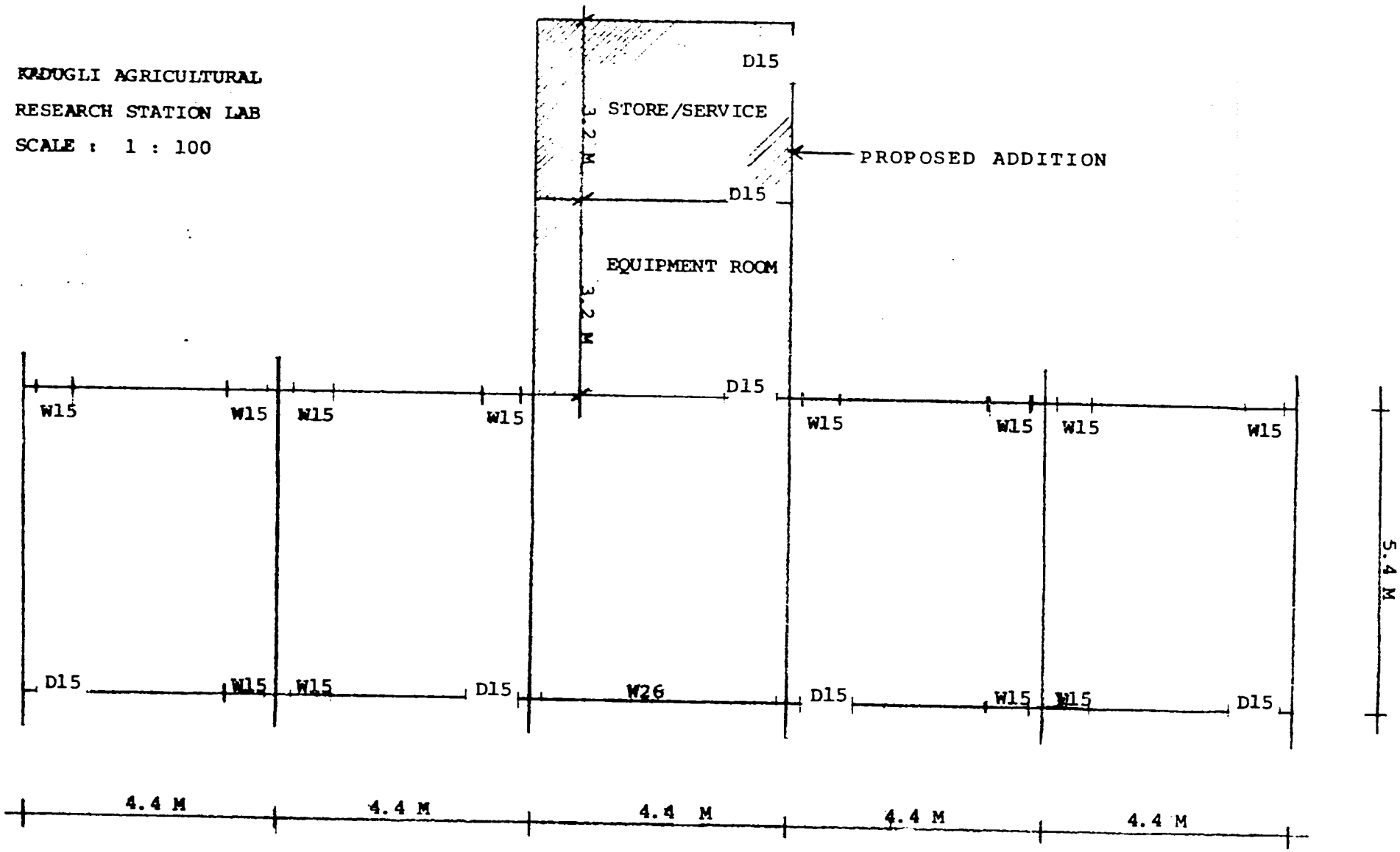
KADUGLI AGRICULTURAL RESEARCH
STATION POWER HOUSE
SCALE 1 : 100

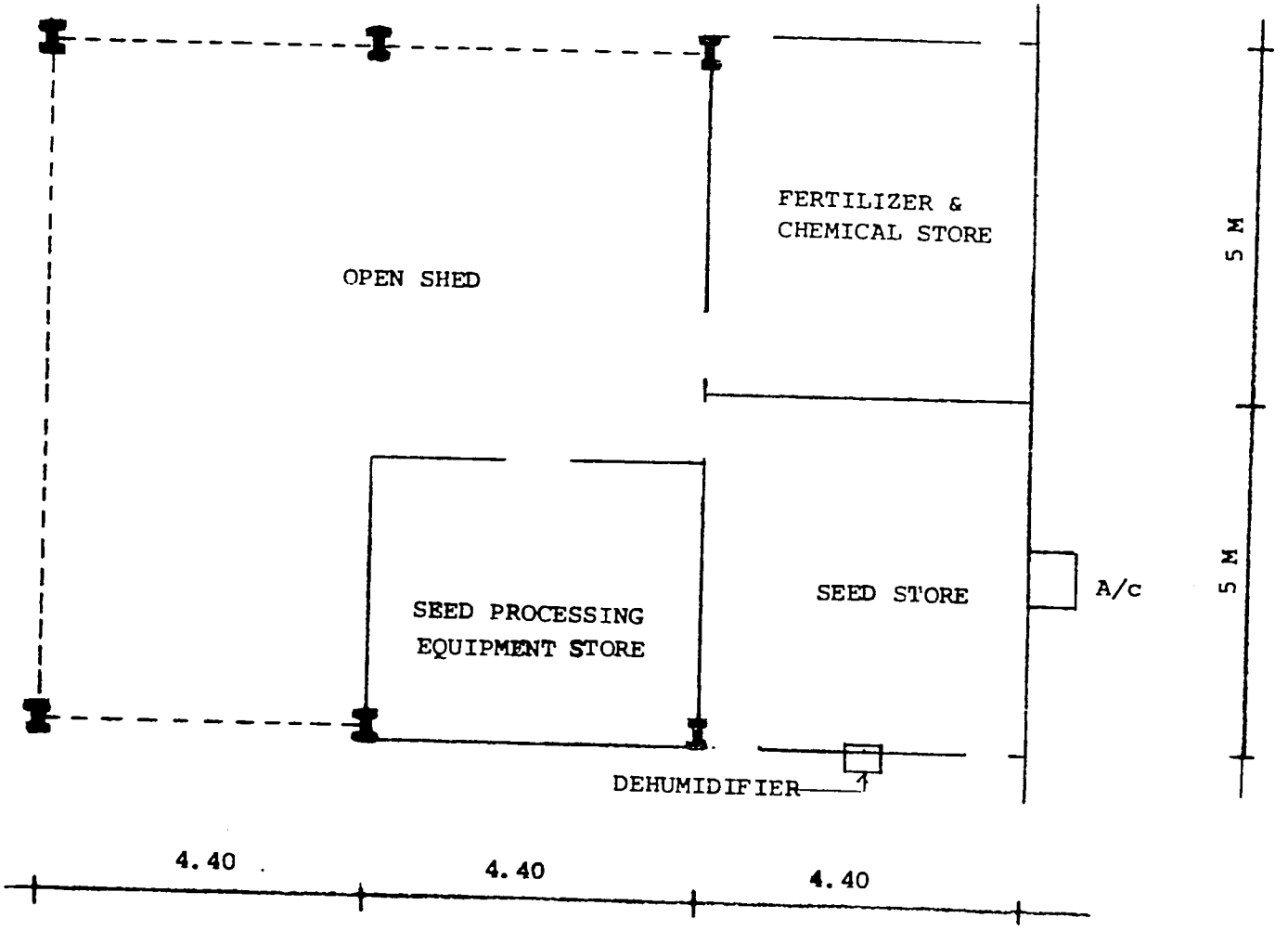


WORKSHOP AT KADUGLI

SCALE 1 : 200

KADUGLI AGRICULTURAL
RESEARCH STATION LAB
SCALE : 1 : 100





CROP WORK
SHED, KADUGLI
SCALE 1 : 100