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COMMODITY PROGRAM PRIORITY SETTING: THE EXPERIENCE OF THE KENYA AGRICULTURAL RESEARCH INSTITUTE

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The past decade has seen the development of a number of alternative approaches to formal priority setting in agricultural research. The challenge for national agricultural research institutes is to develop procedures adapted to the needs of their organizations. Crucial factors in this choice include internal and external demands for priority setting, the information available, and the level of participation desired from both within and outside the institute.

This Briefing Paper presents a process for national commodity-program priority setting designed to explicitly address these factors in the Kenya Agricultural Research Institute (KARI). An examination of the existing priority-setting process revealed a need to deepen the institute's information base through program-level exercises that identified priority research themes and geographical areas. A collaborative effort by KARI and ISNAR set up a five-step process that synthesized information on client constraints, expert opinions on the potential for generation and adoption of technologies, and quantitative georeferenced data on climate, soils, population, prices, and production levels.

The process first compiles an information base on a commodity and then identifies research-program target zones, assesses the potential for technology generation and adoption, estimates research-induced benefits, and establishes priorities with stakeholders. Detailed descriptions of each step are provided here and are illustrated with an example from KARI's sorghum program exercise. This paper concludes with a report on the progress of the national commodity programs in implementing the process and lists a number of lessons learned, which may be useful for other NARS making similar investments in priority-setting processes.

Additional information on this procedure is available from the Socioeconomics Division of KARI, or from ISNAR.

The Need for Priority Setting

As resources available for agricultural development become increasingly scarce, it is essential that public-sector agricultural research institutes clearly identify priority areas for further research. Priority-setting exercises can increase the efficiency and relevance of the research agendas of national agricultural research institutes (NARIs) by structuring information on environmental, production, and market conditions and focusing attention on client constraints and the potential of research to address those con-

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straints. A clear and systematic presentation of priorities also allows NARIs to take a proactive role in soliciting government and donor support for areas identified as vital to agricultural development efforts. Priority-setting processes can also be used to broaden participation in formulating the research agenda to include stakeholders and clients outside the institute, thereby increasing the institute's constituency base.

Priorities must be set at several levels within an agricultural research institute. For instance, the Kenya Agricultural Research Institute (KARI) is structured across three levels: institute (across research stations and programs), program (national and regional), and project. After KARI's inception in 1986, research priorities were set informally by senior management. This priority-setting focused at the institute level and involved ranking commodity and factor research programs. Institute-wide priorities were then reexamined with the assistance of a scoring model in 1991.

The 1991 exercise highlighted the benefits of a structured priority-setting process; however, it also gave rise to concerns about the quality and quantity of information individual research programs were able to provide for the exercise. There was an expressed need to compile information systematically for more in-depth program-level priority-setting exercises. Program-level exercises were also essential to identify research themes and geographic areas where research efforts could be further concentrated.

In 1994, KARI and ISNAR started developing a process for program-level priority setting that included the systematic collection of basic information, which would provide a basis for identifying the potential benefits of specific research themes for targeted zones within Kenya. As part of this process, initial estimates of research benefits are developed by a priority-setting working group (PSWG). A program research advisory committee (PRAC), composed of major program stakeholders, then reviews the initial results and establishes program priorities. The PRAC also uses these priorities as the basis for an annual review of the relevance of proposed and on-going projects. Similar priority-setting processes are now being piloted with regional and factor research programs. The results of these program-level priority-setting exercises will then form the basis for future reevaluation of cross-program priorities at the institute level.

A Five-Step Process

The priority-setting process combines information on client constraints with expert opinions on the potential generation and adoption of technologies, with quantitative georeferenced information on climate, soils, population, prices, and production levels. There are five steps for synthesizing and using this information in decisions on resource allocation:

Step 1. Compiling the information base

Step 2. Identifying program research target zones and research themes

Step 3. Eliciting the potential for technology generation and adoption

Step 4. Ex ante estimation of research-induced benefits

Step 5. Establishing priorities with program stakeholders

Since this is a program-based exercise, the primary responsibility for its completion lies with the program coordinator. The coordinator is, however, assisted by the program socioeconomist and a priority-setting facilitator from the Socioeconomics Division. Major information inputs into the exercise are provided by the PSWG, which is composed of 10 to 12 disciplinary and regional commodity experts from the research and extension services. The PSWG is constituted by the program coordinator. The assumptions, estimates, and results of the working group are then reviewed by the PRAC. This group is normally composed of 30 to 40 representatives of farmer associations, extension services, processors, input suppliers, traders, policymakers, and other research institutes with interests in the program. The outputs from the PRAC are a list of priorities and a set of resource-allocation guidelines to direct future program development. Details of each step, along with highlighted examples from the KARI sorghum program, are provided below.

Step 1. Compiling the information base

Information is a crucial input into any priority-setting process. The program coordinator, with assistance from the program economist, must identify sources of information in three areas:

- **Client constraints** form the basis for research program development. Information on client constraints is often collected through informal and formal surveys. Many programs have made considerable investments in individual studies and have produced a diffuse set of documents. The program socioeconomist may therefore have to distil constraints from these efforts. A review of available information on client constraints can also assist the program in identifying areas where further investment in information may be warranted. Extension workers and other stakeholders provide supplemental information on

client constraints during the priority-setting exercise, based on their field experiences.

- **Current program structure and results from previous research** provide important information on the resources, particularly human, available to the program, as well as the potential performance of future technologies. The program coordinator should provide information on current program resources in terms of personnel and projects. Previous studies of the geographic variation in commodity production, as well as georeferenced data on key environmental determinants of production, are also useful for stratifying the broad geographic mandate of the program into research zones.

  Information on previously released technologies is best obtained through historical adoption studies. Unfortunately, data on the adoption of previously released technologies is rarely available across the program's mandate area for the range of potential technologies. Available information can be supplemented by the experience of extension personnel with the dissemination of previously released technologies. Similarly, research results identifying the yield potential of alternative technologies as well as the yield gap between station results and farmers fields can provide an important benchmark for technology evaluation. PSWG members are responsible for identifying relevant results within their areas of expertise.

- **Market data** provides information on the importance of the program's commodity within the economy. However, district-level area and production estimates, as well as commodity prices, are also required as historical benchmarks on the sector's performance. In Kenya, agricultural production and pricing statistics are available from the Central Bureau of Statistics (CBS) and the Ministry of Agriculture, Livestock Development and Marketing (MOALD&M). For individual crops, other aggregate statistical sources also exist, such as the Department of Resource Surveys and Remote Sensing for maize and wheat, and the Horticultural Crops Development Authority for horticultural export crops. A substantial initial investment is often required on the part of the program socioeconomist to assess the availability and quality of aggregate statistics. However, once contacts are established with individuals in organizations collecting this type of information, little additional investment is required for periodic updating by the program.

  The major quantitative and qualitative sources of information compiled by the KARI National Sorghum Program are listed in table 1.

Table 1. The Information Base for Sorghum Program Priority Setting

Information	Source
Client Constraints	
Farmer Constraints to Sorghum Production	Rural Appraisals and Field Experience
Program Structure	
Current human resources and projects	Program Coordinator
Georeferenced agroclimatic data	Kenya Soil Survey, CIMMYT and ICRAF
Agroclimate suitability of sorghum	Expert opinion
Previous Research	
Sorghum yield gap	Sorghum program experimental data
Adoption of previously released technologies	Adoption studies, extension observation
Market Data	
District production data	Central Bureau of Statistics and Ministry of Agriculture
Spatial price data	

Step 2. Identifying program research target zones and themes

After an information base is established, the PSWG develops a spatial and thematic framework for the analysis of program priorities.

- **Research target zones** are established by the PSWG, based on expert opinion about the key environmental determinants of commodity production and criteria ranges for those determinants. These criteria and their ranges are used to divide the mandate of the program into areas where the expected biophysical impact of new technologies will be fairly homogenous. A simple software program was developed to allow the PSWG to use a GIS database to experiment with alternative classifications and derive a scheme tailored to the specific circumstances of the program. Once consensus is reached on an appropriate scheme, zone commodity area and production estimates are imputed from district level area and production data.

  In the sorghum program, elevation, temperature, and rainfall were considered to be the key environmental determinants of production. The PSWG identified four target zones based on the criteria shown in table 2. A map of these zones is shown in figure 1. The results found sorghum production to be heavily con-

Table 2. Target Zones for Sorghum Research in Kenya

Zone	Elevation *(meters)*	Rainfall *(millimeters)*	Temperature *(degrees C)*	Production *(1000 mt)*
Humid Coastal	0–250	225–500 March-June, 50 March-April, & 40 June	not applicable	0.02
Semi-Arid Lowlands	250–1150	250–525 March-July or October-December	>11 (average minimum, July)	13.85
Moist Mid-Altitude	1150–1750	500–1250 March-July	not applicable	61.20
Cold-Dry Highlands	1750–2300	40 March-April	>5 (average minimum, July)	3.53

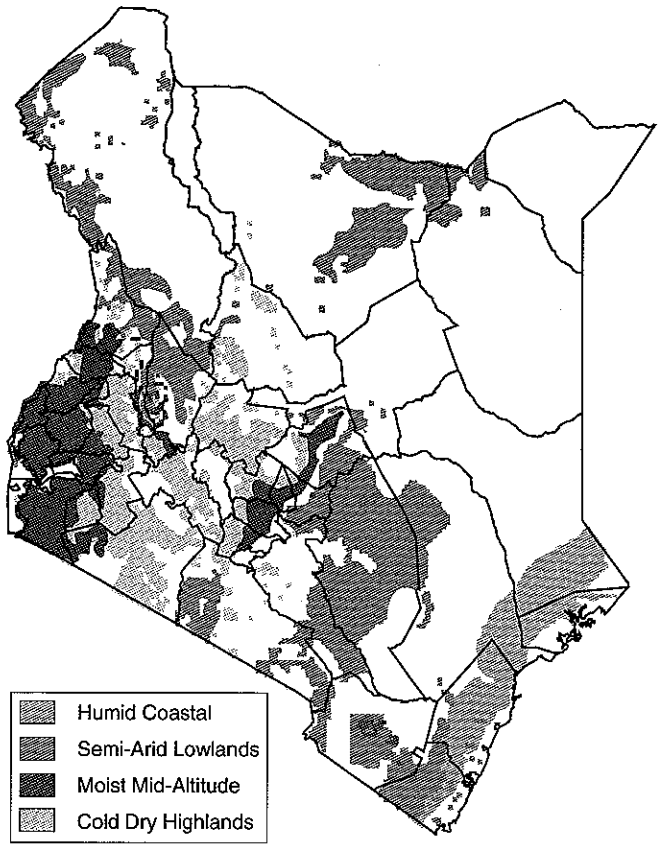

Figure 1. Target zones for sorghum research in Kenya

centrated in the moist mid-altitude zone. The semi-arid lowland zone is second in terms of both area and production.

- **Research Themes** are also established by the PSWG. For each zone, major client constraints are identified either through extensive listing of constraints or through constraint tree analysis. From our experience, extensive listing works well for commodity programs with a good information base on client constraints. Constraint tree analysis is useful in programs where constraints are nested within complex production systems. Research themes are then developed around sets of research activities that address major constraints. In addition, all programs have included a "technology dissemination" research theme that focuses on improving the flow of existing technologies to extension, farmers, and other program clients. The PSWG also identifies the human resources allocated to each program theme by zone.

  For example, in Kenya, after identification of research target zones, all constraints affecting sorghum production and use were listed for each zone. Activities to address major constraints were then aggregated into four major research themes: varietal development, crop management, technology dissemination, and processing, use, and storage. The varietal development theme, for example, was established for the humid coastal zone to address the following farm-level constraints (ranked by importance): (1) climate stress (heat and humidity), (2) stem borer, (3) striga, and (4) grain mold.

Step 3. Eliciting the potential for technology generation and adoption

The potential for generation and adoption of technologies that address identified constraints is then reviewed through a structured elicitation process during a two-day meeting of the PSWG. The exercise is carried out with guidance from the priority-setting facilitator, and the following parameters for generation and adoption of technologies are estimated, based on the current allocations of program personnel to identified themes and zones:

Potential for technology generation

- minimum, most likely, and maximum expected yield gains
- costs associated with use of alternative technologies
- threshold net yield gains necessary for dissemination of technologies

Adoption profile

- time frame for research and development
- number of years from release to maximum adoption
- time from maximum adoption to both start and completion of disadoption
- maximum percentage of commodity producers likely to adopt the technology

The outcome of research is not realized immediately and results cannot be directly imputed from experimental data or historical trends. Thus, expert opinion must also be used to predict potential yield gains and technology adoption. However, biases inherent in subjective estimates must be guarded against. The process described here contains three elements to mitigate potential bias. (1) Estimates are compared with benchmark information on yield trends and the adoption of previously released technologies. (2) Elicitation of potential research impact occurs within a group setting, which reduces strategic behavior by individuals and develops a consensus on realistic assumptions. (3) Assumptions are reviewed by a larger group of program stakeholders.

Tables 3 and 4 provide examples of parameters for the generation and adoption of technologies for varietal development in KARI's Sorghum Program. Under this research theme, potential net yield gains are highest in the humid coastal zone, followed by the semi-arid lowlands, moist mid-altitude, and last, the cold-dry highlands. Since the threshold for dissemination of technologies is the same across zones, the calculated probability of eventual dissemination is higher for technologies with higher expected yield gains. In terms of adoption, the research and development phase is estimated to take six to eight years. The research lag is then followed by a period of between 10 and 15 years, depending on zone, untill maximum adoption. Expected maximum adoption rates are highest in the cold-dry highlands and lowest in the humid coastal zone. Since varietal development is a continuous process, farmers can expect to begin replacing varieties six to eight years after maximum adoption. If replacement occurs because of the obsolescence of current varieties, then the 'disadoption' phase should be included in the adoption profile.

Table 3. Estimated Expected Yield Gains from Research

	Net yield gains (%)			
Theme/Zone	Minimum	Most likely	Maximum	Dissemination threshold
Varietal Development				
Humid Coastal	7	41	54	15
Semi-Arid Lowlands	5	38	50	15
Moist Mid-Altitude	0	14	42	15
Cold-Dry Highlands	0	10	22	15

Table 4. Estimated Adoption Parameters

Theme/Zone	Research & devel. lag *(years)*	Maximum adoption *(years)*	Maximum adoption rate *(%)*	Start of disadoption *(years)*	Complete disadoption *(years)*
Varietal Development					
Humid Coastal	7	22	5	29	44
Semi-Arid Lowlands	6	16	20	22	32
Moist Mid-Altitude	6	16	20	22	32
Cold-Dry Highlands	8	23	50	31	46

Step 4: Ex ante estimation of research-induced benefits

This step is conducted by the program economist with assistance from the priority-setting facilitator. Information collected on production, potential net yield gains, adoption time frame, and extent of adoption, as well as available information on prices and estimates of demand-and-supply responses to price changes, are combined in a simulation model of potential research benefits. The model allows zone-specific research benefits under different market structures to be estimated. For example, the commodity may be traded on an open international market or in a closed domestic market. A more complex version of the model accounts for other dynamic elements influencing the agricultural sector, including increased demand for commodities due to population growth, variable prices across production zones, and research-induced price spillovers to other production zones. Benefits are then standardized, based on full-time researcher equivalents (FTEs).

Potential returns to sorghum research themes are presented in table 5. Zone-specific sorghum program themes that have a ratio of potential benefits to FTEs greater than 100 million Kenya shillings are shown in gray. Those with a ratio of more than 500 million Kenya shillings are shown in black. They are highlighted as po-

Table 5. Comparison of Current Human Resource Allocation and Potential Benefits

	Ratio of benefits to full-time researcher equivalents			
Research theme	Humid Coastal	Semi-Arid Lowlands	Moist Mid-Altitude	Cold-Dry Highlands
Varietal development				
Crop management				
Technology dissemination				
Processing, utilization, and storage				

Note: Gray cells = discounted present value of research benefits greater than 100 million Kenya shillings per FTE. Black cells = discounted present value of research benefits greater than 500 million Kenya shillings per FTE.

tential priority research areas. Activities grouped under the themes of technology dissemination and of processing, utilization, and storage show very large potential returns in the moist mid-altitude zone because of the large production base in the zone and the high potential for technology generation. More moderate gains are expected from varietal development.

The semi-arid lowland zone has a much smaller production base. However, very high returns on technology dissemination activities and moderate returns from crop management and varietal development activities are still expected. In the cold-dry highlands, crop management and technology dissemination activities have very high potential for technology generation and are expected to yield moderate returns despite the very small production base. Finally, the humid coastal zone has too small a production base to yield productive returns on investments in national programs.

Step 5. Establishing program stakeholder priorities

Steps one through four provide potentially useful information for making better decisions on resource allocation. However, the actual value of this information is increased dramatically when it is integrated within institutional processes for establishing guidelines for resource allocation. Therefore, each research program presents the results of its priority-setting exercise to the PRAC. This group of 30 and 40 program stakeholders reviews and modifies the assumptions of the PSWG to reach a broader consensus on program potential. The results are then used as the basis for defining major program research themes by zone, as high-, medium-, or low-priority areas. The PRAC then generates specific guidelines for program research managers to adjust human resource allocations to priority areas over a medium-term planning horizon. Further, program priorities are expected to be the basis for the PRAC annual review of proposed and existing projects.

Sample guidelines from the Sorghum Program Stakeholder Group for the moist mid-altitude zone and the varietal development theme are presented below. They provide concrete goals for future program investments, particularly in human capital.

- **Moist mid-altitude.** This is the largest zone in terms of both area and production of sorghum. The research thrust of technology dissemination should be given the highest priority. As previously mentioned, the technology dissemination research theme focuses on increasing the flow of existing technologies onto farmers' fields. Current activities under this theme can be strengthened by clearly assigning the specific responsibility for heading technology dissemination efforts in sorghum research to an individual in each Kenyan regional center. In order to maintain capacity in varietal development, the vacant plant breeder post in this zone should be filled, either by a returnee from training or through redeployment.

- **Varietal development** should maintain the human resource base it has built across the zones, particularly in the moist mid-altitude zone where capacity has been weakened by departures for training.

Progress and Lessons

Under the current plan, all national commodity programs should complete the five-step process by the end of 1997. As of September 1996, substantial progress has been made towards achieving that goal. At the national level, eight out of 15 crop commodity programs have completed the exercise. For the remaining programs, three are close to completion and work has been initiated on the other four. Pilot exercises are also being conducted with livestock, natural resource management, and regional research programs in order to develop similar program-level priority-setting guidelines in these areas.

Some of the constraints encountered in the priority-setting work may be worth mentioning for those interested in developing similar processes.

1. The development of a core of skilled facilitators is crucial. The KARI facilitators acquired their skills through a combination of training and participation in the pilot exercises. Hence, initial exercises took longer to execute than originally planned. Similarly, while priority-setting working groups must be exposed to the basic concepts at the beginning of the exercise, effective understanding of the goals and methods of the exercise are only gained through hands-on experience.

2. The priority-setting process entails heavy investment in information bases. In the case where a program had already invested in a database, the required additional information for priority-setting exercises is easily acquired. However, in most of the programs, basic price and production data had to be collected and compiled for the exercise. This often led to delays in completing subsequent steps in the process. The time invested in collecting aggregate statistics can be considerably reduced if a central person is made responsible for developing and maintaining linkages with agricultural statistical agencies in the country.

3. Effective planning and logistical support is crucial for the success of any priority-setting exercise. Finances for workshops and other necessary support services, such as computers and vehicles, must be accessible. Hence, the process must be designed with explicit recognition of the available human, financial, and logistical capacity. To date, the process has cost between US $3,000 and US $4,000 per program. Financing for the pilot program exercises was provided by the Rockefeller Foundation, and various donors have assisted with other program exercises. However, several programs have still not secured funding for the exercise. Whether the process can be sustained for future rounds will depend on KARI's ability to find funds to support it in all programs.

4. Finally, decentralizing decision making for allocating resources is a highly political issue—one that needs to be handled cautiously. In the case of KARI, the mandate of the stakeholder groups to allocate resources needs to be more clearly defined. While the KARI structure calls for these groups to review program projects annually for coherence with stated priorities, the effectiveness of the review process varies widely.

   Similarly, the composition of participants in the whole priority-setting process is crucial. Not all stakeholders can communicate their interests with equal effectiveness. The program must actively manage participation to ensure that "silent" stakeholders, particularly resource-poor farmers, are heard. The priority-setting exercises provide a valuable foundation of structured information upon which to base these consultations, but major challenges to increasing stakeholder participation remain.

Some major benefits can be clearly identified from the completed priority-setting exercises. Most important, the results of the priority-setting exercises have increased the focus of commodity program research agendas and enhanced the relevance of the projects that are developed by program scientists. The PSWG generally feel they have learned a great deal about the environment within which they operate and how to position the program to effectively address future challenges. The exercises have also widened program constituency bases through the stakeholder groups and increased the perception that KARI is concerned about responding to client needs.

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