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Economic Analysis of Cotton Production in the Gezira Scheme: 1970-2004

Bushara MOA* and Ahmed AMM

Department of Agricultural Economics, University of Gezira, Wad Medani, Gezira, Sudan

Abstract

The Gezira Scheme contributes more than 50% of cotton produced in the Sudan. During the seventies up to late eighties cotton alone contributed between 45 and 65% of the total foreign currency earning. Fluctuation in area, production, average yield and, benefits started from the begging of nineties in addition to high cost of production year after year and Government agricultural policies.

Therefore this study was an attempt to evaluate economic indicators (net present worth (NPW) and benefit cost ratio B/C ratio) of cotton production in the Gezira Scheme for the period (1970/71-2003/2004), also to compare three different periods of cotton production in Gezira (joint account system 1970/71-1980/81), (individual account system 1981/82-1991/92), and (liberalization 1992/93-2002/03) with respect to: Economic indicators (net present worth (NPW), benefit cost ratio B/C ratio), area, production and average yield. To identify some policy measures that may help to improve the production of cotton in the Gezira Scheme. The study mainly based on analysis of secondary data of cotton crop in Gezira Scheme. The methods of analysis used including the measurements of economic evaluation, descriptive statistics, simple mathematics, tabular analysis to describe the different periods.

The study proved that the economic evaluation during the periods (1970/71-2003/2004), (1970/1971-1980/1981), (1981/1982-1991/1992) and (1992/1993-2003/2004) were feasible and positive, fluctuation in the benefits, costs, and net benefits related to the Government agricultural policy. It's recommended that the Government agricultural policies should be proper and subsidized to agriculture particularly increasing the area of cotton crop, and reducing the cost of production are more important, downstream cotton processing for added value, up stream of cotton inputs processing for import substitutions and improving of cotton productivity through research development and extension is necessary.

Keywords: Project analysis; Cotton Gezira scheme; Sudan; Net present worth; Economic indicators

Introduction

Background

Sudan is the largest country in Africa, the area of the Sudan is about one million square miles (2.5 million square kilometers). It is characterized with a variety of climates zones from the desert in the North to tropical zone in the South. This gives it favourable environments for all agricultural activities as well as integrated investment in industries.

The country forms a wide basin sloping gently down towards the North, with high land on the other three sides. The Red Sea Hills and the Ethiopian Highlands on the Eastern side, Jabel Marra range on the western side and the Imatong range in the far South [1].

The Nile system is the main feature in the country, starting in Lake Victoria and running through the country for two and a half thousand miles. Agricultural sector is the most important sector in terms of its contribution to both Growth Domestic product (GDP) and employment. In 2001 agriculture directly accounted for 45.6% of the GDP (Bank of Sudan, 2001). The sector also provides about 80% of the country's exports (excluding petroleum) and contributes to livelihood of 80% of its population. The agricultural sector is the source of raw material for processing factories in the country including textiles, sugar, vegetable oil, soap factories, grain mills, dairies, etc., which contribute 17% of the GDP and sum 20% of foreign exchange earnings [2].

Agriculture in the Sudan depends on two principal sources of water: direct rainfall and irrigation principally, from the Nile and its tributaries. There are also flood irrigation schemes fed by seasonal rivers in the east of the country in the Gash and Tokar deltas. There are five distinct sub-sectors of the Sudanese agriculture, modern irrigated

farming, mechanized rain fed crop production, traditional rain fed farming, livestock and forestry.

The irrigated sub-sectors consist of four million (feddan=0.42 hectare) of cultivated land. The major components of these sub-sectors are large-scale schemes, which are Gezira, Rahad and New Halfa. Among the main agricultural sectors, the irrigation sector contributes 27% of agricultural

GDP and it produces most of the cotton, sugarcane, legumes and orchard crops grown in the Sudan.

The population of the Sudan is about 32.2 million of which 75% are rural according to 2004 population projection, with annual growth rate of 2.8%.

The cotton varieties are: Barakat variety (Extra-long stable cotton) cultivated in Gezira scheme and

Tokar Delta. Barac 67 (Aaka) (Medium stable cotton): It was cultivated in Elgezira, Elrahad, and Elsuki. New Halfa, Blue Nile and White Nile schemes. Albar 12/57 (Short stable cotton): It was cultivated in Nuba Mountain Corporation.

***Corresponding author:** Mohamed OA Bushara, Department of Agricultural Economics, University of Gezira, Wad Medani, Gezira, Sudan, Tel: +249511826694; E-mail: mosman@uofg.edu.sd

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The importance of cotton for the Sudanese economy: Now cotton is cultivated in both the rain fed and irrigated sectors and has a great competitive force. Cotton is not perishable commodity and can be transported for long distances and stored for long periods of time without losing its competitive qualities. Cotton is one of the most important hard currency earning crops; it contributes between 25-60% of the Sudanese national income. More than 13% of the total population depends on cotton cultivation and its subsequent activities before export. Cotton is a permanent source of income for farmers. Most of the industries in the Sudan depend on it for example spinning, textile, oil, soap and paper industries. After harvest, cotton cultivated lands provides a rich posture for livestock. Cotton stalks are used as a source of energy to meet the various needs of the Gezira population [3]. This study is to investigate cotton production at the different phase of its history to update information and evaluate economic aspects of the cotton production in the Gezira scheme.

Problem statement

In the Sudan cotton has been the most important cash crop and foreign-currency earner. Sudan was traditionally one of the world's largest producers of long-stable cotton and medium producer of medium-stable cotton. All cotton in the Sudan is produced under state management, and about 90% of cotton is irrigated, while the remaining 10% is cultivated under rain-fed and flood irrigated conditions [4].

The Gezira Scheme contributes more than 50% of cotton produced in the Sudan. During the seventies up to late eighties cotton alone contributed between 45 and 65% of the total foreign currency earning [5]. In addition cotton is considered as a main source of income for about 13% of the labour-force.

Fluctuation in area, production, average yield, prices and high cost year after year, and in addition Government policies affect cotton's benefits, farmer's net return and farmer motivation. The Scheme contributes about 58% of cotton produced in Sudan, there for the economic evaluation of cotton production in the Gezira Scheme would be very important.

Objectives of the study

The main objective of this study is the economic evaluation of cotton production in the Gezira Scheme.

The specific objectives of the study are:

1. To calculate economic indicators, net present worth (NPW) and benefits cost ratio (B/C) of cotton in the Gezira scheme for the period (1970/71-2003/2004).
2. To compare indicators (NPW) and (B/C) for three different periods (1970/1971-1980/1981), (1981/1982-1991/1992) and (1992/1993-2003/2004).
3. To identify some policy measures that may help improve the production of cotton in the Gezira Scheme.

Research questions

This study answers the main Research questions of economic indicators and the proper basis for comparison of cotton production in the Gezira scheme.

1. What are the main factors affect cotton benefits and farmer's net return?
2. What are the values of economic indicators (NPW and B/C ratio)?

3. What methods appropriate to engage farmers within the three different approaches (joint, individual account and liberalization)?

Historical Background

The Gezira scheme

The name EL-Gezira, that is "the island" was originally applied to all the Gezira scheme which is the largest, oldest, and most important agricultural and also the largest farm in the world under one management, lying between the Blue Nile and the White Nile, without any defined limit to the south. For practical purpose, now it includes only the triangle lying North of Sennar, Kosti railway, a gross area of some 5 million feddan [3].

The Gezira is a gently sloping plain of black clay soil of about 5 million of feddan lying South of Khartoum between the Blue Nile and White Nile. Rainfall was uncertain and before irrigation only shifting cultivation and nomadic grazing was possible. After an initial pilot scheme for cotton at Tayba, in the heart of the Gezira plain, the Sennar Dam was constructed on the Blue Nile in 1925.

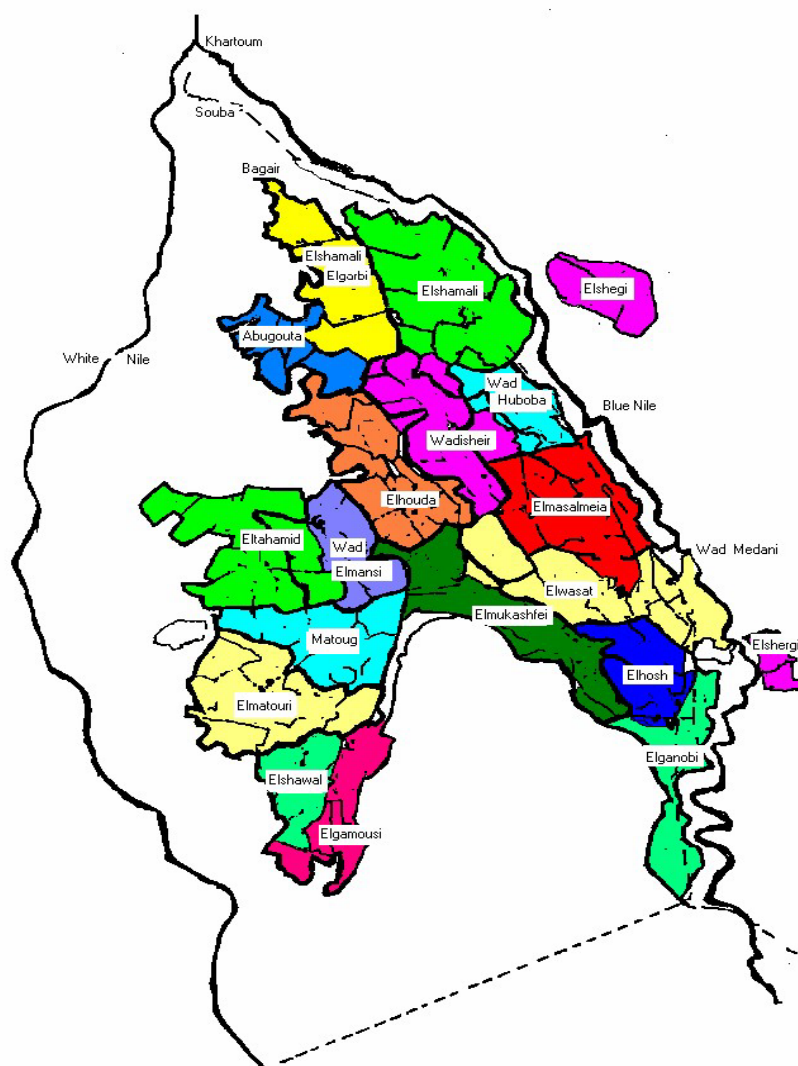
The main Gezira area is about 1.2 million feddans lying adjacent to the blue Nile, and the Managil extension developed between the year 1957/58 and 1962/63 covering on area of about 0.88 million feddan lying to the south west of Gezira scheme [6].

The map in Figure 1 Illustrates the Gezira and Managil irrigated area by groups and blocks. Topography of the Gezira is related to the characteristic of the two rivers. The Blue Nile comes from mountains catchments (Ethiopia plateau) and flows at a relatively steep slope (1/10,000). The seasonal variation of its discharge ranges is as follows: In the low season from January to June, the mean total discharge of the main river below Khartoum is some 13.8 Billions of cubic meter (1 Billions=1,000 million) cubic meters, of which the White Nile contributes 10 Billion and the Blue Nile 3.8 Billion. The Atbra River is dry for practically the whole of this period. From the beginning of July, the main river rises rapidly until the peak of the flood is reached about the end of August (discharge is 76 Billions, of which 16 Billion came from the white Nile 48 Billion from the blue Nile and 12 Billion from the Atbara considering the year as a whole. The surface of soil of the Gezira with high clay content. Soils are in general very good.

The climatic conditions of the Gezira area differ from one zone to another. The annual average rainfall is apparently 400-500 millimeters (mm) in the south, and this average drops gradually towards the North (average 200-300 mm). Climate differences are also observed in the average temperature and relative humidity.

Administration: The Gezira and Managil scheme, has been divided into 18 (eighteen) groups, 10 (ten) in the Gezira and 8 (eight) in the Managil extension. Each group divided into 7-10 blocks with block inspector on top of each, assisted by a number of inspectors. To facilitate the flow of information from the management to the farmers, a production council was set up in each block inspector, which includes some farmers as members. The entomologist, and agricultural extensionist, the agricultural engineer, the auditor, and accountant inspector are also members in the group council. The function of this council is to discuss and settle all problems facing the agricultural program.

Cotton in the Gezira Scheme: Cotton crop was introduced in the Sudan at prehistoric periods and was found barred with deeds since empire 50 years Before Christ (B.C). It seemed that its cultivation



was transferred from India to west Asia to Africa. In the 19th century Mumtaz Basha the Turkish Governor of Sawakin tried growing cotton in Delta Tokar in 1850. A half a century later Sir Reginald Wingate, the Governor General of the Sudan invited an American businessman to invest in the Sudan [3]. An area of 10,000 feddans was allotted on lease hold to him at Zeidab in the Northern Province in 1903.

system. The later system made the tenants accountable to all costs relative to the production of their crops. Government and administration shares during the joint account system were transferred into land rent and water charges imposed on the cultivated areas and are revised each year. This system gave efficient tenants the reaps of their efforts since each tenant is considered individually.

Important development in the Gezira scheme: Cotton production is the production relations these relations were based on the cotton crop and were revised several times to change sharing Percentage of farmers relative to that of the Government which maintaining the share of administration at 10%, in 1980/81.

The cotton marketing: The marketing of cotton at the time the Sudan syndicate, after nationalization of cotton trade during the May regime when solutions took over the marketing for cotton and later in 1985 when Sudan Cotton Corporation was transferred in to the Sudan Cotton Company Limited (Public company). In 1993 under privatization policies shifting the ownership of Sudan Cotton Company limited from the state to the tenants (Figure 1).

Development stages of cotton production in the Gezira scheme (1970/1971-2003/2004)

The development stages of cotton production included the area, production, average yield, for the years 1970/1971–2003/2004 production relations in the Gezira Scheme for the same period (Table 1).

The Table 1 indicates the area grown with cotton was decreased gradually from the first period (1970/1971–1980/1981) to second period (1981/1982–1991/1992) and third period (1992/1993–2003/2004).

The above Table 1 indicates fluctuation of cotton production over those 34 years and also the average yield of cotton crop.

Cotton cultivated area, production, average yield had been decreased. The decrease was attributed to many factors among them were the following:

1. Shortage in machinery and spare parts needed for land preparation and the cultivation of cotton.
 2. Lack of required inputs at the right time. Moreover, it has been found that some of these inputs were not in accordance with scientific specification.
 3. Seasonal labour problems and failure to harvest the crop in right time.
 4. Dependence of cost of production of other crops on income from cotton.
 5. Fluctuation in prices, high cost of production and direct and indirect taxes might have negatively affected farmer motivation.
 6. Agricultural government policies. (Pricing, Taxes, Finance, etc.)
 7. Administrative technical and political factors (Table 2).
- Report at archives section (annual report 1970/71-1980/81)
 - Information and Financial Analysis Unit (report of cotton accounting (1981/82-199/2000)
 - Accounting section (2000/2001-2003/2004)

Production relations in the sudan gezira board (SGB)

The production relations in Gezira scheme is based on the

Season	Areas (Fed.)	Production	Average Yield Kentar/Fed.
1970/1971	5,88,371	31,83,087	5.41
1971/1972	5,89,387	29,17,466	4.95
1972/1973	5,89,387	24,04,699	4.08
1973/1974	6,04,420	30,52,321	5.05
1974/1975	6,03,364	27,75,474	4.6
1975/1976	3,95,637	10,68,220	2.7
1976/1977	4,99,434	18,22,934	3.65
1977/1978	5,18,607	22,24,824	4.29
1978/1979	4,98,023	16,28,535	3.27
1979/1980	5,40,890	14,38,767	2.66
1980/1981	5,01,202	11,52,765	2.3
1981/1982	4,35,314	16,89,018	3.88
1982/1983	4,84,315	22,71,437	4.69
1983/1984	4,97,729	24,48,827	4.92
1984/1985	4,64,792	24,26,214	5.22
1985/1986	4,00,528	14,17,869	3.54
1986/1987	4,15,074	20,46,315	4.93
1987/1988	3,83,037	17,50,479	4.57
1988/1989	4,04,505	20,99,381	5.19
1989/1990	3,57,984	14,78,474	4.13
1990/1991	2,51,048	9,31,388	3.71
1991/1992	2,15,506	12,11,144	5.62
1992/1993	1,74,703	7,25,017	4.15
1993/1994	1,49,603	5,74,476	3.84
1994/1995	2,53,147	9,84,742	3.89
1995/1996	3,01,245	12,47,154	4.14
1996/1997	3,31,047	12,74,531	3.85
1997/1998	2,46,220	10,88,292	4.42
1998/1999	1,53,924	6,80,344	4.42
1999/2000	2,59,495	5,83,864	2.25
2000/2001	2,00,000	9,00,000	4.5
2001/2002	2,00,000	9,40,000	4.7
2002/2003	2,50,000	13,75,000	5.5
2003/2004	2,44,900	12,46,661	5.09
Average	3,82,436	16,19,404	4.24

Source: Sudan Gezira Board [7,8].

Table 1: Areas grown with cotton and quantities produced over 34 years, from 1970/1971–2003/2004, Source: Sudan Gezira Board [7].

partnership agreement between the tenants, the board of directors and the government, which was mainly directed towards the promotion of cotton production neglecting to some extent the production of other crops which were the responsibility of the tenants themselves.

The partnership agreement regulated the duties and rights of each partner. The board of directors was assigned to the managerial tasks in a way that made the scheme operated efficiently. It was required to act on behalf of the joint undertaking [7]. Their responsibilities included: Formulating policies to allocate economic resources available to the most productive uses. Planning for acquiring and utilizing funds. Controlling and implementation of the policy formulated. The tenant's duty under the terms of the joint undertaking was to do all a labour needed for agricultural operations of cotton (e.g. sowing, irrigating, weeding, thinning, fertilizer scattering, harvesting, and delivering the produced to the local collecting stations in the area). The Government provides land and water resources [8].

Joint account system: Joint account system was a production relationship system proposed to recover from the tenants all the costs of inputs and services provided by the scheme and other party [9]. since in effect all costs were assumed to be volume related, these costs were

Season	Gross Benefits (in cash flow)	Gross cost (out cash flow)	Net (Return)
70/71	12,83,38,566	5,61,10,277	7,22,28,289
71/72	11,43,68,309	5,85,31,331	5,58,36,977
72/73	12,43,56,485	5,70,44,798	6,73,11,688
73/74	11,98,88,345	6,01,70,303	5,97,18,043
74/75	11,66,73,785	7,77,91,363	3,88,82,423
75/76	8,05,49,390	7,13,53,680	91,95,710
76/77	14,48,08,750	9,35,99,203	5,12,09,548
77/78	21,25,16,160	10,66,57,178	10,58,58,983
78/79	21,25,69,053	10,63,74,345	10,61,94,708
79/80	15,25,73,654	11,67,56,042	3,58,17,612
80/81	8,71,70,714	7,52,56,134	1,19,14,580
Total	1,49,38,13,210	87,96,44,653	61,41,68,558
Average	13,58,01,201	7,99,67,696	5,58,33,505
81/82	11,32,55,438	9,43,49,577	2,49,60,646
82/83	14,85,35,008	11,39,87,246	4,56,14,108
83/84	19,45,32,077	15,53,14,246	6,22,70,477
84/85	12,66,30,156	9,33,22,248	4,92,54,360
85/86	12,40,09,900	8,70,28,580	4,72,40,104
86/87	11,15,62,753	7,09,41,042	4,56,47,638
87/88	10,62,29,271	6,29,30,158	4,97,18,889
88/89	24,46,21,798	11,84,34,809	12,99,16,598
89/90	22,17,06,127	11,61,89,464	10,96,47,989
90/91	2,56,67,545	2,06,48,998	72,24,670
91/92	2,01,97,769	1,51,06,504	61,53,801
Total	1,43,69,47,842	94,82,52,873	57,76,49,279
Average	13,06,31,622	8,62,04,807	5,25,13,571
92/93	1,93,56,109	2,05,82,544	37,92,871
93/94	2,13,75,787	1,32,26,608	88,99,925
94/95	6,44,30,075	2,94,14,303	3,57,52,892
95/96	7,67,41,306	3,71,60,701	4,05,38,824
96/97	7,69,86,383	6,13,57,120	2,10,84,884
97/98	5,58,37,243	4,55,82,451	1,55,15,204
98/99	2,76,18,695	2,69,79,799	65,43,946
99/2000	3,15,66,751	3,53,98,611	59,52,063
2000/2001	5,61,82,707	3,93,75,767	1,91,91,599
2001/2002	6,52,95,008	3,68,32,320	2,96,97,609
2002/2003	8,37,03,764	4,67,15,314	3,83,67,992
Total	57,90,93,827	39,26,25,539	22,53,37,810
Average	5,26,44,893	3,56,93,231	2,04,85,255

Table 2: The development stages of cotton benefits, costs, and net return of cotton for three periods (1970/71-1980/81), (1981/82-1991/92), (1992/93-2002/2003) in US dollar.

deducted from cotton crop sales value, all the proceeds over and above the total cost were divided among them.

The individual account system: The individual account system and the land water charges have been introduced in the Gezira scheme in 1981/1982 season to replace the joint account system, this system was proposed to recover from each individual tenant the cost of inputs and services provided for him by the scheme and other party, all proceeds over and above the total accrue. The tenant individual account were to be debited with advances, interest on debit, services contracted on an individual basis, material draw on an individual basis and per feddan land and water charges. The in cash and in kind loans provided for cotton were deducted from the tenant' cotton proceeds. Cotton is the only crop sold through the Sudan Gezira Board [8,10], so it was loaded by the debits of the other crops. Its account was charged with various deductions and costs which do not related to cotton.

The economic liberalization policy: Beginning from the season

1990/1991, the financing of cotton operations from the central bank was cancelled and substituted for commercial financing through "The Banks Consortium Fund" which is a number of commercial banks assigned to finance the production of cotton and wheat crops. In February 1992, a number of economic procedures were declared which were directly reflected on the Gezira Scheme, included complete liberalization of the price of the Sudanese pound and equal liberalization of foreign currency transactions. It also included of almost prices of goods and services and remarkable deduction in Government subsidies and other procedures meant to liberalization the Sudanese economy to be in consistence with world economic and financial interactions (Table 3).

Introduction

Cotton average yield in the Sudan is low compared to other cotton producing countries, best practice average yield and average yield achievable in research stations. Cotton average yield in Sudan is only 53, 47, 35 and 61% of the cotton average yield in Egypt, China, Australia and Pakistan, respectively [8].

The World Bank (2000) stated that cotton average yield in the Gezira scheme is only 37.5, 35.8 and 30.5% of the achievable levels in field research for extra-long, medium and short stable cotton, respectively.

It was a challenged for everyone working in the field of production research to find ways and means to improve yields. Such efforts have to be different from traditional approaches aimed at developing high yielding varieties, agronomic management practices and insect pest control. Improvements in traditional cultivation practices would affect yields positively, but a sustained increase in yields requires a non-traditional technological innovation. It is a challenge for researchers to develop such a technology.

The adoption rate for GE technology is the highest for any new technology in the agriculture industry. But, the technology is still new and implications are not fully understood. The technology must be used without compromising the environment sustainability, farmers' interest and mishandling of the cotton genome. The challenges of GE technology include acceptability to the public, employment of the technology for creating non-existing combinations and improving yield [11].

According to Ginger gross accrual revenues for cotton production have been on a downward trend from 1996 to 2002 averaging \$195.98 per acre [11]. Total enterprise costs averaged \$190.48 on a per acre basis and \$0.84 on a per pound basis from 1996 to 2002. Additionally, producers, on average, received positive net incomes in 1996 through 1998 and negative net incomes from 1999 through 2002. The average net income for producers from 1996 through 2002 was \$5.50 per acre. Furthermore, producers had an average enterprise cost of production of \$0.53 per pound from 1996 through 2002. The enterprise cost of production represents the cotton lint price necessary to break-even after accounting for all non-primary product income.

Gross accrual revenues for irrigated cotton production from 1996 to 2002 averaged \$297.45 per acre. Total enterprise costs averaged \$250.87 on a per acre basis and \$0.63 on a per pound basis from 1996 to 2002. Additionally, producers, on average, received positive net incomes in all years evaluated in this study with the exception of 2000. The average net income for producers in the Texas High Plains (THP) (1999) from 1996 through 2002 was \$46.58 per acre. Furthermore, producers had an average enterprise cost of production of \$0.43 per pound from 1996 through 2002.

From Table 4 gross revenues foe irrigated cotton production in

Season	Government	Tenants Share%	Administration	Local government	Social development	Reserve
	Share%		Share %	Share %	Share %	Fund%
1950/51-1956/57	40	40	20	-	-	-
1957/58-1962/63	42	42	10	2	2	2
1963/64-1964/65	40	44	10	2	2	2
1965/66-1968/69	36	48	10	2	2	2
1969/70-1970/71	36	47	10	2	3	2
1972/73-1975/76	36	47	10	2	3	2
1976/77-1980/81	36	47	10	2	3	2

Source: PSERU (Planning And Socio-Economic Research Unit) (1950/51-1980/81) Literature Review [8]

Table 3: The development of profits share for the three partners during the joint account system.

Periods	Average gross revenues per feddan	Average gross cost revenues per feddan	Average net incomes per feddan
1970/71-1980/81	251.96	148.37	103.59
1981/82-1991/92	333.41	220.02	113.39
1992/93-2002/2003	229.86	155.84	74.02

Table 4: Profitability of cotton production in The Gezira Scheme for the period (1970/71-1980/81), (1981/82-1991/92) and (1992/93-2002/2003) per dollar.

Gezira Scheme during the period (1970/71-1980/81) averaged 251.96 dollar per feddan. Total gross cost averaged 148.37 dollar per feddan. The average net income for producers in Gezira Scheme from (1970/71-1980/81) was 103.59 dollar per feddan. In (1981/82-1991/92), revenues averaged 333.41 dollar per feddan. Total gross cost averaged 220.02 dollar per feddan. The average net incomes (net benefits) was 113.39 dollar per feddan. In (1992/93-2002/2003), gross revenues averaged 229.86 dollar per feddan. Total gross cost averaged 155.84 dollar per feddan. The average net incomes were 74.02 dollar per feddan (Table 4) [8].

Data and Methodology

The theoretical frame work of the model

In the economic analysis of an agricultural project, the changing value of money over time must be considered. If the project extends over several accounting periods, the values of the cost and benefits streams must be standardized to provide a proper basis for comparison. This can be done by reducing the values to their “present worth” also referred to as present value or discounted value. The process of calculating the present value of a sum of money due sometime in the future is called discounting. It calculates the present value of future cash flows. Discounting looks backward from the future to the present [12,13].

Discount factor

The rate for discounting is called the discount factor. The difference in the value of the same sum of money in two different periods is determined by the discount factor. This is affected by the length of time and by the discount factor used. At any given discount factor the value of the sum of money becomes less and less far in the future it is to be received. For instance, \$100 today is more value than \$100 to be received one year later. Also the greater the discount rate, the greater the difference will be between the value of a sum of money in two different periods. For purposes of discounting Gittinger assumes that both costs and benefits fall on the last day of each project year, including the first year, and so all costs and benefits in the first year are discounted as though they arose at the end of the year. Given the discount rate, the present worth of an amount due in any year in the future can be found by multiplying that amount by the discount factor shown in the tables for corresponding year [12].

Discounted measures of project worth: Two important measures

of project worth incorporate the principle of discounted measures: a. Benefit/cost ratio.

b. Net present worth, also called net present value.

Benefit/cost ratio: The benefit cost ratio compares the present worth of the benefits and cost of a project and express their relation as a ratio. The discount rate used is usually the opportunity cost of capital. The method of discounted gross benefits divided by the total discounted gross costs.

Net present worth: The net present worth is the difference between the present worth of the benefits and costs of a project. As in the case of the benefits/cost ratio, the rate used for discounting is usually the opportunity cost of capital. The simple decision rule is to accept projects for which the net present worth is positive. Unlike benefit/cost ratio, it's not affected by the different methods used in calculating it [13].

Decision formulas criteria

• NPW (net present worth) or (net present value)

$$NPW = \sum_{t=0}^n \frac{(B_t + C_t)}{(1+r)^t} \quad (1)$$

B=Benefits t=year C_t =cost

r=rate of interest (discount factor)

$(1+r)^t$ =defined as present worth factor

Decision rule of this formula: - Accept IF NPW>0 Reject IF NPW<0

Benefit/Cost Ratio

$$B/C = \frac{\sum_{t=1}^n \frac{B_t}{(1+r)^t}}{\sum_{t=1}^n \frac{C_t}{(1+r)^t}} \quad (2)$$

Decision rule: - If B/C>1.0 accept IF B/C<1.0 reject.

Periods of analysis

The proper basis for comparing three different periods of cotton production in the Gezira scheme (joint account system 1970/71-1980/81), (individual account system 1981/82-1991/92), and (liberalization 192/93-2002/03) with respect to:

Source of data: This study mainly based on analysis of secondary data of cotton crop such as area, production, average yield, benefits, costs, return, net return. The most important sources of secondary data includes: Agriculture Administration, Statistical Information Unit, Financial Administration (Accounting Section), Report and Papers relating to cotton production at the Archives Section (annual report and statement of accounts for the years ended 30th June, Information and Financial Analysis Unit (report of cotton accounting 1981/82-1999/2000), Planning And Socio-Economic Research Administration “PSERA”, Informal And Private Institutions (Bank of the Sudan, Sudan cotton company etc.).

Results and Discussion

It was found that the mean cotton area decreases from 538,975 Feddan in the first period and to 391,803 feddan in second period and

to 229,035 feddan in the third period respectively and it has been found that the mean production in the same period decreases from 2,151,736 Kentar in the first period to 1,797,322 Kentar in the second period and to 943,038 in the third period respectively while cotton average yield during the same periods increases from 3.99 in the first period to 4.59 K/f in the second period and decreases to 4.12 k/f in the third period. That means the cotton cultivated area had been decreases steadily from first period to the second period and third period respectively and also production decreases steadily from 2,151,736 Kentar to 1,797,322 Kentar and to 943,038 Kentar. That means the major factor affecting cotton production was the area allocated for cotton. Cotton average yield increases from 3.99 to 4.59 and decrease to 4.12 that means the best period is the second one (individual account system) that means the Government policies affecting cotton average yield because that period has many advantages (Figures 2-4).

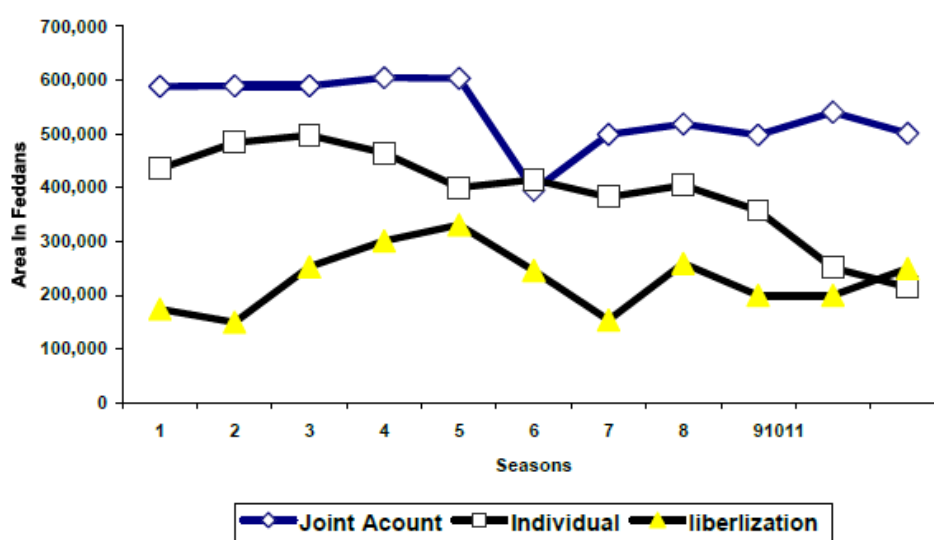


Figure 2: Cultivated Areas During (JAS), (IAS), (LIB) systems.

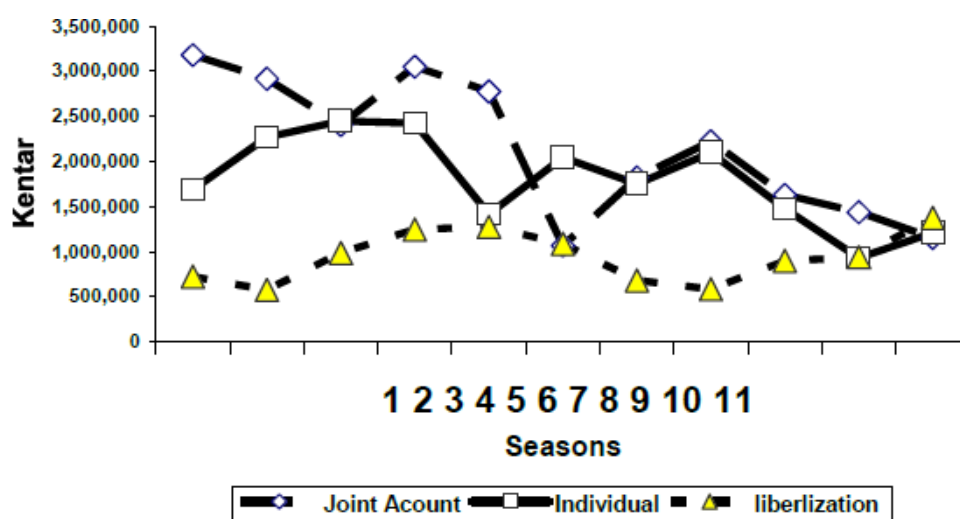


Figure 3: Cotton Production During (JAS), (IAS), (LIB) systems.

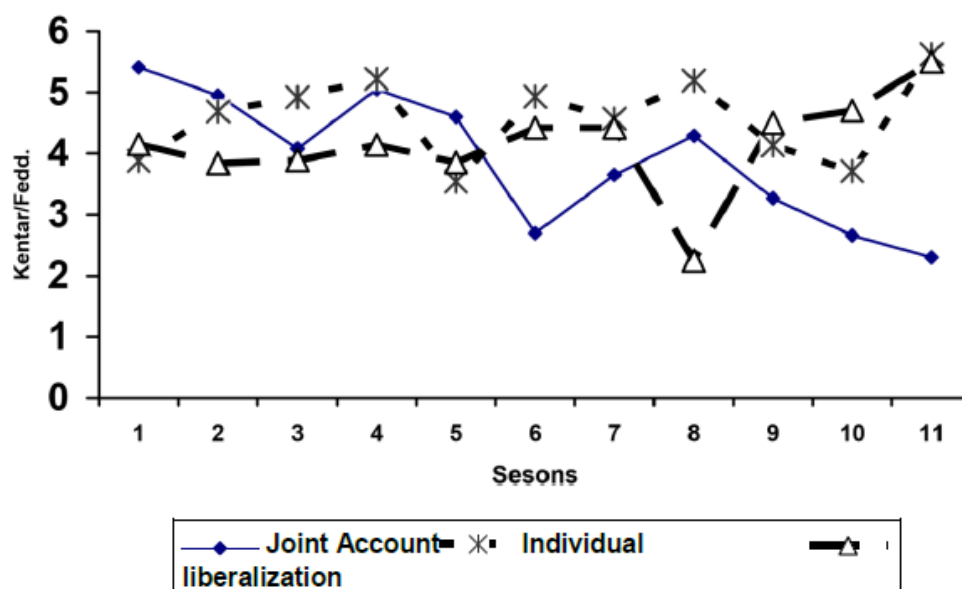


Figure 4: Cotton Average yield During (JAS), (IAS), (LIB) systems.

Three periods' joint account, individual account and liberalization:

1. First period (1970/71-1980/81)

It was found that the mean area allocated in this period for cotton production 538,975 Feddan, the mean production amounted to 2,151,736 Kentar, average yield 3.99 kentar/Fedd.

2. Second period (1981/82-1991/92)

It found that the mean area allocated in this period for cotton production 391,803 Feddan, mean production amounted to 1,797,322 Kentar, average yield 4.59 Kentar/Fedd.

3. Third period (1992/93-2002/03)

It found that the mean area allocated in this period for cotton production 229,035 Feddan, mean production amounted to 943,038 Kentar, average yield 4.12 Kentar/Fedd (Table 5).

It was clear that the coefficient of variation for the three period differ significantly from one period to another, ranging from 11.96% for JAS to 22.81 for IAS and 25.63 for LIB that means the variation in cultivated area is low during JAS period compared to IAS and LIB respectively, while the variation in production and average yield were high during the JAS than LIB and IAS respectively this result is consistent with the results (Table 6).

E B/C at 12%=1.68.

ENPW at 12%=\$ 438,890,074.

From the above Table 6 the calculation of economic benefit/cost ratio and net present worth of Gezira cotton (Dollars) for years (1970/1971-2003/2004) were those:

- present worth of gross benefits at 12%=1,039,679,541.
- present worth of gross cost at 12%=618,837,857 - present worth of gross return at 12%=438,890,074.
- the E B/C=1,039,679,541/618,837,857=1.68.

	Area	production	Average yield
Joint account system	11.96%	35.94%	27.31%
Individual account system	22.81%	28.10%	14.87%
Liberalization	25.63%	29.90%	19.06%

Table 5: Coefficient of Variation for the three periods.

The economic benefit cost ratio (EB/C ratio)=1.68 that means the project is economically feasible because the simple decision rule is to accept the project if the benefit/cost ratio is greater than one and to reject it if the ratio is less than one and the economic net present worth (ENPW)=438,890,074\$ that means the economic net present worth is positive. (The simple decision rule is to accept the project).

E B/C at 12%=1.78 (JAS). (ENPW) at 12%=340,819,877\$ (JAS).

E B/C at 12%=1.44 (IAS). (ENPW) at 12%=87,124,036\$ (IAS).

E B/C at 12%=1.49 (LIB). (ENPW) at 12%=10,086,706\$ (LIB)

The above Table 7 shows that the calculation of economic benefit/cost ratio and economic net present worth of Gezira cotton (Dollar) in different periods (1970/1971- 1980/1981), (1981/1982-1991/1992), (1992/1993-2002/2003), joint account, individual account, liberalization respectively at 12% were those:

First periods (1970/1971-1980/1981), joint account

- present worth of gross benefits at 12%=779,735,486\$.
- present worth of gross cost at 12%=438,915,609\$-present worth of gross return at 12%=340,819,877\$.
- the E B/C=779,735,486/438,915,609=1.78.

Second periods (1981/1982-1991/1992), individual account

- present worth of gross benefits at 12%=231,982,202\$.
- present worth of gross cost at 12%=160,988,623\$.
- present worth of gross return at 12%=87,124,036\$.
- the E B/C=231,982,202/160,988,623=1.44.

Season	Present worth of gross. benefits at 12%	Present worth of gross cost. At 12%	Present worth of return at 12%
70/71	114,606,339	50,106,477	64,499,862
71/72	91,151,542	46,649,471	44,502,071
72/73	88,541,817	40,615,896	47,925,922
73/74	76,248,987	38,268,312	37,980,675
74/75	66,154,036	44,107,703	22,046,334
75/76	40,838,541	36,176,316	4,662,225
76/77	65,453,555	42,306,840	23,146,715
77/78	85,856,529	43,089,500	42,767,029
78/79	76,737,428	38,401,139	38,336,289
79/80	49,128,717	37,595,446	11,533,271
80/81	25,017,995	21,598,511	3,419,484
81/82	29,106,648	24,247,841	6,414,886
82/83	34,014,517	26,103,079	10,445,631
83/84	39,879,076	31,839,420	12,765,448
84/85	23,173,319	17,077,971	9,013,548
85/86	20,213,614	14,185,659	7,700,137
86/87	16,288,162	10,357,392	6,664,555
87/88	13,809,805	8,180,921	6,463,456
88/89	28,376,129	13,738,438	15,070,325
89/90	23,057,437	12,083,704	11,403,391
90/91	2,387,082	1,920,357	671,894
91/92	1,676,415	1,253,840	510,765
92/93	1,432,352	1,523,108	280,672
93/94	1,410,802	872,956	587,395
94/95	3,801,374	1,735,444	2,109,421
95/96	4,067,289	1,969,517	2,148,558
96/97	3,618,360	2,883,785	990,990
97/98	2,345,164	1,914,463	651,639
98/99	1,021,892	998,253	242,126
99/2000	1,041,703	1,168,154	196,418
2000/2001	1,854,029	1,299,400	633,323
2001/2002	2,154,735	1,215,467	980,021
2002/2003	2,762,224	1,541,605	1,266,144
2003/2004	2,451,928	1,811,473	859,455
Total	1,039,679,541	618,837,857	438,890,074

Table 6: The economic present worth of the gross benefits, gross costs and return for years (1970/1971-2003/2004) per Dollars at discount factor 12%.

Season	Present worth of Gross Benefits At 12%	Present worth of Gross Cost At 12%	Present worth of Returns at 12%
70/71	11,46,06,339	5,01,06,477	6,44,99,862
71/72	9,11,51,542	4,66,49,471	4,45,02,071
72/73	8,85,41,817	4,06,15,896	4,79,25,922
73/74	7,62,48,987	3,82,68,312	3,79,80,675
74/75	6,61,54,036	4,41,07,703	2,20,46,334
75/76	4,08,38,541	3,61,76,316	46,62,225
76/77	6,54,53,555	4,23,06,840	2,31,46,715
77/78	8,58,56,529	4,30,89,500	4,27,67,029
78/79	7,67,37,428	3,84,01,139	3,83,36,289
79/80	4,91,28,717	3,75,95,446	1,15,33,271
80/81	2,50,17,995	2,15,98,511	34,19,484
Total	77,97,35,486	43,89,15,609	34,08,19,877
81/82	2,91,06,648	2,42,47,841	64,14,886
82/83	3,40,14,517	2,61,03,079	1,04,45,631
83/84	3,98,79,076	3,18,39,420	1,27,65,448
84/85	2,31,73,319	1,70,77,971	90,13,548
85/86	2,02,13,614	1,41,85,659	77,00,137
86/87	1,62,88,162	1,03,57,392	66,64,555
87/88	1,38,09,805	81,80,921	64,63,456
88/89	2,83,76,129	1,37,38,438	1,50,70,325
89/90	2,30,57,437	1,20,83,704	1,14,03,391

90/91	23,87,082	19,20,357	6,71,894
91/92	16,76,415	12,53,840	5,10,765
Total	23,19,82,202	16,09,88,623	8,71,24,036
92/93	14,32,352	15,23,108	2,80,672
93/94	14,10,802	8,72,956	5,87,395
94/95	38,01,374	17,35,444	21,09,421
95/96	40,67,289	19,69,517	21,48,558
96/97	36,18,360	28,83,785	9,90,990
97/98	23,45,164	19,14,463	6,51,639
98/99	10,21,892	9,98,253	2,42,126
99/2000	10,41,703	11,68,154	1,96,418
2000/2001	18,54,029	12,99,400	6,33,323
2001/2002	21,54,735	12,15,467	9,80,021
2002/2003	27,62,224	15,41,605	12,66,144
Total	2,55,09,925	1,71,22,152	1,00,86,706
2003/2004	24,51,928	18,11,473	8,59,455
Total	24,51,928	18,11,473	8,59,455

Table 7: The economic present worth of the gross benefits, gross costs and return in different periods (1970/1971-1980/1981), (1981/1982-1991/1992), (1992/1993-2002/2003), joint account, individual account, liberalization respectively per Dollars at discount factor 12%.

Third periods (1992/1993-2002/2003), liberalization account

- present worth of gross benefits at 12%=25,509,925\$.
- present worth of gross cost at 12%=17,122,152\$ - present worth of gross return at 12%=10,086,706\$.
- the E B/C=25,509,925/17,122,152=1.49.

In these three periods, it was found that the E B/C ratio decreases from 1.78 to 1.44 in the second period and increases to 1.49 in the third period.

It has also been found that the economic net present worth decreases from 340,819,877\$ to 87,124,036\$ and to 10,086,706\$ in the third period respectively (Figures 5 and 6).

In the Sudan cotton is the most important cash crop and foreign-currency earner. It was found that the big fluctuations in cotton area, production, decreases of benefits and increasing of production cost during the seventies, eighties up to the season 2003/2004. Combinations of factors were negatively affecting cotton area and production during the different periods. These were due to insufficient and timely finance Government agricultural policy improper implementation of intended crop rotation, centralized decision of area allocated by management and difficulties in irrigating areas.

From Tables 6 and 7 it was found that the calculation of the economic benefit/cost ratio (EB/C ratio) of the cotton production in the Gezira Scheme to the period (1970/71-2003/2004) has improved that the ratio is greater than one, that means accepted also the economic net present worth has improved that the calculation for the same period (1970/1971-2003/2004) was positive.

The comparison between the three periods (joint account system 1970/1971-1980/81), (individual account system 1981/82-1991/92) and (liberalization 1992/93-2002/2003) with respect to the (EB/C) and (ENPW), area, production, average yield, cost of finance and inflation resulted in Tables 8 and 9 below:

Summary, Conclusion and Recommendation

Introduction

In this section the conclusions are summarized below:

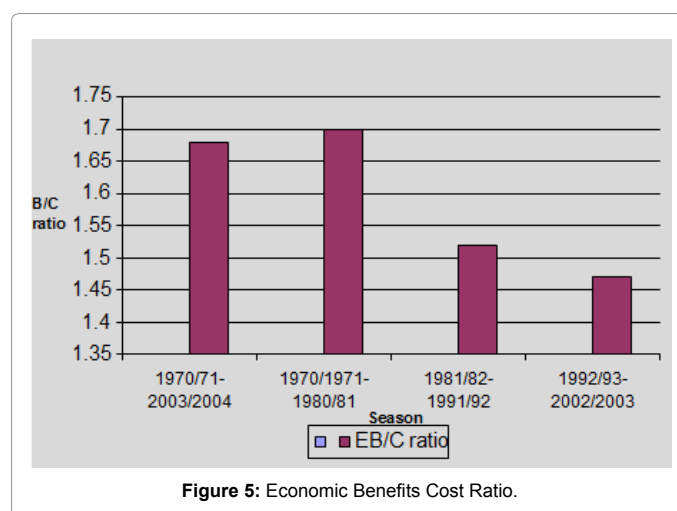


Figure 5: Economic Benefits Cost Ratio.

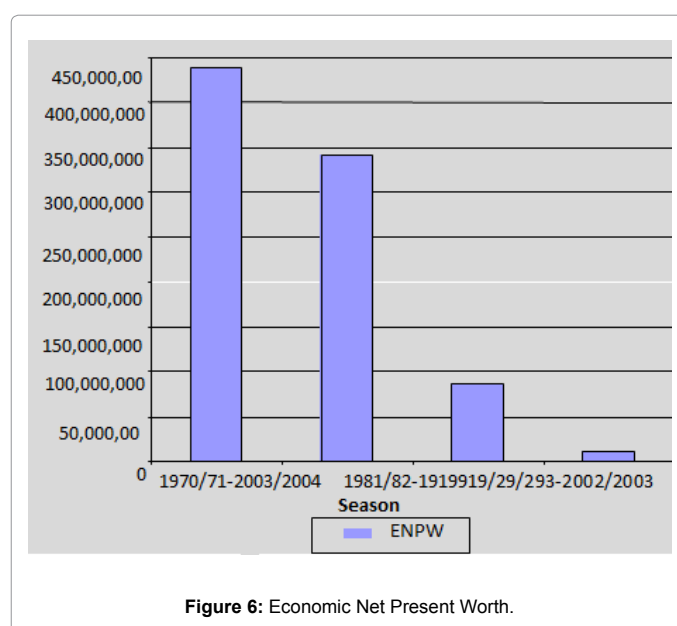


Figure 6: Economic Net Present Worth.

	Joint AC	Individual AC	Liberalization
Area (mean) feddan	5,38,975	3,91,803	2,29,035
Mean production	21,51,736	17,97,322	9,43,038
Average yield	3.99	4.59	4.12
Source of finance	Bank of Sudan	Bank of the Sudan The banks consortium fund	The banks consortium fund
Cost of finance	7%	9%	12-45%
General inflation	0.97-33.91	22.56-122.52	8.02-130.44
Gross benefit (dollar)	1,49,38,13,210	1,43,69,47,842	57,90,93,827
Gross cost (dollar)	87,96,44,653	94,82,52,873	39,26,25,539
Return (dollar)	61,41,68,558	57,76,49,279	22,53,37,810
Discounts (dollar)	0	16,87,53,813	5,14,01,286
Net return (dollar)	61,41,68,558	40,88,95,466	17,39,36,524
Discount factor	12%	12%	12%
Present worth of gross benefit at 12% (dollar)	77,97,35,486	23,19,82,202	2,55,09,925
Present worth of gross cost at 12% (dollar)	43,89,15,609	16,09,88,623	1,71,22,152
Present worth of return at 12% (dollar)	34,08,19,877	8,71,24,036	1,00,86,706
Present worth of net return at 12% (dollar)	34,08,19,877	6,03,12,716	76,74,729
EB/C ratio	1.78	1.44	1.49
Economic net present worth (dollar)	34,08,19,877	8,71,24,036	1,00,86,706

Table 8: Comparison between three periods (1970/71-1980/81), (1981/82-1991/92), (1992/93-2002/2003).

1. The calculation of the economic benefit/cost ratio (EB/C ratio), and economic net present worth (ENPW) of cotton production in the Gezira Scheme for the period (1970/71-2003/2004) was that: EB/C ratio=1.68, and economic NPW=438,890,074 dollar. The B/C ratio is accepted and the net NPW is positive that means the economic evaluation of cotton production in Gezira Scheme were positive and feasible.
2. The summary of the comparison between the three periods (1970/71-1980/81), (1981/82-1991/92), (1992/93-2002/2003) - JAS, IAS and LIB with respect to EB/C ratio, and ENPW area, production and the average yield. It found that EB/C ratio=1.78, 1.44, 1.49 respectively and the ENPW=\$340,819,877-\$87,124,036-\$10,086,706 respectively that means the EB/C ratio is better in the joint account system than liberalization and individual account system respectively. The economic net present worth (ENPW) also is better in the joint account system (JAS) than the individual account system (IAS) and liberalization (LIB) respectively. On other hand the (JAS), (IAS), (LIB) compared with respect to area, production and average yield, it was found that the mean total area allocated for cotton=538,975-391,803-229,035 feddan respectively is better under the (JAS) than the (IAS) and (LIB) respectively and also the mean production=2,151,736-1,797,322-943,038 Kentar respectively but the average yield=3.99-4.59-4.12 kentars/feddan respectively which is better under the (IAS), (LIB) and (JAS) respectively because the (IAS) aimed at motivation the tenants to increase cotton crop production.
3. It have been improved that the increasing and decreasing of the EB/C ratio and ENPW through the different periods (JAS, IAS and LIB) related to the agricultural policy of the Government (Figure 7).

Recommendations

The result of economic evaluation of cotton production in the Gezira Scheme is accepted but it needs revision of Government policies and more incentives to the producers and part of the petroleum revenues should be devoted to agriculture particularly to the cotton production to increase the farmer's net return. It's recommended that

Season	Akaka	Barakat
1993/94	74	121
1994/95	80	94
1995/96	72	124
1996/97	78	103
1997/98	83	120
1998/99	46.05	70.95
1999/2000	46.28	75.58
2000/2001	33.36	75
2001/2002	33	58
2002/2003	48.34	65.61
2003/2004	63.7	81
2004/2005	46.2	71

Table 9: Prices of the cotton lint per dollar for the period 1993/94-2004/2005.

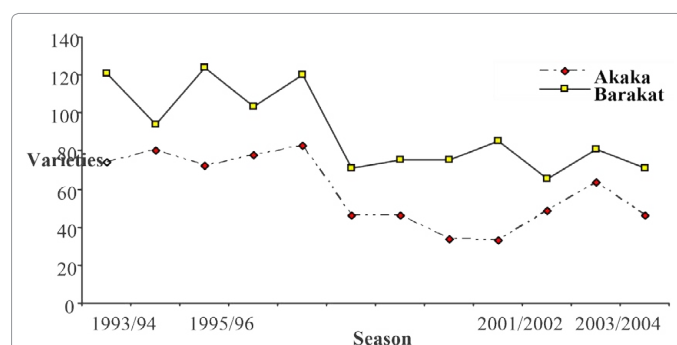


Figure 7: Prices of the cotton lint per dollar for the period 1993/94-2004/2005.

the agricultural Government policies should be proper and subsidized to agriculture particularly increasing the area of cotton crop, yields and reducing the cost of production are more important, downstream cotton processing for added value, up stream of cotton inputs processing for import substitutions, and improving of cotton productivity through research development and extension is necessary.

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