

# Technology management in the Sudan: strategic and policy challenges

Allam Ahmed

University of East London, London, UK

## Keywords

Technology, Management, Agriculture, Strategy, Policy, Sudan

## Abstract

This paper addresses the strategic and policy challenges facing technological transformation and productivity increase in the Sudan. It examines the various factors which influence agricultural technology adoption decisions as well as the constraints facing the agricultural sector in the Sudan. The paper also demonstrates that complexity and linkages of the various technology adoption factors represent real challenges in future technology management in the Sudan. Finally, a number of findings emerge which outline the key issues relating to the effective management of technological transformation in the Sudan and other similar African countries.

**The author is grateful to Professors John Adams (Napier University), David Newton (The Royal Agricultural College) and Roy Fawcett (Edinburgh University) for their invaluable insights and inspiration, and for their helpful refereeing comments. The author is also grateful to the Department of Economics of Napier University for funding this research trip. Collaboration of the ARC, and farmers' participation from the Gezira Scheme are warmly acknowledged.**



Management Decision  
41/3 [2003] 267-273

© MCB UP Limited  
[ISSN 0025-1747]  
[DOI 10.1108/00251740310469756]

## 1. Introduction

The process of agricultural technology and growth has remained outside the concern of most development economists (Hayami and Ruttan, 1985). For Schultz (1964), the critical factor in raising productivity is "technical change" and the role of the government is to promote technical change. Schultz's policy prescription was for government to invest in agricultural research stations and in the provision of agricultural extension services. Schultz's approach argues the important dimension that the process of agricultural development can be accelerated through provision of new and improved inputs and technologies (particularly improved seeds, fertilisers, pesticides, and irrigation systems). What farmers need are new high-payoff inputs and technologies to increase their productivity. Many theories, however, have been suggested to explain how the basic sources of "growth" (labour, natural resources, capital, increase in scale or specialization, improved efficiency, and technological progress) can be stimulated and combined to generate broad-based agricultural growth (Norton and Alwang, 1993). Theories put forward include: resource exploitation theory, resource conservation theory, location theory, diffusion theory, high-payoff input theory, and induced innovation theory (see Hayami and Ruttan (1985) and Norton and Alwang (1993)). However, despite the different explanations these theories provide, they all agree that all farmers – small, medium, and large – respond to economic incentives, but the focus on farmers calls for special attention to the small farmer. Bureaucratic public sector agricultural research systems in most African countries consistently fail to serve the majority of small farmers effectively,

therefore, the purpose of farmer participation in agricultural technology development is to involve small farmers as active decision makers in the development and transfer of new technology. The result is they get the technology they want and can adopt.

Negatu and Parikh (1999) examine the conventional (traditional) factors which influence farmers' adoption decision and identify these factors to include: resource endowments as the availability of funding greatly influences the transfer of technology; socio-economic status; demographic characteristics; as well as access to institutional services (extension, input supply, markets, etc.). Studies on the effect of these conventional factors on adoption are extensive and numerous (Feder *et al.*, 1985; Feder and Umali, 1993). However, if agricultural technologies can be improved, additional resources mobilized, and appropriate policies adopted in industrial and developing countries, then faster agricultural growth will be achieved. Economic development, particularly of the poorer countries like Sudan, will speed up and poverty will be reduced.

Meanwhile, there has been a long history of research recommendations being rejected by farmers and endless debates about the need to reorganize national research systems. Therefore, it is very important to strengthen the linkages with farmers and among farmers themselves. Information is an essential production factor in agriculture. Farmers need information to improve or adapt their farming practices. Farmers need extension only to the extent that it can provide them with relevant and timely information. The basic idea is that transfer of existing technologies and economic knowledge from the more progressive to the lagging farmers could increase productivity.

The Emerald Research Register for this journal is available at  
<http://www.emeraldinsight.com/researchregister>



The current issue and full text archive of this journal is available at  
<http://www.emeraldinsight.com/0025-1747.htm>

This idea has provided part of the rationale for agricultural extension systems, particularly in farm management. Moreover, innovation was thought to be the best single indicator of the multi-faceted dimension called modernization, the individual-level equivalent of development. Therefore, research on the new technologies was justified because it was assumed that technology was the prime mover in development. More success, however, has been achieved with transferring knowledge than with transferring technologies and adoption of transferred technologies has been limited except where efforts have been made to adapt the technologies to the new setting (Norton and Alwang, 1993; Rogers, 1976).

## 2. Sudan

Sudan is an agricultural country[1], agriculture employs 80 per cent of the country's labour force and its industry contributes about 42 per cent of the country's GDP – the largest of all sectors, over 90 per cent of the exports and foreign cash earnings, and in addition it produces over 90 per cent of the national food requirements (IMF, 1999; Europa World, 1998). Therefore, productivity and efficiency of the agricultural sector are central to any programme of economic recovery. According to the recent FAO Crop Assessment Mission to Sudan (FAO, 2000), Sudan is facing serious food shortage problems vis-à-vis socio-economic development. The FAO has estimated that wheat and sorghum output in 2000 was about 60 per cent and 24 per cent below the previous five years' average respectively and that the overall aggregate production of cereals in 1999/2000 estimated at 3.14 million tonnes represents a drop over last year and the previous five years of some 39 per cent and 24 per cent respectively.

The remarkable agricultural feature in Sudan is the Gezira Scheme. The Gezira Scheme is the largest agricultural irrigation scheme in the Sudan responsible for the production of almost all the major crops in the country particularly cotton which is the main export crop produced and supplemented with sorghum, groundnuts, wheat, and rice. Few agricultural ventures in the developing world, have evoked as much international attention as Sudan's Gezira Scheme. This 70-year-old Scheme (over 2 million acres) is seen by some as the first demonstration of Sudan's vast potential as an Arab and world granary (Yousif, 1997; O'Brian, 1981). Others see it as a pioneering and successful experiment in the field of

direct foreign investment in export oriented production in the Third World (Yousif, 1997; O'Brian, 1981). To others it was the earliest proof of the viability of partnership in modern farming (Barnett, 1981, 1979, 1977). The Sudanese government greatly depends on the Gezira Scheme for its hard currency return from exports (Yousif, 1997). The main distinctive characteristics of the Gezira Scheme is land acquisition. Each farmer is allocated 30 feddans (12.6 hectares) regardless of the original ownership of the land for which owners were paid an annual rent. The production relations within the Gezira Scheme allowed the administration to evict any tenant who proved to be unable to abide by the set laws and regulations. This agreement was operating until the year 1950 immediately after nationalisation of the Scheme when the tenants were able to enforce an agreement which was then referred to as a joint account or partnership system.

The Gezira Scheme accounts system started as a Joint Accounts System (JAS) based on the agreement that, 40 per cent of the annual net profit for the tenant and the rest should accordingly be spent on research, social services, pay business profit tax and loan interests and any surplus should be kept as a reserve fund. The JAS was then abolished and replaced by the Individual Account System (IAS) in June 1980. The IAS is aimed at motivating tenants to increase crop production where they would be responsible for all costs as well as pay certain land and water charges to the government. Different components were included in these charges including irrigation costs, administration costs, depreciation and interest on capital. The charges were made according to the number of irrigation intakes for each crop in the agricultural rotation. The land and water charges as well as cotton and wheat prices were fixed by a technical committee set up by the Minister of Agriculture and the Ministry of Finance and include membership of the Gezira Scheme, Rahad Scheme and Agricultural Research Corporation. The net profit would thus go to the tenant after the deduction of all individual costs, and accountability would be in accordance with the purchasing system proclaimed by the State. However, in addition to the land and water charges, other costs of production for a typical tenant farmer in the Gezira Scheme include: land preparation, cultural operations, harvesting, material inputs, services, transport as well as other expenses. The most evident disadvantage of this system is

that farmers would bear any risk that might adversely affect their crops due to reasons beyond human control, such as unfavourable weather conditions.

Agricultural research in the Sudan started in 1902 with an overall goal to find ways to increase the productivity of specific crop and livestock species, while maintaining soil, water and vegetation as renewable resources (Ageeb and Hamdoun, 1997). The major National Agricultural Research Institutions (NARIs) include the Agricultural Research Corporation (ARC)[2], Animal Resources Research Corporation (ARRC), Environment and Natural Resources Research Institute (ENRRI) as well as the academic institutions. Technology transfer agencies include the extension services, production corporations, private companies, development projects as well as individual farmers and tenants. Although NARIs argue that, farmers' productivity increases could achieve up to 100 per cent if the recommended technologies are fully adopted by farmers, crop productivity in the Gezira Scheme is extremely low and does not exceed 30 per cent of the level attained in NARIs' research farms. Given this low productivity in the Gezira Scheme a number of fundamental research questions are addressed:

- Why are technologies provided by NARIs not fully implemented by farmers?
- Can the farmers increase productivity with the existing resources limitations?
- Does the production system fail to recognize the fundamental economic constraints facing traditional farming systems in the Sudan?
- What are the strategic and policy challenges for the government in improving farmers' productivity and speeding the national economic development process?

### 3. Research method

A series of detailed (interview-based) surveys were implemented in order to generate the data required to measure the economic and technical variables associated with the determinants of the technology adoption within the Gezira Scheme, the spatial focus of most agricultural research in Sudan. Within the Gezira Scheme, the Centre group was chosen for the study because it has the same average yield (1,498kg/hectare) as the whole scheme for cotton. Moreover, the centre group is accessible by roads and has varied socio-economic characteristics and resource endowments. And since the distance of

households from a town or from the main roads connecting villages within the blocks (a block is an administrative region designed by the Scheme for management purposes) or a neighbouring village is considered to be a possible important factor influencing farmers' access to information, inputs and markets, it was used as a stratifying criterion to select the different administrative regions (blocks) within the centre region. Thus four blocks were chosen from the centre group, Barakat, Hamad Elnile, Abdel Hakam and Elkomor. A total of 30 tenants were drawn from each selected block at random. These selected tenants within each block were categorised into three strata, high, medium and low. This stratification was based on cotton yield variability from the 1998 season, where those who achieved more than (2,043kg/ha) were considered high, 1,498-2,043kg/ha were considered medium and less than 1,498kg/ha were considered low. Therefore, the total sampling units is 120 tenants chosen from four blocks.

The study used multiple choice and scale type questions in order to identify and assess farmers' education level, performance, funding sources, accessibility of information and marketing of their produce, etc. Most of the questions in the study were in relation to the traditional farming practices as compared to the modern agricultural practices in the research and academic institutions. The whole questionnaire text was translated into Arabic language and data were then gathered from 120 farmers.

## 4. Results and discussion

Non-parametric statistical methods were applied to the large data set in order to produce deeper insights into the economic, technical and social variables generated in the survey. The results of the analysis are presented and discussed in the context of the four research questions posed at the beginning of the paper.

### 4.1 Finance and funding

Finance is the major constraint facing farming in Sudan where the majority of the farmers (88 per cent) have serious problem(s) with finance and they argue that these financial problems are mostly created by the government. However, for the remaining 12 per cent, for whom finance is not a problem, they either have their own businesses (trade) or receive substantial support from other family member(s) or relative(s) working abroad (mainly in the Middle East).



Meanwhile, farmers with inadequate funding are enforced to either rent part of their land or sell part of their fertilisers to other farmers who can afford the cost of farming obtained from other sources. Consequently, the majority of poor farmers get poorer and the minority of farmers with good funding availability get better. The problems associated with finance and funding can be summarized in the following:

- The Government delays previous payments which results in deficit in the next season and usually these payments are not made at the time needed.
- Low profitability of the different crops grown.
- High taxes.
- Water charges.
- The Government normally provides fertilisers with prices above the market prices or does not provide fertilisers and in this case farmers have to pay the black market price.
- Hybrid seeds are very expensive and not included in the credit package provided by the Government.
- Low productivity in the previous season(s).
- Banks and village traders refuse to provide farmers with loans which result in financial difficulties for farmers. Due to the very difficult economic situation of the country and the very high inflation rate, businesses including banks have become very sensitive to the daily speculations about prices change and uncertainty particularly farm products. Furthermore, banks are no longer confident of farmers' returns as the government pays farmers only after a long period of time.

The majority of the farmers surveyed (76 per cent) depend mainly on their own personal financing since they receive no support from the government for their sorghum, groundnuts, vegetables and other crops. According to most of the farmers surveyed, very little financial support is provided by the government for the cotton and wheat crops. Therefore, farmers have to find other sources of finance; 30 per cent are either in partnership arrangements for their groundnuts and sorghum, or sell some household items, animals and even sell part of their fertilisers supplied by the government to finance important timely operations such as cultivation of cotton. Only 27 per cent of the farmers have received bank loans and 21 per cent received loan(s) from merchants, friends or relatives.

#### 4.2 Poor returns

What is most evident from the study is that farmers found the technologies transferred are of no significant returns compared to their traditional practices and that priorities are always given to cotton rather than other crops. The government argues that, to meet national needs, such as earning foreign exchange, farmers are encouraged to grow cash crops such as cotton, with production for export. Hence the need to disseminate becomes a need to be selective in dissemination, to steer farmers in a particular direction. Almost all farmers surveyed agree that the technologies provided are very expensive to adopt and they have no source of funds even if they are not expensive in the first place. The study reveals that, farmers' returns from their produce as per the individual accounts system is very low and that farmers bear any risk that might adversely affect their crops due to reasons beyond human control, such as unfavourable weather conditions. Therefore, 34 per cent of the farmers are performing other jobs in addition to farming to earn extra income. Additional jobs include: local village traders or businesses, local school teachers, employee, working in the nearest big towns as well as doing some casual jobs in their villages. However, for most farmers farming is just a tradition they inherited and they cannot think of themselves doing anything else.

#### 4.3 Loss of produce

More than 91 per cent of the farmers have lost their produce during the last period for a variety of reasons. Disease is found to be the most important factor caused by: inefficient pesticide delivered by the government for different crops, bad pesticide recommended for cotton and that no compensation was given by the government in such incidences. Weeds (e.g. Adar, Puda, etc.) destroyed the wheat and sorghum, and unavailability of the pesticides recommended. The absence of the entomologists and/or extensionists made the situation more severe and consequently resulted in crop(s) failure. Other important factors mentioned by many farmers include: some irrigation canals are not fully opened, full of weeds and not completed to the end of the block which results in water shortage or uneven distribution of water and flooding mostly during the raining season. Farmers claim that they have been complaining about this problem for years but nothing is corrected. According to some farmers, the nearest farms normally receive about 20 irrigation units, three for the moderately

located and just one for the farms located further away.

Few farmers lost their produce due to poor land fertility and others lost produce because of animal invasion of their farms despite the government security guards. The difficult climatic conditions prevailing during the growing season, particularly the very hot weather, are also considered one of the factors resulting in loss of produce. The inefficient management resulted in some farmers failing to perform the different cultural operations on time as some farmers' fields receive bad or delayed land preparation and/or delayed wheat plantation (sowing date). Some farmers attributed the loss of their produce to the bad or inferior seeds supplied, particularly wheat seeds. A few farmers related the loss of their produce to the shortages of input materials, one farmer has attributed the loss of his produce to theft of the crops; some farmers could not say exactly why they lost their produce.

#### **4.4 Farm location and ownership**

Farm productivity varies in relation to the proximity of urban-industrial centres and to the quantity and quality of transportation systems. Closeness to cities and transport matters because of differences in transportation and marketing costs, in the effects on labour and capital market, in the ease of obtaining new and more productive inputs, and in the ease of information flows. The study reveals that farms located near the irrigation canal are most likely to be visited by extensionists, researchers and other officials as well as receiving enough irrigation water. Moreover, according to the government regulations nearest farms should be cultivated with vegetables which farmers prefer for their quick and direct return. Vegetables need adequate irrigation water at regular intervals, therefore, they should be grown in the farms near to the main irrigation canals to avoid any water shortages. Farmers normally prefer vegetables over other crops (like cotton) as they are allowed to sell them directly in the market and under their full control unlike the case of cotton where the government collects the crop immediately after harvesting and sells through certain official channels. Strong linkages between agriculture and markets for inputs and outputs can help stimulate the local economy (Norton and Alwang, 1993; Dickinson, 1969; Grigg, 1982; Schultz, 1953).

Moreover, the study reveals that almost 85 per cent of the farmers surveyed tenanted their farms and for the rest (15 per cent) the farms either belong to another family

member or a close relative and there is only one partnership arrangement where the farm does not belong to the farmer interviewed. Partnership arrangement is a common subletting contract (mostly verbal) which takes place between the farm owner and a third party where the third party will cultivate the land and pay all the farming costs and then pay the owner an agreed share from the produce or simply agree on certain rent to be paid at the harvesting period.

#### **4.5 Technology absorption capacity**

The study reveals that almost 72 per cent have completed a reasonable level of education including high school (in the past high school in Sudan referred to intermediate and secondary school while today there are only secondary schools and their graduates can read and write perfectly), primary school, as well as post secondary education including university level. However, achieving any level of education particularly higher levels within the farmers' community has encouraged them to leave farming to find another job in the nearby town or city.

#### **4.6 Marketing**

The marketing channels for the different crops for all farmers surveyed are similar. Cotton and wheat are taken (by force) by the government and the farmers have to accept the prices given after a long period of time. Farmers market their sorghum, groundnuts, and all other crops personally. Farmers normally keep the sorghum for their families' domestic use and store the groundnuts till the price increases as village traders give low prices during the harvesting period. Farmers depend mostly on their groundnuts to pay their debts. According to many farmers, the government charge high prices for fertilisers (above the market price) which makes their produce less profitable and farmers are forced to take these very expensive fertilisers only because they have no cash to buy it from the market at low prices, therefore, for many of them it is better to buy the sorghum needed for domestic use from the market rather than grow it on their farms.

#### **4.7 Farmers union**

Almost all the farmers surveyed claim that the farmers union is not helping them with technology diffusion and marketing of their produce. In the past the union used to help farmers with land preparations, played a vital role in advising them and determining the prices of the different crops particularly the cotton and wheat as well as helping

farmers purchase subsidised fertilisers and other inputs. The farmers union has established some business activities such as a milling factory and a pharmacy but for many years farmers received their share just once and hence the farmers union has a very poor relationship with its members. Furthermore, no support is given as to product prices nor any credit and/or financial facilities.

### **5. Policy implications and recommendations**

The main policy implications and recommendations of this study include:

- Explicit linkage policies are required from the research, extension, farmers and universities, these policies should be backed by sound linkage strategies and by the financial, human, and physical resources required. However, these linkages are not usually effective if they are imposed by decree or administrative circular and, therefore, it is important to stress the fact that these linkages can improve only if there is a real consensus and commitment among managers at all levels of all the organizations involved to make improvements.
- To achieve production targets the Sudan will need to strengthen its present agricultural technology capabilities for planning and implementing system-building strategies in agricultural technology policy, organization and management. This requires the involvement of farmers in research trials as experience shows farmers would normally follow and adopt the recommendations when fully convinced by the return; research strategies should consider the feedback of farmers and extension services and inadequate absorption capacities of the extension services and farmers could be overcome through training and farmers' education. Farmers' socio-economic environment plays a key role in improving productivity. Research should consider the characteristics of the labour force and the resources available in the farming community. Researchers should consider the small-scale farmers' requirements; cheap, easy to understand and require minimal training for successful adoption. However, interventions should include adjustments in resource allocations to correct imbalances, and a range of techniques to improve research-extension-farmer linkages.

- Technology transfer agencies (extension services) in the Sudan are only a marginal source of information for farmers, that extension services are directed by political priorities, and that by themselves they cannot do much to help the small farmers.
- Adoption of the "right" micro and macro economic policies. National policies should be changed from very high taxes and very expensive inputs to raise output prices and lower input prices. Also offering loans to farmers, improved credit facilities as well as proper funding for all agricultural operations.
- Improving storage facilities, solving key socio-economic problems such as health problems as well as improving infrastructure (irrigation channels, roads, and other necessary and vital services).
- Better management to make inputs (fertilisers, chemicals, etc.) available at the needed time and fully understanding the timely application of these inputs, timely land preparation, availability of irrigation water at the needed time as well as the adoption of mechanization and the recommended technological packages.
- Politicians must refrain from interference in agricultural policy. A stable agricultural and marketing policy as well as the formulation of a fair production relationship with farmers is required.

### **6. Conclusion**

Finally, in conclusion, this paper has identified some of the key strategic and policy challenges facing agricultural technology management in the Sudan. It has also provided a better understanding of the production system constraints in Sudan within the framework of demographic, socio-economic, technical and cultural variables. Policies aimed at improving the productivity in the future in Sudan have been suggested. It is concluded that by implementing the recommendations, based on the findings of this study, the future productivity in Sudan can be substantially increased.

### **Notes**

- 1 With an area of 2.5 million square kilometres, Sudan is the "largest country in Africa" and "9th largest in the world" (IMF, 1999), with the "longest river in the world". Sudan has boasted the "largest farm in the world" in the Gezira irrigated cotton scheme (Yousif, 1997), and the "world's largest sugar-producing complex" in the Kenana project; it was also until recently the "biggest producer of Gum Arabic in the world" (Food Matters Worldwide

(1991). Sudan was optimistically referred to as an "awakening giant" by the hype merchants of the 1970s, and its vast plains were seen by development experts as a potential "bread-basket" – either for Africa or for the Arab World across the Red Sea (O'Brian, 1981). In the international wealth scale, measured by gross national product (GNP), Sudan held place 115 at the beginning of the 1990s (UNDP, 1992). According to the human development index, Sudan has been ranked even lower, at position 145 among 160 countries covered by UNDP (Grawert, 1998). Economic development indicators depict Sudan with the majority of people depending on agriculture, a low degree of industrialisation, a disproportionately large and costly public sector, a high rate of consumer price inflation, and a state budget hit by soaring foreign debt and immense war expenditure (Grawert, 1998).

- The Agricultural Research Corporation (ARC) is the oldest agricultural research institution in Africa and the major research institution in the Sudan, and accounted for nearly half the country's agricultural research capacity in terms of full-time equivalent researchers (Yousif, 1997; ISNAR, 1995). The ARC mission is to provide attractive and realistic technologies to improve and sustain productivity in agriculture.

## References

- Ageeb, O.A.A. and Hamdoun, A.M. (1997), *A Project For In-depth Analysis of NARIs in 26 West Asian and North African Countries (WANA)*, Sudan Case Study, FAO/ARC – Sudan.
- Barnett, T. (1977), *The Gezira Scheme: An Illusion of Development*, Frank Cass & Co. Ltd, London.
- Barnett, T. (1979). "Why are bureaucrats slow adopters? The case of water management in the Gezira scheme", *Sociologia Ruralis*, Vol. 19 No. 1, pp. 60-70.
- Barnett, T. (1981), "Evaluating the Gezira scheme: black box or pandora's box", in Heyer, J., Roberts, P. and Williams, G. (Eds), *Rural Development in Tropical Africa*, Macmillan, London, pp. 306-24.
- Dickinson, H.D. (1969), "Von-Thunen's economics", *Economic Journal*, Vol. 79, December, pp. 894-902.
- (The) Europa World (1998), *The Europa World Year Book 1998*, 39th ed., Europa Publications.
- FAO (2000), *Food Crops and Shortages*, No. 3, June, Food and Agriculture Organization of the United Nations, via delle Terme di Caracalla, 00100 Rome, available at: [www.fao.org/WAICENT/faoinfo/economic/giews/english/liens/sude.htm](http://www.fao.org/WAICENT/faoinfo/economic/giews/english/liens/sude.htm).
- Feder, G. and Umali, D.L. (1993), "The adoption of agricultural innovations, a review", *Technological Forecasting and Social Change* Vol. 43, pp. 215-39.
- Feder, G., Just, R.E. and Zilberman, D. (1985), "Adoption of agricultural innovations in developing countries: a survey", *Economic Development and Cultural Change*, Vol. 33, pp. 255-98.
- Food Matters Worldwide (1991), Issue Twelve.
- Grawert, E. (1998), *Making a Living in Rural Sudan*, Macmillan Press Ltd, London.
- Grigg, D.B. (1982), *The Dynamics of Agricultural Change*, St. Martin's Press, New York, NY, pp. 135-150.
- Hayami, Y. and Ruttan, V.W. (1985), *Agricultural Development: An International Perspective*, revised ed., John Hopkins University Press, Baltimore, MD, pp. 41, 52, 62 and 506.
- International Monetary Fund (IMF) (1999), *Sudan: Recent Economic Developments*, IMF Staff Country Report No. 99/53, IMF, Washington, DC.
- International Service For National Agricultural Research (ISNAR) (1995), *Statistical Brief on the National Agricultural System of Sudan*, No. 22, ISNAR indicator series project, phase II.
- Negatu, W. and Parikh, A. (1999), "The impact of perception and other factors on the adoption of agricultural technology in the Moret and Jiru Woreda (district) of Ethiopia", *Agricultural Economics*, Vol. 21, pp. 205-16.
- Norton, G.W. and Alwang, J. (1993), *Introduction to Economics of Agricultural Development*, McGraw-Hill International Editions, New York, NY.
- O'Brian, J. (1981), "Sudan: an Arab breadbasket?", *Merip Reports*, No. 99, pp. 22-6.
- Rogers, E.M. (1976), "Communication and development: the passing of the dominant paradigm", *Communication Research*, Vol. 3 No. 2, pp. 213-40.
- Schultz, T.W. (1964), "Transforming traditional agriculture", Yale University Press, New Haven, CT.
- Schultz, T.W. (1953), *The Economic Organization of Agriculture*, McGraw-Hill, New York, NY.
- Yousif, G.M. (1997), *The Gezira Scheme: The Greatest on Earth*, First print.
- United Nations Development Program (UNDP) (1992), *Human Development Report*, Oxford University Press, New York, NY, pp. 26-33.