

Staff Paper

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CRAFTING SMALLHOLDER-DRIVEN AGRICULTURAL
RESEARCH SYSTEMS IN SOUTHERN AFRICA

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Summary. — The National Agricultural Research Systems (NARSs) in sub-Saharan Africa have made enormous progress over the past four decades in replacing European with African scientists, increasing the number of scientists and shifting priorities from export to food crops. Nevertheless, most NARSs are having difficulty in producing a steady stream of new technologies for small-scale farms and in generating adequate financial support from their governments. Zimbabwe and Malawi are among the first countries in Africa to mount indigenous-led reforms of their NARSs. This paper documents the steps taken by the Agricultural Research Council of Zimbabwe to generate a consensus among scientists, farmers and policy makers to reform the National Agricultural Research System by increasing the voice of smallholders and other stakeholders in setting research priorities, making scientists more accountable to smallholders and generating new sources of financial support from user fees and taxes on commodities. Malawi is pursuing a commodity approach to revitalizing its NARSs. The experience of both Zimbabwe and Malawi has shown that there is no blueprint for reforming NARSs in Africa. Donors can assist the reform process by supporting local initiatives to craft smallholder-driven research systems that are staffed with accountable scientists who are adequately financed from local sources.

Key words — Africa, agriculture, institutions, research, NARSs, Zimbabwe, and Malawi

1. INTRODUCTION

With two-thirds of the people in Africa engaged in agriculture and population growth outpacing food production, it follows that Africa's future economic growth depends crucially on revitalizing its agrarian economy. But Africa's farmer support systems for smallholders are in serious disarray.¹ Central to the task of getting agriculture moving in Africa is the restructuring and revitalization of its national agricultural research systems (NARSs).² The role of foreign aid in this task is problematic because there is growing evidence that Africa's heavy dependence on foreign aid, especially in the 1975-95 period, has prematurely inflated the size of NARSs (i.e., number of scientific and technicians, number of research stations), and taken the pressure off the managers of NARSs to mobilize domestic political and financial support to sustain the systems after foreign aid is phased out (Eicher, 1989). In 1991, for example, foreign aid accounted for 43 percent of agricultural research expenditures in Africa and in seven countries it exceeded 60 percent (Pardey, *et. al*, 1997).³ But in the final analysis the causes of the crisis in agricultural research in Africa must be shared by African governments, research managers and members of the donor community.

Over the past decade, donor-initiated economic policy reforms have failed to achieve the desired increase in aggregate agricultural output in many countries in Africa. There is now ample evidence that these reforms must be complemented by indigenous efforts to revitalize agricultural research systems. There is also a growing awareness

that an array of public and private research models is needed in a continent embodying 47 countries, seven colonial histories and diverse political ideologies, ecologies and resource bases. The critical political and financial question for the future is the following: how do African governments, with public budgets and institutions in crisis, ensure that useful research is produced for extension agents and smallholders without insisting that government monopolies continue to serve this function?

This paper focuses on southern Africa where African-led initiatives are underway to reform, rebuild, and revitalize national public research systems in order to make them more effective in meeting the needs of smallholders and improving their financial sustainability. This paper is organized as follows: In section 2 we discuss institutions in transition. Section 3 discusses historical trends in agricultural research in Africa during the colonial period (1900-1959) and independence (1960-1994). Section 4 discusses the evolution of agricultural research in southern Africa and the current problems facing NARSs in the region. In parts 5 and 6 we discuss on-going reforms of R&D systems in Zimbabwe and Malawi. Section 7 draws lessons from Zimbabwe and Malawi's reforms for policy makers, agricultural research managers and donors.

2. INSTITUTIONS IN TRANSITION

Seventeen of Africa's 45 colonies gained their independence in 1960 followed by the Portuguese colonies of Angola, Mozambique and Cape Verde in 1975, Zimbabwe in 1980, Namibia in 1990, while South Africa gained majority rule in 1994. After independence African research managers have been forced to grapple simultaneously with five complex transitions which ultimately will influence the productivity and sustainability of NARSs:

- * managerial transition from colonial to local research administrators;
- * scientific transition from expatriate to indigenous scientists;
- * financial transition from dependence on financial support from colonial governments and large scale farms to mobilizing support from governments and donors;
- * political transition from commercial farms to smallholders in dual agrarian societies; and
- * transition from public to private research and new forms of public/private research partnerships.

Few agricultural research managers have had a blueprint for solving these difficult transitions. Because of the failure to resolve these complex transitions, many donors are withdrawing their support and urging the managers of NARSs to pursue privatization of research, NGO initiatives, contract research, regional research, user fees and research endowments.⁴ Although these initiatives may reduce public and donor expenditures on agricultural research, they are unable by themselves to reach the majority of African smallholders.

The development economics literature provides little guidance on institutions in transition and how to develop effective smallholder-driven farmer support services, including research. North (1990) stresses the importance of “time” in institution building. Bonnen (1990) underlines the time dimension by chronicling the U.S. experience in pragmatically piecing together a system of interactive development institutions over a period of sixty years, 1860-1920. The induced innovation literature of technology development utilizes a comparative statics framework where farmers “press the public research systems to develop the new technology and also demand that agricultural firms supply modern technical inputs...and perceptive scientists and science administrators respond...”(Hayami and Ruttan, 1971, p. 57) But smallholders in most African countries have historically been politically marginalized; today they are so widely dispersed and unorganized that they are simply not in a position to “press the public research systems to develop new technology.” With a rapid turnover in managers of public research systems (6 in the past 12 years in Malawi), NARSs are unable to respond according to the induced innovation model and turn theory into practice. Because of the lack of smallholder participation in the political arena and in research priority setting, foreign aid has provided a short term substitute for the lack of domestic political and financial support for research. But the project approach to foreign aid has exacerbated the coordination of donor assistance. For example, in 1996, 180 different agricultural projects in Zambia were being supported by 10 major donors.

3. EVOLUTION OF AGRICULTURAL RESEARCH IN AFRICA

(a) Colonial Period, 1900-1960

Despite many shortcomings of colonial research models, Africa’s colonial experience has generated several valuable insights for addressing the managerial, scientific and financial problems facing NARSs in Africa today.⁵

During the colonial period small commodity research teams with continuity of funding were highly effective in carrying out research on export crops.⁶ Also, scarce resources were pooled and coordinated through global research networks (e.g., the Empire Cotton Growing Corporation), and regional commodity research institutes (e.g., West African Cocoa Research Institute) (Eicher, 1989). Another colonial research innovation was the pursuit of research on agriculture and forestry in the same regional research program in East Africa in the 1960s.⁷

(b) Independence: 1960-1994

Pardey, Roseboom and Beintema (1997) have documented the major trends in agricultural research in Africa from the beginning of independence in the early sixties to the mid nineties:

- * The total number of full time equivalent African researchers climbed more than four fold - i.e., from 2,000 in 1960 to 9,000 by 1990.
- * Ten percent of the agricultural researchers in the early 1960s were Africans and 90 percent were expatriates. Vigorous training programs were launched after independence and, by the early 1990s, 90 percent of the scientists were African.
- * The size of most NARS increased dramatically following independence (Table 1). The number of agricultural scientists increased from 1 in Botswana in 1961 to 54 in 1991. In Nigeria the number of scientists increased from roughly 100 at independence in 1960 to 1,000 by 1985.
- * Domestic financial support for research increased in the 1960s and early 1970s, peaked in 1981 and declined throughout the eighties. Foreign aid increased dramatically in the seventies and eighties and slowed in the nineties.
- * The number of research scientists and research budgets per researcher grew in tandem from 1961 to 1981, but real research expenditures stalled after 1981 while the number of researchers continued to increase in the eighties (Pardey, Roseboom and Beintma, 1997, p. 413).⁸
- * Donor funding currently accounts for 61 percent of total agricultural research expenditures in francophone countries and 26 percent in anglophone countries (36% if South Africa is excluded).

[Table 1: Trends in the Number of Agricultural Researchers in Nine Countries in Southern Africa, 1961-91]

While African nations have more scientists and greater numbers of Africans engaged in agricultural research today than in the 1960s, numerous factors have undermined the creation of a scientific culture in NARSs and the delivery of useful technology to smallholders. The quality of human capital has been eroded in many NARS because of low salaries and poor incentives (Idachaba, 1991). Finally, many African NARSs are heavily dependent on foreign aid which is known for its instability.⁹ Most NARSs have a modest local constituency and long-term consistent funding is problematic (Howard, 1997; Kumwenda, *et. al.*, 1997).

(c) Payoff to Research

Studies of the rate of return to investment in agricultural research in Africa show mixed but positive returns, ranging from negative for several cases to 135 percent for maize in Mali (Table 2). These studies support the proposition that the payoff to agricultural research in Africa is consistent with the positive returns in Asia and Latin America (Oehmke and Crawford, 1996).¹⁰ But studies of the payoff to research in Africa have generally been of known successes while many failures remain unexamined. Studies of the payoff to research have been of limited use to policy makers and donors because they do not shed light on four problems:

- what explains the gap between the high payoff to research and the claims that most NARSs and farmer support organizations are not meeting the needs of the majority of smallholders;
- why do most NARSs lack a broad base of indigenous political and financial support if the payoffs to research are high; and
- why are most NARSs not fiscally sustainable?
- what makes some research systems successful and others unsuccessful.

[Table 2: Ex Post Rate of Return (ROR) Studies of African Agricultural Technology Development and Transfer]

After 35 years of independence in Africa, there are few hard data to show under what circumstances agricultural service institutions (teaching, research and extension institutions) can make the transition from a top down colonial technology development model to being highly responsive to, and answerable to smallholder clients. Research is urgently needed on how alternative incentive structures shape the scientific discovery process, how to

build political and financial support for relevant research for smallholders, and how to develop new partnerships between public and private research organizations. But transactions costs (the core of the new institutional economics), have been difficult to measure in comparative studies of institutional and technical change in African agriculture.

4. AGRICULTURAL RESEARCH IN SOUTHERN AFRICA

This paper addresses the critical institutional problems facing public agricultural research services (NARS) in one of the five major subregions of Africa - southern Africa. We have chosen one subregion rather than Africa as the unit of our comparative analysis because of the immensity, diversity and complexity of Africa. Most countries in Southern Africa have dual agrarian societies of 'commercial' farmers and smallholders.¹¹ Commercial farmers are generally located in favorable areas and have the political and financial resources to bias agricultural research and farmer support institutions in their favor. By contrast most smallholders are poor, land constrained and have little political power.¹²

Most political leaders in southern Africa are entranced with the vision of large scale commercial agriculture as the model of development for the 21st century, despite at least nominally claiming, as a priority, to address the problems of smallholders (Eicher and Rukuni, 1996). The influence of commercial farmers is deeply entrenched in development ideologies, political structures and institutions in the region. Although private research and seed distribution are playing an expanding role in technology development and transfer in southern Africa, strong smallholder-focused public research systems have an important role to play, especially in serving extension workers and farmers in less favorable agricultural areas.

There is general agreement that an agricultural growth strategy for smallholders requires a chain of technologies, institutions, and policies that function as an efficient system of development institutions rather than as disarticulated parts (Lynam and Blackie, 1994). But this type of system does not currently exist in any of the twelve countries in Southern Africa. Smallholders throughout southern Africa do not have sufficient political power to articulate their economic interests in policy formulation, technology development and in exerting pressure on the government to restructure public farmer support services to meet their technical and economic needs. Donors are

part of the problem. Although a plethora of donor projects have helped train scientists, purchase vehicles and equipment and build physical infrastructure, this represents a narrow approach to building productive and sustainable national research systems.¹³

(a) Agricultural Research Policy Issues

We believe that strong and cost effective national public research systems are the cornerstone in developing sustainable research systems for smallholders in southern Africa. Four major issues currently dominate agricultural research policy debates in Southern Africa.

1. The gap between the high payoffs to research and the disappointing performance of public research, extension, and credit institutions in meeting the needs of the majority of smallholders. Whiteside (1996) presents *prima facie* evidence that the basic national agricultural organizations— research, extension, training, finance, marketing, and land settlement—are currently not functioning as efficient national systems in most Southern African countries. The challenge is to help leaders of separately - governed farmer support organizations come together and work toward a common goal of increased smallholder productivity (Rukuni, 1996a).

2. The lack of accountability of scientists for generating a stream of new technology that is useful to smallholders. There are many components of this problem. The lack of accountability is linked to scientists working in public bureaucracies under civil service procedures that generally do not reward quality and accountability. The experience of Malawi shows that the pursuit of “good science” has largely missed the target in terms of developing useful technology for accelerating the productivity of smallholder agriculture (Blackie and Jones, 1993). Science can be professionally respectable, or technically satisfactory, while simultaneously being irrelevant to “real world” issues facing smallholder farmers with little voice in the research and political systems. Another problem is that most of the data that are used for farmer recommendations are derived from research sites in favorable environments (Byerlee and Heisey, 1996). As a result many of the recommendations on input use and crop management are impractical from the perspective of smallholders (Carr, 1989).

3. How to incorporate the voice of the smallholder in the research system, including priority setting, and mobilizing political support for agricultural research (Sands, 1988; Tripp, 1991; Anandajayasekeram and Rukuni,

1995). Most smallholders are dispersed and are not confident in dealing with political and social change and structural adjustment programs that are now taking place. The challenge is how to organize smallholders into coherent and effective commodity groups or representative bodies and articulate their economic interests in the political process and participate in impact reviews, priority-setting, and pressuring scientists to be accountable to meeting their needs (Rukuni, 1996a). But a word of caution is in order. Even if smallholders do increase their role in setting research priorities and evaluating research results, increasing the voice of smallholders is not likely to resolve financial and managerial constraints facing NARSs.

4. Financing agricultural research.¹⁴ Zimbabwe, South Africa, Botswana and Namibia are the only countries in the region that are financing most of the cost of their NARSs from national sources. The NARSs in these countries, however, have historically given priority to meeting the needs of commercial farmers. One critical issue to examine is reducing the size of NARSs because generous flows of foreign aid have helped increase the size of the public research system, including the number of scientists, technicians, experiment stations as well as the number of commodity research programs. Other issues to examine include the privatization of research, research endowments, contract research, and user fees (Pray and Umali-Deininger, 1998).

(b) Reforming National Research Systems

We now turn to an examination of indigenous led reforms of NARSs that are currently underway in Malawi and Zimbabwe. In both Malawi and Zimbabwe, the reforms of agricultural research are being spearheaded by local scientists and policy makers, not by donors. Malawi and Zimbabwe are pursuing different approaches to revitalizing their NARSs. In Zimbabwe because of the poor performance of the research system for smallholders and a 33 percent real decline in government funding for research since independence in 1980, reforms are underway to re-engineer two public sector research organizations: the Agricultural Research Council (ARC) and the Department of Research and Specialist Services (DRSS). Several task forces are examining how to create a stronger voice for smallholders in the system and how to harness domestic political and financial support for research. By contrast, instead of trying to strengthen its public research system across the board, the government of

Malawi is focusing on maize research. In 1995 the government set up a Maize Productivity Task Force and charged it with improving the productivity of maize - the staple food in both rural and urban areas.

5. ZIMBABWE: CRAFTING A SMALLHOLDER-DRIVEN RESEARCH SYSTEM

Agricultural research was launched in Zimbabwe in 1903 by the British colonial service with an objective of serving European settlers on large farms. A number of research stations and testing farms were established over the ensuing decades. In 1948 the Ministry of Agriculture integrated its scattered research stations and set up the Department of Research and Specialist Services (DRSS). In 1961 the government launched the Agricultural Research Council and charged it with developing national agricultural research policies and priorities, and serving as an advisory committee to the Ministry of Agriculture (Rukuni, 1996b).

At independence in 1980, the new majority-ruled government headed by President Robert Mugabe inherited a national treasure - a sustainable national public agricultural research system - with an international reputation for high quality research for commercial farmers, especially tobacco, maize and cotton for large scale commercial farms.¹⁵ The entire budget of DRSS was locally financed and it had a small but well paid local staff with low turnover, thus ensuring continuity of scientific effort. Soon after independence DRSS's mandate was broadened to serve the rural majority - the 700,000 smallholders (Blackie, 1982). In 1982 the new government decided to reduce the voice of large-scale farmers in R&D policy matters, by stripping the ARC of its control over DRSS's budget and limiting its future role to that of an advisory body to the Minister of Agriculture. However, a few years after independence, the managers of DRSS found themselves overwhelmed by the common problems of an institution in transition: an exodus of experienced research officers, a declining budget and a vanishing political base as commercial farmers pooled their resources and set-up a private research farm (Eicher and Kupfuma, 1997).

(a) The Crisis of Public Sector Research

Soon after independence in 1980 the new government launched a number of initiatives to level the playing field for smallholders, including the integration of its two national extension services, dramatically increasing the budget for extension (Table 3), and directing DR&SS to reorder its priorities in favor of smallholders. However, instead of increasing DRSS's budget to address its broader mandate, the government slashed the real budget of

DRSS by 33 percent from 1980/81 (Z\$8.0 million) to 1993/94 (Z\$5.38 million) (Table 3). Most research stations currently only have adequate operating budgets for about six months of the financial year and the DRSS no longer has a capital budget. About 80 percent of DRSS staff are located on research stations in high potential areas where the bulk of the commercial farmers are located, while 90 percent of smallholders live in low potential areas (ISNAR, 1988). The disturbing consequence of DRSS's declining real budget is the contraction of off-station trials and on-farm research for smallholders (Shumba, 1991).

[Table 3: Zimbabwe: Trends in Agricultural Research Funding by the Government]

High staff turnover has undermined the continuity of scientific leadership and the maintenance of a scientific culture where scientists are accountable to the majority of farmers--the smallholders. In 1994, 80 percent of the professional staff had less than 10 years of experience (Agricultural Research Council, Zimbabwe, 1995). Restrictive civil service working conditions make it difficult for staff to acquire additional training. In recent years, more than half of its new Ph.D.'s leave the department soon after completion of their training.

(b) Building Indigenous Support for Reforming Public Sector Research

An important aspect of the reform and revitalization of public agricultural research in Zimbabwe is the degree to which the institutional reform process is driven by internal stakeholders rather than international experts. In the mid 1980s, several studies by international organizations, proposed a number of reforms in public agricultural research (ISNAR, 1988). Although these reports contained many valuable suggestions, few of them were implemented. But in the early 1990s the need for reform was agreed upon by DRSS scientists and managers because of the significant decline in the real budget of DRSS, the departure of a large number of senior scientists and recent Ph.D. graduates, and the rigid regulations surrounding government transport, personnel and financial management.

The need to reform the DRSS was flagged when a Commission of Inquiry into Land Tenure consulted with farmers, members of local government and farm organizations throughout the country and discovered that many of the farmer support institutions, including DRSS, and the national extension service were reaching a small

percentage of their smallholder clients (Rukuni, 1994). In 1994, for example, government credit was available to less than three percent of the estimated one million smallholders in the mid nineties (Chimedza, 1994).

The report of the Land Tenure Commission was followed by a 1995 meeting on the status of Zimbabwe's agricultural institutions (Zimbabwe, 1995). The meeting was attended by representatives of all farmer support services, the private sector and universities. The meeting resolved that the Agricultural Research Council (ARC) was the logical organization to assume the leadership of a coordinated effort to reform and revitalize DRSS. The ARC subsequently designed a plan of work which was approved by the Ministry of Agriculture and secured a grant from the Rockefeller Foundation to carry out a number of special studies and implement reforms in both the ARC and DRSS.

Over the 1995-97 period members of the DRSS consulted with agricultural leaders, scientists and extension workers to figure out how to restructure and revitalize public research and extension in Zimbabwe in order to meet the needs of smallholders. These discussions generated a plethora of reasons for the decline of the DRSS. Extension specialists reported that there were insufficient useful results to address the key constraints on smallholder agriculture such as declining soil fertility, particularly management of sandy soils and moisture conservation. Public agricultural research managers noted that the civil service system currently rewarded length of service, rather than the quality of research and accountability to clients. Senior researchers commented on the need for improving the work environment, including staff management, salary and remuneration. Many public sector leaders recommended that the role of the Agricultural Research Council should be broadened to include developing agricultural research policy guidelines for the DRSS, reviewing broad research priorities and monitoring the DRSS budget.

A distressing outcome of the discussions with agricultural leaders, farmer groups, and extension and research workers over the past three years was the realization that the DRSS had lost much of its capacity to develop useful technology for its clients. But the discussions did serve to galvanize scientists to consider radical change in DRSS.

(c) The Reform Process

A critical step in the reform process has been garnering the support of both the scientific and farming communities. In 1995, the ARC convened a meeting of all DRSS senior scientists to enlist their voice and participation in the reform process. The scientists resolved that there was need to grant greater autonomy to the DRSS, and to reorganize and restructure it in order to increase its efficiency and effectiveness. Later in 1995 the Minister of Agriculture pledged his support to the reform process and approved the following changes in the composition and operation of the Agricultural Research Council:

- * one member from each of the three farmers' unions was appointed to the Board of the ARC;
- * the directors of research, extension, veterinary services, as well as a representative from higher agricultural education and several representatives from the private sector were appointed to the Board of the ARC
- * the Agricultural Research Fund (ARF) was transferred from the DRSS to the ARC; (the ARF is the repository of financial contributions from commodity associations, farmer groups, donors and revenues from taxes on crops); and
- * the ARC was authorized to set up a new operational structure to enlist broader participation in the governance, planning and evaluation of research financed under the Agricultural Research Fund.

In August 1996, the new ARC Board mapped out a strategy for reforming the public sector research system. The Minister of Agriculture subsequently convened a meeting of the key stakeholders in the reform process, including representatives of each of Zimbabwe's three farmer unions, the heads of public and private sector agricultural organizations as well as those of semi-private research organizations. The reform strategy and plan were discussed and agreed upon by the stakeholders and the ARC was charged with leading the reform process. The ARC, therefore, has assembled the key stakeholders, beyond research, to participate in developing a relevant, effective and sustainable technology development and diffusion system.

The ARC established a number of task forces to:

- * re-define the role, mandate, functions and responsibilities of the re-engineered ARC, including necessary legislative and administrative changes;
- * re-draft the constitution of the Agricultural Research Fund in order to secure greater participation of farmers in financing research and setting research priorities;
- * explore the means and mechanisms for sustainable financing of the administration of the ARC;
- * set-up a mechanism for planning, priority setting and evaluation of public sector research; and
- * develop improved mechanisms for client-research-extension linkages.

The task forces completed their work in mid 1997 and submitted a number of proposals to the government for re-engineering the ARC and the DRSS (ARC, Zimbabwe, 1997). The reforms were approved by the Minister of Agriculture in July, 1997 (Kangai, 1997). The reforms require the ARC to perform effectively at three levels: policy, strategy, and problem solving. The ARC is now strengthening the voice of smallholders by establishing decentralized provincial committees on which other major stakeholders are represented. Provincial committees are charged with facilitating farmer-researcher-extension linkages and commodity committees are establishing scientific priorities and providing strategic direction. The three farmers' unions and independent scientific organizations are represented on these committees. The council has been restructured to strengthen the voice of farmers in general, and that of smallholders in particular. Half of the members of the council are now farmers.

The government has transferred the responsibility for the Agricultural Research Fund (ARF) from DRSS to the ARC. The ARC is expected to grow over time as farmers' organizations and government channel research grants through the fund. The government is in the process of passing legislation that will levy a cess (tax) on farm produce for various purposes, including research. The reforms over the past two years have renewed interest in financing agricultural research by both government and donors. The World Bank, for instance, will provide support from its Agricultural Services Management Project to the ARF.

In order to convert DRSS into a client-driven national research organization, DRSS is decentralizing its operations and decision making systems for managing the research program, staff and finances. This is expected to

raise staff morale and foster linkages between scientists and farmers as well as other interest groups. DRSS has government approval and the support of the ARC to draw up plans for cost recovery in three areas:

- services such as soil and fertilizer analysis and seed services;
- sale of produce from experimental farms; and
- sale of technological products not yet commercialized, such as multiplication of seed and seedling for crops not supported by commercial firms.

DRSS has also proposed to pursue commercial farming operations to enhance its financial position. This proposal, however, has been treated with reservation by the ARC because of the mixed record of government farm production schemes and the fear that it may divert attention away from research.

DRSS, in a departure from the past, is now required to synchronize its planning and review processes with the ARC. As a client-driven organization, DRSS will work closely with the ARC in the annual research planning and review processes, as well as priority setting exercises. These review exercises include decentralized consultation with the provincial committee structures, research station planning meetings as well as annual general meetings.

Although these reforms hold promise in revitalizing agricultural research in Zimbabwe, such reforms require time to execute. The voice of smallholders has been enhanced in the national research system. The reforms emphasize change through experimentation and a recognition that there is no blueprint for revitalizing NARSs to meet the needs of small farmers.

(d) Interim Findings

The reforms are expected to be complete in 1999/2000. The interim findings of the DRSS and ARC task forces are now available (Tawonezvi et al 1997). There is agreement among the three farmers' unions and various government departments that:

- DRSS ought to remain as a government department, and that the ARC should become a stronger and farmer-empowered body which guides DRSS policy.

- research partnerships will be encouraged in order to address major problems of scientific importance;¹⁶
- public and private sector accountability to the clients, particularly smallholders, is essential for success;
- a dualistic agricultural sector requires a strong central organization (ARC) that is representative of various farmer groups and focused on providing policy direction to the DRSS;
- decentralization of research is necessary to facilitate decision making in cooperation with local clients;
- greater emphasis will have to be placed on cost recovery from services and technology provided to various groups of farmers.

6. MALAWI: REVITALIZING THE NATIONAL MAIZE RESEARCH PROGRAM

(a) Evolution of the Public Research System

Malawi was colonized by the British Government at the end of the 19th century and European settler farmers were permitted on a modest scale, but little associated financial support was provided by the British. The new settler-farmers naturally gave priority to setting up research institutes for the main cash crops. Research on food crops only began in earnest after Malawi's Great Famine of 1949.

At independence in 1964 virtually all the researchers were expatriates on short-term contracts. The Department of Agricultural Research (DAR) was expanded gradually, acquiring additional responsibilities in 1975 for cotton, grain legumes and soils.¹⁷ The Agricultural Research Council (ARC) was dissolved in 1975, re-established in 1985 and given the responsibility for setting agricultural research policy for the DAR. The DAR was subsequently reorganized into commodity teams, each of which was expected to develop and defend its own research programme. In 1993, a World Bank commissioned Master Plan for agricultural research identified the following weaknesses of the public agricultural system: high staff attrition, difficulties in career advancement for staff, financial constraints (mainly for transportation and facilities), lack of basic information on the agroecological and social and institutional environment for smallholders and dispersed, fragmented and ineffective research

projects (Malawi, 1995). Recent government changes have added further layers of complexity to the research system. A National Research Council (NRC), which reports to the Ministry of Research and Environmental Affairs, acts as the senior research coordinating body in Malawi. The functions of the ARC overlap with those of the Agricultural Sciences Committee (ASC), a sub-committee of the NRC. The most significant role of the ASC, has been commissioning contract research in an attempt to promote demand-driven research.¹⁸

Despite various reorganizations, Malawi's public research service is in crisis. In 1995, the Department of Agricultural Research (DAR) employed 86 Malawian graduate staff, including 20 with a Ph.D. However, staff turnover has been high at all levels. There have been six directors of the DAR over the past twelve years, 1985-1997. By comparison Zimbabwe had four directors of its hybrid maize research program over a fifty-six year span, 1932-88 (Eicher, 1990). Also despite generous financial and technical assistance from donors, little improved technology for smallholders has been developed over the past 10 to 15 years except several maize hybrids. The lack of relevance of many research results is illustrated by the fertilizer recommendation for maize. For decades, a single fertilizer recommendation for maize (40 kgs of P_2O_5 per hectare) was disseminated over the entire country even though, as elsewhere in Southern Africa, Malawi has marked variability in climate, soils and farmer circumstances. A review of existing data from the early 1990s showed that many soils had sufficient levels of phosphate for maize production, and that, while yields varied from site to site, an application of greater than 20 kgs per hectare produced little extra benefit to farmers. Thus many Malawi smallholders, already some of the poorest in the region, had been encouraged for years to use a phosphate fertilizer rate twice as high as agronomically effective, let alone financially sensible. Unsurprisingly, most farmers ignored the recommendations.

The defining features of smallholder agriculture are the dominance of maize in the cropping pattern (around 85 percent) and the low level of maize productivity. Per capita maize production in Malawi fell steadily in the 1970s and 1980s, despite substantial investments in maize technology development (Smale and Heisey, 1997). Currently less than one-third of the rural population (wealthier smallholders and estate tenants) produce enough maize to feed themselves each year. The annual gap between national maize production and maize consumption requirements averaged over 260,000 tons over the 1990 to 1995 period. The maize shortfall imposed severe costs in

terms of social welfare. Malnutrition is widespread, with about half of all children under the age of five showing signs of stunting.

(b) The Maize Productivity Task Force

Instead of pursuing Zimbabwe's approach to reforming the entire national research system, the government of Malawi decided to focus on increasing maize productivity. This targeted approach was pursued by the International Rice Research Institute (IRRI) when it was established in the Philippines in 1960. Instead of hiring scientists to carry out research for the leading scientific journals, the founding Director General of IRRI issued a simple proclamation: carry out team research to put more rice on the table. After six years of commodity-focused research IRRI scientists released the famous IR-8 rice variety that helped launch the Green Revolution in Asia. Faced with a classic Ricardian food bottleneck, Malawi's Ministry of Agriculture and Livestock Development published an Agricultural and Livestock Development Strategy and Action Plan in 1995 to address the decline in per capita maize production and national and household food insecurity (Malawi, 1995). The Action Plan concluded that increasing the productivity of smallholder maize production was the key to the development of the agricultural sector and the reduction of poverty. The Plan argued that until smallholders were assured of sufficient quantities of maize, either through their own production or the market, they would be reluctant to shift from maize to higher value crops. The low levels of maize productivity were a result of several factors including poor soil fertility, limited rotations or fallowing of land due to declining average farm size, the dominance of the late maturing and low yielding local maize varieties, and poor crop management. In most years, the majority of smallholders did not use hybrid seed or fertilizer. The costs were too high and the risks too great.

Senior members of the Ministry of Agriculture and Livestock Development recognized the need to take urgent action to stimulate maize productivity. Several major donors shared this concern and agreed to support a Malawi-led initiative to quickly increase smallholder maize productivity. In May, 1995, the Government set up the Maize Productivity Task Force (MPTF) and charged it with developing and implementing a program to increase the productivity of maize-based cropping systems.

The maize task force was established as a committee of the Malawian Government, embracing the Ministries of Agriculture and Finance, the private sector, and the NGO community. The activities of the task force were funded by the Government and several donors. Representatives of the major donors were not members of the task force itself but were to be invited to participate in meetings of the task force as appropriate. An important principle underlying the task force was that the effort would not require an appreciable amount of new funds. Rather existing resources were to be reallocated so as to increase the efficiency and impact of their use.

The Maize Task Force set-up four action groups. The four groups accomplished the following during 1995/96:

Fertilizer Recommendations: The fertilizer action group carried out 2,000 simple trials on farmers' fields with guidance from the maize commodity research team in the Department of Agricultural Research, input suppliers and NGOs. An important task was to explore, through joint ventures with donors and private sector input suppliers, practical ways to make good quality farm management advice more readily available to farmers and to make modern inputs accessible and profitable to farmers. An investigative and verification program led to the development of fertilizer recommendations for localized areas at a reasonable cost (Benson, 1997).

Seed Distribution System: The seed action group was charged with reviewing the seed choices for maize, including the rapid testing of open pollinated varieties (OPVs) and potential legume crops with the goal of having seed available for distribution or purchase by smallholders in the 1996/7 season.

Marginal Farmers: This action group focused on the agricultural production and food insecurity problems of the poorest farmers which represent about 40 percent of the smallholder population. Most of these households are not well served by research and extension programs. This action group was charged with developing a long term technology development plan for these farmers with the realization that increasing maize production is only one component of an anti-poverty program.

Organic Soil Fertility: This group was charged with addressing the problems faced by those farmers who could not afford to purchase fertilizer. It focused on organizing a research agenda for organic matter creation and

management on smallholder farms and reviewing the best available technologies: promiscuous soyabeans, pigeon pea, phaseolus beans, and agroforestry practices.

(c) Assessment of Malawi's Experience

The Maize Task Force represents a targeted but limited experiment to revitalize its national agricultural research system. Mobilizing the Ministries of Agriculture and Finance, the private sector and the NGOs to focus on the most important economic and political crop in the country represents a new approach to technology development. The four month time scale from the initiation of the effort in May to its implementation in September, 1995 was tight. Under these circumstances, it would have been miraculous if all had gone according to plan. Nevertheless, the achievements of the maize task force have been significant. Revised fertilizer recommendations based explicitly on the cost of fertilizer, the price of maize, and the local soil type were developed for the 1996 cropping season. A decision tree was drawn up to help field staff in the interpretation of the new recommendations drawing on results of the trials on farmers' fields. The Task Force prepared a maize policy paper which analyzed the effects of the massive change in the maize: nutrient price ratio which had occurred the previous season. The seed distribution group set up a system of training smallholders in seed production. New seeds (primarily legumes and OPV cereals) were imported.

The fertilizer and seed action groups made the most progress because they were able to draw on well established methodologies for developing fertilizer recommendations and had access to information on seeds in southern Africa, as well as expertise from both the public and private sectors. By contrast, the action groups dealing with marginal farmers and organic soil fertility issues had a much harder task because they had less experience, in-country expertise and field-tested technology at their disposal. The organic soil fertility group recognized this at the outset and invited scientists from International Agricultural Research Centers (IARCs) based in Malawi to contribute to the initiative. The contribution of the IARCs, however, was modest.

The first year's results showed that where leadership and direction were available, the action groups adapted to a new working environment and operated effectively as a team. Where such leadership skills were

scarce, and the problem less well defined, the task force mechanism did not provide adequate back up, nor was it constituted in a way that could deal quickly with operational problems as they arose.

Assistance from three main donors - the European Union, the World Bank, and the Rockefeller Foundation - for the task forces proved to be difficult to coordinate. There were conflicting objectives and serious problems of coordination and disbursement mechanisms. In part, these came about because of the short lead time (four months) between planning and implementation of the task force. But it was also evident that each donor brought its own view about the priorities of the task force. The tendency of donors to impose their views over the choices of the Malawian-led task force compromised the authority of the effort.

A review of the first year's efforts of the Task Force has yielded valuable insights (Jones, 1996). For the 1996/7 season, the activities of the fertilizer and the soil fertility action groups were merged in order to deal with the practical problem of helping farmers figure out how to manage and increase soil fertility rather than dealing with soil fertility in the disciplinary sense of organic and inorganic fertility sources. The seed group continued to focus on widening the seed choices available to farmers, but there was little progress on the crucial problem of providing seeds for marginal farmers. Active discussions are ongoing between the various parties to increase the Malawian "ownership" of, and direction to, the task force effort. Although Malawi's maize task force has only been underway for two years, the experience to-date has been sobering. The reform and revitalization of Malawi's national public research system is going to require another five to ten years of experimentation, trial and error and determined effort.

7. LESSONS FROM THE EXPERIENCE OF ZIMBABWE AND MALAWI

Soon after African nations reclaimed their independence in 1960, virtually all of them embarked on training programs to replace colonial research officers. In the 1970s donors started to assist NARSs and the period from 1970 to 1985 can be described as a period of expansion and optimism. However, despite the rapid build up in the size of NARSs over the 1960-85 period, a number of studies in the mid-eighties revealed that many NARSs were not providing useful technology for extension workers and smallholders, morale of the scientists was low, turnover was high, and there was little indigenous political and financial support for research. The period from 1985 to the

present has been dominated by declining research expenditures per scientists and a heavy dependence on foreign aid. These are disturbing trends because increasingly yield-increasing innovations will have to replace area expansion as the major source of agricultural growth in Africa. Today there is general agreement that the causes of the research crisis in Africa are complex and must be shared between African governments and donors. Today most African nations have weak and ineffective public research systems that are not serving the majority of farmers. Although foreign aid has assisted in human capital development and increasing the size of many NARS in Africa, there is increasing concern that the size of most NARSs is not going to be sustainable after foreign aid is withdrawn.

This paper has examined the process of building indigenous support for reforming public research systems in two countries - Zimbabwe and Malawi - in southern Africa. Each of the two is pursuing a different approach to reforming their NARSs because of crucial differences in their stage of their human capital and institutional development, local history and degree of donor dependency. Zimbabwe is pursuing a broad approach to revamping both its Agricultural Research Council and its Department of Research and Specialists Services. By contrast Malawi is pursuing a targeted approach by revitalizing its maize research program. At independence in 1980 Zimbabwe inherited a dual agrarian structure and a vibrant public agricultural research system that was efficiently serving 4,000 large scale commercial farmers. Soon after independence, the new government directed the public research system to revise its mandate and give priority to meeting the needs of 700,000 smallholders. But after 18 years of independence, Zimbabwe's NARS (DRSS) is in crisis. The budget for DRSS has been sliced by one-third in real (inflation adjusted) terms from 1980/81 to 1993/94 and the DRSS is not providing timely and useful technology for smallholders. The government of Zimbabwe is in the third year of a process of mobilizing stakeholder support for research, strengthening the role of the Agricultural Research Council in terms of agricultural research policy and exploring means of increasing research productivity, mobilizing new sources of cost recovery and reducing staff turnover.

Malawi is a poor country of around 10 million people and a per capita GNP of US\$170. The government of Malawi has received generous foreign counsel on increasing the productivity of its NARSs through

reorganization and the preparation of master plans. However, after several reorganizations, the Department of Agricultural Research is still in crisis. In 1995, the government set-up a maize task force of indigenous representatives in 1995 and charged it with improving the productivity of maize-based farming systems. Much has been accomplished by the maize task force over the past two years but the reform process is proving to be slow and complex. It will likely take another five to ten years of hard work before Malawi's research system is a reliable generator of new technology for smallholders.

What are some lessons from the experience of Zimbabwe and Malawi for other African countries and for donors? The first lesson is that because of the variability in the stage of human capital and scientific development, there is no blueprint for restructuring and revitalizing NARSs in order to make scientists responsive to and accountable to meeting the needs of smallholders. The implication of this lesson is that donors should support indigenous-led initiatives to craft demand-driven NARSs that are effective and fiscally sustainable organizations. Rather than impose the preparation of master plans on NARSs, donors can help NARSs by financing local initiatives and institutional innovations to foster the accountability of scientists to farmers and clientele groups, mobilize adequate funds for researchers and achieve fiscal sustainability after donor funding is finished.

The second lesson is that because NARSs in southern Africa are at an earlier and institutional development than their counterparts in Asia and Latin America, it is understandable that the managers of NARSs in Zimbabwe and Malawi are giving first priority to strengthen their public rather than private research programs. Since private research normally follows in the footsteps of public research, donors should assist NARSs in strengthening NARSs, and developing public and private research partnerships rather than aggressively promoting the privatization of research.

The third lesson is that it is extremely difficult to increase the voice of smallholders in research systems in dual agrarian economies that pervade southern Africa. And even when the voice of the smallholders is enhanced in research priority setting, strengthening voice alone will not resolve many of the financial and managerial constraints facing most NARSs in Africa.

The fourth lesson is that the most common donor prescriptions for reforming NARSs--the preparation of master plans, regional frameworks and reorganizing NARSs--all fall short of the complex and arduous process of developing human capital, creativity, accountability and performance. Moreover throwing large grants at the reform process is likely to enhance donor-dependency and an attendant list of preconditions. The Rockefeller Foundation's provision of a small but "no strings attached" grant to the ARC of Zimbabwe enabled it to commission studies by local researchers, and to establish task forces to lead the reform process. The unrestricted nature of the grant was crucial in enhancing local self-confidence and in creating a positive atmosphere for internal reform. In summary, donor funds are not a substitute for time, patience and learning by doing.

*Table 1. Trends in the Number of Agricultural Researchers in Nine Countries in Southern Africa, 1961-91**

Country	Researchers (full-time equivalent)				Annual Growth Rate+ (percentage)			
	1961	1971	1981	1991	1961-71	1971-81	1981-91	1961-91
Botswana	1	16	47	54	31.9	11.1	-0.2	12.5
Lesotho	1	7	17	28	19.2	8.3	5.2	10.4
Malawi	30	81	126	185	12.0	4.8	3.2	6.1
Mauritius	3	8	10	13	9.1	1.8	1.3	4.0
South Africa	737	957	1,140	1,339	2.7	1.6	1.3	2.0
Swaziland	6	12	5	20	5.7	-9.8	5.6	3.8
Zambia	26	101	175	279	14.4	4.6	4.1	8.0
Zimbabwe	114	167	173	291	3.4	-0.5	5.9	2.7
Tanzania	49	142	345	546	11.9	8.6	3.9	8.8

*Data includes crop, livestock, forestry and fisheries researchers working in government, semi-public, and academic agencies.

+Growth rates were calculated using a least-squares regression method.

Source: Adapted from Pardey, Roseboom and Beintema, 1997.

Table 2. Ex Post Rate of Return (ROR) Studies of African Agricultural Technology Development and Transfer

Author(s)	Year	Country	Commodity	Time Period	Annual ROR in %
Abidogun	1982	Nigeria	Cocoa	--	42
Makau	1984	Kenya	Wheat	1924-74	33
Evenson	1987	Africa (Regional)	Maize and Staple Crops	1962-80	30-40
Karanja	1990	Kenya	Maize	1955-1988	40-60
Mazzucato and Ly	1992	Niger	Cowpea, Millet and Sorghum	1975-1991	< 0
Schwartz, Sterns and Oehmke	1992	Senegal	Cowpea	1981-1986	31-92
Sterns and Bernsten	1992	Cameroon	Cowpea	1979-1992	3
Howard et. al	1992	Zambia	Maize	1978-1991	< 0, 90-103 ^a
Laker-Ojok	1992	Uganda	Sunflower, Cowpea, Soybean	1986-1991	< 0
Boughton, Henry de Frahan	1992	Mali	Maize	1969-1991 1962-1991	135 54
Kupfuma	1994	Zimbabwe	Maize	1932-90	43

^aIncluding and excluding real costs of maize program subsidies, respectively.

Source: Adapted from Oehmke and Crawford, 1996.

Table 3. Zimbabwe: Trends in Agriculture Research Funding by the Government

Year	Ministry of Agriculture Allocation to:		Real Research Expenditure at 1980 Prices
	Research (Z\$ Million)	Extension (Z\$ Million)	
1965/66	1.52		
1970/71	2.57		
1975/76	4.23	5.37	6.42
1980/81	8.07	12.59	8.07
1981/82	7.73	15.31	6.81
1982/83	8.24	14.71	6.18
1983/84	9.20	17.30	6.56
1984/85	11.38	21.94	6.61
1985/86	12.51	23.41	6.55
1986/87	15.04	31.68	6.88
1987/88	14.60	31.62	6.39
1988/89	16.94	36.53	6.50
1989/90	19.55	42.44	6.82
1990/91	24.89	53.06	7.59
1991/92	26.70	63.96	6.53
1992/93	29.52	70.33	5.14
1993/94	37.56	80.49	5.38
1994/95	43.22	152.78	

Source: Zimbabwe, 1995.

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NOTES

1. See ISNAR, 1988; Eicher, 1989; Blackie, 1994; Agricultural Research Council, South Africa, 1994; Zimbabwe, 1995; Malawi, 1995; Corbett and Coulter, 1995; Eicher and Rukuni, 1996; Rukuni, 1996a.
2. In this paper, the term “NARSs” refers to ISNAR’s definition which includes all public, semi-public, private and academic research institutions in a country.
3. This does not include the research expenditures of the CGIAR in Africa. The CGIAR estimates that 39 percent of total CGIAR expenditures, were directed toward Africa in 1994, (CGIAR, 1996, p. 38).
4. For example, USAID has funded 35 endowments ranging from \$3 million to \$118 million. The majority are in Latin America and the Caribbean (Horkan and Jordan, 1996).

5. The weaknesses of the colonial research system included the following: under investment in training local scientists, lack of smallholder voice in setting research priorities, and lack of attention to research on food crops.
6. For example, in the 1950s, the cotton research station at Namulonge, Uganda enjoyed quinquennial funding, a large measure of autonomy in administration and a reasonable degree of continuity in staffing (Arnold, 1976, p. 13).
7. Instead of setting up separate regional research institutes for agriculture, agroforestry and forestry in East Africa (Kenya, Uganda and Tanzania), the British colonial service established a regional research organization, East Africa Agriculture and Forestry Research Organization (EAAFRO) in 1960 and charged it with pursuing research on agriculture and forestry in the same organization.
8. In a group of 17 African countries in 1991, spending per scientist was only 53 percent of the resources available per scientist in 1961. Pardey, Roseboom and Bientema, 1997, p. 414.
9. USAID slashed its global expenditures for NARSs and universities by 73 percent or from \$205 million annually in 1984-86 to \$56 million in 1994-96 (Alex, 1996, p. 13).
10. Maize is now Africa's most important food crop and it is the food staple in eastern and southern Africa. Recent diffusion studies have documented the rapid spread of improved (hybrid and open pollinated) varieties which are now grown on 40 percent of the maize area in Africa, a figure comparable to that of Asia and Latin America (Blackie, 1994; Byerlee and Eicher, 1997).
11. The economic interests of farmers in the region has been dominated by commercial farmers who typically represent less than five percent of the total number of farmers in a country. In Zimbabwe there are currently 4,000 commercial farms controlling about 40 percent of the land and 800,000 communal (smallholders) controlling the other sixty percent. In South Africa, 60,000 commercial farms control 86 percent of the land and 1.25 million smallholders control 14 percent..
12. There are pockets of highly productive smallholder agriculture throughout Southern Africa but these pockets are too isolated and too modest to create the rapid productivity growth and job

creation needed to address the needs of the growing rural population.

13. The difficulties encountered by the World Bank in strengthening NARSs are spelled out in a recent assessment by the Bank's Operations Evaluation Department (Purcell and Anderson, 1997).
14. For an overview of recent institutional innovations for organizing and financing research in Latin America see Echeverria, Trigo and Byerlee, 1996.
15. Before Zimbabwe's independence, research on tobacco, pigs and sugar was carried out by private and quasi-public organizations. The key partners in public sector research are the Department of Agricultural Technical and Extension Services, the Department of Veterinary Services and the Faculties of Agriculture and Veterinary Science at the University of Zimbabwe in Harare and a Faculty of Agriculture and Natural Resources at a new private university, Africa University, Mutare (Rukuni and Eicher, 1994).

16. A competitive grants program is being considered.
17. The public sector organizations involved in agricultural research in Malawi, are the Department of Agricultural Research (DAR), the Department of Animal Health and Industry, the Forestry Research Institute of Malawi (FRIM), and the University of Malawi. The DAR has a well developed infrastructure of research stations covering the administrative regions of the country. Malawi has one university-The University of Malawi.
18. Most of the funding for contract research is from the World Bank.