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TOWARDS A NEW ORIENTATION TO THE CHALLENGE OF TECHNOLOGY TRANSFER SYSTEMS AND FOOD PRODUCTION IN THE 21ST CENTURY AFRICA

Paper Presented at the Regional Workshop

on

"TECHNOLOGY OPTIONS AND TRANSFER SYSTEMS"
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by

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ABSTRACT

The development, processing, production, dissemination and utilization of improved technologies in Africa's agriculture has been a subject of speculation, research and discussion at several Workshops, Seminars and Conferences. Often times, the emphasis is on structural and institutional designs, modalities and methods, procedures and impacts, problems and constraints in the process of information and skill delivery from centres of technology development and production to agricultural end-users (farmers) where they live and work. The process has been evolutionary and has taken on different characteristics (though with great similarities) and nomenclatures in different countries. It transcends the advisory services of the United Kingdom through the Agricultural Extension Services of the United States of America, to the more contemporary concepts of agricultural development projects, specialized commodity production parastatals and modern educational approaches of integrated rural development. It has been construed as a subject-matter area of learning (discipline), a function of Government Agency and a programme of deliberately influencing the behaviour of a given client group (farmers). Over the years, the contextual reality of technology transfer has changed, due partly to alterations in population growth and movements, industrial development, basic changes in agricultural production systems, environmental imperatives (climate change, drought, flood, etc.), civil strife and severe food deficits.

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..../2

But perhaps, the most important reason for concern is, the recent realization that while agricultural research in Africa has made substantial progress in the development of new technologies, the correct application of which should result in increased food production, the desired impact is hardly noticeable, due in part, to ineffective technology transfer mechanisms.

In this paper, an attempt is made to review past models and efforts at technology transfer in agriculture with a view to revalidating reasons for failure and/or limited success. The paper postulates that in order to prevent the mistakes of the past, there is a need for a new orientation consistent with the perceived challenge of food production in the 21st Century. This orientation, grounded in theory and practice, should take due cognisance of the multi-dimensional and multi-disciplinary nature of the problem involved in technology development and transfer process in order to steer a relevant course essential to meeting the challenge ahead.

"Africa carries out relatively little research with 8.5% of the world population, it produces only 0.9% of the World's Scientific publications. Even the little Research and Developemnt output Africa produces is abandoned prematurely : little of it is ever developed into usable technologies."

Adnan BADRAN,
Assistant Director General
UNESCO, Paris, 1994.

INTRODUCTION

Agricultural research is perhaps the most important single determinant of agricultural development in sub-saharan Africa. This is because no nation has been known to have achieved any meaningful progress in agricultural growth without huge investments in agricultural research. In Africa, the food, agriculture and natural resources sector occupy a central position in the economic structure. Consequently, its development has obvious implications for overall development.

The need for agricultural research in Africa has always been informed by the frequently mentioned problems of poor productivity, incessant and intractable food shortages. The failure to achieve food self-sufficiency and food security are many and varied. It is often argued that much remains to be done in improving technologies, modernizing obsolete structures, reviewing the technology utilization capacity of the resource poor farmer and more importantly, integrating the small farmer into the improved agricultural production and development process. By implication, it is assumed that success is achievable through effort to upgrade and revitalize the entire System of agricultural research, technology development and transfer.

Experience of some developed countries suggest that significant progress, was achieved in agricultural development as a result of machines (technology) invented and manufactured during the industrial revolution. The development of "agricultural science" and a research and educational concept was a major facilitating factor.

The acceleration of the growth rate in the agricultural sector, its transformation from subsistence to a commercially viable activity and its diversification was dependent on research focussed on the development, spread, adoption and use of modern agricultural technology.

The last twenty years has witnessed enormous investment in agricultural research and development of new technologies in Africa. The National and International Research Centres have reported significant yield increases in maize, rice, sorghum, cassava, yam, cow-pea, soybean etc...Insect pest and disease damage to plants, animals and crops have been brought under substantial control. Fertilizer technology is no longer a novelty. The list is long and impressive, yet, the African small farmer remains relatively unaware of or lacks the skill and/or resource to take full advantage of what agricultural reseach has made available through new and improved technology.

In this short discussion paper, an attempt is made to focus on the concept of the transfer of research results and technology in Africa's agriculture. The modalities for the transfer of agricultural research results are identified. The paper posits that effective transfer of agricultural research result and technology is achieved where and when cooperative relationships are established among research, technology transfer and rural farmers as (equal) partners in the technology development and utilization process.

THE PROBLEM AND CHALLENGE OF TECHNOLOGY DEVELOPMENT AND TRANSFER IN THE 21ST CENTURY

The thrust of African Government to create viable, stable and democratic economies is heavily dependent on the agricultural sector. This is because agriculture is the primary source of employment, domestic food requirement and foreign exchange earnings. Agriculture supplies raw materials for domestic industries, creating the required demand for consumer goods and commercial inputs with a direct impact on the non-agricultural sectors of the economy. Also, agriculture plays an important role in food self-sufficiency and security at national and household levels.

Yet, the contribution of agriculture to gross domestic product of Africa in the aggregate has dropped to 32.4 per cent in 1991, from 37.9 per cent in 1965. Even though individual African nations may show increases in agriculture and food production, such improvements may have been offset by disproportionate increases in population. Thus, the agricultural economies of Africa have continued to portray a crisis characterized by:

- a decline in per capita food and agricultural production;
- a decrease in agricultural export earnings;
- a degradation of the environment occasioned by careless over-exploitation of the natural resource base;
- increasing population pressure and
- poor performance of agricultural investments.

The above scenario draws attention to two particularly relevant factors in the African agriculture and food crisis consideration, viz, the relatively low rate of technology development and technology transfer and utilization in african agriculture. The combined effect of both factors may explain the greatest limit situation and stagnation in Africa's agricultural productivity. Therefore, if Africa has to cope with the challenge of the 21st Century, it must transform (improve) its agricultural base as a pre-condition to significant and sustained economic growth and social development.

An analysis of current world order and events would suggest that Agriculture and food production programmes of the 21st Century would have to face up to the challenge of:

- increasing food security and self sufficiency described as adequate access by all people at all times to sufficient food and nutrition for a healthy and productive life
- increasing the competitiveness of African agricultural commodities and products in the world and regional market
- increasing the income level of the broad masses of the population through increased gainful employment in agriculture
- maintaining and enhancing a sustainable capacity of the natural and genetic resource base for the benefit of agricultural development.

For Africa to adequately deal with the perceived challenge, there is need for collaborative reorientation between policies and actions in a wide range of activities covering policy, infrastructure, support services, human resource development, farmer participation, technology development, validation and transfer.

TECHNOLOGY TRANSFER : ISSUES OF OPERATIONAL DEFINITION AND TERMINOLOGY

Technology Transfer in its original connotation was used to imply the transfer of industrial art in a developed system. In that context, Vitta[1] defines technology as the "knowledge and procedure used to transform inputs derived from the natural environment into useful output, normally called goods and services". It can also refer to the logistics and social relations of production or to the style of presenting and delivering the final production.

Agricultural technology, in specific term, may be defined as the overall combination of complementary techniques emplyed in the production of goods of market value. It is sometimes conceived as consisting of "software" and "hardware" e.g. fertilization is one such technique, while maize growing in all stages is undertaken by means of an agricultural technology. Roling[2] et al refer to technology partly as "software" - accumulated knowledge which has proved effective in exerting control in the real world....and partly as "hardware", such as seeds, tools, equipment, programme etc, in which knowledge is embodied. It can be an idea, a physical object or an abstract entity.

Technology transfer in its contemporary usage in agriculture has been defined as a "process by which the recommended practices developed and perfected at research institutes are transmitted through the extension agents to users. It encompasses three main sub-systems:

- the technology generation/research sub-system
- the technology utilization/clientele sub-system and
- the technology dissemination/extension sub-system.

The Technology transfer process is a difficult concept to operationalize in real life. This is because of the several barriers to the technology transfer process. Baron [3] in his study, for example, identified several barriers to the transfer of profitable technologies developed at National Laboratories at tax payers' expense to the private sector industrialists. Technology transfer initiatives by Government seem to run foul of end-users perceptions. Often times, industrialists and agricultural entrepreneurs visit national technology development laboratories and research centres with a view to acquiring a technology "nugget" only to find that a specific resultant product of the technology development process is not sitting on the shelf to be moved into the commercial sector. "Some of these venture capitalists have no appreciation of the technology nor the effort required to bring a good idea into the market place". [4] Some Research and Developemnt scientists though well trained, competent and exeprienced, have no idea of how to transfer technology within or between organizations. In some cases, there is a cultural difference between the research technology development and the technology application departments which block information flow and technology transfer between them. This gap must of necessity be bridged.

In other circumstances, basic research is undertaken for research sake with no specific product in mind. Results are reported openly and discussed freely at several fora. There is usually no cost-benefit analysis to ascertain acceptable levels of investment. Some researchers are highly protective of the research they undertake and resent any dilution of their pure studies and research prowess with demand for industrial and field application.

In industry and agriculture, the approach to research is more often with a short term orientation,,bearing in mind the desire for directly applicable, mission-oriented objective for return on investment. Confidentiality of information is of the essence in order to retain competitiveness. This behaviour pattern can only inhibit information exchange and technology transfer even though it could enhance technology (product) development.

Yet, in other cases, barrier to technology transfer has been occassioned by the fact that mechanisms that promote and facilitate technology transfer from agricultural research centres to farmers are either:

- poorly developed or not available at all
- not only obsolete, but tenacious,economic, legal and social barriers exist that prevent a more cohesive research - technology transfer - end-user (farmer) interface.

Sometimes, the problem is endemic in the technology development and transfer environment. The logic in the decision process of farmers to adopt a given technology is sometimes difficult to understand. Consequently, it could become problematic to design strategies for technology transfer to accelerate the adoption - decision process.

Finally, most of the problems of technology transfer derive from the nature of the technology transfer system itself. The stereotype agricultural research scientist often concentrates on the technology itself, without giving adequate thought to how to transfer it.

The assumption often being that if the technology is profitable and solves a given problem, then those who need it will spontaneously acquire it; which is often not the case. This is because:

- the technology transfer system does not of itself initiate the process or generate technology. It is primarily a conduit for technology delivery to the farmer. Sometimes, however, it may be involved in technology modification. Consequently, if the technology generation system is deficient, passive or inoperative, the technology transfer system is immobilized and dysfunctional.

- the main function of the technology transfer system is knowledge, skill and material transfer. It tends to be geographically dispersed and operates downstream, mainly at the farm level. Therefore, good logistic support becomes essential for effective performance.

- technology transfer arrangements are often fragmented. Consequently, functional linkages between research, technology transfer operatives and farmers as well as active feedback mechanism are a pre-conditions for success.

- government policy and intervention can sometimes be a constraint.

..../12

THE NEED FOR TRANSFER OF AGRICULTURAL RESEARCH RESULTS AND TECHNOLOGY

It has been generally acknowledged that in order to contribute to development in Africa, agricultural research need to be innovative and relevant and its resutls widely tranferred and/or acquired by those who require it. It is also a statement of fact that increased farmer productivity requires access to new and improved technologies. These technologies derive largely from agricultural research. For agricultural research to remain relevant and attract desired investment for its sustenance, it must tackle user priority needs and problems. There is evidence that research recommendations applied and advocated at national agricultural research centres are frequently not adopted, even by farmers resident just outside the research stations. The need for conserted effort and organized responsibility for technology transfer has therefore become an added responsibility (though jointly) of agricultural research. For effective technology transfer to take place, there must be effective coordination between agricultural research, technology development and transfer at all levels. In most cases in Africa, this does not happen, due mainly to the fact that available important services are considered as performing parallel functions. Consequently, both functions - agricultural research and technology transfer are considerably weakened.

The need for organized and systematized technology transfer programme in Africa's agricultural research system is further justified by the frequent reasons adduced for poor dissemination of agricultural research results. Some researchers claim that the farmer is at fault, suggesting that preferences, based on traditionalism lead farmers to reject unfamiliar technologies.

Some castigate agricultural extension services, arguing that the utility of new and improved technologies has not been adequately demonstrated to farmers. Others insist that inadequate credit limit farmer ability to adopt technologies. Some indicate that inputs, essential to technology acquisition and use are not available on time and at affordable price. But, less frequently mentioned, are problems of inappropriate technology for farmers adoption.

Shaner et al (1982)[5] indicate that the endemic problems of technology transfer is further compounded by a research orientation "that farmers cannot generate and provide information that is useful for improving technologies and that technology transfer workers (extension workers) are professionally inferior and therefore have little to contribute."

Realising that agricultural research has little merit unless it leads to adoption and use of a derived technology by farmers, the challenge facing agricultural research systems in the 21st Century Africa becomes obvious. Agricultural research systems must therefore conceptualize an effective mechanism and develop the capacity to implement the transfer of their research results and technolgoies. It has been suggested that this may require shifts in research policies and priorities, changes in the organization and management of research and technology transfer agencies and the development of functional links between these agencies and farmers. One has been around long enough to know that some of these changes and experimentation with methods an approaches have been undertaken.

Yet the problem persists. It is my fervent hope that this Workshop is one effort to look, yet more closely, at how past changes have been implemented.

Most agricultural development experts believe that achievements in increased agricultural production recorded during the late colonial and immediate post-independent era which was due mainly to the expansion of land under agricultural production will no longer be possible as Africa enters the 21st Century. They argue and I agree with them, that, beyond the year 2000, information on new technologies, will become the key element in increasing yields and improving overall agricultural production. The developed world is already speculating that biotechnology is expected to drive yield increases in the future. Also, a greater use of improved technology and management will be a key factor in increased productivity per head in animal production. Sustainable agricultural development and environmental protection are also predicated on the n ational use of agricultural research result, the benefit of which will depend on access and transfer.

In the early stages of agricultural growth, research was simple and technology transfer may have been undertaken through copy, immitation or borrowing. With advance in the application of science and agriculture, Africa has been more conscious and evolved a technology sharing process involving a wide range of Specialists dispersed over a wide technology transfer continuum. This advance has produced new problems which in themselves require new theories, research and approaches to resolve. In general, and deriving from the need to formally organize the transfer of agricultural research results from Research Institutes to farmers, African nations have opted for a systematized and specialized approach generically described as "agricultural extension".

This specialized activity, be it general extension service, training and visit approach, farming systems research, networking, research - extension linkage, agricultural extension research liaison service etc. has several problems, three of which are very important to the issues discussed in this Paper. These problems include:

1. The lack of effective linkage among specialized functions. Merill - Sands and Kaimowitz [6] in a recent study asserted that "links between agricultural Research Institutes and their clients - farmers and technology transfer agencies (extension) are vital to successful technology development and delivery. Direct links with farmers developed through on-farm research (adaptive research), ensure relevance and feed-back." The two links are complementary, both are necessary and one cannot substitute the other. Research managers have found these links difficult to organize and sustain, particularly when addressing the needs of resource poor farmers. Yet, experience has shown that weak links have costs, which few African developing countries can afford. Linkage problems, not only reduce efficiency, they also impair performance and diminish the impact of agricultural research. The problem of weak linkages in agricultural research and technology transfer has been exacerbated with the adoption of the Specialized Technology Transfer option and its concomittant compartmentalization of functions

II. The lack of relevance of the technologies developed under systems based on predominantly one-way flow of information from Scientists for farmers. The research agenda is, traditionally, set by the agricultural Scientists and researchers with less than adequate input from the end-user of agricultural research results. Sometimes the interaction between scientists within the same organization is limited. It has been argued by some experts that specialized technology transfer systems have become highly inefficient, due in part, to specialization of disciplines and staff deployment at various stages of the process, resulting in communication break down among actors and loss of information and knowledge in the process. The practice of specialized technology transfer approaches has been further reinforced by the belief that agricultural development implies a shift from traditional methods of production to new science based methods of production that include new technological components, new crops, animals and sometimes, new farming system. Borrowing a leaf from industry and management theory, agricultural scientsits have come to accept that specialization of functions is the best way to organize work in order to enhance efficiency.

..../17

However, where specialized technology transfer functions are not well planned and managed to ensure complementary interaction among actors, it can lead to development of inappropriate technologies, existence of missing functions and inefficiency.

III. Lack of access to knowledge of available research results and technologies. For farmers to benefit from agricultural research results and new technologies, they must first know about them, learn about them and learn how to use them correctly in their farming programme. Where the technology is a physical input, they must have acccess to it at an affordable cost. The issue of availability and access as a primary factor in technology transfer is well known.

TRANSFER OF AGRICULTURAL RESEARCH RESULTS AND TECHNOLOGY: EXPERIENCE WITH SOME APPROACHES

Critics of agricultural research in Africa and elsewhere have increasingly raised concern about the dominant position that research must originate from the top and diffuse downwards to the farmers. It has been argued that research, technology development and transfer must be viewed more and more as catalytic processes of "freeing the creative forces of the impoverished and exploited of the Society and enabling those forces to come to grips with the problems of under-development" . This contention has prompted the search for alternative approaches, reflecting several concerns:

> That quantitative research methods are not providing for an adequate understanding of the complex reality of the agricultural production process in a predominantly non-literate society; and the desire for practical research that can be used as a basis for setting policy and developing programmes that will promote social justice and greater self-reliance. The premise being a view of human behaviour which sees individuals as active participants and agents of development in their environment rather than passive objects to be researched.

Until very recently, farmers in Africa have been served by researchers and technology transfer agencies through what can be described as a "delivery oriented" approach. There has been an extensive concentration on deliveries (technologies and supplies) to farmers without adequate corresponding effort to enhance the capacity of farmers to lay claim to these deliverables and become self-sufficient. The delivery oriented approach to technology transfer has been criticized for marginalizing and disempowering the African small farmer. The approach was based on the assumptions of conventional research and extension which are in sharp contrast with the emerging liberating assumptions of PARTICIPATORY RESEARCH and EXTENSION. According to the proponents of this approach to the transfer of agricultural research results and technology, the factors which have contrained the development and transfer of technology in sub-saharan Africa include:

..../19

- the fact that farmers are frequently spatially and politically marginalized and hence poorly served by research and extension;

- the tendency for researchers and technology transfer functionaries, through their top-down professional orientation, to be dismissive of farmers' apparent reluctance to change;

- the likelihood that the reductionist scientific methods which examine individual commodities or technologies without a holistic outlook, will produce misleading recommendations where systems interaction are strong;

- the apparent neglect of the importance of farmers' indigenous knowledge of their complex and highly variable real life environment.

From the above analysis, it can be seen that a demand driven technology transfer system really never existed in Africa, until very recently, through the Agricultural Development projects, designed to interface between researchers formal workplan and farmers indegenous knowledge, in order to take advantage of the best of each. It is now increasingly evident that since the farmer is the common denominator in the technology transfer process, he must get into the equation.

A recommendation that has often been made is for research and technology transfer to interact more frequently in order to better understand each other's objectives, interests and capabilities, in the interest of the technology transfer process. The approaches, in recent times, directed at a more effective transfer of agricultural research results and technology have been informed by the above considerations.

The functions of technology transfer systems are organized differently from country to country. Some countries have experimented with various options, most of which have been subject of extensive investigation and recommendation. The general characteristic is that they are all public sector activity, even though they have been organized and implemented differently with varying effectiveness. These approaches are common knowledge and without going into a detailed discussion, let me refresh your memory with a short list:

- The conventional agricultural extension approach exemplified by the pre-independence advisory service and the post-independence national extension services (vulgarization agricole). Their gerneral objective was increased food crops, export crops and animal production. The impact was substantial in the early years, but it soon slipped into decay and became relatively dysfunctional in later years.

- Commodity Extension Approach - characterized by cocoa, Oil Palm, Banana, Rubber, Rice and groundnut parastatals in several African countries. The guiding principle was that a specialized technology transfer system with a known package of recommendation supported with a firm research and development programme wi ll be more effective. The intent was to develop a production system to effectively satisfy the market demand for relatively high value commodities.

..../21

This approach was successful for as long as the commodities enjoyed competitive world or domestic market prices and farmer demand for high technology was sustained. But, government policy changed in the early 1980 as food security became a major objective. Most farmers withdrew resources from export crops, the demand for technology collapsed and the technology transfer systems were dismantled.

- Integrated Approaches to Technology Transfer - typified in Africa, by the advent of the Integrated World Bank Assisted Projects - Agricultural Development Projects and its accompanying Training and Visit System. Integrated approaches to technology transfer surely have merit, but, the African experience did not absolve it of the usual criticism of high cost and rigidity of organization.

These three major approaches have been complemented with:

- Farming Systems Research and Extension Approach;
- University Technology Transfer Research and and Development programmes;
- Participatory Rural Appraisals and Surveys;
- Rural Research Committees and NGO pilot projects;
- Rural Animation and General Awareness Programmes in agriculture, etc.

Every one of the above efforts had a significant technology transfer component with extensive input by the research and technology transfer systems. Yet, the problem persists. So what is wrong? That is the question that I believe this Workshop is organized to partially answer, so that Africa can better chart its future course.

CONCLUSION AND SUGGESTION

Our continent is currently faced with the serious problems created by climatic instability, food deficits, lack of foreign exchange and severe debt burden, rapid population growth, environmental scourge and limited progress in food production. Under this condition, it is necessary to combine short-term measures to push growth as fast as possible with a long-term approach to develop and transfer new technologies and techniques to end-users in agriculture.

In this discussion Paper, an attempt has been made to discuss the transfer of agricultural research results and technology against a background of an evolving system dedicated to improved agricultural production through the application of science. Over the years, Africa has experimented with various technology transfer approaches in the technology transfer process. The approaches have been informed and sustained without adequate recognition of the role of the the farmer in the development and transfer of technologies developed through research. Unfortunately, the desired effect is always not achieved. The several policy changes and re-organization of the research - technology development and transfer system notwithstanding, the adoption of available technologies by the small farmer remains an intractable problem.

As Africa approaches the 21st Century and contemplates a new orientation to development, the issue of the transfer of agricultural research results and technology is revisited. There is evidence to suggest that the conventional top-down approach to the determination of agricultural research agenda has not served its purpose. A participatory research and technology transfer approach is suggested. This orientation is not new, since it fits well into the farming system research approach and the on-farm client oriented research paradym for the development and transfer of technology. It will be very complementary to the Training and Visit System of extension which was the most recent organizational and administrative innovation in technology acquisition in most African countries. If through joint participation, cooperative relationships are established among research, technology transfer institutions and rural communities, all partners in the technology development process, there will be improvement in the level and rate of development and cooperation between between specializations will be further enhanced.

The African experience seem to suggest that:

- no specific research strategy can substitute for technology transfer as a seperate activity that must be planned for and adequately funded;
- researcher and technology transfer workers must collaborate and cooperate to ensure both the broad coverage required for impact and the site specific selection and adaptation of technologies.
- research and technolgy transfer systems need each other. None is a substitute for the other.

..../24

Finally, let me conclude this Paper by making one remark and one only suggestion. Technology transfer is a researchable phenomenon to which too little attention has been paid in the development of agricultural research progammes. As Africa's Agricultural Research programmes seek a new orientation, I suggest that the necessary attention be given to Research on the TECHNOLOGY OF TECHNOLOGY TRANSFER, with emphasis on:

- re-examination of the concept of technology transfer
- assessment of alternative approaches to technology transfer
- participation of women in technology transfer programmes and food production
- institutionalizing input assessment as an essential component of the technology transfer process
- modernizing technology transfer processes and methods at national level with emphasis on:

    - conventional extension
    - several variants of the Training and Visit extension system
    - group oriented food production cooperatives
    - profit oriented technology transfer agencies and NGOs
    - extension research liaison services
    - training
    - a revisit of linkages and the technology transfer system
    - international cooperation in research on technology transfer.

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