# KARI/CIMMYT MAIZE DATABASE PROJECT

# OBJECTIVES, STRUCTURE AND ORGANIZATION

PROJECT DOCUMENT NO. 1

**September 1992**

By

Rashid M. Hassan
Daniel D. Karanja

PROJECT SECTRETARIAT
KARI
P.O. BOX 57811
NAIROBI

CONTENTS

## INTRODUCTION

The KARI/CIMMYT Maize Data Base (MDB) Project is a collaborative two-year project between the Kenya Agricultural Research Institute (KARI) and The Economics Program of the International Maize and Wheat Improvement Centre (CIMMYT). The project was borne out of joint consultations between the two institutions and various donor organizations. The project resources are drawn from KARI, CIMMYT, the Rockfeller Foundation and the United States Agency for International Development (USAID). The MDB project is motivated by the fact that Kenya's population has been growing much faster than productivity in strategic agricultural commodities such as maize, the food staple for all Kenyans. Unless more land is taken away from other uses to put under maize or maize productivity is raised to cope with population growth, less per capita maize will be available from domestic production.

In order for Kenya to guarantee food security in the future and avoid persistent shortages in domestic maize supply, a well planned long-term strategy for maize research and policy is imperative. This will require a comprehensive knowledge of the production circumstances under which maize is grown in Kenya. Current knowledge of the farm level status and productivity is poor in Kenya relative to other countries in the region. Since 1980 no comprehensive surveys of maize production have been conducted, at either regional or national level. Thus, the main objective of the project is to establish a comprehensive data base for maize in

Kenya that would help KARI scientists and management, as well as policy makers, assess potentials for increased productivity from relevant maize technology and policy research.

The project is based at KARI headquarters and staffed with two full-time economists, one from CIMMYT and the other from KARI. The project duration is divided into two major phases: the data collection, collation and codind phase and the data analysis phase. The implementation of the project activities is done in collaboration with the six major KARI maize research centres and the GIS unit at the Kenya Soil Survey section of KARI. In each of these centres there is an MDB Regional Coordination Committee (RCC) (Appendix) comprising of a multi-disciplinary maize research team whose primary purpose is to coordinate and implement the project activities at the regional mandate of the respective research centres. Scientists from relevant disciplines at other KARI centres were selected to coordinate MDB project work with the respective centre. A National Steering Committee (NSC) (Table 1, Appendix) was appointed to provide technical guidance on the overall project planning and implementation.

## OBJECTIVES

The major objective of the project is to build a comprehensive data base for maize in Kenya to enable KARI scientists and management to: (1) identify maize production constraints; (2) define and measure potential impacts and yield gains from better and efficient technologies designed to alleviate

identified production problems; (3) assess the relative importance of technological options and set priorities for maize research; and (4) allocate limited research resources between alternative research activities for effective maize technology development strategies.

The MDB project is expected to serve as a model for KARI that is replicable on other commodities. It is therefore necessary to develop and establish a methodology of building information systems crucial to proper planning of agricultural research. Consequently, two other objectives of this project are: (1) to develop and apply procedures for combining farm survey and experimental and on-farm research data with Geographical Information Systems (GIS) in a format suitable for analyzing research priorities; and (2) to support institutional capacity building for effective participation of the newly established Socio-Economics and GIS units, and maize researchers in an interdisciplinary approach to research planning in KARI.

## CONTENTS AND STRUCTURE OF THE MAIZE DATABASE

The MDB will consist of several components fully integrated in a digital form to make easier regular update and instantaneous retrival. The principal components of the MDB will be:

a. Agro-climatic and soils data

b. On-farm and On-station experimental research data

c. Regional aggregates and other secondary data

d. Farm survey data

Each of these elements is described in detail below.

## A. Agro-climatic and soils data

Kenya has a relatively well developed set of agro-climatic and soils data. The advent of software and analytical techniques for GIS and the establishment of a GIS unit at KARI headquarters has made spatial data more accessible to a wide range of KARI scientists. The MDB project acknowledges the fact that agricultural production technologies in general are site specific and sensitive to spatial diversity. Maize productivity is no exception, and hence is greatly influenced by variations in agro-climatic and soil attributes. The spatial (GIS) data will therefore be required to delineate zones with distinct production environments for maize farming in Kenya. This primary classification of maize production regions will help define germplasm needs and assess potential impacts of various other technological interventions by environment. GIS data will also be employed to develop a spatial sampling frame which will be used to:

1. Sample farmers for the formal survey;
2. Facilitate the incorporation of all data collected from farmers surveys, on-station and on-farm research records, as well as other secondary sources into the GIS format;
3. Provide a semi-perminant framework for future sampling for spatial representation of maize production environments.

At the same time, the project will take the opportunity to establish collaboration with, and enhance the capacity of KARI's GIS unit.

B. **On-farm and on-station experimental research data**

There exists a considerable amount of information from experimental trials done by maize researchers in Kenya. Most of this information are either lost or remain underutilized for lack of proper documentation, e.g. unpublished reports that are scattered and hard to trace. On the other hand, the inadequate attention given to the synthesis and utilization of such data is considered one of the most common failings of on-farm research. For this reason, the MDB project hopes to collate all experimental and on-farm research data, including data from previous surveys, and incorporate them into the integrated data base. This will help make these data more readily available for future research planning and analysis. Experimental data will also serve as an indicator of the true potential for technological improvement by site and thus contribute to establishing the productivity gap between research and farmers' yields for impact assessment.

C. **Regional Aggregates and other secondary data**

There are various sources of existing data on maize production in Kenya. These include publications from the Ministry of Agriculture, Ministry of Planning and National Development, the Central Bureau of Statistics, etc. Relevant micro- and macro-level

data on national maize production, area and yield trends, maize input prices and levels of utilization, marketing, milling and other infrastractural information, etc. was sought to provide a background to the analysis of farm level data. Integration of such information provides a clear picture of the infrastructural and institutional environment within which farmers operate. Particular emphasis is placed on ensuring the secondary information can be easily updated and expanded. Like all other components of the data base these data will be arranged by location for easy integration into the GIS format and subsequent mapping.

## D. Farm survey data

The farm survey is expected to cover between 750-1000 maize farmers country-wide. Because of the complexity involved, in terms of varying production systems and crop seasons, most of the project's first year will be spent in the planning and execution of the survey. As part of the planning process, a series of informal surveys and workshops in the six research centres covering all maize-producing areas in the country will preceed the nationwide survey. The informal survey workshops attended by maize researchers of various disciplines will serve to orientate the researchers to regional production problems and variations and provide an inter-disciplinary interaction ever so rare in most research activities. Invitation of respective agricultural extension staff to participate in the workshop is expected to provide a needed researcher-extensionist exchange of ideas and knowledge. The

exercise is also geared to provide the researchers with a capacity in informal survey techniques and implementation.

The formal survey will be stratified by agroclimatic characteristics as well as knowledge about variations in soils and production systems aquired from the informal surveys. The farm surveys will provide information on the following, inter-alia: (1) maize production practices and constraints; (2) farmer criteria for varietal choice, planting time, etc.; (3) agronomic variables such as spacing, fertilizer use, weed and pest infestations, and disease incidences; (4) soil fertility and maintenance; (5) variation in maize production practices by region, season and years; (6) post-harvest practices and problems; and (7) maize sales and utilization. The survey will be carried out by a multi-disciplinary team of researchers from the regional centres, agricultural extension agents in the respective regions and, possibly, hired enumerators.

## UTILIZATION AND CAPACITY-BUILDING

It is important to emphasize the point that other than creating a maize data base for KARI, this project is destined to strengthen KARI's socio-economics and GIS units and the institution's research planning and priority-setting abilities. The data base will be organized in a standardized way that can easily accommodate the need to develop other information systems for KARI and replicable on other commodities. The establishment of a feasible and sustainable set of procedures for developing

information critical to agricultural research planning and thrust determination is emphasized rather than a "showcase" exercise of documentation of one commodity, maize. Maize is used as an example.

On the development of KARI's GIS unit capacity, the project provides an opportunity for the unit to synthesize the available agro-climatic and soils data and develop exclusive maps for maize production zones. This may provide a unique output that will be more relevant to maize researchers than the broad, and often diffuse, agro-ecological zonations which exist at the moment. A novel contribution of this project will be the development of methods for integrating survey, experimental and other data into the spatial data base and mapping of farming systems and socio-economics data together with the climate and soils information.

The farm surveys and other activities related to establishing baseline data provide an excellent opportunity for hands-on training in procedures that are crucial to the development of a strong socio-economics unit. These activities include: planning, design and analysis of survey and experimental data; questionnaire development and testing; and research planning and priority-setting. To ensure that the capacity building objective is achieved, the project will involve KARI socio-economists in the different aspects of data base development. In addition, some complementary training activities, e.g. seminars and workshops, will be conducted for the socio-economists.

Finally, it is generally expected that the project outputs will attempt to cover a wide range of issues such as: (1)

appropriate domains and locations for breeding programs for high, medium and low altitude, and dry regions; (2) current production status and utilization of research recommendations, the later being useful measure of the effectiveness of research/extension in the technology generation and transfer process; (3) relative emphasis on breeding vs agronomy, late-maturity vs mid- and early maturity cultivars given production constraints, climatic circumstances and productivity growth potentials; (4) relative priority to high, medium and low potential zones for increased maize production; (5) a baseline to measure future progress of maize research effort; and (6) assessment of policy issues related to input use, marketing and pricing.

## BUDGET AND INSTITUTIONAL RESOURCES

An operating budget of US$ 260,000 is jointly provided by the Rockefeller Foundation and USAID/Kenya. This budget covers the costs of technical assistance, surveys and field work, office expenses, planning and training workshops and meetings, administration and other expenses for the two years duration of the project.

The Rockefeller foundation contributed $160,000 to the total budget and the remainder ($100,000) is borne by USAID. However, many other resources were committed to the project by KARI and CIMMYT. Three vehicles and seven computers plus other hardware (printers, etc.) were provided by the CIMMYT Economics Program to facilitate the project's activities and support the building of

KARI's capacity to conduct such research. In addition to the full-time economist leading the MDB project, technical assistance provided by CIMMYT include among others, two months of a GIS expert as well as participation of a regional maize agronomist and members of the CIMMYT Economics program in the various activities of the project.

A member of KARI's socio-economics unit is assigned full-time to the project. KARI also provided office space for the MDB project secretariat and made available vehicles and other resources for the field work and other activities of the project. Sufficient time of KARI's research personnel is committed to the project in order to direct activities and ensure the relevance of the data base to the needs of the institution. KARI socio-economists and maize scientists are expected to lead discussions of data needs, participate in planning for the farm survey and the design and testing of the questionnaire, take part in the formal and informal surveys and be ready to utilize the generated data base. The GIS unit at KARI is also expected to provide the necessary support to project needs related to compilation, digitizing, processing, and mapping of agro-climatic, experimental, and survey data.

## ORGANIZATION OF PROJECT ACTIVITIES

The MDB project comprises of a Secretariat based at KARI Headquarters, a National Steering Committee (NSC) and five Regional Coordination Committees (RCC). The Secretariat is headed by a CIMMYT economist, who is also the project leader, assisted by a

KARI socio-economist. The NSC is made up of a joint team of researchers from CIMMYT and KARI; most of them are maize scientists (see Appendix). The NSC is charged with the responsibility of defining national project strategy, providing technical advise and guidance, and making decisions on overall aspects of project management and implementation. The committee, whose chairman is also KARI's Maize Research Coordinator, meets regularly to monitor progress of project activities and review future plans.

The five RCCs are based at the following KARI maize centres: NARC-Kitale, RRC-Kakamega, RRC-Mtwapa, RRC-Embu and NDFRC-Katumani.[1] The idea of forming the RCCs was borne out of the realization that there exists a spatial diversity of maize production environments in Kenya. Maize research programs are distributed accordingly in order to serve different agro-climatic conditions and target different farming circumstances. Thus, it has been recommended by the project's secretariat and NSC that maize data be compiled and organized on a regional basis. The regions correspond to the mandate districts of the selected maize research centres. This arrangement was meant to ensure the relevance of the generated information to regional research problems and to facilitate easier and faster access to, and utilization by, researchers at the respective centres.

The following criteria was used to select centres as regional bases for the maize data: (1) whether the centre's mandate

---

[1]The RCC at Kakamega comprises of members from RRC-Kisii. Therefore, it is a joint Kisii/Kakamega team of scientists.

region characterizes a distinct maize production environment; (2) whether the centre has an existing maize research program; (3) the maize research capacity at the centre, i.e. the "mass" of maize researchers and experience available to generate, process and utilize the data; (4) the amount of information already existing at the centre such as previous research, experimental data and literature; (5) existing logistics, computing facilities and other support services; and (6) relative importance of maize in the region as approximated by maize area and number of farmers, and consequently the amount of information expected to be generated and managed at the centre.

Table 3 of the Appendix provides a framework used to select the regional data bases. Six centres; Kitale, Kakamega, Kisii, Katumani, Embu and Mtwapa were chosen to host the regional maize data. KARI's Ol-Joro-Orok sub-centre was left out because its mandate area represents a small proportion (3%) of the total maize area. Moreover, the Very-High Altitude breeding program was moved to Kitale. This, in addition to the almost non-existent field logistics and computing facilities at Ol-joro-Orok, led to dropping the sub-centre as an independent regional base. Information and data for the very-high altitude maize region will be built as part of the Kitale data base. Similarly, the National Plant Breeding Research Centre (NPBRC) at Njoro was not considered since there is no maize research program at the centre. Information about maize production in the districts mandated to NPBRC will be collected by researchers from, and built at, appropriate research centres among

the six selected above, depending on similarities in agro-climatic conditions. The National Agricultural Research Centre (NARC) at Muguga was relegated because its regional responsibility for maize research overlapped with Embu's. However, a maize breeder at the NARC-Muguga and an entomologist at the National Agricultural Researce Laboratories (NARL) were appointed to coordinate the project's activities at these centres.

The last three columns of Table 3 of the Appendix assess computer time and storage capacity at the relevant KARI research centres. To ensure that selected centres had the capacity to build up the regional databases, the MDB project provided supplementary computing and printing facilities to them as follows:

| CENTRE | EQUIPMENT PROVIDED |
|---|---|
| 1. Kitale | Gateway 386 Computer - 120MB |
| 2. Katumani | Unisys 386 Computer - 55MB |
| 3. Embu | Gateway 386 Computer - 120MB |
| 4. Kakamega | Gateway 386 Computer - 120MB |
| 5. Mtwapa | Epson Printer |

The project plans to provide the RRC-Kisii with a computer because of the complexity and volume of information expected, and the few computing facilities available at the centre. The RRC-Mtwapa was found to cover a relatively smaller maize area and has a very small number of maize researchers (Appendix). Accordingly the available computer facility at the centre was considered

adequate for the expected volume of data that will need to be stored and processed, and the expected demand on computer time. Three other computers were placed in the project secretariat offices at KARI Headquarters, Nairobi.

**PLAN OF WORK**

The following tasks and schedule of activities are planned in order to achieve the stated objectives within the two-year duration of the project, commencing March, 1992:

1. Building the data base

This task involves surveying various secondary and primary sources of information as follows:

**(a) Phase one (March-June 1992):**

i. Survey of Secondary data sources:
-Agro-climatic and socio-economic information, demographic statistics, previous farm surveys, on-farm research and experimental data, and a review of literature on maize.

ii. Develop a format to organize the secondary data for easy retrieval, transformation and display using GIS and relational data base softwares. This requires building of a digital information system.

iii. Delienate zones of distinct maize-production environments.

iv. Identify research centres where regional maize data bases will be built and set up computing and data processing facilities.

**(b) Phase two (July-September 1992):**

i. Informal survey of primary data sources.

ii. Sampling and designing of formal survey using the GIS and informal survey data.

iii. Questionnaire development and testing.

iv. Training of enumerators and arrangement of logistical support.

**(c) Phase three (October-January 1993):**

i. Execution of formal farm surveys.

ii. Coding and building of data files on computers at the regional centres and developing of an integrated information base at KARI headquarters.

iii. Training KARI researchers on using relational data base and other softwares for building integrated data sets.

2. Analysis of Data

**(a) Phase one (February-July 1993):**

i. Analysis and reporting of descriptive results by region.

ii. Incorporating the farm survey and experimental data into the GIS format.

iii. Training workshops on survey methods and experimental data analysis.

**(b) Phase two (August 1993-February 1994):**

i. Extensive quantitative analysis of regional and aggregate maize production problems and research priorities.

ii. Reporting quantitative analysis results and panel discussions.

iii. Final project reports.

## APPENDIX

**Table 1: The MDB Project's National Steering Committee.**

| | |
|---|---|
| 1. Dr. Kiarie Njoroge | - Chairman - Maize breeder, KARI.* |
| 2. Dr. A.M. Mailu | - KARI Headquaters Liaison. |
| 3. Dr. Roberto Arias | - Maize Agronomist, CIMMYT-Kenya. |
| 4. Dr. Rashid Hassan | - Project Leader-Economist, CIMMYT-Kenya. |
| 5. Daniel D. Karanja | - Deputy Project Leader-Agric. Economist, KARI. |
| 6. Ruth Onyango | - Maize Agronomist - KARI-NARC, Kitale. |
| 7. Peter F. Okoth | - GIS Specialist - KARI-Kenya Soil Survey. |

* Dr. Kiarie is also the National Maize Research Coordinator, KARI.

APPENDIX (Cont'd)

Table 2: The MDB Project's Regional Coordination Committees (RCCs).

**RCC - Kitale:**

1. Ruth Onyango - Maize Agronomist - Chairperson.
2. A.K. Laboso - Maize Breeder.
3. J.M. Ngeny - Biometrician.
4. M.O. Mulaa (Mrs) - Crop Protectionist.
5. L. Mose - Agronomist/Economist.
6. N.M. Mwania - Maize Agronomist.
7. Centre Director, Kitale - Member.

**RCC - Kakamega/Kisii:**

1. R.M. Otsyula - Maize Breeder - Chairperson - Kakamega.
2. B.D. Salasya - Socio-Economist - Kakamega.
3. H.M. Wakhonya - Agronomist - Kakamega.
4. M.D.A. Mudeheri - Biometrician - Kakamega.
5. S. Ajanga - Pathologist - Kakamega.
6. C.N. Macharia - Agronomist - Kisii.
7. O. Okuku - Agronomist/FSR - Kisii.
8. Centre Director, Kakamega - Member.
9. Centre Director, Kisii - Member.

**RCC - Mtwapa:**

1. G.M. Kamau - Maize Agronomist - Chairperson
2. E.N. Wekesa - Socio-Economist.
3. S.G. Kiarie - Maize Breeder.
4. G.K. Kinyua - Pathologist.
5. Centre Director, Mtwapa - Member.

**RCC - Katumani:**

1. S.N. Mugo - Maize Breeder - Chairperson.
2. L.M. Kimotho - Agronomist/Farming Systems.
3. M. Gatheru - Biometrician.
4. W.A. Songa - Pathologist.
5. Centre Director, Katumani - Member.

**RCC - Embu:**

1. F.M. Muriithi - Socio-Economist - Chairperson.
2. D.T. Kirubi - Maize Breeder.
3. J.O. Ojiem - Maize Agronomist.
4. L.M. Muriithi - Pathologist.
5. Centre Director, Embu - Member.

## APPENDIX (Cont'd)

## Table 3: Selection of Research Centres

| Center | Production | Maize in Mandate area | | Growing season | | Maize research program | % of total staff | Computing facility | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 000 Ha | % of total | Major | Minor | | | Machine /RO[a] | MB/ RO[b] | MB/000 Ha |
| 1. Kitale-NARC | High-Altitudes (1600-2300m). Late maturing (unimodal rain) | 166 | 15 | APR-NOV | - | Breeding & Agronomy | 48% | .17 | 10 | 1.8 |
| 2. Kakamega-RRC | High-Medium Alt.(1600-2000m). Late maturing(uni- or bimodal rain) | 231 | 21% | APR-NOV APR-SEP | - OCT-FEB | Breeding & Agronomy | 24% | .19 | 9 | 0.6 |
| 3. Embu-RRC | Non-moisture stressed, Medium Alt. (1500-1800) Interm. maturing (bimodal rain) | 190 | 17% | MAR-SEP | OCT-FEB | Breeding & Agronomy | 42% | .13 | 8 | 1.1 |
| 4. Katumani-NDFRC | Moisture-stressed, Mid-Alt.(500-1600). Early maturing, draught-resistant (uni- or bimodal) | 108 | 10% | MAR-SEP OCT-FEB | OCT-FEB MAR-SEP | Breeding & Agronomy | 40% | .20 | 8 | 1.7 |
| 5. Mtwapa-RRC | Lowland-Tropical (less than 500) Bimodal, unreliable 2nd rain. | 47 | 4% | APR-SEP | OCT-FEB | Breeding & Agronomy | 20% | .22 | 12 | 2.1 |
| 6. Kisii-RRC | High-Medium Alt. Long-Interm. maturing (bimodal) | 204 | 19% | MAR-OCT MAR-SEPT | - OCT-FEB | Agronomy | 18% | .09 | 5.5 | 0.29 |
| 7. Ol-Joro-Orok | Very-High Alt. (above 2300). Late maturing (unimodal rain) | 36 | 3% | MAR-DEC | - | - | - | | | |
| 8. Muguga-NARC | Medium-Low Interm. maturing. | - | - | MAR-SEP | OCT-FEB | Breeding & Agronomy | - | | - | |
| 9. Others including NPBRC-Njoro | High-Medium & Low (uni- or bimodal rains). | 120 | 11% | MAR-SEP | OCT-FEB | None | - | - | - | |

Compiled from: Ottichilo and Sinange (1991); MDB Project's Informal Surveys (1992); and KARI (1992).
[a] RO denotes Research Officer; [b] MB refers to Megabytes of computer memory.

## REFERENCES

KARI. 1992. Proceedings of a KARI/ISNAR Workshop on the Review of the National Maize Research Program held in November 19-23, 1990 at Kakamega, Kenya.

Ottichilo, W.K. and R.K. Sinange. 1991. Long Rains Maize and Wheat Production Trends in Kenya for 1990. Technical Report No. 140. Department of Resource Surveys and Remote Sensing. Ministry of Planning and National Development. Government Printers: Nairobi.