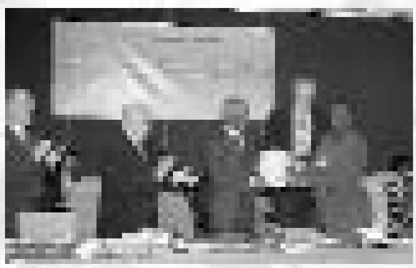
AFRICA'S RAINBOW REVOLUTION

WILL AFRICA BE ABLE TO FEED ITSELF? THE ANSWER IS 'YES' – BUT ONLY IF IT ADOPTS A MULTIFACTED STRATEGY THAT RECOGNIZES THE CONTINENT'S UNIQUE ECOLOGY AND CULTURE. THAT'S THE CONCLUSION OF A RECENT REPORT BY THE INTERACADEMY COUNCIL (IAC).



Africa is rich in both natural and human resources. Yet nearly 200 million of its people are undernourished because of insufficient food supplies. Strategies must be adopted across the continent to harness the power of science and technology in ways that boost agricultural productivity, profitability, and sustainability – ultimately ensuring that all Africans have access to enough safe and nutritious food to meet their dietary needs. TWAS Founding Fellow M.S. Swaminathan, one of the co-chairs of the InterAcademy Council's (IAC) panel that prepared the recent report, Realizing the Promise and Potential of African Agriculture*, highlights the main elements of the action plan recommended to increase the productivity of African agriculture.*

There have been numerous studies, symposia and books on African agriculture in recent decades, each proposing strategies to ensure sustainable food security in Africa.

Several of these studies have shown that a 10 percent increase in crop yield would lead to a 6 to 10 percent increase in the annual survival rate of African women and men earning US$1 or less per day. Because more than 80 percent of Africa's population depends on crop and animal husbandry, fisheries, agro-forestry and agro-processing for its livelihood, enhancing farm productivity provides the best safety net against poverty and hunger.

Agriculture in Africa serves as the backbone of the food, livelihood and ecological security systems. What Africa needs is science and technology that helps to produce more food, more jobs and more income.

Building on the vast volume of data and information available and placing total confidence in the wisdom and innovativeness of African farm families and farm scientists, the InterAcademy Council's (IAC) panel report, *Realizing the Promise and Potential of African Agriculture*, calls for the launch of an ever-green revolution in African agriculture driven by the enhanced productivity, profitability, stability and sustainability of the major farming systems of this diverse and resource-rich continent.

The IAC report, however, refers to the productivity-based progress of African agriculture not as an ever-green

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revolution but as a 'rainbow revolution' because unlike Asia, where wheat and rice are the dominant food crops, Africa does not have a dominant farming system on which food security largely depends.

In recent decades, Africa's agricultural progress has been hampered by the spread of the HIV/AIDS pandemic; uncertain market access and fluctuating market prices associated with the trade and subsidy policies of industrialized countries; political instability; and ethnic conflicts. Nevertheless there have been several success stories on the continent that can serve as signposts for the road that lies ahead. These include:

- Soil health enhancement through nitrogen-fixing shrubs and rock-phosphate applications.
- Biological control of the cassava mealy bug.
- Cultivation of maize with improved protein quality.
- Development of tissue culture for the disease-free multiplication of banana.
- Development of New Rice for Africa (Nerica).

The steps that led to the conversion of unpromising 'hot spots' into appealing 'bright spots' were:

- Indigenous research by African scientists.
- Strategic partnerships with farm women and men, as well as with advanced research institutions, including institutions belonging to the network of the Consultative Group on International Agricultural Research (CGIAR).
- Farmer participatory research and knowledge management systems leading to the demystification of technologies.
- Location-specific technologies supported by such services as credit and seed inputs.
- End-to-end strategies involving all steps in the technology development, verification, adaptation and adoption process.
- Political support at the highest level that ensures access to remunerative markets and accords greater social prestige to agricultural scientists.
- Sustained funding for agricultural research, education and development.

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The formation of the Forum for Agricultural Research in Africa (FARA) and the New Partnership for Africa's Development (NEPAD) also constitute organizational

'bright spots' that can help accelerate the pace of agricultural progress.

ACTION

Let me highlight the principal components of the action plan devised by the IAC panel for leading Africa's agricultural future in the right direction.

Most African soils are both hungry and thirsty – that is, short of nutrients and water. Therefore an indispensable priority must be the nurturing of soil fertility and the development of measures for water harvesting, conservation and efficient use.

Rain-fed agriculture is dominant in Africa. That makes community water harvesting and watershed management as essential as the cultivation of high-value, low-water crops. Our panel has therefore placed considerable stress on the adoption of an ecological production approach in land and water use planning. Of the 17 distinct farming systems identified in different parts of Africa, we concluded that the following four systems offer immediate promise for increasing African food security:

- Maize-mixed system based primarily on maize, cotton, cattle, goats and poultry. The system recognizes the importance of off-farm work.
- Cereal-root crop mixed system based primarily on maize, sorghum, millet, cassava, yams, legumes and cattle.
- Irrigated farming system based primarily on rice, cotton, vegetables, cattle and poultry.
- Tree-crop-based system involving cocoa, coffee, oil palm, rubber, yams and maize. This system also recognizes the importance of off-farm work.

In addition, coastal areas hold promise for agroforestry systems involving aquaculture and such halophytic plant species as mangrove and saltbush. Ethiopia's highlands also hold promise for significant gains in productivity if the proper agricultural systems are put in place.

The IAC panel suggests methods for strengthening national agricultural research systems and establishing African Centres of Agricultural Research Excellence (ACARE) by building on the strengths of existing institutions. Because ecological agriculture is more knowledge-intensive than capital- or chemical-intensive, we

STUDY PANEL

Responding to a request from the Secretary-General of the United Nations, in 2002, the InterAcademy Council (IAC) appointed a study panel on agricultural productivity in Africa. The panel was composed of co-chairs Speciosa Wandira Kazibwe, past vice-president of Uganda and former minister of agriculture, animal industry and fisheries; Rudy Rabbinge, dean, Wageningen Graduate School, and professor of sustainable development and systems innovation, Wageningen, Netherlands; and M.S. Swaminathan, chairman of the M.S. Swaminathan Research Foundation in Madras and father of India's green revolution in the 1960s. The panel also included 15 other distinguished members mostly from Africa. Jim Ryan of Australia, former director-general of the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) in Hyderabad, India, served as the study director. The panel's mandate was to produce a consensus report for the UN that (1) addressed how science and technology could help improve agricultural production in Africa and (2) identified the larger economic, social and political conditions that are essential for effective use of science and technology in both the public and private sectors. The report was presented to the UN Secretary General in New York on 25 June 2004. The full text may be browsed at www.interacademycouncil.net.

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SUCCESS WITH RICE

Such cultivated rice species as Oryza sativa*, which are indigenous to Asia, have been subjected to many cycles of selection and improvement by both farmers and scientists and, as a result, now yield up to 12 tonnes per hectare. In contrast, Africa's only native rice,* O. glaberrima*, despite having been domesticated centuries ago, yields only one tonne per hectare. It does, however, possess strong resistance to weeds and local pests – the reasons why Asian rice varieties are not widely grown in Africa. Until now, these two species of rice were genetically incompatible. Using a technique developed in the 1980s, known as 'embryo rescue', scientists have now combined the high-yielding traits of elite Asian rice with the pest-resistant properties of African rice. The product, labelled Nerica (New Rice for Africa), yields up to 2.5 tonnes per hectare and matures quickly, allowing farmers to grow a second crop – beans, for example, that fix nitrogen and help build soil fertility. Farmers throughout the upland rice growing regions of west Africa are currently cultivating Nerica varieties. Indeed Guinea saved some US$13 million in rice imports in 2003. Nerica rice is also being promoted in Uganda, where some 6,000 hectares have been planted. Thanks to Nerica, Africa is expected to be self-sufficient in rice by 2010.*

recommend the extensive application of modern information, education and communication technologies involving the integrated use of the internet, cable television, community radio and local press. And we call for the establishment of an African Virtual Academy for Agricultural Progress and Rural Prosperity to stimulate the spread of a rainbow revolution in rural areas.

Women play a key role in both the production and post-harvest phases of African agriculture. That's why our panel suggests that a 'women in agriculture programme' be initiated to promote both knowledge enhancement and skill empowerment of women farmers and women farm labourers. Programmes for bridging the 'digital divide' should also aim at narrowing the gender divide in technological capacity building. The panel also recommends that, rather than lamenting the brain drain, efforts should be made to support educated professionals who continue to live and work in their native countries. "Care for the brains at home" should be the motto.

Monetary compensation alone, although important, may not be able, on its own, to attract and retain creative scientists. Indeed such non-monetary benefits as well-equipped laboratories, a nurturing environment, academic freedom and efficient research management that encourage initiative and invention are just as important as high salaries in arresting the brain drain.

Finally, our panel recommends an African 'grid' of participatory science and technology pilot projects to introduce farm women and men to the opportunities offered by modern science and technology. The goal is to enhance agricultural productivity and income on an ecologically sustainable basis in a wide range of farming systems.

These pilot programmes should be set up where the production-processing-marketing-consumption chain can be assessed – and subsequently implemented – and should include:

- Indigenous technologies relevant to the improvement of productivity and food security.
- Market potentials and constraints for existing and prospective commodities in farming systems.
- New technologies to enhance productivity and food security, including:
  - Integrated nutrient and soil fertility enhancement.
  - Integrated pest management.
  - Small-scale water harvesting and use of micro-irrigation systems for delivery of water and nutrients.
  - Applications of improved genetic strains, biofertilizers and biopesticides.
  - Use of improved farm implements and appropriate mechanization for increasing labour productivity, reducing drudgery and ensuring timely farm operations.
  - Introduction of appropriate post-harvest processing, storage and marketing techniques.
  - Promotion of non-farm employment through introduction of technologies adding economic value to primary products and through agri-business.
  - Development of communication programmes to provide location-specific information related to meteorological, management and marketing factors and to


promote genetic and trade literacy among rural farm families.
– Establishment of farmer field schools for integrated pest, disease and weed management, integrated water and fertility management, and other aspects of production and post-harvest technologies based on the principle of learning-by-doing.
– Promotion of such institutional structures as co-operatives and self-help groups that can confer the power of scale to small landholders at the production and post-harvest phases of farm operations.
- For each pilot programme, the scope for other institutional innovations should also be explored, including:

In African nations, as in other developing countries, if agriculture goes wrong, nothing else has the chance to go right.

– Promotion of a participatory knowledge coalition led by small landholders, who are encouraged to become involved with universities, national agricultural research institutions and extension agencies for the purposes of exploring new modes of partnership.
– Identification of candidates for ACARE centres to serve the interests of small landholders.
– Stimulation of public-private partnerships to address priority constraints that cannot be alleviated by independent activities and that are aimed at building convergence and synergies.
– Identification of the constraints that prevent the realization of the promise and potential of the pilot pro-

SUCCESS WITH CASSAVA

More than 60 percent of the world's cassava is grown in sub-Saharan Africa. In the early 1970s, production of this root crop was threatened by the accidental introduction into west Africa of the cassava mealybug, Phenacoccus manihoti. *In the absence of natural enemies, the cassava mealybug spread at a pace of more than 300 kilometres per year. By the 1980s, it could be found throughout tropical Africa, endangering the food supply of 200 million people who relied on cassava as a subsistence crop. Among the several natural enemies introduced by scientists of the Nigeria-based International Institute for Tropical Agriculture (IITA) and collaborating agencies was a parasitoid wasp,* Apoanagyrus lopezi, *from Paraguay, the native home of the mealybug. Techniques were developed for mass-rearing the wasps, which were then distributed from aeroplanes. This large-scale strategy quickly led to the control of the pest over a wide area. The parasitoid wasp has now established itself in 26 African countries and continues to provide safe and effective control of the cassava mealybug throughout the region.*

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SUCCESS WITH BANANA

Banana is a major staple crop and source of income for more than 20 million people in east Africa, many of them resource-poor women farmers. Yet production is less than half the level it could be due to pests and diseases. The problem lies in the way bananas are traditionally propagated – simply by uprooting a sucker and transplanting it. Using this method transfers all the diseases that are infecting the ageing mother tree. Tissue culture propagation, on the other hand, can be used to produce thousands of tiny plantlets free of bacterial, fungal and viral diseases. Apart from being pest- and disease-free, tissue-cultured plantlets have several other advantages over traditional planting material. For example, trees reach maturity earlier and bear fruit bunches up to 50 percent heavier than traditionally raised trees. In addition, each tree produces double the number of suckers than traditionally propagated trees, which provides a rapid means of multiplying and disseminating improved planting material. A project launched in 1996 brought together the Kenya Agricultural Research Institute (KARI), the Institute of Tropical and Sub-Tropical Crops (ITSC) in South Africa and others to encourage the production, testing, dissemination and adoption of tissue-cultured banana plantlets. The private sector in South Africa is already producing more than 4 million banana plantlets each year, mainly for export, and private laboratories have also been set up in Kenya. An estimated 500,000 small-scale farmers in east Africa now grow bananas derived from tissue culture. In Kenya, as a result of farmers planting healthier banana plants, household income has reportedly increased from 700 Kenyan shillings (less than US$10) to 5,000 Kenyan shillings (US$60) per harvest.

grammes to improve agricultural productivity and food security at the local level.

– Introduction of a horizontal dimension to the different vertically structured programmes relating to the realization of the UN Millennium Development Goals.

The IAC panel suggests that interdisciplinary teams from national agricultural research systems, universities, extension services and farmers' organizations be constituted to prepare business plans and research agendas in each of the priority farming systems described above.

Nothing succeeds like success. Therefore the sites for the initial rainbow revolution pilot programmes should be developed where there is a socio-economic, political, scientific and ecological environment conducive to the achievement of the programmatic goals. For each pilot programme, a local farmers' advisory council, involving both men and women, should be constituted to assume ownership and undertake monitoring and evaluation.

In African nations, as in many other developing countries, if agriculture goes wrong, nothing else has the chance to go right. Bilateral and multilateral donors and national governments should lose not a minute more in implementing IAC's recommendations. Just as African societies take pride in rainbow coalitions at the political level, African agriculture can lead the world in demonstrating the power of a science-and-technology-based rainbow revolution in agriculture for eliminating poverty and hunger. ■

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For the full text of the IAC report, see
www.interacademycouncil.net