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

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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 system1981/82-1991/92), and (liberalization 1992/93-2002/2003) 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 materials 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.
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 heat 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 Abra 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.

In 1906, the first pump was installed and Egyptian cotton was grown. In 1907 the area was increased to 800 feddans of cotton the Zeidab farm was later managed by the Sudan plantation syndicate using direct labour which later was substituted with land rent after the interference of the Sudan Government at that time, in 1908 the company had put the system into real practice. In 1911 the experiment was introduced into the Gezira plains. A pump was installed and the syndicate was asked to manage an area of 600 feddan at Tayba village 250 feddan were grown with cotton and 350 with other crops. The success of the experiment resulted, into an extension of area to 2000 feddans. Another increase was of 1000 feddans was made in 1914. The syndicate at its own cost established another pilot pumping station to irrigate 2000 feddans at Barakat and additional pumps followed at Hag Abdalla, and Wad El.

nor south of Barakat. In 1925 Sennar Dam was built and the Gezira Scheme came into being. The Gezira area was leased from its owners for 25 years and was distributed to these owners on leasing bases.

The cotton area increased from 80031 feddans in 1925/26 to 206274 feddans in 1938/39. The average yield per feddan was about 4.5 kentars. However in 1931/32 up to 1934/35 the cotton was seriously affected by diseases and the yield dropped to 1.4-2.3 kentars. The year 1950/51 was a time mark in the scheme history of the Gezira Scheme. It is the year when was nationalized and the management was entrusted to the Sudan Gezira Board which substituted the Sudan plantation syndicate, the area was 207433 feddans and the average yield per feddans about 6.78 kentars. The share were settled at 49% to tenants, 36% to Government, 10% to administration and 5% to social services and local Government calculated after covering the joint account.

Another point mark in the Gezira scheme history is that of Managil Extension which increase the Gezira scheme area from less than one million feddans to 2.1 million feddans in (1958/62).

The joint system gave way in 1981/82 to tenant individual account.
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 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 1970/71-198081)
   - 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 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   | 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  | 3.85                     |
| 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     | 9,90,000   | 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     | 12,46,681  | 5.09                     |
| Average  | 3,82,436     | 16,19,404  | 4.24                     |

Source: Sudan Gezira Board [7,8].
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 reflect on the Gezira Scheme, included complete liberalization of the 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.

A remarkable deduction in Government subsidies and other procedures was 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).

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.

| 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                  | 5,85,31,351               | 5,58,36,977  |
| 72/73  | 12,43,56,465                  | 5,70,44,796               | 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                   | 7,13,53,580               | 91,95,710    |
| 76/77  | 14,46,08,750                  | 9,35,99,203               | 5,12,08,548  |
| 77/78  | 21,25,16,160                  | 10,66,57,178              | 10,58,58,983 |
| 78/79  | 21,25,69,653                  | 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  | 12,40,90,900                  | 8,70,28,580               | 4,72,10,404  |
| 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  | 24,46,21,796                  | 11,84,34,809              | 12,99,16,586 |
| 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  | 2,01,97,796                   | 5,11,60,504               | 61,53,801    |
| Total  | 143,69,47,842                 | 94,82,52,873              | 57,76,49,279 |
| Average| 13,06,31,622                  | 8,62,04,807               | 4,25,13,571  |
| 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               | 4,05,88,284  |
| 96/97  | 6,79,86,383                   | 6,13,75,120               | 5,24,48,888  |
| 97/98  | 5,58,37,243                   | 4,55,82,451               | 1,15,15,204  |
| 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  |

Gross accrual revenues for irrigated cotton production from 1996 to 2002 averaged $297.45 per acre. Total enterprise costs averaged $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.

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.

From Table 4 gross revenues for irrigated cotton production in
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)

\[
NPW = \sum_{t=1}^{n} \frac{(B_t + C_t)}{(1+r)^t}
\]  

**Decision rule:** - Accept IF NPW>0 Reject IF NPW<0

**Benefit/Cost Ratio**

\[
\frac{B}{C} = \frac{\sum_{t=1}^{n} B_t}{\sum_{t=1}^{n} C_t}
\]

**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 1992/93-2002/03) with respect to:

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**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                        |
| 1992/93-2002/03 | 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 (1992/93-2002/03) 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 income (net benefits) was 113.39 dollar per feddan. Total gross cost averaged 220.02 dollar per feddan. The average net incomes were 74.02 dollar per feddan (Table 4) [8].
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 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).
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/Feddan.

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/Feddan.

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/Feddan (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.
### Table 6

| 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                        | 6,414,866                     |
| 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                        | 9,015,348                     |
| 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                         | 6,664,465                     |
| 88/89  | 28,376,129                            | 13,738,438                        | 15,070,325                    |
| 89/90  | 23,057,437                            | 12,083,704                        | 11,303,391                    |
| 90/91  | 2,387,082                             | 1,920,357                         | 671,894                       |
| 91/92  | 1,676,415                             | 1,253,840                         | 510,675                       |
| 92/93  | 1,432,352                             | 1,523,108                         | 280,672                       |
| 93/94  | 1,410,802                             | 872,956                           | 587,895                       |
| 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                         | 990,590                       |
| 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                         | 980,261                       |
| 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                       | 438,809,074                   |

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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 (1970/1971-2003/2004) 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:

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%. 

| Year | Gross Benefits | Gross Costs | Gross Return |
|------|----------------|-------------|--------------|
| 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 | 14,18,435      | 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      | 9,88,253    | 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     |
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: $\text{EB/C ratio}=1.68$, and economic $\text{NPW}=438,890,074$ 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 $\text{EB/C ratio}=1.78, 1.44, 1.49$ respectively and the $\text{ENPW}=340,819,877-87,124,036-10,086,706$ 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 (IAS) than the individual account system (IAS) and liberalization (LIB) respectively. On other hand the (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 (IAS) 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 (IAS, 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 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.

References

1. El-Hassan AM (1967) Structure of the Sudan Economy. In El-Hassan AM (Ed) An Introduction to the Sudan Economy. Khartoum University Press.
2. Sudan A (2002) Large Irrigated Agricultural Scheme.
3. Yousif GM (1997) The Gezira Scheme the Greatest on Earth. Africa University House, Sudan pp: 321.
4. Company1 SC (1993) Country Statement of the Sudan delegation to 52 plenary meeting New Delhi.
5. Company2 SC (1993) Sudan Cotton Facts and Figures. Khartoum-Sudan.
6. Taha TE (1973) The Development of Managil South Western Extension to the Gezira Scheme: A case study. Barakat 14: 240-250.
7. Board SG (2004) Statistical Section and Information Unit Agriculture Administration) Area, Production, Average yield 1970/71-1999-2002.
8. Unit PSER (2004) Sudan Reports and papers relating to cotton production at the Archives Sections (1911/12-1970/71), for different periods
9. Abdalla AK (1993) Production Responsibility Centre and Average Yield Information.
10. Board SG (2004) Report of Cotton Accounting (2000-2004).
11. Blackshear J, Johnson P (2004) Profitability of Cotton Production in the Texas High Plains 1996-2002. Texas Tech University, USA.
12. Gittinger JP (1982) Economic Analysis of Agricultural Projects. Johans Hopkins University Press, Baltimore, USA.
13. Gittinger JP (1973) Compounding and discounting Tables for project Analysis. Johans Hopkins University Press, Baltimore, USA.