

PART II

Technology and Scientific Knowledge Transfer

Technology Transfer in Sudan: Challenges and Constraints

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Abstract: Agriculture contributes 48% of GDP in Sudan. The research institutions (ARC) managed to produce new varieties and improved agronomic packages for the major crops; yet this had no impact on yield levels. This is blamed on the poor linkages between research institutions, extension and the farmers. However, all these are grossly under staffed and badly funded which makes it difficult for them to perform their functions satisfactorily. Efforts are being made to find ways for the Sudanese Diaspora to involve them in local development projects through the introduction of some new technologies developed in their programmes in the developed countries.

1 Introduction

Sudan is the largest country in Africa spanning an area of more than 250 million hectares. Arable land constitutes about one third of this area of which only one-fifth is cultivated. About two-fifths is accounted for by pasture and forested lands. Sparse montane regions total about 250,000 hectares. The Sudan has several ecological zones defined by differences in soils, temperatures and rainfall. These zones extend from the arid desert (50%), semi-arid low and high rainfall savannahs, swamps and uplands.

The Sudan is blessed with vast agricultural resources of land, water from the Nile system and its tributaries, rainfall and underground water. However, the arid and semi-arid zones in the clays of Central Sudan and the sands of Western Sudan are characterized by low rainfall where frequent droughts exacerbate vulnerability to declining soil fertility, low agricultural productivity and persistent food insecurity.

2 Farming Systems

Crop production is practiced under three systems namely:

- i. **Irrigated System:** Covers about two million hectares and includes the Gezira and Managil, Rahad, Suki, NewHalfa, and Kenana. Crops grown are cotton, groundnuts, wheat, legumes, fruits and vegetables.
- ii. **Semi-mechanized Rainfed System:** Receives 400-800mm on an area of 8 million hectares. Sorghum and Sesame crops are grown in addition to a small area of sunflower and guar. Average yields are low due to lack of rotations, prevalence of weeds, and absence of fertilizer use.
- iii. **Traditional Rainfed System:** This system dominates the western, southern and eastern central parts of Sudan, where farming is practiced by small farmers and herdsmen in an area of about 10 million hectares. This system contributes about 90% of millet, 48% of groundnuts, 28% of sesame and 100% of gum Arabic and 11% of sorghum.
- iv. **Livestock Sector:** Pastoral land supports about 134 million heads of cattle, sheep, goats, and camels and constitutes potential for producing enough animal protein for local consumption and surplus for export.

- v. Fisheries: Marine and inland fisheries resources are estimated at 110,000 tons of fish a year while present production is about 45,000 tons.
- vi. Horticulture: Irrigated commercial vegetable production along the Nile and seasonal river banks in central and northern parts of the country. Vegetables grown include onions, tomatoes, okra, cucurbits, melons, cauliflower, tea, and coffee in the South. Fruits are grown in scattered parts where soils and water are available and these include dates, mangoes, bananas, citrus, guavas, and tropical fruits.

The agricultural sector contributes 48% of the GDP and employs about 70% of the labour force. It also provides the major food crops and large portion of the raw materials for industry.

3 Institutional Support Systems

i Agricultural Research

Agricultural research in Sudan dates back to 1902. However, the present Agricultural Research Corporation (ARC) was preceded by several institutional changes and developments until 1967 when it was granted a status that would enable it to perform its functions efficiently. It covers research in crops and forestry. The Animal Resources Research Corporation (ARRC) covers research in animal health, animal production and vaccine production. There is also the National Research Centre (NRC) the Universities, the Hydraulic Research Station.

ii Extension

Agricultural extension services are provided by the General Administration of Technology Transfer and Extension of the Federal Ministry of Agriculture and Forests at the federal level, and by the state ministries at the state level. There are also extension services for forestry, livestock, and irrigation.

4 Challenges to Development

The Sudan with its rich natural resources possesses good potential for development if various challenges are encountered through optimization of the present production systems by the use of improved technologies and the improvement of the rural and public infrastructure. The present levels of productivity are low. Sustainable agricultural growth is constrained by natural and structural constraints, low level technologies, socio-institutional policies and infrastructure constraints. However, seasonal variation of rainfall and chronic drought conditions in the form of recurring droughts is an important challenge since they are threatening the existing cultivation of about 8 million hectares of rainfed, mechanized farming and 10 million hectares of traditional rainfed lands. Pastoral and nomadic groups in the semi arid areas of the Sudan are also affected.

Other challenges include degradation of some agricultural resources such as soils and forests in the mechanized farming sector, as well as poor agricultural industries, illiteracy, disease and poverty. Above all, the advent of globalization has resulted in significant changes which have far-reaching implications comprising economic restructuring, liberalization of international trade, international looking agricultural policies, preparedness to contend with international competition, and readjustments complying with international requirements.

Some of the measures suggested to counter these challenges include:

Supporting and strengthening research capabilities, integrating academic cadres in universities and research institutions to address urgent national development issues, and maximize the returns from natural resources through the use of improved technologies.

5 Technology Transfer

Low productivity in all the major crops continues to be of main concern in Sudan. Ibrahim (2002) reports that the disparity between yields of cotton long staple and medium staple as well as open-pollinated and hybrid sorghum continues to be substantial. For instance, cotton yields realized in farmers' fields are only 37.5% in the long staple cotton, 30.5% in medium staple cotton, 34.7% in open-pollinated sorghum and 29.6% in hybrid sorghum as compared to yields obtained under experimental conditions. According to Mahmoud (2008, personal communication) the grain yields of sorghum under irrigated conditions for seasons 1996-2000 averaged 2005 kg/ha, in 2006 average yield was 1945 kg/ha, in 2007 average yield was 2380 kg/ha and 2310 kg/ha average yield in 2008. Under the rainfed mechanized conditions, the respective grain yields obtained were 528, 528, 585, and 388 kg/ha. The grain yields of sorghum obtained from seed increase fields of 31,200 ha averaged 1250 kg/ha. Musa (2008) in a presentation at a seminar held at the Faculty of Agriculture in Shambat reported that the average cotton yields in SGB from 1991 to 2007 were lower than 5.0 KT / F in 14 out of 17 years. Fig (1-5). This level of cotton yields is barely equal to the break even level considering the cost of production. Musa commenting on the situation in SGB stressed that the it is beset with technical, institutional and structural problems, which he mentioned included low and fluctuating productivity, rising cost of inputs, and low returns, lack of funds, lack of available inputs at the right time and inadequate amounts, poor implementation of research recommendations, lack of commitment to proper field operations,

Fig. 1 Musa 2008

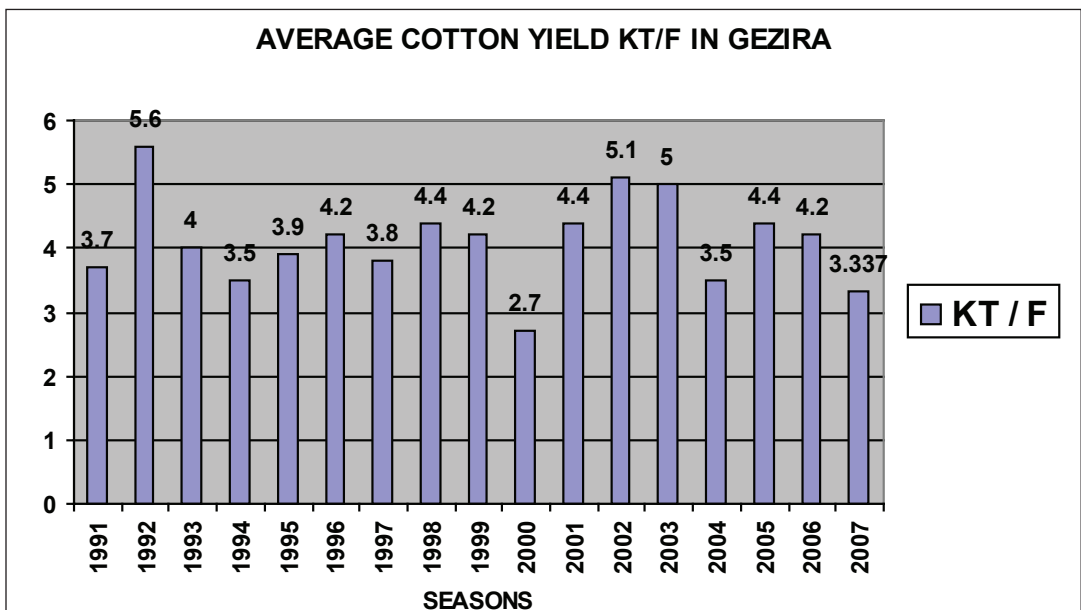


Fig. 2 Musa 2008

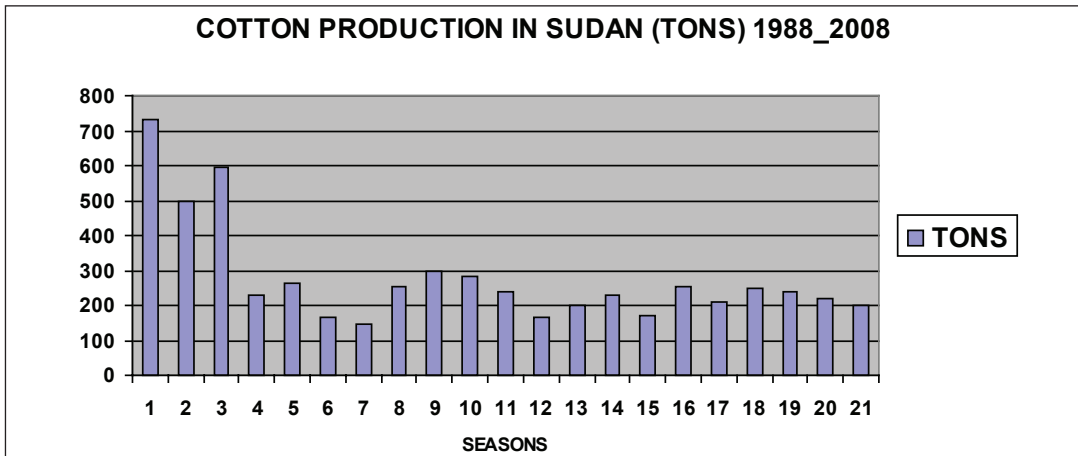


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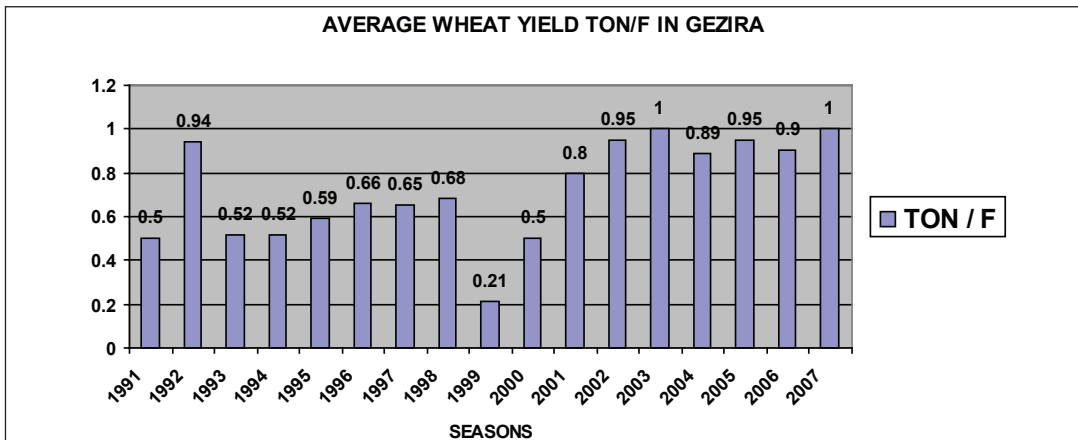


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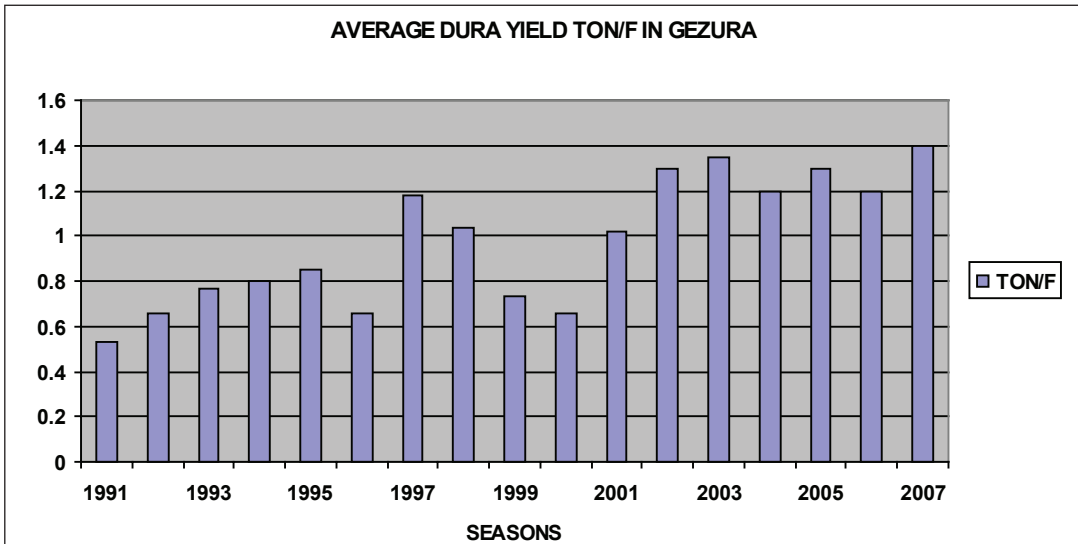
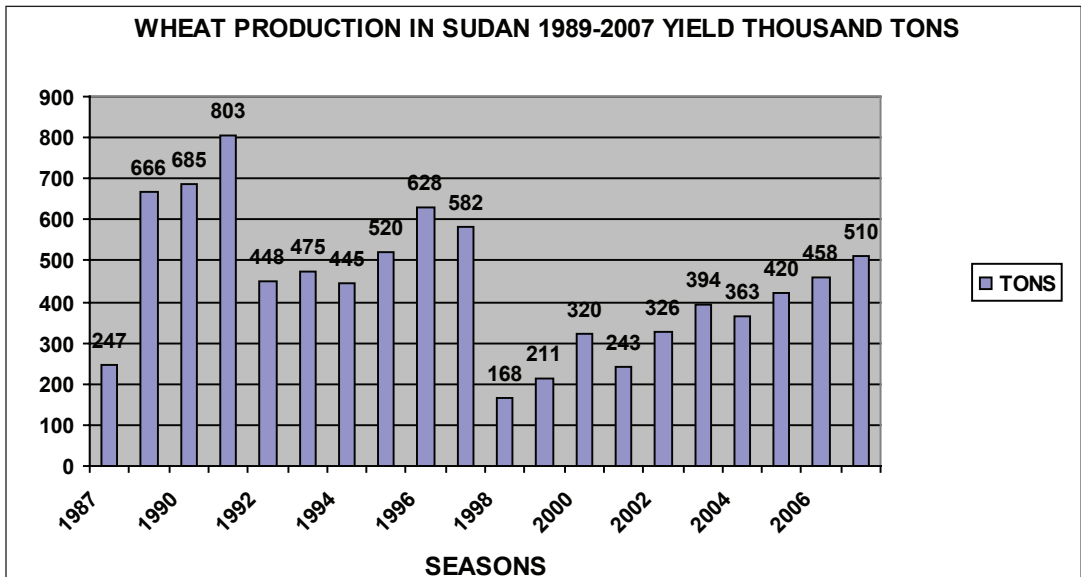


Fig. 5 Musa 2008



absence of extension services, poor aging farmers, reluctance of the younger generation to associate themselves with the farming profession, and lack of transparency and credibility on the side of the Administration.

From all this, it seems that little has changed since Ahmed (2000) made his study on “Internal Technology Transfer in Sudan: The Dichotomy between Agricultural Research and Agricultural Practice”. In his study Ahmed conducted detailed and elaborate analysis of the status of Technology Transfer in Sudan with emphasis on the Gezira Scheme. He stressed that weak linkages between the research institutions, farmers and the extension services were considered as one of the critical factors that have diminished the effectiveness of agricultural research in Sudan. Furthermore, agricultural extension was considered as the main means of communication and mode of technology transfer in SGB. The field inspectors who served as extension officers were constrained by the fact that they were overburdened by their duties and overstretched due to their few numbers in relation to the vast area they are supposed to cover. The weak extension service available was poorly trained applying non-participatory approach with very weak linkages to research and had to deal with uneducated farmers.

6 Adoption of Technology

According to his study Ahmed seems to indicate that there were serious problems in technology generation assessment and transfer systems that affect diffusion and adoption of technologies in Sudan. He emphasizes the need for farmer participation in the formulation of research programmes to allow for development of technology appropriate to farmers conditions and also open communication channels with the farmers. Some other factors that influence adoption has to do with education, age of the farmer, farm location, farm ownership, finance and funding availability as well as on-farm visits by researchers, academic staff, and extensionists. The vital role of the extension services in the efficient and timely transfer of new technology cannot be

over stated. Impediments that face adoption are also related to the fact that frequently blanket recommendations of new agronomic packages are passed to small farms spanning heterogeneous environments resulting in disappointing results in some cases thus creating an atmosphere of distrust of research recommendations. Appropriateness of technology transfer has significant impact on its ability to overcome transfer barriers. Impediments can be political, social, economic, and cultural. There is evidence of some instances where there was active involvement of research scientists between the mid-eighties and 1996 in a programme in which technology transfer was a major component where scientists undertook weekly visits to farmers' fields, met with farmers in their offices, staged field demonstration training and education sessions. These programmes were supported by donors and were subsequently abandoned when funding ended.

Ibrahim (2002) confirmed that the problem of technology transfer still persisted. However, conscious of the need to overcome these difficulties, the ARC had it promulgated in its laws that one of its obligations is to work towards ensuring that any new developments should reach the beneficiaries. To achieve that purpose the ARC arranged for all stakeholders to be involved in all stages of research programmes formulation. There was also full realization of the significant role of extension and for that reason they are also represented at all stages of programme development. There is some praise for the IPM model which was tried through German aid in programmes of vegetables improvement, which showed some success. Ibrahim is of the opinion that projects that received donor support usually were not sustainable once funding was ended.

However, there are some promising developments. Recently, Technology Transfer and Extension Administration (TTEA) has been established within the Ministry of Agriculture and Forests (Dawaelbeit 2003). TTEA has a mandate for agricultural extension in Sudan. A memorandum of 12 pages, entitled "Guidelines for Agricultural Technology & Extension", provided information about its mandate which aims at adoption and transfer of appropriate technologies, strengthening linkages among agricultural institutions (Research, Credit, and Marketing) and mobilizing the stakeholders in agriculture. The memo provides information on organizational structure, the administrative linkages and operational mechanisms of the proposed transfer of technology and extension in Sudan at all national, state, province, locality and village levels. A Farming System Development is considered the most effective and efficient means of extending agricultural technology to all farmers in Sudan in an equitable and sustainable manner. The system will be based on having small teams of well-trained extension officers at the state level.

Dawaelbeit reported some success stories by TTEA in which grain yields of sorghum in Sennar State were increased from 1.15 to 10-13 sacs per feddan, the farmers secured their staple food, generated more income, changed their attitudes about the use of improved seeds, the practice of early seeding, and weeding. In mechanized farming the use of herbicides became acceptable, and the links were strengthened between sunflower growers and millers. New crops were introduced like potatoes.

7 The Role of the Diaspora in Sudan

Technology Transfer presupposes the presence of viable active technology generating entities capable of producing the goods. In Sudan this role is largely assigned to the Agricultural Research Institutions like the ARC, the AARC and the Universities. At present, the status of the universities

is rather poor with regard to their capacity to perform their functions of research. With the recent proliferation in the number of government and non-government universities as a result of what is referred to as “Higher Education Revolution” a new and difficult situation developed. One of the inevitable consequences has been a severe shortage in the number of qualified academic staff. The few numbers of staff in government universities found their services becoming increasingly in high demand in all the new universities scattered around the country. In the present economic climate and the ever rising cost of living coupled with the comparatively low salaries of the academic staff, it was only understandable to see most, if not all of them, moving from one university to another teaching as part-time staff or on joint appointment basis or even defecting to those private universities, which were prepared to offer better terms of service which is still cheaper than employing expatriate staff. The declining budgets for the research activities are making a bad situation worse. This resulted in a situation in which very little time is left for meaningful research with regards to size or content. However the very little research taking place is confined to graduate candidates MSC and PHD projects. In this connection several government universities are conducting MSC post graduate programmes with inadequate funding and less than competent staff supervision. Consequently, poorly trained graduates seek and find employment as lecturers resulting in a vicious cycle of inadequately trained supervisors who end up graduating another generation of below standard graduates and so on. The situation in the research institutions is not brighter. Indeed as in the universities budgets are very low just enough to pay the salaries with very little left to sustain research programmes. The researchers in research institutions, as staff in universities, are benefiting from the proliferation of the universities by finding employment either on part-time or joint appointment terms.

Under these unfavourable circumstances, it is not unreasonable to see increasing number of staff of all ages seeking employment outside the country thus swelling the numbers of an already substantial community of Sudanese abroad.

This brings us to the issue of the Diaspora. The phenomenon of the emigration of citizens of developing or African countries has been an issue of discussion for many years. Oyowe (1996) estimates that Africa lost 1.2 billion dollars of investment on 60,000 professionals lost to the continent from 1985 to 1990. The discussion focused on the value of the remittances that reach the respective countries from their citizens working abroad largely ignoring the consequences of the phenomenon on the human resources and institutional capacity and capacity building expertise, which in some cases has been eroded to the extent that there is insufficient capacity to provide quality training for the new generation. Sudan is undoubtedly approaching this situation. Oyowe discussing the underlying causes of the “brain drain” classified these into:

- i Push factors which include economic political and social factors.
- ii Pull factors which include better remuneration abroad, better access to inputs necessary for job satisfaction, flexible career paths, high living standards and value placed on intellectual worth. In the new knowledge-based economy, countries have embarked on aggressive immigration policies in the U.S and Germany to attract skilled professionals. Among the professionals sent abroad to acquire higher skills and degrees about 35% did not come back and of those who came some also managed to return to those countries in which they had received their training or to find their way to the oil rich countries.

Efforts to reverse the trend had little impact as long as the so-called pull-factors and push-factors remained unchanged. Almost all African countries are seeking to tap the skills of African professionals (and Sudan is no exception), in the Diaspora to offer what they can for development in their respective countries. A basic question is how the African countries position themselves to benefit from the vast pool of skills in the Diaspora and persuade them to get involved in its development projects. Many of those in the Diaspora especially academics may wish to contribute to human capital development and durable capacity building for radically changing the socio-economic situation in the countries concerned. However, a serious constraint for this to happen is the absence of effective channels of communication and means of contact. Up to now the African Diaspora including those from Sudan had to rely on adhoc small-scale programmes outside the mainstream development agencies. However, there is a wide realization internationally and regionally about the potential development role that can be played by the African Diaspora e.g.:

Both the African Union (AU) and the New Partnership for Africa's Development (NEPAD) recognized the African Diaspora as a key player in Africa's development programmes. Furthermore a number of African states such as Sudan, Uganda and Ghana enacted dual citizenship legislation to cement the relationship between these countries and their Diaspora. Many members of the African Diaspora have arranged themselves into groups to support development in their countries. Another approach involves skills transfer through networks of professionals and intellectual programmes for return of expatriates. One limitation, however, is the huge sums of money and salaries, setting up to date equipment, and facilities. Another limitation is inability to import the knowledge networks within which expatriates used to operate effectively. In isolated instances, contacts have been established between academics in Africa and counterparts in the North in the form of joint research and publication, short-term guest teaching appointments at African institutions, joint supervision of graduate students and distance teaching projects making use of ICT. Similar approach has also been used in Sudan. The South African Network of Skills Abroad through the website invites professional Africans to sign up to enable South Africans working abroad to be in touch with their own universities.

According to previous experiences in Sudan in the past, whenever new technologies were introduced through donor programs it became necessary to take steps to make whatever modifications are needed to adapt the new technology to the new set of local conditions i.e. before adoption it is always important to adapt the technology. An example for this situation is provided by the introduction of the technique of zero tillage by the Arab Authority for Agriculture Investment and Development. An Australian company was assigned the role of carrying out the demonstration of the technique. They had to spend sometime to test their specialized machinery under the clay conditions of the mechanized rain lands before recommending the practice to local farmers.

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