

# SOIL FERTILITY NETWORK FOR MAIZE-BASED FARMING SYSTEMS

Report for the Period 1 October 1994 to 30 September 1995

Prepared for the Rockefeller Foundation

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# SOIL FERTILITY NETWORK FOR MAIZE-BASED FARMING SYSTEMS IN SELECTED COUNTRIES OF SOUTHERN AFRICA

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Prepared for the Rockefeller Foundation

by

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The Soil Fertility Research Network for Smallholder Maize-Based Farming Systems in Selected Countries of Southern Africa began on 1 October 1994. It is coordinated from the CIMMYT Maize Research Station at the University of Zimbabwe Farm near Harare. Total funding for the year was US\$ 209200. Full background to the project is given in the network proposal (dated May 1994)<sup>1</sup> and in Waddington (1995)<sup>2</sup>.

## NETWORK AIMS

The goal of the Network is to help smallholder farmers in Malawi and Zimbabwe produce higher, more sustainable and profitable yields from their dominant maize-based cropping systems<sup>3</sup>.

The Network aims to achieve that through raised soil fertility – improved management leading to higher efficiencies in farmer use of scarce organic and inorganic fertilizer inputs – following adoption of technology developed through the Network.

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<sup>1</sup> *A Soil Fertility Research Network to Improve the Productivity of Smallholder Maize-Based Cropping Systems in Countries of Southern Africa*. A Project Proposal submitted in final form to the Rockefeller Foundation, May 1994. pp.25.

<sup>2</sup> *A Soil Fertility Research Network to Improve the Productivity of Smallholder Maize-Based Cropping Systems in Countries of Southern Africa*. By Stephen R. Waddington, January 1995. In: *Report on the First Meeting of the Network Working Group*, The Rockefeller Foundation and CIMMYT, Harare, Zimbabwe. pp. 66-69.

<sup>3</sup> Maize is planted on up to 90% of the smallholder arable area each year in the subhumid unimodal rainfall (700 - 1200 mm rainfall per year) parts of Malawi and Zimbabwe in loose rotations or intercropped with annual grain legumes. These areas have a long history (at least 30 years and often much longer) of intensive cropping with little fallow and usually little use of chemical fertilizers. These are the high yield potential maize growing areas of the region that provide most of the maize to maintain a growing human population. There soil fertility, not rainfall, constrains yields in most years.

The Network brings together fragmented regional expertise to better focus on appropriate soil fertility technology for smallholders, develop links with other component technologies (such as germplasm) and facilitate technology transfer to end users.

It emphasizes the development of effective, targeted research and extension through joint priority setting, planning and implementation of complementary soil fertility activities across maize-based agroecologies by participating organizations. This involves enhanced interaction between research, extension and the farmer.

Activities include research priority setting, planning and integration; the conduct of priority research and extension; information exchange and training for network scientists; and the distribution and use of output information through links with farmers, extension, NGOs and input suppliers.

## PARTICIPATING ORGANIZATIONS AND INDIVIDUALS

The Network was formed by the Rockefeller Foundation with CIMMYT because of a need to bring together an expanding group of Foundation grantees working on soil fertility in Malawi and Zimbabwe. This group of grantees, assisted by several Rockefeller Foundation postdocs in Malawi, have formed the core of the Network over the year. Grantees are members of the following organizations:

- The Maize Commodity Team, the Soils Commodity Team and the Agroforestry Team of the Department of Agricultural Research, Malawi
- Bunda College of Agriculture, University of Malawi
- Extension/NGO initiatives in Malawi
- Agronomy Institute, Farming Systems Research Unit and Chemistry and Soils Institute, Department of Research and Specialist Services, Zimbabwe
- The Departments of Crop Science and Soil Science, Faculty of Agriculture, University of Zimbabwe
- Africa University, Zimbabwe
- The Rockefeller Foundation in Malawi
- CIMMYT in Zimbabwe

Over the year several persons from other organizations have been invited, because of their expertise in key areas, to work closely with our Network. Table 1 lists the core group of Network members together with the main research and networking activities they are involved in.

In addition, during the report period the Network has attempted to develop links with other research and extension organizations as opportunities arose.

These include:

- The Tropical Soil Biology and Fertility Program (TSBF) in Kenya and members of the TSBF's African Network, *AfNet*, in relation to basic process orientated research
- The Rockefeller Foundation, KARI and CIMMYT in Kenya
- The African Centre for Fertilizer Development (ACFD) in Zimbabwe

**Table 1. Research and network activities underway by “core” members of the Soil Fertility Network from Malawi and Zimbabwe, late 1995.**

Core members are those that conduct research in association with the Network and/or regularly and actively participate in Network meetings, proposal reviews etc. Most receive financial support from the Rockefeller Foundation.

Research/Activity Theme	Lead Person(s)	Organization(s)
<b><i>Inorganic Fertilizer Management for Maize</i></b>		
Verification of a soil management package for smallholder maize in Zimbabwe, involving fertilizer amounts and timing conditional on rainfall	Melvyn Piha	Dept. of Soil Science, University of Zimbabwe
Trials and demonstrations to improve the management of inorganic fertilizer on maize in Malawi, involving new formulations of basal fertilizer, targeting to deficient areas, timing and placement issues	John Kumwenda, Webster Sakala, Todd Benson and Sieglinde Snapp	Maize and Soils Commodity Teams, Department of Agricultural Research (DAR), Ministry of Agriculture, Malawi
<b><i>Integrated Organic-Inorganic Fertilizer Management for Maize Systems</i></b>		
Soil fertility management through green manuring for maize	Lucia Muza	Agronomy Institute, Department of Research and Specialist Services (DR&SS), Ministry of Agriculture, Zimbabwe
Integrated maize crop management research in Chinyika, involving the development and testing of new technologies in soil fertility management	Irvine Mariga and Augustine Chivinge	Dept. Of Crop Science, University of Zimbabwe
Use of leaf biomass from leguminous shrubs in maize hedgerow intercrops and interactions between inorganic and organic fertilizer in this system	Alex Saka, Henry Phombeya and Richard Jones	Agroforestry Commodity Team, DAR, Malawi
Soil and plant nutrition research to calibrate soils data with maize yield (for use in area specific fertilizer recommendations), improve methods to predict maize N response and impact of organic/inorganic management practices on soil fertility, and improved laboratory quality control	Sieglinde Snapp, Allan D.C. Chilimba and Simeon Materechera	Soils Commodity Team, DAR, Malawi, Crop Science Dept., Bunda College, University of Malawi
The role of green manure legumes as improvers of soil fertility when relayed into maize in Malawi	John Kumwenda	Maize Commodity Team, DAR, Malawi
Crop yield and soil fertility trends with current smallholder maize + groundnut cropping patterns in Zimbabwe	Stephen Waddington	CIMMYT Maize Program, Zimbabwe
Tillage x fertilizer x weed management interactions in maize	Stanford Mabasa	Weed Research Team, Agronomy Institute, DR&SS, Zimbabwe

**Table 1. continued**

<b><i>Soil Fertility Management for Other Crops in Maize Systems</i></b>		
Crop sequence and fertility management for sunflower in maize-groundnut systems of Zimbabwe	Danisile Hikwa	Agronomy Institute, DR&SS, Zimbabwe
Soil management options for improved groundnut production in Zimbabwe	Fanuel Tagwira	Faculty of Agriculture, Africa University
Production of fodder banks using multipurpose perennial legumes in Zimbabwe	Sam Chikura	Farming Systems Research Unit, DR&SS, Zimbabwe
<b><i>Research Networking, Support and Extrapolation</i></b>		
Mapping crop and soil nutrient status for improved fertilizer recommendations in communal areas of Zimbabwe	Linus Mukurumbira	Soil Productivity Research Lab., DR&SS
Development of database on previous maize trials and soils at sites in region, and link with Geographic Information Systems in Zimbabwe	Alois Hungwe	Soils Inc., Zimbabwe
Development of area specific fertilizer recommendations using GIS and labor use surveys with emphasis on soil fertility management	Todd Benson	Maize Commodity Team DAR, Malawi
Network planning and extension liaison in Zimbabwe	Ishmail Pompi	AGRITEX, Zimbabwe
Network planning and extension liaison in Malawi, especially in relation to Action Group 3 (Agricultural Production Problems of the Poorest Farmers) of Maize Productivity Task Force in Malawi	McKey Mphepo	Blantyre ADD, Maize Task Force extension representative, Malawi
Network planning, especially related to Action Group 4 (Organic Matter Management) of Maize Productivity Task Force in Malawi	Susan Minae	Malawi/ICRAF Agroforestry Project, Malawi
Network planning/consultancy, especially on use of legumes in maize systems, and research student supervision	Ken Giller	Department of Biological Sciences, Wye College, University of London, England
Lead development of a soil fertility bibliography for maize-based systems in Malawi	Spider Mughogho and Margaret Ngwira	Crop Science Dept. and Library, Bunda College of Agriculture, Malawi
Lead development of a soil fertility bibliography for maize-based systems in Zimbabwe	Lucia Muza	Agronomy Institute, DR&SS, Zimbabwe
Lead development of an agronomic trial site and trial design database for past agronomic research on maize-based cropping systems in Malawi and Zimbabwe	Todd Benson and Jestinos Muzeziwa	Maize Commodity Team, DAR, Malawi and Chemistry and Soils Research Institute, DR&SS, Zimbabwe

- Government extension services in Malawi and Zimbabwe
- Natural Farming Network (a grouping of local NGOs) in Zimbabwe
- SADC Maize and Wheat Improvement Network members planning new soil fertility research in neighboring countries such as Zambia, Swaziland and Lesotho.

Table 2 lists our contacts with those organizations and other individuals that have been involved with our Network during the year. These persons may be developing research proposals in conjunction with our Network, may have helped on a Network activity, are working on similar complementary activities in other countries, or may be interested in using outputs from our Network.

## RESEARCH PRIORITY SETTING, PLANNING AND INTEGRATION

As planned in the project proposal this has been the main activity of the Network over the report period. With the start of a new Network it was felt necessary to provide opportunities for members to learn about the ongoing work of other members, plan Network activities and participate in the development of new project proposals. The main vehicles for this were two full meetings of the core group of Network members, a process of peer review of research proposals and several smaller sub-group meetings.

### First Meeting of Network Working Group

The aim of this meeting was to review current soil fertility research by Network members, and develop coordinated activities and methods for the Network, leading to necessary long term commitment from involved staff. Twenty-nine participants (nine from Zimbabwe, five from Kenya and the rest from Malawi) attended the meeting, which took place at Salima, Malawi, 1 to 3 November 1994.

Because this was the first opportunity for most members to meet together as a Network, the outcomes of the meeting have had a major influence on the direction of the Network over the year. Decisions on Network activities included:

1) *System characterization*: Set up sub-groups to look further at several aspects of system characterization including

- \* data sets and databases for site characterization
- \* farmer target grouping
- \* ways of working with/for farmers and the use of indigenous farmer knowledge.

2) *Information standardization*:

- \* Develop a comprehensive soil fertility bibliography for maize-based soil fertility research in member countries and commission several specialist reviews of previous work
- \* Produce a matrix of current research and priority interests of network members for circulation
- \* Produce a Network Bulletin or Newsletter.

3) *Priorities for technology research*:

- \* fertilizer use efficiency
- \* organic/inorganic interactions

**Table 2. Other persons and organizations that have had contact with the Network during the year, but not at the level for inclusion in Table 1. They may be persons that are developing research proposals, helped on a network activity, are working on similar complementary activities, or be interested in using outputs from our Network.**

<b>Person(s)</b>	<b>Organization</b>
David Dhliwayo and Owen Mandiringana (Now in South Africa)	Soil Productivity Research Laboratory, Department of Research and Specialist Services (DR&SS), Zimbabwe
Herbert Murwira, Luke Mugwira and Jestinos Muzeziwa	Chemistry and Soils Research Institute, DR&SS, Zimbabwe
Monica Murata and Paramu Mafongoya	Agronomists, Agronomy Institute, DR&SS, Zimbabwe
Albert M. Rambakudzibga	Weed Research Team, Agronomy Institute, DR&SS, Zimbabwe
Peter Jeranyama, Chinaniso Chibudu and Maxwell Mudhara	Agronomists and Agricultural Economist, Farming Systems Research Unit, DR&SS, Zimbabwe
Cornelius Chiduzo and Chris Nyakanda	Lecturer and Research Fellow, Department of Crop Science, University of Zimbabwe
Bruce Campbell and Peter Frost	Professors, Department of Biological Sciences, University of Zimbabwe
Norman Manyowa and Sam Muchena	Research Officer and Director, African Centre for Fertilizer Development (ACFD), Zimbabwe
David Rohrbach	Agricultural Economist, SADC/ICRISAT, Zimbabwe
Batson Zambezi	Maize Scientist, SADC/CIMMYT Maize and Wheat Improvement Research Network
Simba Muzuva and Dumezweni Mkwananzi	Director, Natural Farming Network, Zimbabwe
John Scoggan	Care International, Zimbabwe
Vernon Kabambe	Agronomist, Maize Commodity Team, Department of Agricultural Research, Malawi
Omar Itimu	Agroforester, Agroforestry Commodity Team, DAR
Suzgo Kumwenda	Chief Agricultural Research Officer (CARO), Department of Agricultural Research, Ministry of Agriculture, Malawi
Charles Matabwa	Deputy Chief Agricultural Research Officer (DCARO), Department of Agricultural Research, Ministry of Agriculture, Malawi
Chief Agricultural Extension and Training Officer (CAETO), Malawi	

**Table 2. continued**

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E. P. Ching'amba	Programme Manager, Salima Agricultural Development Division, Ministry of Agriculture, Malawi
J.P. Raath	General Manager, Optichem (Malawi) Ltd., Malawi
Mike J. Swift	Director, Tropical Soil Biology and Fertility Programme (TSBF), Kenya
Mwenja Gichuru	Executive Officer, TSBF, Kenya
Simon E. Carter	Programme Officer: Resource Integration, TSBF, Kenya
Stephen M. Nandwa	Kenya Agricultural Research Institute, Kenya
Elizabeth Dyck	The Rockefeller Foundation, Kenya
John Lynam	The Rockefeller Foundation, Nairobi, Kenya
Larry Harrington	Manager, Natural Resource Management Unit, CIMMYT Economics Programme, Mexico
Paul Seward	Research, Extension and Marketing for Integrated Development (REMIND), Portugal and Kenya
O.TODO Edje	Professor, Crop Production Dept., Faculty of Agriculture, University of Swaziland
Holger Kirchmann	Associate Professor, Dept. of Soil Sciences, Swedish University of Agricultural Sciences, Sweden
Derek Byerlee	Agriculture and Natural Resources Dept., World Bank, USA
Philip K. Thornton	Systems Modeling, Research and Development Division, International Fertilizer Development Center (IFDC), USA

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- \* increasing the availability and use of organic sources, and
- \* organic matter management.

Some of this work should be organized as common "Network Trials" across agroecologies, with a degree of uniformity in treatments and methods. New research proposals will be subjected to review by Network members. Set up a sub-group to look at technical research methodologies.

4) *Dissemination of information:*

- \* Develop better linkage of research-extension-farmers and exchange of information among them
- \* Develop active links with other appropriate agencies such as fertilizer suppliers.

A full report on the meeting was compiled by the coordinator and circulated to all members in January 1995.



## **Second Meeting of Network Working Group**

This took place at Kadoma, Zimbabwe, 17-21 July 1995. Around 45 participants attended, plus several sponsored by the SADC Maize and Wheat Improvement Network. This was an opportunity for all participants to update members on their research and networking activities during the year.

Research papers were presented by all core researchers on inorganic fertilizer management for maize, integrated organic-inorganic fertilizer management for maize systems and soil fertility management for other crops in maize systems. Several new proposals were outlined. Other papers covered research support, extrapolation and extension activities. We also had updates on key networking efforts such as bibliographies and databases. Invited speakers covered the research agenda of the African Centre for Fertilizer Development and the synchrony theme of TSBF.

Group sessions were organized to plan Network trials (see later) and to look at how best to organize our downstream activities with output users, especially as farmers, NGOs and extension. Significant steps were made in forging closer links between our Network and the TSBF AfNet. These may involve joint development and review of selected proposals, joint thematic workshops and a joint newsletter.

The Network came of age with the Kadoma meeting. The meeting was characterized by a clear positive attitude and common sense of purpose. A full proceedings of this meeting is in preparation.

## **Peer Review of Research Proposals**

Our Network manages a peer review process for the development and implementation of new projects related to soil fertility, and for the renewal of existing projects.

Eight proposals were reviewed during 1994/95. They are of two basic types.

- 1) Those submitted to the Rockefeller Foundation for funding.
- 2) Others where authors request assistance in developing the proposal for later submission to the Rockefeller Foundation or other donors.

Normally the proposal is reviewed by three members of the Network and often by the coordinator. Reviewers are selected that have experience of the topic. To ensure timely reviews of high quality, Network members receive an honorarium of US\$ 150.

Network members also suggest (at network meetings, through the newsletter etc.) topics that require more emphasis on the Network. For example, the meeting at Kadoma identified soil acidity (including free aluminum and manganese), crop residue management, management of annual legumes in maize systems, matching soil nutrient availability to crop demand (synchrony research) and risk assessment (interaction with moisture) as key research areas for more research on the Network. We will be looking to encourage the development and support of proposals on those topics in the future.

Proposals accepted by the Network are forwarded to the Rockefeller Foundation (and through the foundation to other donors), who then considers grants to applicants. This process fosters

regional research by prioritizing proposals that address pressing needs and have a high likelihood of clear practical outputs.

The peer review process has been highly successful this year. Several new project proposals have now been funded by the Rockefeller Foundation. These include:

- Soil organic matter and N dynamics to improve N-use efficiency in smallholder agriculture in Malawi (Sieglinde Snapp and Simeon Materechera);
- Malawi maize commodity team agronomy proposal, as modified for implementation through the Maize Productivity Task Force (John Kumwenda);
- Weed management under different tillage systems and fertility levels in small-scale farming areas of Zimbabwe (Stanford Mabasa).

Proposals at present under review and development include:

- physiology of annual legume/maize competition
- research on the use of sewage sludge on peri-urban smallholder farms in Zimbabwe
- dissemination of pigeonpea to smallholders in Zimbabwe and its potential as a soil fertility improver, and
- incorporation of naturally-nodulating soyabean into smallholder systems.

Related to the above, the Network coordination office is on the lookout for new, compatible opportunities to widen our activities to other countries or to improve the range of skills available to soil fertility research in the region. We participated in the development of two pre-proposals with IFDC to increase crop model and GIS support, and to bolster extension/NGO efforts. These were submitted to ODA and the Government of Japan. We have received word from ODA that they cannot fund our proposal. We have also been looking at various funding possibilities to support socio-economic work related to our Network. To date there are no firm developments with that.

## CONDUCT OF PRIORITY RESEARCH AND EXTENSION

### Research "Projects" by Network Members

When our Network began late in 1994, most core members already had soil fertility research projects supported by the Rockefeller Foundation. Fifteen of these projects are underway in Zimbabwe and Malawi and are listed in Table 1. Most integrate organic and inorganic fertilizer in maize systems, a few look at inorganic fertilizer on maize, or other crops such as groundnuts and sunflower in maize systems. Three of the projects are funded through the Rockefeller Foundation Forum on Agricultural Resource Husbandry. Several other projects are more loosely associated with our Network. We are encouraging the development of new research projects as described in the section on review of research proposals.

### Network Trials

A key role for our Network is the development and implementation of Network Trials to organize network research on a more interactive, regional mode. Features of Network Trials include common objectives among cooperators, some (but not necessarily all) common treatments, and some common methods and measurements.

Priorities for Network Trials were obtained from a questionnaire circulated to members in May and June before the Working Group meeting at Kadoma. At Kadoma, members began to plan two trials: one to quantify the maize yield and N cycling efficiency of combined organic and inorganic N inputs compared to inorganic alone; the other looking at incorporation of more high quality legume organic matter on-farm, involving the testing of more annual legumes for their potential to raise soil fertility. These were developed further by interested members in September/October and will be implemented at several sites during the 1995/96 season.

### **Research Field Tours**

Our first Network Field Tour, involving 20 to 25 persons from Zimbabwe, Malawi and England took place in Central and Southern Malawi, 12 - 19 February 1995. The theme was *Inorganic and Organic Fertilizer Targeting and Management*.

We visited a wide range of trials over five days, including: basal inorganic fertilizer verifications, *Dolichos* bean - maize intercropping, fallows improved with *Sesbania*, N response trials in the presence and absence of Zn and S, hedgerow intercropping with *Senna spectabilis*, and production of maize under a *Faidherbia albida* tree. Extension and NGO efforts were also well represented by VEZA (a small NGO running a credit scheme for smallholder farm inputs and fertilizer demonstrations), ADDFOOD hedgerow intercropping activities with maize, and Blantyre ADD extension service integrated soil conservation on-farm (involving contour ridges planted with bananas, and hedgerow intercropping with *Senna spectabilis*). We also had a short tour of the Optichem fertilizer blending plant that is producing new basal fertilizer blends.

The Network also supported a much smaller field tour in Zimbabwe (6-8 persons over two days in March). We visited DRIS sites in Mangwende communal area and sunflower trials in Zwimba communal area of northern Zimbabwe.

It is extremely important and enlightening to get into the field to see the benefits and limits to available soil fertility technologies. Because of this we plan another major field tour and some smaller ones in 1996.

### **Trial Site and Trial Design Database**

The Network sponsored a meeting in Harare 22-23 June for ten persons to plan a Trial Site and Trial Design Database of past trials involving soil fertility in maize systems. This was a follow-up to the Salima meeting (and initial efforts by Alois Hungwe). The database will relate a minimum site characterization dataset to a summary trial description, with pointers to where results are kept. The group devised the sets of fields for the database and outlined ways of relating the database to the bibliographies. Todd Benson and Sieglinde Snapp inputted data from a small set of trials into the database structure in MSAccess and mounted a demonstration at our Kadoma meeting.

Small and focused meetings, such as this one, appear very cost effective. We plan to hold more this coming year.

### **Equipment Purchases for Research**

The Network has a modest amount of funds available for the purchase of equipment and consumables for use by Network members. These are normally items that will be used

infrequently and so are not justifiable on individual proposals, but can be justified for collective use. In 1995 we purchased a geographic positioning system (GPS) for use in Zimbabwe. Further purchases are expected to help with Network Trials, e.g. supplies of N<sup>15</sup>.

During the year the Network coordination office has been able to help with the importation of vehicles and computer equipment for grantees of the Rockefeller Foundation working on soil fertility issues in Zimbabwe.

## INFORMATION EXCHANGE AND TRAINING

### Reports on Network Working Group Meetings

Comprehensive reports on the Network Working Group meetings are important to produce and distribute quickly. The report of the first meeting (Salima, November 1994) was distributed to all members of the Network in January 1995. The report of the second meeting (Kadoma, July 1995) should be ready for distribution in December 1995.

### Target Newsletter

Four issues of the Network newsletter, *Target*, were produced and distributed this year, in January, April, July and October 1995. Each issue of *Target* includes news on network events and activities, information about activities of related organizations, ideas to improve the efficiency of our work, summaries of important research and extension findings by Network members, and assessments of the value and impact of our work. *Target* relies heavily on contributions from members. With the last two issues we have seen a rise of interest in *Target* by members. Network members are encouraged to contribute short items on any relevant topic.

Each issue is between two and six letter-size pages long, with a current production run of 100 copies per issue. It is distributed to all Network members, and an increasingly large mailing list of other interested organizations and individuals in Africa, Europe and North America. We are pursuing with Herbert Murwira, TSBF AfNet Liaison Officer, the possibility of a joint Newsletter.

### Soil Fertility Bibliography for Maize Systems

At the first (Salima) meeting of the Working Group there was a strong recommendation that the Network commission bibliographies of soil fertility research in the maize-based systems of the region. The Malawi bibliography was started in June by Spider Mughogho and Margaret Ngwira at Bunda College, with input from other researchers. A similar effort for Zimbabwe began in August 1995 led by Lucia Muza, with Luke Mugwira, Jestinos Muzeziwa and Chris Nyakanda.

Both of these bibliographies include "interpretive summaries" of the key references. These emphasize research results, how they have been used, including their effect on recommendations, and implications for further work. The bibliographies are being compiled on the CDS/ISIS (UNESCO) bibliography software for microcomputers at Bunda College and DR&SS. The Network expects to distribute paper and diskette copies of both bibliographies by early 1996.

## Inventory of Member Research Interests and Activities

This is another suggestion from the Salima meeting. Most members have submitted summaries of their current activities and interests related to soil fertility research and extension. A draft was distributed to members in April. It will be updated each year.

## Network Working Paper Series

To help make Network members and end users more aware of the outputs from our Network we have developed two series of Network Papers. One series will cover results from completed programs of research. The other will describe useful concepts or methods that we may want to use in our work. Network members are encouraged to submit outlines or scripts of likely issues in these series. We have almost finished editing the first issues in these series. Methods Series: Number 1 (*The Utility of Soil Fertility Kits in the Tropics*) is due in October. Research Series Number 1 (*Soil Fertility Management in the Smallholder Maize-Based Cropping Systems of Southern Africa*), is due in November. These will be distributed to all those that receive Target.

## Book Purchases and Document Distribution

Over the year the Network coordination office has purchased a small stock of key soil fertility books. Most of these are held at the coordination office for use by members. Copies of two books have been distributed more widely. Other papers, reports etc., are distributed as appropriate.

## Study Tours

The Network has some funds to support members to travel within southern and eastern Africa to see relevant work. Alois Hungwe, Todd Benson and Stephen Waddington were sponsored to visit Kenya in January to learn more about crop modeling and GIS. John Kumwenda, Vernon Kabambe and Webster Sakala were also supported to Kenya in June, on a tour of soil fertility research in their maize-based cropping systems.

## Conference Attendances by the Coordinator

These include:

*Soils Management in Eastern and Southern Africa* (Belaggio, Italy, January)

*The Emerging Maize Revolution in Africa: The Role of Technology, Institutions and Policy* (Michigan State University, USA, July)

*Driven by Nature: Plant Litter Quality and Decomposition* (Wye College, England, September)

*Rockefeller Agricultural Resource Husbandry Zimbabwe In-Country Meeting* (Mutare, Zimbabwe, September).

## Network-Related Papers Prepared by Coordinator

Karigwindi, J., S.R. Waddington, and J. Chifamba (1995). Yield and soil fertility trends in current maize-with-groundnut cropping patterns on smallholder farms in Zimbabwe. Paper presented at the Second Meeting of the Soil Fertility Research Network Working Group, Kadoma, Zimbabwe, 17-21 July 1995.

Kumwenda, J.D.T. and S.R. Waddington (1995). The relief of micronutrient deficiencies on maize in Malawi: Example of a long term research process. In: *Report on the First Meeting of*

*the Network Working Group*. Report on a meeting held at Salima, Malawi, 1-3 November 1994. Soil Fertility Research Network for Maize-Based Farming Systems in Selected Countries of Southern Africa. The Rockefeller Foundation Southern Africa Agricultural Sciences Program, Lilongwe, Malawi, and CIMMYT Maize Program, Harare, Zimbabwe. pp. 74-83.

Kumwenda, J.D.T., S.R. Waddington, S.S. Snapp, R.B. Jones and M.J. Blackie (1995). Soil fertility management in the smallholder maize-based cropping systems of southern Africa. Paper presented at the conference *The Emerging Maize Revolution in Africa: The Role of Technology, Institutions and Policy*, Michigan State University, East Lansing, MI, USA, 9-12 July, 1995.

Waddington, S.R., compiler (1995). *Report on the First Meeting of the Network Working Group*. Report on a meeting held at Salima, Malawi, 1-3 November 1994. Soil Fertility Research Network for Maize-Based Farming Systems in Selected Countries of Southern Africa. The Rockefeller Foundation Southern Africa Agricultural Sciences Programme, Lilongwe, Malawi, and CIMMYT Maize Program, Harare, Zimbabwe. pp. 110.

Waddington, S.R. (1995). A soil fertility research network to improve the productivity of smallholder maize-based cropping systems in countries of southern Africa. In: *Report on the First Meeting of the Network Working Group*. Report on a meeting held at Salima, Malawi, 1-3 November 1994. Soil Fertility Research Network for Maize-Based Farming Systems in Selected Countries of Southern Africa. The Rockefeller Foundation Southern Africa Agricultural Sciences Program, Lilongwe, Malawi, and CIMMYT Maize Program, Harare, Zimbabwe. pp. 66-69.

Waddington, S.R. and J.K. Ransom (1995). Linking soils, agronomy and crops research for maize: CIMMYT initiatives in southern and eastern Africa. Paper presented at the meeting on *Soils Management in Eastern and Southern Africa*, Bellagio, Italy, 30 January - 2 February 1995.

Waddington, S.R. (1995). Status of the soil fertility network in mid 1995. Paper presented at the Second Meeting of the Soil Fertility Research Network Working Group, Kadoma, Zimbabwe, 17-21 July 1995.

## LONG-TERM SOIL FERTILITY RESEARCH IN THE MAIZE-BASED SMALLHOLDER FARMING SYSTEMS OF ZIMBABWE

In 1992/93, CIMMYT-Zimbabwe started a series of long-term trials. These look at the effects of current cropping patterns and fertilizer management on trends in soil fertility and crop productivity of maize dominated farming systems in sub-humid parts of Zimbabwe<sup>4</sup>. With the start of the 1994/95 season these trials became the research contribution from CIMMYT-Zimbabwe to the Soil Fertility Network. The Network grant assists with staff salaries and transport while casual labor and consumables are covered by CIMMYT core funds.

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<sup>4</sup> A full description of these trials and results from 1992/93 through 1994/95 is available in the CIMMYT-Zimbabwe Annual Research Reports for 1992/93 and 1993/94, and in *Yield and Soil Fertility Trends in Current Maize-With-Groundnut Cropping Patterns on Smallholder Farms in Zimbabwe*, a paper by J. Karigwindi, S.R. Waddington and J. Chifamba presented at the 2nd Meeting of the Soil fertility Network Working Group, Kadoma, Zimbabwe, 17-21 July 1995.

In the main project we measure long-term crop yield and soil fertility effects of continuous maize and a maize-maize-groundnut-maize rotation grown either at current smallholder inorganic and cattle manure fertilizer levels, or without fertilizer, on smallholder farms. Continuous groundnut and maize/groundnut intercrop treatments are included. Inorganic fertilizer and cattle manure are used at rates that reflect smallholder farmer practice in sub-humid Natural Region II communal areas in Zimbabwe. Seven sites are used: one at the AGRITEX Training Center, Domboshava; three in Chinyika resettlement area and three in Wedza communal area.

The main expected outputs are:

- a) trends in yield with current maize/groundnut cropping patterns and soil fertility inputs on smallholder fields,
- b) trends in soil fertility with such systems, and
- c) guidelines on the relative benefits from legume rotations, legume intercropping, cattle manure, inorganic fertilizer and maize stover incorporation on-farm.

Base soil fertility levels are low. Soils at the sites are loamy sands, sandy loams and sandy clay loams derived from granite, with low pH (pH 4.2 - 4.7), carbon below 1% at most sites, low levels of P, low cation exchange capacity (CEC) and low levels of several cations.

Response to inorganic fertilizer was low at most sites in 1994/95. Grain yields with fertilizer were above 1 t ha<sup>-1</sup> at only four out of seven sites. This was mainly due to intermittent drought during early development of the crops which became severe throughout grain filling. Season rainfall totals of just 290 mm to 355 mm were recorded for 1994/95, and *Striga asiatica* was a problem at two sites. Sole-crop groundnut kernel yields were also low, averaging 189 kg ha<sup>-1</sup>.

Significant improvements in maize grain yield were achieved where inorganic fertilizer was combined with cattle manure. Without manure, fertilizer raised grain yield by 0.51 t ha<sup>-1</sup> whereas with manure, fertilizer raised yield by 0.82 t ha<sup>-1</sup>. This implies an improvement in the use-efficiency of the inorganic fertilizer when manure is present even in a drought year. We expect larger increases in wetter years.

In these trials we are beginning to see a divergence in crop yields with cropping pattern and fertilizer history, and indications that combining organic fertilizer with inorganic is important for improved fertilizer use efficiency and yield sustainability. The magnitude of yield changes over time will be important to monitor to see where this system is going and how quickly. In our experience to date, low rainfall has had the overriding effect on crop yield. Rainfall variation from season-to-season may mask yield trends due to changes in soil fertility. A serious challenge for the Network is how to manage and exploit fertilizer x moisture interactions.

CIMMYT-Zimbabwe staff supported under the Rockefeller Foundation Soil Fertility Network grant:

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## NETWORK ACTIVITIES PLANNED FOR OCTOBER 1995 TO SEPTEMBER 1996

### Proceedings of the Second Meeting of the Network Working Group

This will be compiled by the coordinator and circulated to all Network members by January 1996.

### Field Tour in Zimbabwe

A one week tour of soil fertility research sites in Zimbabwe is planned for 11-17 February 1996. Twenty to 25 persons will be invited.

### Network Workshops

- 1) *The Use of Soil Fertility Technology*: At the Kadoma meeting it was decided to plan a meeting to look at improving the use of soil fertility technologies coming from Network research. This meeting will involve extension, NGOs, farmer representatives and a few researchers. A small committee has been set up to draft objectives and an agenda for the meeting to take place mid 1996.
- 2) *Improving Fertilizer Use Efficiency Through Combined Organic/Inorganic Sources*: The meeting will review current knowledge on this strategic research topic and plan follow-up. It will be restricted to researchers with an active interest in that work. We hope to develop this as a joint meeting with TSBF.

Each of these meetings will be limited to 15-20 persons. The next full meeting of the Network Working Group will be in early to mid 1997.

### Network Trials

A Network Trial will quantify productivity and N use gains from combining organic material with inorganic N fertilizer for maize at rates practicable for smallholder farmers. It will be planted by cooperators at about eight sites in Malawi and Zimbabwe during November/December 1995. The organic source will be cattle manure in Zimbabwe and leguminous shrub leaf prunings in Malawi. Planning of other trials will continue during the year.

### Research Planning, Information Exchange etc

Many other Network activities will continue, including the proposal review process, development of the bibliographies and databases, production of Target and the two Working Paper Series, support to study tours etc.

### Strengthening Links

Special emphasis will continue on strengthen links with:

- Basic process research organizations (TSBF-AFNet; Wye College, University of London; ACFD; IFDC)
- Technology users (government extension services/NGOs (Veza and ActionAid in Malawi, Natural Farming Network in Zimbabwe); farmers; fertilizer suppliers).

The utility of the Maize Productivity Task Force Action Group concept in Malawi for distributing outputs needs to be evaluated. It may be useful in Zimbabwe.

SRW, Harare, 24 October 1995





