Wheat Special Report No. 35

Assessment and Development of an Agricultural Research Station: Physical and Personnel Needs

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J.A. Stewart, and F. Gonzalez

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Abstract

The agricultural research station plays a vital role in the generation of both new knowledge and appropriate technologies for farmers. However, despite the importance and complexity of running research stations, there is very little information available on how to develop new stations or improve existing ones.

This special report is divided into two parts. The first deals with a procedure that can be used to evaluate the physical needs of and for a station. The procedure involves four steps: 1) establishing the needs "for" and "of" an experiment station based on the present and projected requirements of the research programs; 2) reviewing requirements with administrators and scientists; 3) preparing a detailed conceptual plan, and 4) preparing a detailed working plan.

The second part deals with some of the management and personnel needs of a station. Management of a station is generally far more complex than most people realize, simply because they do not see the range of activities that a station manager has to handle.

Note: The authors would appreciate any suggestions as to how to improve the procedures outlined.

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Introduction

The agricultural research station continues to play a critical role in improving the scientific understanding of soil-plant-animal systems and developing appropriate affordable technologies for farmers. In recent years, on-farm research (OFR) activities have increased to complement research conducted on the experiment station (IRRI 1987). In some cases, research stations have actually been closed to pursue other research options (e.g., renting farmers' fields). However, despite such occurrences, the success of research depends upon the integration of commodity and disciplinary research conducted both in farmers fields and on experiment stations (Merrill-Sands and McAllister 1988). Therefore, despite changes in research strategies, the experiment station is expected to continue as a key to successful research.

Quality on-station research requires research stations with a high level of management (Hariri 1987). As such, effective station management requires professionally trained and highly motivated staff, properly laid out fields with adequate facilities and good research support services. Despite the importance of these issues, however, and the breadth of activities undertaken on a station there is little in the literature which describes the procedures for developing or maintaining research stations.

This special report focuses on 1) one approach for establishing needs in developing a new station or assessing an existing research station, and 2) identifying personnel needs of a station. The approach to station evaluation has been implemented, either in part or in its entirety, by CIMMYT staff for evaluating, improving, and/or developing the physical facilities of CIMMYT's research stations and research stations in a number of developing countries.

Developing and Improving an Experiment station: Physical Needs

There are two ways of achieving better physical facilities for an experiment station, namely:

- Develop a new station, or
- Improve an existing one.

Both are facilitated by working through the following steps:

- Establishing the needs "for" and "of" an experiment station (based on present and future requirements of the research programs);
- Reviewing requirements with administrators and scientists of the research programs;
- Preparing a detailed conceptual plan;
- Preparing a detailed working plan.

Development committee

The plans should be drawn up by experienced station development specialist(s) working in conjunction with a committee especially appointed for this purpose. The members of the development committee should represent all research and administration programs that will use the facilities.

For brevity, the following discussion is presented in terms of developing a new station. However, it should be apparent which steps are to be pursued when evaluating how to improve an existing station.

Step 1: Establishing the needs "for" and "of" an experiment station

The need "for" a station--To ensure obtaining the maximum benefit from investments in station development, the first step is to establish the need "for" a research station (i.e., clearly state why a station is needed). The following points should therefore be addressed:

- Why is a station needed?
- Could needs be met through some other mechanism (e.g., property rental, on-farm research)?
- How important are the commodities or agricultural system to be studied? An estimate should be made of the area (ha) and number of farmers who would be affected.
- What is the potential for increasing the productivity of the system (i.e., what are the expected returns from the investment? What are the estimates of present and projected productivity?)
- Who will benefit?

The needs "of" the station--Once the need "for" a station has been clearly established, the needs "of" the station can be developed (i.e., what does the station need to function). It is imperative that a master plan be developed before commencing work to establish the station. All decisions made at this juncture will play a critical role in the future management of the station.

The master plan should include both immediate and future (e.g., next 5 to 10 years) needs. Three areas need to be covered by the plan, namely: 1) environment (**Table 1**); 2) human resources (**Table 2**), and 3) physical resources, including architectural and civil engineering needs (**Table 3**). In developing the plan, the points listed in Tables 1-3 can be used as a check list.

Table 1. Points relating to the environment that should be included in draft plans before proceeding with station development.

Objectives

Brief description of station objectives.

Environmental conditions

Weather

- Collect data available for the site. If not available, obtain as much data as possible from nearest weather station. Data should include: rainfall, temperature, wind velocity, humidity, evaporation, and other pertinent information (e.g., proximity to rivers, risks of floods, storms, etc.)

Soil

- Classify soils by their chemical and physical characteristics (i.e., texture, structure, depth and stratification, water infiltration rate, moisture holding capacity, cation exchange capacity, nutrient status, pH, organic matter).

Vegetation

- Identify types of vegetation and species of plants, trees, etc.

Topography

Develop:

- Map (scale: 1:2000; i.e., 1 cm = 20 m) of stations with an area of 100 ha or less and a map (scale: 1:5000; i.e., 1 cm = 50 m) of stations having areas greater than 100 ha.
- Map (scale: 1:200) of areas where buildings and residential houses will be.
- Map with 1 m contour intervals for contours more than 200 m apart (i.e., slope $<$ 0.5%) or half this if contours less than 200 m apart (i.e., 0.5 m contours for land with a slope $>$ 0.5%).

Estimate:

- Total number of hectares required to meet program needs (crop, forage, pasture, animals).
- Crop cycles per year and planting dates.
- Area under irrigation and rainfed conditions, for each cycle and each crop.

List:

- Crop rotations and what cover crops, if any, are used.

Table 1. Continued.

List:
- Planting practices for each program, giving plot size and row spacing required for each.

Designate:
- Introduction blocks for quarantine purposes.
- Areas for specific research activities having residual effects (e.g., herbicide and fertilizer trials).

Water
- Develop map showing water sources.
- Estimate peak water consumption (field, offices, and residential areas)

Evaluate:
- Water quality and remedial action required.
- Depth of water table.

Natural pests
- Identify disease, weed and insect pressures, and potential interactions with research.

Expected land use in the surrounding area
- Estimate predicted urban development around the station. The use of chemicals and water can influence the long-term viability of a station, particularly when a station becomes surrounded by housing. Chemicals associated with potential health risks may be a concern, and urban development may compete for water.

Table 2. Points relating to human resources that should be included in draft plans before proceeding with station development.

Staffing

Develop lists showing:
- Organizational charts showing how scientific and support programs are staffed, managed, and intercommunicated.
- Present training requirements.
- Expected training requirements.
- Availability of permanent labor, temporary labor, and craftsmen.

Table 3. Points relating to physical resources that should be included in draft plans before proceeding with station development.

Station needs

Develop lists showing:
- Equipment needed for general fields and research plots, laboratories, buildings, animal traction, vehicles, irrigation systems (pumps, tubing, and underground main), and fuel storage. Note whether earth moving equipment is available, either from private or government agencies. Details should be given on the work space needed per piece and any special requirements (safety, ventilation, power supply,

Table 3. Continued.

Develop lists showing: etc.). Equipment sheds and parking spaces should take into account present and future needs. • Availability of services for skilled mechanics, workshops, dealerships, etc. • Building plans and space required for administration, program offices, laboratories, workshops, residential area, equipment, seed handling and storage, fuel storage, incinerators, and disposal of unwanted (toxic) materials.
Station layout
Develop a station map showing: • Field layout: plot location, size, and orientation, headlands, irrigation hydrants or canals, plot and road drainage systems (both above and below ground), threshing areas outside of plots (critical to avoid threshing in the fields, which gives rise to volunteers in the following cycle). • Building layout: facilities, residential areas, waste disposal, sewage and water treatment, recycling (good access among work areas and from them to the field; they should be well separated from residential areas. Layout should ensure that movement between buildings is as efficient as possible.) • Areas to be left without land forming. • Roads, paths, bridges, types of fencing, power lines, wells, and telephone lines.

Site identification--The crop(s) and/or animals of interest, along with the desired characteristics of the production environment (e.g., rainfall, temperature, and disease pressure), give a first approximation to the agroclimatic zones that are potentially suitable for a research site. Next, desired soil characteristics further define potential sites. When available, both soil and agricultural productivity maps should be consulted and analyzed. Several potential locations should be examined before the final selection is made. Historical weather information should be collected and analyzed to check for desired or adverse climatic conditions. Background information on other natural phenomena and crops should also be collected from long-standing records and local residents. Criteria for rejecting a site or selecting it for further analysis are outlined in **Tables 4** and **5**. Geographical information systems (GIS) now present powerful tools for developing regional maps based on climatic, soil, and even socio-economic conditions. Such maps greatly facilitate identification of appropriate sites and the extent to which they represent key parameters of the region.

Table 4. Factors to consider when establishing a new station or evaluating an existing station.

Land and water needs

Ensure that:

- Sufficient area for present and future programs and building needs.
- There is a "buffer" zone between the station and population centers. The probability of urban development around a station needs to be considered, as well as the likelihood of such development leading to problems of station viability
- No limiting factors exist for land improvement or for irrigation (were it required)
- There is water of acceptable quality and quantity for both domestic and field requirements

Electricity and communications needs

Ensure:

- Proximity to electrical supply, with sufficient capacity for all foreseen future requirements.
- Good communications (telephone, radio, telex, Internet, etc.)

Staffing considerations

Ensure:

- Sufficient local labor.
- Access to adequate medical facilities, schools, etc., for staff and labor.
- Area is free from diseases and other natural hazards.
- Access to suitable transport (roads, bus service, airport, etc.).

Table 5. Points to check before purchasing land for a new station.

- Make sure that all land titles are in order.
- Check for any "right of ways" that may exist on the property; if they do, how to re-route them.
- Agree with neighbors on exact location of common boundaries.
- Evaluate growth potential.
- Obtain as much historical data as possible on previous crops and agricultural practices.

Potential sites should be listed in order of desirability. The soil of the top three sites should be extensively sampled (e.g., 50 x 50-m grid) in order to evaluate chemical (especially pH), physical (drainage), and depth characteristics. This step need not be prohibitively expensive, as field pH test kits and field observations by experienced scientists will often provide sufficient detail. If feasible, both the crops of interest and indicator crops (**Table 6**) should be planted at the three sites before proceeding with development. If planting the site is not feasible, soil samples can be taken across the area and greenhouse pot trials conducted to assess potential soil problems. Because of their sensitivity, indicator crops will aid in identifying soil deficiencies and potential problems--otherwise the main crops to

Table 6. Indicator crops. Adapted from Chapman (1966).

Nutrient	Indicator crop(s)
N	Cereals
P	Maize, Tomatoes, Lettuce
K	Legumes, Maize, Cotton, Potato, Tomato
S	Legumes, Crucifers, Rice
Ca	Legumes
Mg	Maize, Cauliflower, Broccoli, Potato
Cu	Wheat, Alfalfa
Zn	Maize, Sorghum, Cotton, Beans, Tomato
Mn	Cereals, Pea
Fe	Cereals
B	Sunflower, Canola, Broccoli, Cauliflower
Mo	Cauliflower, Cabbage, Legumes, Lettuce, Tomato

be grown should be used in the trial. All the points in Tables 4 and 5 should again be considered prior to starting any rehabilitation or development work.

After a site is selected, ecological concerns need to be addressed as station cropping areas and plots are being developed and formed. A common procedure is to set aside a fenced plot, 1-2 ha in area, in an isolated part of the station, in order to preserve, as a reference point, the original flora of that particular region. Other environmental concerns, such as future housing development around a station, should also be considered. Such urban development may threaten the long-term viability of a station, particularly if certain practices (e.g., chemical applications and dust from tillage) are of potential concern to surrounding inhabitants.

Defining needs--It is essential that all necessary data (Tables 1-3) be collected. The station development specialist(s) and the special committee should identify constraints and the research programs' specific needs. The meetings will help establish a dialogue that is essential for station development. A series of alternate drafts and scenarios should be prepared and weighed against the needs of research programs and natural constraints. The developer(s) should attempt to clearly meet the needs of the programs while respecting, to the extent possible, financial limitations and environmental and ecological requirements.

Step 2: Review of requirements by administrators and scientists

Once a draft of the master plan is ready, it is discussed with and approved by administrators or their designates. It is then presented in an open meeting to all concerned scientists, their directors, the development specialist(s), and the development committee.

Although the draft plan will likely need modification, it is useful because it focuses the discussion and planning. Without such a plan, discussion sessions often lead to indeterminate and inappropriate conclusions. All pertinent suggestions from the meeting are considered and incorporated.

The next step is for the developer(s) and the committee to discuss with the research programs any detailed requirements (e.g., for particular field practices, specific building and laboratory needs, and special plot and research equipment). The meeting with the programs should be preceded by "departmental" meetings to discuss and clarify those special requirements.

Again, it is important to emphasize that these meetings and open participation give people the opportunity to report their specific needs and get involved in the planning process.

Step 3: Detailed conceptual plan

Once data on specific needs have been obtained from all concerned research programs and administration, the development specialist(s) should begin drawing up detailed plans and estimating costs of individual activities. The detailed conceptual plan should cover:

- The field layout (Table 3).
- Buildings and layout (Table 3).
- Machinery and equipment (Table 3).
- Development phases. This section should outline the sequence of activities and their time frame. It should also identify activities needed to initiate and complete a phase.
- Estimated costs. This section should give a comprehensive cost outline for all development phases. It should also indicate what funds will be needed at what stage of the development, and the guidelines for judging the work as acceptably completed (i.e., quality standards).

The plan is then thoroughly discussed with the development committee, administrators, and others involved to ensure that: 1) all requirements have been covered; 2) if it did not already exist, an efficient station management system is in place, and 3) necessary training at all levels is built into the plan.

Step 4: Detailed working plan

After the scientists have approved the draft plan, funds will be released in order to start drawing up the detailed working plan for development (plot layout and development, building plans, specifications, etc.). This step often takes time (six months to a year), but can be very effectively used for planning field activities, preparing timetables for development events, training station managers and other key personnel staff, both on site and, if necessary, overseas.

Due to the typically large investment that will be made in developing a station, the planning stages should not be rushed. A little extra time and thought invested during the planning can prevent future difficulties and unnecessary costs.

Developing and Improving an Experiment Station: Personnel Needs

Managing a research station is generally much more complex than most people realize. Few people have appreciation for the wide range of skills required. For example, generally scientists are only concerned about having a plot or field ready to plant--they are not interested in or often even aware of the myriad of other activities required to perform that simple operation (e.g., how one maintains the machinery to get the land ready, how one contracts the labor or pays the insurance for the workers, where the fertilizer was bought from, etc., etc.). Thus, few people have the experience to clearly state what personnel are required and/or how they should be organized. The following discussion outlines a simple procedure that will help in establishing such needs.

In establishing the personnel needs of station, firstly, the activities involved in running a station need to be defined. **Table 7** presents a summary of the activities typically carried out on a station. Very generally, the activities can be divided into five categories:

- Administration,
- Field operations,
- Maintenance,
- Stores,
- Control.

Typically, depending on the size of the research station, a single person can not handle all these activities. Thus, to establish the personnel required to run a station, an organogram such as that presented in **Figure 1** can be used in combination with Table 7 to help identify requirements; decisions can be made as to what are the needs, how these needs can be met, and what staffing structure may be most appropriate. For example, a station has machinery management requirements. This need implies both operators and maintenance for the machines will be required. However, either or both of these needs may be met,

Table 7. List of activities generally conducted on a research station.

Administration

General

Accounting
Cash and Banks
Contracts
  Construction
  Development
Insurance - equipment and buildings
Payments of:
  Utility
  Water rights
  Land taxes
Public relations
Purchases
Reports
Sales
  Equipment
  Produce
Stores control
Tracking operation history
Visitors

Personnel management

Contracts
Federal registration
Hiring
Housing tax inscriptions
Housing tax payment
Income tax retention
Insurance inscriptions
Insurance payments
Payroll preparation
Social security registration
Social security payments
Vacation planning and payment
Bank loan management
Worker's files
Training

Programs

Accounting
Labor
Purchases
Stores
Training

Field Operations

Field

Chemical applications
Cultivation
Grain
  Drying
  Storage
Harvesting
Irrigation
Land allocation
Land preparation
Pest control
Planning
Planting
Plot preparation
Rotations
Seed handling
Training
Transport

Table 7. Continued.

Field Operations	
Personnel	
Interprogram coordination	Planning
Management	Training
Allocation	
Control	
Supervision	
Maintenance	
Buildings and grounds	Fencing and boundaries
Building water supply	Field irrigation system
Drainage	Machinery
Electrical system	Roads and bridges
Equipment	
Stores	
Fuel and gas	Chemicals
Lubricants	Program needs (e.g., pollination bags)
Spare parts	
Control	
Meteorological station	Vehicles
Security	

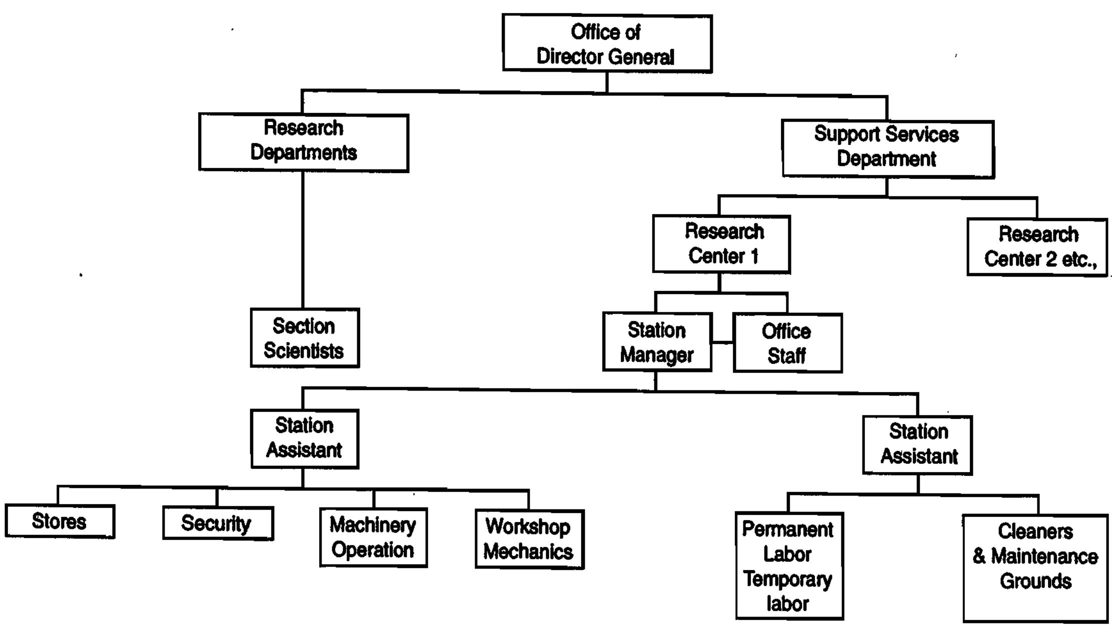

Figure 1. Scenario for Research System Organization.

fully or in part, by hiring from outside, and thus the number of permanent staff and costs may be reduced.

Once the staffing requirements and structure are decided, some operational guidelines need to be established. One of the key features of managing a station efficiently is to have a person with both the responsibility and the power to make decisions and take action. Often times, however, a station manager has the responsibility, but not the power, and thus they find themselves constantly faced with demands that they are unable to make, or decisions they are unwilling to make due to the inefficiencies associated with the request. Generally, these problems arise due to insufficient resources to cover demands, or a lack of understanding by the scientist as to the inefficiencies involved in their request. These problems can be illustrated by the following example.

Imagine any station:

- Fact: For any given scientist, his or her work is the most important.
- Fact: For any given scientist, his/her work has priority.
- Sometimes fact: When limitations are explained to scientists, they are willing to cooperate to help make a system more efficient.

If the scientists have the limitations or problems clearly explained to them, then simple communication of needs, problems, and solutions often suffice to avoid friction and help improve the efficiency of running station. However, if a scientist fails to see the logic, then the station manager either needs support from someone with authority or must have the authority themselves to be able to decree the course of action. At times, due to research demands, a certain amount of inefficiency may need to be tolerated. Under such circumstances, the scientists should have sufficient budget allocations to cover the costs associated with such nonstandard practices.

Conclusions

The steps spelled out in this special report can be used equally for assessing a station in existence and its relevance for further development. The methodology can alternately be used to determine if a station should closed down.

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