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SUSTAINABLE FOOD PRODUCTION IN AFRICA: THE CHALLENGE TO NATIONAL AGRICULTURAL RESEARCH SYSTEMS (NARS)*

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Abstract—In the years prior to independence, farmers had access to the international market through the production of export crops which at that time received considerable input from research. Access to export crops has dwindled, support for research by national governments is disappointing, human resource development is inadequate, donor funding is uncoordinated, and the food crisis has taken on political dimensions. The assumption that direct importation of western technology can solve the problems of Africa is no longer valid in the face of several failures. The challenge to national agricultural research systems and the problems associated with the generation or adapting of farmer-oriented, location-specific technologies for sustaining agricultural production are discussed. Examples are drawn from India and an agenda for action, involving national governments, the international agricultural research centres and donors, in resolving these problems is presented.

Key Words: Sub-Saharan Africa, agriculture, research, commodities, appropriate technology, manpower, policies, governments, donors, funding, priorities, management

Résumé—Dans les années avant l'indépendance, des cultivateurs ont eu accès au marché international grâce à la production des cultures d'exportation qui bénéficiaient alors d'une forte contribution de la recherche. Mais, maintenant, l'accès aux cultures d'exportation a baissé, le soutien à la recherche par des gouvernements nationaux est peu satisfaisant, le développement des ressources humaines est inadéquat, le financement par des bailleurs de fonds est non coordonné et la crise alimentaire revêt une grande importance politique. La supposition que l'importation directe de la technologie occidentale peut résoudre les problèmes de l'Afrique n'est plus valable face aux plusieurs échecs. Le défi aux systèmes nationaux de recherche agricole et les problèmes liés à la création ou à l'adaptation des technologies appropriées aux régions spécifiques et vusés aux paysans dans le cadre de la production agricole soutenue sont discutés. Des exemples tirés de l'Inde et un programme d'action faisant appel aux gouvernements nationaux, aux centres internationaux de recherche agricole ainsi qu'aux bailleurs de fonds en vue de résoudre ces problèmes sont présentés.

Mots Clés: Afrique sub-saharienne, agriculture, recherche, produits, technologie appropriée, ressources humaines, politique, gouvernements, bailleurs de fonds, financement, priorités, gestion

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INTRODUCTION

When Paddock and Paddock (1967) published their famous book, *Famine—1975!* in which they described India as a hopeless case, Africa was not considered to have a food problem. However, while India now has several million tonnes of grain stocks, sub-Saharan Africa (SSA), formerly a food-exporting region has become a net food importer. The situation in SSA has worsened to the extent that donors are frantically searching for ways and means of arresting what is seen as an impending calamity.

The international community, spear-headed by the World Bank, recognizing that national development is dependent upon sustained agricultural development, has sunk several billions of dollars into various sectors of agriculture. In recent years, the national agricultural research systems (NARS) of SSA have been the focus of this drive. National Agricultural Research Systems include all organizations — agricultural research institutes, extension services, universities and colleges — with the capacity to conduct research, train individuals and/or extend results that are relevant to agricultural development.

Practically everyone, governments, donors, administrators, policy-makers, social scientists, scholars on Africa, agree on the factors that have contributed and still contribute to the African dilemma: poorly conceived objectives, inadequately trained research personnel, understaffing and under-funding, structural inadequacies, poor co-ordination between research and agricultural development projects, poor institutional links, absence of incentives; multiple, unco-ordinated, and inappropriate donor funding, importation of non-adaptable technology, etc.

In recent years, the documentation on African agricultural development and NARS has grown to such proportions that it occupies a significant portion of the world's best libraries. Unfortunately most of the existing documentation describe the same scenarios and prescribe the same remedies. Therefore, rather than give the classical analytical dimensions of the role of NARS, I pose a question. In the search for an answer, I draw on historical evidence, present the constraints, seek relevant parallels from India and by synthesizing these, I develop an action plan which addresses the interactive roles of national governments, NARS, International Agricultural

Research Centres (IARCs) and the donor community.

CAN AFRICA'S NARS GENERATE ITS OWN TECHNOLOGY?

The answer to this question is a definite yes, but the evidence dates from the years before independence, 1930–1959. However, when viewed from current perspectives, and in general for NARS of SSA, the answer is a probable no with the following exceptions, Kenya, Nigeria and Zimbabwe. Several African NARS were effective producers of technologies that were of benefit not only within their own national boundaries but served to enhance the agricultural production of neighbouring countries. Examples of such success stories come from Zimbabwe, Kenya and Zaire.

The Kenya maize programme produced high-yielding hybrids in the late 50s and early 60s that resulted in a significant increase in maize production in the then East African Community. In Zimbabwe, the development of hybrid maize, SR-52 in 1960 is a classic example of a technology generated by NARS. The distinctive feature of the Zimbabwe story was that this hybrid was developed from local germplasm, whereas the Kenya case was a cross between a local variety and one introduced from Ecuador.

Another example comes from Zaire, the Belgian Congo at the time under consideration. The success story of oil palm and rice research of the national agricultural research service, INEAC, at Yangambi in northern Zaire had far reaching effects on the oil palm industry in Nigeria, Côte d'Ivoire, Malaysia and Indonesia (Eicher, 1967; Hartley, 1970). Ninety per cent of the upland rice variety that is grown in Nigeria today is INEAC's O.S.6 variety.

Other examples include the development of rust-resistant wheat in Kenya, improved tea clones in eastern Africa, cotton in Uganda and Nigeria, groundnut in Nigeria and Senegal, soybean and cotton in Zimbabwe, coconut in Côte d'Ivoire, sorghum in Uganda, coffee in Kenya, Zaire and Côte d'Ivoire, cocoa in Ghana and Nigeria and pyrethrum and sisal in Kenya and Tanzania.

While it may be argued that the above examples come from Africa's colonial past, there are NARS today whose indigenous research personnel are generating viable technologies.

Kenya's 1986 food policy is today structured to provide security, export and home consumption, to raise farm income and earn foreign exchange. This strategy has been developed around what is defined as seven essential commodities namely, coffee, tea, maize, wheat, horticultural crops, milk and meat. Along similar lines, maize production in Zimbabwe has tripled from independence in 1980 to 1987 (Rohrbach, 1988). In Nigeria, in spite of a reduced support for research from the Federal Government, sorghum cultivars for beer production have been developed. Cowpea cultivars developed by the Institutes of Agricultural Research in Samaru, Zaria and Moore Plantation, Ibadan are in high demand by farmers. Maize hybrids from the National Cereals Research Institute in Ibadan are being widely grown. But the successes of today do not in any way compare with those of the colonial period. The obvious question is: Why are Africa's NARS not generating technologies today? The answers to this question date from the period preceding the present political and economic problems that have overtaken sub-Saharan Africa.

INSTITUTIONAL CHANGES DURING THE POST-INDEPENDENCE PERIOD

Many African leaders in their zealous efforts to shed all vestiges of their colonial past took drastic steps that destroyed the foundations upon which their newly emerging national status could have developed into nation-states. Nyerere in Tanzania abolished local government and farm co-operatives in the 70s only to admit much later that "there are certain things I would not do if I were to start again" (Nyerere, 1984). But at least he admitted failure in this respect and was instrumental in reversing his decision later on. Nkrumah however scrapped Ghana's extension service and Sekou Toure sent the French packing out of Guinea soon after independence and plunged their countries almost a quarter century back in time! But the ignorance that was fostered by misplaced enthusiasm in the fathers of Pan-Africanism is today surpassed by the short-sightedness of some of Africa's leaders who fail to see indigenous agricultural research as a prerequisite to reliable food surpluses which is a precondition for the development and expansion of the industrial sector.

With independence, several countries vied to establish as many research institutions and conduct research on as many commodities as they

could possibly lay their hands on. The West Africa Cocoa Research Institute (WACRI) in Ghana which had served both Ghana and Nigeria until 1962 was dissolved and Nigeria established its own Cocoa Research Institute of Nigeria (CRIN) and WACRI became CRIG, the Cocoa Research Institute of Ghana. CRIG later diversified its effort into other crops: coffee and kolanuts. A similar fate was experienced by the West African Institute for Oil Palm Research (WAIFOR) which after Nigeria's independence became NIFOR and then later expanded its responsibility to cover all sorts of palms. Both Ghana and Nigeria have paid for this by losing the oil palm and cocoa markets to Malaysia and Indonesia.

The dissipation of Africa's leadership in these vital commodities was not only the result of an over-enthusiasm in the expansion of mandate crops. In NIFOR, thanks to Nigeria's crude oil boom, staff positions increased by 2000-fold between 1955 and 1970 with two thirds of its staff in administration! Most of NIFOR's budget is used to pay the salaries of its overwhelming administrative staff and research receives little or no funding. Similarly, the East African Agricultural and Forestry Research Organization (EAAFRO) was dismantled after independence. It had become understaffed and under political pressure from member governments, EAAFRO recruited fresh graduates and unqualified indigenous staff. The political turmoils that overtook the East African Community saw the death of EAAFRO.

CURRENT IN-COUNTRY SUPPORT FOR AGRICULTURAL RESEARCH

Most African governments have a biased view of the role of agriculture in national development and this attitude is translated into the weak support that is given to agricultural research. During the first 10 years after independence, governments placed emphasis on industrial and urban development, improving the literacy level and social services. At the same time, the political support for research declined, precisely when there was the need to invest in research to improve productivity and income in diverse farming systems. While some support for cash crops (coffee, tea, cocoa, oil palm, rubber and cotton) continued, research on food crops received little or no emphasis except for some staples (cassava in Tanzania, rice and cassava in Zaire and maize in Zimbabwe and Kenya).

The national allocation to agricultural research in SSA ranges from 0.1% to slightly above 2% of the agricultural gross national product (GNP). A target figure of 1% is considered desirable and <0.5% as inappropriate (SPAAR, 1987). In 1980, Mali, Senegal and Burkina Faso spent only an average of 0.91% of their GNP on research. In 1983, the Government of Mali allocated \$1.25 M to the Institut d'Economie Rurale (IER), which was only 40% of IER's budget to pay salaries of 715 local staff as well as fund operational activities and meet recurrent costs. Burkina Faso allocated \$715,000 in 1983 to the Institut Burkinabe de Recherche Agronomique et Zootechnique. Senegal did not set up a university level faculty in agriculture until 19 years after independence (Eicher, 1986). In Nigeria both politicians and the military agree on one thing: that university professors are intellectually arrogant and must be subdued. The budget allocated to research is hardly sufficient to pay salaries. Less than 50% of Zambia's research budget comes from government funds. Only recently did Tanzania establish a state agricultural university (Eicher, 1989).

But in political rallies and government white papers, national leaders continue to emphasize agriculture as the "priority of priorities" and encourage farmers to produce more food, without they themselves, providing the basic support to the research arm of agriculture.

DONOR ASSISTANCE — BLESSING OR BANE!

A significant number of NARS exist only through donors, although it is questionable if this is an advantage or a disincentive to self-reliance and development. A major drawback in the financial and technical assistance that is provided to Africa is that many are not requested by the recipient countries but are undertaken at the insistence of different donors and as such, are often modelled after donors' perception of what the recipient needs (Nwanze, 1988; Uma Lèle and Goldsmith, 1989). As a result, donors are paying for a large share of the research budget in several African countries. Consequently several directors of NARS find it easier and turn to donors rather than their governments to obtain extra funds and governments in turn not only withhold, but refuse to support their own NARS until donor funding is assured. Ghana, Mali, Niger, Rwanda, Senegal, Zambia, Burkina Faso, Malawi, Lesotho, Gambia

and several others receive substantial funds from donors for recurrent expenditures of their NARS.

The response of donors to Africa's crises is unpredictable, but most probably conditioned by political affiliations. Dramatic food crises send donors vying for the "big brother" position in tonnage of food aid. In other circumstances, there is a frenzied response with a flood of overnight consultants and experts, extrapolating incoherent strategies that are unfortunately implemented with little or no understanding of the problem. And some of these so-called experts may have, at best, only spent a few weeks in Africa!

The number of foreign assistance efforts in NARS of SSA is often beyond the management capabilities of national systems. For example, in 1984, the USAID had approximately 1000 active projects in 35 countries in Africa (Eicher, 1986). In Rwanda, the World Bank in one project alone endorsed research on 17 commodities. Many of these projects are not integrated within NARS and they distort programme balance, especially when they cease. The often cited project efficiency, accounting regulations and need for autonomy are of less importance to the overall efficiency and existence of NARS. Several donors are noted for their short duration, over-financed projects (2-5 years), poorly conceptualized with misplaced objectives, large number of commodities, quick impact generating activities (buildings and vehicles), multiplicity of projects at the same time and for the same NARS and unco-ordinated support for the same projects. The obvious effects are that the absorptive capacity of NARS become overstretched and their efficiencies diminished.

Several NARS also recognize the obvious failures of donor-sponsored projects which donors themselves continue to fund and into which they pump millions of dollars (Zurek, 1985; Cernea, 1985; World Bank, 1988; Eicher, 1984, 1988). Half of the World Bank's research and development (R&D) projects in SSA are known to have totally failed (World Bank, 1988). This is an unnecessary investment in inappropriate technologies. In Malawi, small holders did not adopt the new dent varieties of maize, because they prefer flint types for processing and consumption under village conditions. Dent maize is planted mainly on larger holdings. In northern Nigeria, small holders did not adopt technologies developed for sole-cropping since they grow cereal-cowpea crop mixtures. Although donors are pumping millions into Somalia each year, it is not achieving the objective of building the national capacity of Somalia's NARS.

But why do governments continue to entertain such donor projects? They are prestigious especially when block and mortar structures are involved, they create jobs, stabilize their economies, divert attention, and permit them to shift funds into other sectors. But the anti-climax is the negative impact on NARS.

IS HUMAN RESOURCE A CONSTRAINT TO NARS?

Many donors, African countries, experts and students on African agricultural research have argued that the overlying problem of NARS is the shortage of well-trained staff (Uma Lele and Goldsmith, 1989; Nwanze, 1988; World Bank, 1985, 1987; Eicher, 1986), although in some countries new agricultural graduates are unable to find employment (Rocheteau et al., 1988). But the seeming under-staffing in some NARS is also the result of an unrealistic attempt to conduct research into every possible commodity (even when they are not of sufficient national importance to warrant any research effort) and an expansion into non-research areas such as plantation management, processing plants, distribution and sale of produce. Consequently, a large proportion of the already meagre research budget is used to pay staff salaries at the expense of the overall quality of research. For example, personnel salaries accounted for 80% of the operational budget of Kenya in 1987, 70% in Malawi in 1985 and 90% in Nigeria in 1988 (World Bank, 1985, 1987; FAO/World Bank, 1988).

One major consequence is that, not only is there insufficient financial support for actual research, research support services also become totally neglected. For example, there are very few, if any, well-staffed, well-stocked NARS libraries in Africa. Most libraries are unable to subscribe to international journals, maintain up-to-date literature, let alone procure modern facilities in library science. Book shelves are either empty or stocked with "latest" issues that date 2-10 years ago. The sad result is that NARS scientists are doomed to develop a "give up" attitude and are unable to intelligently discuss recent advances in scientific research with their western counterparts.

While there is an acute shortage of experienced indigenous researchers, several NARS are staffed by expatriates or inexperienced less qualified local personnel. One fourth of NARS researchers and academic staff in Faculties of Agriculture in Africa are expatriate (Eicher, 1986). In 1986, of

the more than 700 research professionals in the 8 Sahelian countries nearly one third were expatriates. Similarly in Côte d'Ivoire, out of 201 researchers in agriculture only 28% are Ivoirian nationals. The others are expatriate staff. This figure is topped by Mozambique where 83% of agricultural researchers are expatriates. Very few of the national scientists and researchers in Sahelian West Africa have training beyond the *Ingenieur Agronome* Diploma. Less than 10% of the 531 national scientists have postgraduate degrees. This is in sharp contrast to the figures for 10 countries in eastern and southern Africa where in 1987, 1570 research staff had at least a B.Sc. degree. Forty-six per cent of this number, which does not include certificate and diploma holders, had either an M.Sc. or Ph.D. (Mukiibi and Omari, 1989).

The issue is not only one of numbers, but also of quality. A good proportion of NARS researchers are inappropriate both in their skills and attitudes to undertake research which requires high levels of expertise and commitment. In several countries of SSA, returning home from overseas training with a graduate or postgraduate degree is still looked upon as the ultimate achievement and the acquisition of an assured position of authority and privilege. Few Africans recognize that there is a gestation period of 10-15 years between the commencement of graduate training and the productive research years of the individual. With this attitude, many are never able to develop the ability to generate the products of their training.

LESSONS FROM INDIA

India's development of its research organization and the progress in food sufficiency is a classical example of what can be achieved by a combination of assured long-term donor support and commitment from the highest level of government.

In contrast to Africa, at independence in 1947, India had 17 degree-granting agricultural institutions (Uma Lele and Goldsmith, 1989). In Africa, there were few scattered colleges — Makerere College in Uganda, Yangambi in Zaire, the University College of Ibadan in Nigeria, the University of Science and Technology, Kumasi, Ghana, the present University of Ghana at Legon, Njala University College, Sierra Leone and Bunda Agricultural College in Malawi. Even then, only Nigerian universities had any significant number of M.Sc. and Ph.D. graduates in the early 80s. At

independence in India, there was already an institution with a calibre of intellectuals who could at least borrow from the international storehouse of knowledge and bring about an easy transfer of laboratory and field results onto the farm. A good example of the opposite situation was in Zaire which at independence had only 11 agricultural graduates! Other promising institutions such as Makerere University were devastated during internal political upheavals. Even today, out of 28 agricultural institutions in the Sahel, none offers training to M.Sc. or Ph.D. levels (INSAH, 1984).

The Indian government was also instrumental in encouraging its scientific sector and support was given from the highest level. In contrast, top level support for research is absent in Africa and this has hampered institutional development. A distinct difference between technical assistance to India and Africa after independence is the close ties and long duration projects that were fostered by the US Agency for International Development (USAID), the Ford and Rockefeller Foundations and the Indian research sector.

Success of the long-term commitment of the Americans in Indian agriculture was guaranteed by their involvement in only major research projects. In collaboration with the Rockefeller Foundation, India embarked on adaptive research on hybrid maize. The success of maize in India though muffled by the net returns of rice, had spin-offs on other crops. Through the All India Co-ordinated system of research, sorghum and pearl millet made major improvements in the late 60s. In Africa, the reverse occurred after independence. In Nigeria, with the oil boom in the 70s and 80s, the agricultural sector which was responsible for over 70% of the country's foreign exchange earnings was neglected and both export crops (cotton, rubber, oil palm, cocoa and groundnuts) and food crops research was given very little or no attention.

The placing of highly qualified staff and the continuity in technical assistance personnel over several years in India are in contrast to the short-duration terms and diversity of in-country experience that is encouraged by bilateral donor agencies in Africa. The USAID sponsored Integrated Pest Management (IPM) Project of the Institut du Sahel was mandated to work on five crops — maize, rice, sorghum, pearl millet and cowpea over an initial 5 year period (Nwanze, 1988). The FAO recruited "experts" with a diversity of experiences and in some cases, to

satisfy the political pressures from member countries of the Sahel.

The Indian food crisis of 1965 was a catalyst in the increased support for adaptive research by the Indian government and the crisis over the adoption of introduced high yielding varieties (HYV) led to the development of locally adapted wheat and rice varieties (Uma Lele and Goldsmith, 1989). In Africa, the food crisis has resulted in massive food aid and a disincentive for governments to sponsor and support agricultural research. The demand for research and the support for enhancing the research capability which India has generated are lacking in Africa. While it was the Indian government which invited USAID, Rockefeller and Ford Foundations, much of the effort in Africa is the result of what the donors consider best for their recipient countries.

Three major lessons should be taken from the Indian experience for Africa. First, support from the highest level of government is required for building an effective capacity and capability for science and technology. Second, a long-term commitment from national governments and donors, both in capital and human resource development, is a prerequisite for sustained development of NARS. Third, actual donor involvement in institution building across the three arms of NARS — training, research and extension should receive equal priority.

AN AGENDA FOR ACTION

From the foregoing sections, the obvious question that must be addressed by national governments, donors and NARS is: What should be done to strengthen NARS so that they can become more productive in the development and utilization of agricultural technology?

In earlier sections, I have discussed the problems of NARS in SSA within the single context of a region, occasionally highlighting differences between countries, zones and sub-regions. An Africa-wide strategy for strengthening NARS is unrealistic and cannot be effective. An action plan should begin on the basic knowledge that NARS are as varied and diverse in their composition, capacities and capabilities, performance potential and viability as African nations themselves. They are also influenced by the nature of international political interests. A strategy to strengthen SSA's NARS should first determine which NARS can generate technologies (e.g. Nigeria and Zimbabwe) and

which can adapt or borrow technologies. There are several countries (e.g. Mauritania, Guinea Bissau and Cape Verde) where it will be totally unrealistic to attempt to mount a research effort without the necessary institutional capacity, nor the commitment and political will for such an effort. The following section should therefore be viewed within the above context.

Action by governments and NARS

An undisputed premise for any effort to bring about changes resides in the indigenous ability of a people to mobilize domestic political support that foster the developmental processes needed to generate such changes. The failure to recognize a problem precludes any effort at searching for solutions. Incremental donor funding for NARS without matching budgetary increases from governments will not generate but deter improvements in agricultural research. The basic requirements are therefore:

(1) National governments should allocate adequate funds for research and ensure timely disbursement and long-term provision for operational and capital budgets.

(2) The demand for research must increase and this must come from farmers, both small and big, who are the primary beneficiaries of technology and from the political elite (planners and political advisers) who, hopefully, recognize the role of technology in agricultural development. This calls for rigorous and unrelenting canvassing of both interest groups by research managers and scientists, who must continue to show proof of the benefits that can accrue from research.

(3) An inventory of research needs to be prepared by commodities, disciplines, personnel and capital requirements. ISNAR's role in this area should be exploited.

(4) Improve linkages between research stations, extension services and farmers. Seek and encourage farmer participation and feedback.

(5) Ensure a balance between commodities for food security and income-generating commodities for home consumption and export that will raise farm income and earn foreign exchange.

(6) The research teams that generated technologies for maize, tea, cotton and groundnuts were small and focused. An adjustment in the size of some NARS both in personnel and research stations may be necessary in order to create a critical mass of good

researchers and maximize the productive use of scarce scientific resources. This means the creation of small but effective multidisciplinary research teams.

(7) Along the same lines, fewer but relevant commodities should be mandated to NARS. Research priorities should be identified, not by policy-makers or research directors alone, but with the full participation of researchers and farmers. Research priorities should be matched with realistic institutional and manpower capabilities.

(8) Similar to determining research priorities, research thrusts should be developed and a balance between farming systems research and commodity research should be emphasized. It should be recognized that research may be location-specific. For example, while increases in sorghum and pearl millet production in the Sahel will come mainly from improved soil and water management technologies, in the more humid coastal zone, genetic crop improvement technologies will play a major role.

(9) Given the limitation in indigenous researchers, NARS should focus on applied and adaptive research and not be unrealistic as to wander into strategic research although there may be major technical problems that require long-term strategic research. Establishing linkages with outside institutions is a better approach and several of the IARCs and international development agencies in Africa have a role to play in this area.

(10) Improve the quality of existing staff through in-service training opportunities. Strengthen the institutional base of NARS through an expansion of personnel in higher education (research, training and extension) in order to speed up human capital development.

(11) Identify, train and provide adequate leadership and managerial skills for NARS and deploy researchers to their appropriate areas of competence.

(12) Improve linkages between research institutes and universities where often there are staff with fundamental knowledge in the natural sciences and socio-economics.

NARS/IARCs—partners in development

The initial success of the first two International Agricultural Research Centres, CIMMYT and IRRI led to the creation of more Centres. Several of these (IITA, ILCA, ILRAD and WARD) are

located in Africa as are non-CG Centres like ICIPE and ICRAF. ICRISAT has recently established a regional sub-Centre in Niamey, Niger and has two regional programmes, the West African Sorghum Improvement Programme (WASIP) and the SADCC/ICRISAT regional programme for the improvement of sorghum and pearl millet. Both CIAT and CIMMYT also have Africa-based projects.

Although the results of the activities of the IARCs in Africa are not as dramatic as those that triggered CIMMYT and IRRI's green revolution in Mexico and Asia, there have been considerable gains by African countries. The Nile Valley Faba Bean Project, supported by ICARDA has led to the release of higher yielding and disease-free bean varieties. In the Gambia, maize acreage tripled between 1982 and 1985 and was sustained as a result of the IITA/SAFGRAD effort in that country. Zimbabwe has found that varieties of sorghum and millet from ICRISAT's programmes in India and West Africa are performing well in initial adaptive trials of the SADCC/ICRISAT programme. The tremendous staff improvement, both in numbers and quality, in Mali's NARS, Institut d'économie rurale (IER) is the result of a long association between ICRISAT/USAID and IER.

The IARCs came into existence because the NARS were unable to and incapable of meeting the challenges posed by food shortages. Donors rallied around because governments were also unable to meet the challenge. However, the ultimate success of the IARCs will be measured by how much and to what extent NARS themselves are able, in the long run, to successfully meet this challenge and not necessarily on the volume of technology generated by the IARCs. This calls for equal partnership in the generation, adoption and dissemination of appropriate technologies. The IARCs should:

(1) Expand training programmes to provide opportunities for NARS researchers, especially mid-career scientists to participate in professional fellowship over protracted periods of intensive learning by on-the-job experience at the Centres.

(2) Provide in-country support to NARS by posting experienced Centre staff for long assignments within existing national programmes. The ICRISAT-Mali Programme is a good example of this strategy. This should involve the posting of 2-3 Centre staff in appropriate disciplines, especially in breeding and agronomy

to assist in conducting adaptive research. As distinct from expatriates of bilateral donor-funded projects, these scientists receive good back-stopping from the Centres, stimulate NARS scientists, provide foreign exchange for urgent and important equipment and training.

(3) Co-ordinate the different training programmes offered by IARCs to avoid duplication and overlap. Increase emphasis on short- to medium-term specialized training courses in specific disciplines.

(4) Provide opportunities for degree training at the graduate level, especially for thesis research and cut down on general group courses. There are several NARS with technicians but no researchers to direct and supervise them. The African Regional Postgraduate Programme in Insect Science (ARPPIS) of ICIPE is already in the forefront in this area.

(5) Conduct strategic research that is of relevance to NARS and the sub-Sahara African region and ensure the participation of NARS and involvement of farmers in the planning of research and in the transfer of technologies.

Action by donors

The IARCs cannot operate without support from donors. Donors should:

(1) Adopt a sub-regional approach and classify NARS into categories based on their capabilities and potential. Within each sub-region, identify NARS with the greatest potential for development and assist them into a leadership role as technology generating NARS.

(2) Assist NARS with programme reviews, reorganization, redesign and orientation, in order to increase their specific capacities, capabilities and productive efficiency. ISNAR's role in this activity is well recognized.

(3) Streamline bilateral projects, co-ordinate multi-donor funding, provide long-term funding (10-15 years), encourage longer duration of expatriate assistance, and integrate donor-assisted research projects into the national programme.

(4) Insist on counterpart funding (no matter how small), accountability and participation by national governments.

(5) Provide support for training and also assist in developing a coherent long-term strategy to shift the centre of postgraduate training from industrial countries to selected universities in Africa where responsibilities on a regional

context are apparent (e.g. University of Zimbabwe for southern Africa, University of Ahmadu Bello, Nigeria for Sudano-Sahelian West Africa). This would involve investment in improving the quality of faculty staff and research facilities in such universities. In the long run, it would pay-off when one realizes that the cost of overseas postgraduate training in an industrialized country ranges between \$50,000–100,000.

(6) Training should address all aspects of NARS, namely research, management and extension. Support for human resource development should have a long-term perspective in view of the rapid turnover of well-trained staff in the region.

(7) Assist in strengthening faculties of agriculture and related academic departments through affiliations with mentor institutions and universities, assignment of faculty and exchange programmes, and development of postgraduate curricula. In the long run, these universities will be able to offer high-quality postgraduate programmes.

(8) Assist in the development of effective regional information and documentation services. There is an urgent need for easy access by NARS scientists to scientific and technical information if they are to keep abreast with the scientific world. Staff training in library science and the support of such libraries with adequate funding for the procurement of journals is particularly important.

Joint action

A sub-regional approach calls for collaboration between governments and between NARS, co-operation with IARCs and support of donors. This will be particularly beneficial to countries where it will be unreasonable to attempt to mount a full and independent agricultural research programme. While larger and viable NARS will, more and more, take the responsibility of generating appropriate technologies for their sub-regions, smaller NARS will have the advantage of directly "borrowing" from a next door neighbour.

There is evidence of successful regional inter-governmental institutions in SSA. Sub-regional institutions require strong political commitment from the participating governments and investments should be modest and complement ongoing programmes in order not to affect individual country programmes.

Implicit in the sub-regional approach is the creation of regional research networks which reduce costs, minimize duplication, boost efficiency and favour the much-needed existence of a critical mass of professionals working in the same location or project. Networks can be based on similar agroecological conditions, farming systems, research problems, priorities or strategies. The participation of the IARCs and support by donors in regional networks is essential. But networks are for NARS and should be run by NARS.

CONCLUSIONS

When science and technology were mobilized to transform traditional agriculture into highly productive systems of farming and the concept of genotype/environment interactions was exploited to develop new crop varieties, especially wheat and rice, that took advantage of improved levels of agronomic management, mankind once again ascertained his ability to enhance natural processes and speed-up evolution to the betterment of the human race. While in some countries, this phenomenal discovery was exploited and conditions created to provide scientists with opportunities to explore new frontiers in agricultural research, resulting in impressive gains in agricultural production, in SSA an actual decline in production is a shameful index of managerial incompetence and poor governance.

The major constraint in SSA is the lack of the right attitudes in the highest levels of the decision-making machinery to recognize the importance of agricultural research in the economic recovery, long-term progress and future prosperity of the region. This opinion is aptly supported by Dr. M. Toure of Senegal: "One of the reasons perceived (in the lack of genuine and effective political commitment to research) in many countries is the absence of a top-notch, unified, and cohesive community at the political, administrative and scientific level who are convinced of the critical role of research in development..." (Pickering, 1988).

Similarly, the green revolution that has transformed the agricultural production of Asia's rice, wheat and maize and some of Africa's large farm-holders (Zimbabwe and Kenya) may not be appropriate for the small farm-holder. Location-specific technology for such farmers and making it possible for them to produce more through

changes in price policies, are key areas in sub-Saharan African agriculture (Odhiambo, 1984; Doggett, 1984).

Almost 30 years after independence some Africans are still moaning over the curse of their colonial heritage. India, which had been described as a hopeless case was feeding most of Asia and exporting technology to the rest of the developing world within the same time frame after independence. SSA must wake up to its self-imposed incompetence and inability to compete with the rest of the world in producing its own food. There is a limit to which we must continue to rely on the international community and must formulate policies that will stimulate the agricultural sector to achieve stable levels of production. African countries should devote more effort to ensuring political stability, consistency in their policies and allocation of resources on a continuous basis to agricultural research and development at levels commensurate with their declared priority of achieving self-reliance and food security (Okigbo, 1988).

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REFERENCES

- Cernea M. (1985) *Putting People First: Sociological Variables in Rural Development*. Oxford University Press, New York.
- Doggett H. (1984) Cereal production needs and achievements. In *Advancing Agricultural Production in Africa* (Edited by Hawksworth D. L.), pp. 51–55. CAB, Slough, UK.
- Eicher C. K. (1967) The dynamics of long-term agricultural development in Nigeria. *J. Farm Econ.* 49, 1158–1170.
- Eicher C. K. (1984) International technology transfer and the African farmer: Theory and practice. *Working Paper 3/84*. University of Zimbabwe, Department of Land Management, Harare, Zimbabwe.
- Eicher C. K. (1986) Transforming African agriculture. *The Hunger Project Papers*, No. 4. Hunger Project, San Francisco.
- Eicher C. K. (1988) An economic perspective on the Saskawa-Global 2000 initiative to increase food production in Sub-Saharan Africa. *Presented at the Workshop on Reviewing the African Agricultural Projects*. Nairobi, Kenya, 18 March 1988.
- Eicher C. K. (1989) Sustainable institutions for African agricultural development. *Working Paper No. 19*. ISNAR International Service for National Agricultural Research, The Hague, Netherlands.
- FAO/World Bank Cooperative programme investment center (1988) *Nigeria: National Agricultural Research Project Working Paper No. 2*. FAO, Rome, 21 December 1988.
- Hartley C. W. S. (1970) Oil palm research and development in Africa and Malaysia. In *Change in Agriculture* (Edited by Bunting A. H.), pp. 97–104. Gerald Duckworth, London.
- INSAH (Institut du Sahel) (1984) Permanent Interstate Committee for Drought Control in the Sahel. *Assessment of Agricultural Research Resources in the Sahel*. 3 Vols. INSAH, Bamako, Mali.
- Mukiibi J. K. and Omari M. I. (1989) Training for agricultural research and development in eastern and southern Africa. Selected *Proceedings of the Workshop on Training Needs in Agricultural Research in Eastern and Southern Africa*. Arusha, Tanzania. IITA/IDRC. 21–25 July 1987.
- Nwanze K. F. (1988) National agricultural research programmes in Sahelian countries of West Africa: Problems and recommendations. *Agric. Admin. Extension* 28, 227–238.
- Nyerere J. K. (1984) Interview. *Third World Q.* 6, 815–838.
- Odhiambo T. R. (1984) The effects of pest and non-pest constraints on the production and utilization of crops. In *Advancing Agricultural Production in Africa* (Edited by Hawksworth, D. L.), pp. 46–50. CAB, Slough, UK.
- Okigbo B. N. (1988) Agricultural research in Sub-Saharan Africa: The role of international agricultural research centers. In *African Agricultural Research and Technology Development. Proceedings of a High Level Meeting in Feldafing*, Federal Republic of Germany, 24–27 Sept. World Bank, Washington, DC.
- Paddock W. and Paddock P. (1967) *Famine — 1975!* Little, Brown and Company, Boston, USA.
- Pickering D. (1988) African agricultural research and technological development. *Proceedings of a High Level Meeting in Feldafing*, Federal Republic of Germany, 24–27 Sept. 1987. World Bank, Washington, DC.
- Rocheteau G., Bennell P., Mclean D. and Elliott H. (1988) Organizational, financial and human resource issues facing West African

- agricultural research systems. *Working Paper No.9*. ISNAR. International Service for National Agricultural Research, The Hague, Netherlands.
- Rohrbach D. (1988) The growth of smallholder maize production in Zimbabwe: Causes and implications for food security. *Ph.D. dissertation*. Michigan State University, East Lansing, Michigan, USA.
- SPAAR (Special Programme for African Agricultural Research)(1987) *Guidelines for Strengthening National Agricultural Research Systems in Sub-Saharan Africa*. World Bank, Washington, DC.
- Uma Lele and Goldsmith A. A. (1989) The development of national agricultural research capacity: India's experience with the Rockefeller Foundation and its significance for Africa. In *Economic Development and Cultural Change*. The Univ. of Chicago, Chicago. pp. 305-343.
- World Bank (1985) *Agricultural Research and Extension: An Evaluation of the World Bank's Experience*. World Bank, Washington, DC.
- World Bank (1987) *West African Agricultural Review*. World Bank, Washington, DC.
- World Bank (1988) *Rural Development: World Bank Experience, 1965-1986*. World Bank, Washington, DC.
- Zurek E. (1985) *Integrated Rural Development— Research Results and Program Implementation at Bonn Conference*. Weltarchiv, Hamburg, Germany.