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Wheat Economics and Future Policy Options in Sudan

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Abstract

In Sudan, wheat is considered as one of the main strategic crops beside sorghum and millet. It contributes to rural and urban livelihoods and food security. The gap between the production and consumption of wheat is still large and exceeds 100% of the total production, which leads to the burden of the high import bill. This research deals with some important macro and micro economic aspects that aim to support opportunities for expansion of wheat production in Sudan within the framework of its competition in the cropping structure. While the analysis of its content benefited from the available secondary data and information in relation to the subject, it was largely based on a field survey conducted in the year 2021 targeting the main three States of wheat production in the country namely, Gezira, Northern and River Nile States. The sample size and data collection are fully representing the different agricultural systems was determined by using the multi-stage stratified sample technique. The survey consists of a questionnaire directed to samples of wheat growers in the selected areas. The study also looks to draw the relevant policy options for increasing wheat production, trade and development. Moreover, it applies scientific research methods to achieve its aims. Policy Analysis Matrix (PAM) was used to analyze the effects of government policies, competitiveness and comparative advantage on the wheat production. Descriptive statistics also used to illustrate the potential and feasibility of the crop. Finally, the study concluded that wheat import bill constitutes a huge burden, which requires providing support for wheat expansion by raising wheat productivity to the highest levels through advance technologies utilization, providing wheat subsidies for storage to benefit from the high prices after harvest, which raises the profitability of wheat to compete with the profitability of other crops and supporting prices of inputs at wheat production areas.

Keywords: Wheat economics, wheat import, policy options, Sudan.

اقتصاديات القمح وخيارات السياسة المستقبلية في السودان

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المستخلص

يعتبر القمح في السودان من أهم المحاصيل الإستراتيجية إلى جانب الذرة الرفيعة والدخن .يساهم في سبل كسب العيش الريفية والحضرية والأمن الغذائي .لا تزال الفجوة بين إنتاج واستهلاك القمح كبيرة وتتجاوز 100٪ من إجمالي الإنتاج ، مما يؤدي إلى عبء ارتفاع فاتورة الاستيراد .يتناول هذا البحث بعض الجوانب الاقتصادية الكلية والجزئية الهامة التي تهدف إلى دعم فرص التوسع في إنتاج القمح في السودان في إطار تنافسه في التركيبة المحصولية .في حين استفادت الدراسة من تحليل محتوي واسع من البيانات والمعلومات الثانوية المتاحة فيما يتعلق بالموضوع ، فقد استند بشكل كبير إلى مسح ميداني تم إجراؤه في عام 2021 واستهدف الولايات الثلاث الرئيسية لإنتاج القمح في الدولة وهي الجزيرة والشماليةونهر النيل .تم تحديد حجم العينة وجمع البيانات التي تمثل النظم الزراعية المختلفة بشكل كامل باستخدام تقنية العينة الطبقية متعددة المراحل .يتكون المسح من استبيان موجه لعينات من مزارعي القمح في المناطق المختارة .تتطلع الدراسة أيضًا إلى رسم خيارات السياسة ذات الصلة لزيادة إنتاج القمح وتجارته وتنميته .علاوة على ذلك ، تطبق أساليب البحث العلمي لتحقيق أهدافها .تم استخدام مصفوفة تحليل السياسات (PAM) لتحليل آثار السياسات الحكومية والتنافسية والميزة النسبية لإنتاج القمح .يستخدم الإحصاء الوصفي أيضًا لتوضيح إمكانات وجدوى المحصول .وأخيراً خلصت الدراسة إلى أن فاتورة استيراد القمح تشكل عبئاً ضخماً يتطلب دعم التوسع في إنتاج القمح من خلال رفع إنتاجية القمح إلى أعلى المستويات من خلال استخدام التقنيات المتقدمة ، ودعم تخزين القمح للاستفادة من ارتفاع الأسعار بعد الحصاد ، الأمر الذي يرفع ربحية القمح لمنافسة ربحية المحاصيل الأخرى ودعم أسعار المدخلات في مناطق إنتاج القمح .

كلمات مفتاحية: اقتصاديات القمح ، استيراد القمح ، خيارات السياسات ، السودان

Introduction

The Republic of Sudan is the third largest country in Africa, covering an area of approximately 1,886,068 km^2 and divided administratively into 18 states. Sudan had a population of 41.8 million inhabitants in 2018, according to the Central Bureau of Statistics of Sudan, and its economy revolves mainly around traditional agriculture and livestock husbandry. Agriculture is the backbone of the Sudan's economy and is crucial for the country's food security. Although between 1960 and 2020 agriculture ranked second to services in terms of contribution to real gross domestic product (GDP) each adding, respectively 35.2% and 48.7%; recently, it generates47.4% of employment with 69% of the own-account businesses operating in the sector. Accordingly, the sector is not only the main source of livelihood for the majority of population, but it is also the main employer of skilled labor. About 35.7% of skilled workers reported operating in the sector in 2014 compared with 11% skilled workers engaged in the services sector (ERF, 2021). Sudan's agriculture is distinguished by three crop production systems: the irrigated, mechanized rain-fed and traditional rain-fed farming systems.

Sudan is one of the most vulnerable to climate change countries as more than two thirds of the population and twelve states out of the country eighteen states are fully located on drylands, i.e., depending entirely on rainfall for their livelihood. Productivity of the main food and cash crops in the three crop production systems is very low compared to the regional, international and national

research standards (Osman and Ali, 2010). The agriculture sector is expected to regain its role as a key source of foreign exchange. The loss of oil revenues in 2011 after the separation of South Sudan has been followed by resurgence in agriculture's share in the country's exports, reaching 55% in 2019 as reported by the United Nations International Trade Statistics Database, and helping cushion some of the impact of the loss of oil revenues. This improvement has been mainly led by the good performance of major agricultural export commodities like livestock, sesame, gum Arabic, and cotton. For at least three of Sudan's key exports sheep, goats, and gum Arabic—the ability to export in processed forms presents significant upside potential. Overall, the agricultural trade balance remains negative due to the high food import bill, which mainly goes for imports of wheat and wheat flour, sugar, and oils (World Bank 2015). Compares the performance over the agricultural and the oil eras, as seen, the average value added share of industry has increased by 8.9 percentage points.

Wheat (*Triticum spp.*) cultivation in the world goes back into history. It was one of the first domesticated food crops and for 8,000 years has been the basic staple food of a high portion of civilizations in the world and continues to be the most important food grain source for humans. The crop is occupied over 240 million ha than any other commercial crop and the annual global production exceeds 0.6 billion tons. World trade for wheat is greater than for all other crops combined, and it provides more nourishment for humans than any other food source.

Although sorghum and millet are considered as the traditional cereals for Sudanese households' consumption, but nowadays the majority have changed towards the wheat consumption in the form bread in its different forms. It contributes to rural and urban livelihoods and food security. Over the past two decades, wheat production, which is almost entirely irrigated, has been fluctuating and declining due to declining yields and soaring input costs. Since the end of 1990s decade, the Government liberalized agriculture and removed all support programs. Those policies have affected a lot of wheat growers to consider wheat as a secondary crop and extend the lucrative cash crops areas, such as legumes, pulses and vegetables. No doubt wheat importation constitutes the largest burden among agricultural food imports and a major discount to the country's modest foreign exchange resources. In 2020, wheat imports quantity for Sudan was 2,200 thousand tones. According to the data of the Bank of Sudan, the average quantities of imported wheat and flour during the last decade amounted to 2,181,113 tons (wheat equivalent) with an average value of $890.436 million. The wheat bill during that period constituted an average of 42% of the value of food imports and 10% of the total value of the country's imports.

This research has been carried out in the year 2021 targeting the main three States of wheat production in the country namely, Gezira, Northern and River Nile States. The region is considered as one of the most promising areas in the country, it is enjoing relatively cooler weather during the winter season and retiched fertile alluvial soils, moreover, it has a comparative advantages compared to other parts of the Sudan in producing relatively high-value agricultural crops. Nile River is known as one of the longest rivers in the world, it is considered as the main source of irrigation water for the agricultural cultivated areas, particularly for the mentioned winter crops production which are considered as the principle crops for farmers and agricultural companies in the region, while the summer and autumn season crops are ranked after them due to

some environmental advantages and some economical aspects.The farming system of the States is consisted numerous types of irrigated schemes such as the public irrigated schemes, forien investmet schemes, agricultural companies, private and cooperative schemes with different production relationship systems. These schemes are regarded as main potential ones for developing agriculture in general and specifically to produce winter season crops due to their high acreage share, possess capital, mechinaries, and comprise high number of farmers. The research sellected the River Nile and the Northern States where agricultural schemes include governmental, private, cooperative schemes. The research obsarved some critical constraints regarding determination of crop combination in area of the study. These problems contribute mainly to the low levels and fluctuation of winter crops yield include inadequate practices of crops technical packages used by farmers, misuse of agricultural resources, stress caused and inflicted by changing of environmental and climatic conditions especially temperature beside the widespread of different diseases, insects, pests, weeds and power failure that a companied by lack and high cost of fuel and spare parts to operate the pumps. Numerous research mentioned that the high cost of production coupled with low levels of crop yields and instable source of power has contribute to difficult for the tenants to realize the full potential of the State. In addition, development is considered by serious limitation on the two basic resources namely, land and water. Regarding irrigation water in the State, there were many hindrances contributed to inefficiency of irrigation water use and affected crop production in the irrigated schemes in RNS such as inadequate supply of irrigation inputs in proper time and at right prices. Generally, improvement of the farming system in the region considering climatic change, food security and economic requirements of the local populations is regarded as a great challenge for researchers, policy makers, scientists, agricultural administrators in public and private sectors, related organizations, and investors. Finally, the study was applied PAM analysis approach to examine the impact of government policies on wheat production to evaluate the contribution of the sub-sector to economic empowerment. Furthermore, PAM might help policy makers in comparisons of before and after the policy change as well as measures policy impacts. It shows successful public investment when raise the value of output or lower the cost of inputs. Also, it is a simple tool and powerful to communicate with policy makers for preparing agriculture strategies particularly in developing countries as well as with donor support such as World bank, UNDP and others.

Methodology

This research deals with some important macro and micro economic aspects that aim to draw the relevant policy options for increasing wheat production, trade and development and to support opportunities for expansion of wheat production in Sudan within the framework of its competition in the cropping structure. While the analysis of its content benefited from the available secondary data and information in relation to the subject, it was largely based on a field survey conducted in the year 2021 targeting three states of wheat supply in the country namely, Gezira, Northern, and River Nile States. The sample size and data collection are fully representing the different agricultural systems in the areas of the study, it was determined by using the multi-stage stratified sample technique. The survey consists of a questionnaire directed

to samples of wheat growers in the selected areas. The study utilized both primary and secondary data and employed PAM to analyze the collected data. PAM defined as a mathematical framework that helps divide the commodity system into its essential components, namely, private profitability estimated at special prices (prices in the local markets), social profitability calculated at social prices (prices in the world markets), and the difference between the two measures of profitability. The policy analysis matrix is specifically designed to analyze market distortions and price policy interventions and their impacts on the commodity system. Where, inputs divided into non-tradable inputs that not internationally traded, such as services and land where the demander and the producer must be in the same location (Jenkins and Harberger, 2011), and tradable inputs that are internationally traded, such as seed, fertilizer, pesticide, etc. It is a policy analysis tool based on a very simple and basic equation. PAM helps policy makers by addressing three central agricultural issues: *'Profit = Revenues – Costs'*. Agriculture Policy Environments Estimation is based on private (financial prices) and social prices (economic). Impact of new public investment mostly the divergence between two types of profitability comes from policy intervention.

Data collection: The research depends on both primary and secondary data. The primary data were obtained mainly from interview by using a structured questionnaire beside field observation. Data collected included inputs requirements, market prices for inputs and outputs, transportation cost and returns. The secondary data were obtained from relevant sources; it included production aspects, import and export information and the exchange rate.

Sampling technique: Multi-stage sampling technique was applied for selecting respondents. The first stage involved the purposive selection of the main states of wheat production in the country namely, Gezira, Northern and River Nile States. The questionnaire was designed with the aim of collecting primary data for the sample chosen for the study targeting River Nile and Northern States. The questionnaire aimed to captures the suitable information that attains the objectives of the study. Due to the absence of official records for farmers in the two states, the research noticed that most of the farmers within the agricultural pattern are homogenous (i.e. similar, irrigation technology system, crop combination, inputs, ….), and after referring to the numbers of farmers as well as other similar previous studies in the States under the study, a sample size of 450 farmers was selected from the three States, 150 respondents for each state and distributed over the different agricultural schemes. The sample of the Gezira State was totally collected from the Gezira Scheme, while for the River Nile State was collected from Al Ddamer locality and implied four districts, namely Al-Damer, Al-Makabrab and Al-Alayab, and from Berber locality, also information was collected from the Al-Kafaa-Al-Rajhi scheme, representing the different farming systems in the State. The same procedure was employed in the Northern State where a sample size of 150 farmers was selected from the schemes in Dongola locality with focusing on four districts, namely Al-Gould and Al-Manasir Al-Jadidah, and Al-Dabbah (El Daman El Egtimai Scheme).

Analytical technique: The policy analysis matrix is a quantitative mathematical, analytical method and used to analyze comparative advantage by measuring the impacts of governmental intervention policies and market distortions on the vertical commodity system or commodity chains from farm to final consumption and export point. The PAM is a matrix of two accounting

identities; one set defining profitability and the other defining the difference between private and social values of a commodity system. The framework of PAM is shown in Table 1.

Table 1: Policy Analysis Matrix (PAM)

Tradable inputs	**Revenue**	**Production Cost**	**Profit**	**Revenue**
		Tradable inputs	Domestic factor	
Private price	A	B	C	D
Social price	E	F	G	H
Policy transfer	I	J	K	L

Source: Monke and Pearson, 1989

Private profitability (D) = A - (B+C)
Social profitability (H) = E - (F+G)
Output transfer (I) = A - E
Input transfer (J) = B - F
Factor transfer (K) = C - G
Net policy transfer (L) = D - H

The main equations and calculation methods of the Policy Analysis Matrix:

***Private Profitability (D)*:** The private profitability demonstrates the competitiveness of the agricultural system given current technology, prices of inputs and outputs, and policy. Measures A, B, C, and D, it is the difference between private (observed) revenue (A) and private costs (B+C) values at actual market prices (private values) received or paid by farmers, marketers or processors in the agricultural system. The private profitability calculations show the competitiveness of the agricultural system, given current technologies, output values, input costs, and policy transfers. The private values implicitly included the effects of all policy interventions in both direct and indirect subsidies, taxes, and all market distortions and failures (Pearson and Monke, 1987).

Social Profitability (H):The social profitability is a measure of comparative advantage and efficiency because inputs and outputs are valued in prices that reflect scarcity values. It is the measured at social prices, which is the differences between social revenues (E) and social values costs (F + G) of domestic factors and tradable inputs prices at social opportunity cost (social values). Social values provide a benchmark policy environment for comparison as these were considered those that would hypothetically occur in free market without policy intervention (Pearson and Monke, 1987).

Social Cost Benefit Ratio (SCBR): A good alternative for the DRC is the social cost-benefit ratio (SCBR), which accounts for all cost and avoids classification errors in the calculation of DRC (Masters and Winter-Nelson, 1995).

Nominal Protection Coefficient (NPC):is referring to the level of protection of the main product.This is used to determine the relationship between the market price and the shadow price of the products (Fabian, 2005). This can be calculated for the output and input. Moreover, if the NPC is more significant than 1, the system takes advantage of the protection and if less than one the system is subject to taxes ,where NPC is the ratio of the revenue in the private prices (A) compared to the income of the social costs (E). While the *Effective Protection Coefficient (EPC)*is referred to as the overall level of protection, taking into account the impact of policies on

the value of tradable products and tradable inputs, it is the ratio of value-added in private market prices (A – B) to value-added in social market costs (E – F). EPC, another indicator of incentives, is used to measure the degree of policy transfer from product market-output and tradable-input-policies. EPC nets out the impact of protection on inputs and outputs, and reveals the degree of protection accorded to the value added process in the processing activity of the relevant commodity (Samarendu and Jagadanand, 2003). *Profitability coefficient (PC) or Policy Transfer* is measure policy reflection on the profitability of the system. If PC greater than 1, the system benefits from net transfers from the sector, but if it is smaller than 1, the economy benefits from net transfers from the system, price must be explained by the effects of policy or by the existence of market failures (Pearson *et al*., 2003). Distorting policies that lead to an inefficient use of resources enhance the stated divergence.

There are three indicators used for comparisons of the relative efficiency or comparative advantage among to agricultural commodities. The first indicator is the domestic resource cost DRC: is a measure of relative efficiency of domestic processing by comparing the opportunity cost of domestic processing to the value generated by the product. The ratio can be used to compare different economic activities in terms of social cost of domestic resource employed in earning or saving a unit of foreign exchange. If the DRC is smaller than 1, the system has a comparative advantage, which means that we use local resources of lower value than global resources. If the DRC is greater than 1, the system does not have a comparative advantage, and social profitability is negative where it is the ratio of the non-tradable inputs in the social prices (G) compared to value-added in social costs (E – F). Another indicator of the system's comparative advantage, it takes into account the full cost of production of the social prices (F + G), which is more appropriate for the relative position of the different systems when they have different cost structure (tradable and non-tradable). Where DRC is biased in favor of the system containing on a larger scale of tradable inputs, but the Social costs benefit SCB calculated dividing the total costs in the social prices on the revenues of the social prices (F + G)/E

Financial cost-benefit (FCB) is a competitive system index, if FCB is smaller than 1, the system is competitive, and if it is greater than 1, the system is not competitive and the financial profitability is negative. FCB is the ratio of Non-tradable inputs (C) to value-added in private prices (A – B).

Nominal Protection Coefficient on Output (NPCO): The NPCO shows how much domestic prices differ from social prices and it is calculated by dividing the revenue in private prices (A) by the revenue in social prices (E).

Nominal Protection Coefficient on Input (NPCI): The NPCI shows how much domestic prices of tradable inputs differ from their social prices. This ratio indicates the impact of policy transfers that cause a divergence between the two prices. The NPCI on tradable inputs in wheat production is therefore defined as private price of input (B) divided by social price of input (F).

Subsidy Ratio to Producers (SRP): Subsidy ratio to producers (SRP) is the net policy transfer as a proportion of total social revenues. The SRP shows the proportion of revenues in world prices that would be required if a single subsidy or tax were substituted for the entire set of commodity and macroeconomic policies (Christo, 2010).

Results and Discussion

Policy Matrix Analysis

The research looking to build components estimates of policy analysis matrix (PAM). The calculation of production inputs costs and revenues at private and social prices would ease the filling of the rows and columns of the sample. The matrix built based on the production of one feddan and State level, and the average of the sample SDG/fed of the wheat production, Table2 shows the results of the policy analysis matrix for the production of wheat in Sudan 2020 on at State level. To determine the private profitability of wheat, the first row in the PAM, private budgets by market prices were calculated. The study was evaluated the total revenue, the total cost and the gross profits were calculated for wheat in all states.

The research compared wheat private budgets in all States of the study, Gezira, River Nile State and Northern States; the results of the matrix indicate that the wheat in the States are profits earned to the producers in the private prices, where D values were positive. was more profitable in River Nile State than Gezira and Northern States and it was more competitive as illustrated in Table (2).

The study also determined the second row for PAM namely, the social profitability (H) of wheat. The calculation of the social (efficiency) prices will reflect the import parity prices of inputs and outputs, decompose non-tradable inputs into their private and social prices, estimate the social prices (opportunity costs) of factors and calculate the capital recovery costs of fixed assets. To avoid quality differentials in wheat outputs international prices, a unit value was used as the reference prices for the different types of wheat. The units' values were calculated as the value of the imported commodity divided by the total quantity imported to Sudan. The unit value data come from Sudan's Custom Statistics Book. To get their free on board prices (F.O.B), the cost of insurance and freight, which obtained from shipping companies or fright forwards in Port Sudan, was subtracted. The costs of all non-tradable inputs (goods and services) should be decomposed into their tradable inputs and domestic factor cost components. These costs, standardized on units such as hours or measures of volume or weight, then can be substituted into the appropriate components of the Private and Social budgets. The researcher decomposed tractor and its thresher services.

Pearson *et al*. (2003) declared that because of the complexity of possible market failures and distorting policies affecting rural credit, it is virtually impossible to measure the extent of these divergences. In principle, social return to capital is represented by the rate of return on the next public or private investment. In Sudan the commercial banks were determined the private interest rate of capital around 10% per year. The social opportunity cost principle was followed to find the social cost of land cultivated by wheat in its best alternative crops that more profitable like onion and sorghum. The researcher estimated the capital recovery cost of a pump as a common fixed asset owned by farmers. Table (2) depicted that the price policy does not encourage to the efficient use of domestic resources, while the results also revealed that the divergences

revenues (I) were positive in all the States matrices of the study, which were the results of the difference between the private prices revenues (A) and the social prices revenues (E). That means the private revenues are higher than the social revenues of all the matrices, which indicates the high government intervention for wheat subsector in Sudan, resulted from the government intervention through making the price of the wheat production in a local price higher than global price, and market failures. The divergences of non-tradable inputs (K) were zero for labor in the results of the matrix for all the provinces, which means that the labor inputs in social prices are equivalent to tradable inputs in private prices, which indicates that there is no any subsidy or tax on non-tradable inputs. The positive value of the net effect (L) resulted in policy matrix analyses Table 2 for every State of this study indicates that the wheat production in Sudan is more profitable for producers with market distortions than the profitability without market distortions. Government intervention policies in the wheat commodity system reflected on the output prices, which are for the benefit of domestic producers for short-term (Mohammed, 2015).

Table 2: The results of the policy analysis matrix for the production wheat in Sudan

State	Tradable Inputs	Revenue	Cost				Profits
			Tradable Inputs	Non-tradable Inputs (Domestic Resources)			
				Labor	Capital	Land	
Gezira	Private	20,105,625	11,011,119.59	32,248	2,450	321,690	8,738,117
	Social	1,887,944	111,541	32,248	3,920	334,070	1,406,164
	Divergences	18,217,681	10,899,578	0	-60,000	-12,380	7,390,483
River Nile	Private	28,879,555	24,699,275.99	119,387	3,679	299,270	4,057,214
	Social	4,663,976	239,549	119,387	3,920	1,049,250	3,251,871
	Divergences	24,215,579	24,459,727	0	-60,000	-749,980	565,831
Northern	Private	28,445,471	24,459,766.78	156,123	3,898	315,710	3,825,684
	Social	4,354,656	77,681	156,123	3,898	780,000	3,336,954
	Divergences	24,090,815	24,382,085	0	-60,000	-464,290	233,020

According to the estimated policy analysis matrix for wheat subsector in Sudan, shown in Table 2 for the matrix of the States and the average of the total sample. We can calculate the protection coefficients and comparative advantage measures, which are economic indicators that can measure the impact of government intervention on inputs and outputs prices and market failures, as well as the resources use efficiency. Table (3) shows States' PAM results interpretations and their indicators, which have been calculated as follow:

The Profitability Coefficient (PC)

PC used to measure policy reflection on the profitability of the system. If PC greater than 1, the system benefits from net transfers from the sector, but if it is smaller than 1, the economy benefits from net transfers from the system, where it is the ratio of the profit in the private prices (D) compared to the advantage of the social prices (H) (Pearson *et al*., 2003).

The PAMs of wheat as illustrated in Table (2) shows positive private and economic profitability in all States and the private ones were greater than the social ones. That

indicated high rates of private profitability coefficients as depicted in the Table and The Gezira State was higher than others States. However, Hussien (1992) studied wheat and sorghum competitiveness and profitability in Gezira scheme in the period (1986/87/1989/90); he found that wheat proved to have more private and economic profitability than sorghum from both the farmers and government point of view. While Ali (2002) assessed the profitability of wheat production in the Gezira scheme during 1991/92 (self-sufficiency-year), he mentioned that it used its domestic resources efficiently based on adoption of the recommended technical packages and enhancement of the suitable government policies. The obtained results were also matched with (Ibrahim, 1993) in River Nile and Northern States, they were greater than one. As a result, the average of Sudan was found greater than one, indicating profitability.

International Value Added (IVA)

Ali (2002) evaluated three successful seasons of wheat production in the Gezira scheme and Northern States between1992-1995.His study was computed the IVA, it revealed that wheat had international absolute competitiveness. In addition, wheat highly outstripped sorghum with its positive IVA in the Gezira scheme as Hussein (1992) stated in his study, moreover, the same results were found for River Nile and Northern States in the study of Ibrahim (1993). IVA of wheat shows foreign exchange earnings or savings and hence they were internationally competitors in all States of the study, because they were positive as illustrated in Table (2).

Nominal Protection Coefficient on Inputs (NPCI)

The NPCI shows how much domestic prices of tradable inputs differ from their social prices. This ratio exceeds one for wheat in all States of the study and indicating high implicit taxes. In Gezira, River Nile and Northern States the NPCI ratios were greater than one by 99%, 103% and 315%, respectively with an average of 140% in the whole Sudan that revealed very high implicit taxes. In general, these results interpretations pointing to high cost of private prices of tradable inputs than its social prices, meaning of policies distortion caused due to high taxes or an appropriate exchange rate that lead farmers' losses. That enhances Osman (2004) declaration that Sudan has not been providing huge subsidies to its agriculture.

Nominal Protection Coefficient on Outputs (NPCO)

The NPCO shows how much domestic prices differ from social prices. The research unveiled that the NPCO ratios of wheat in Gezira, River Nile and Northern States were higher than one by 11%, 6% and 7%, respectively with an average of 7% in the whole country indictor. Most output transfer caused by distorting polices-trade restrictions or taxes/subsides- and disequilibrium exchange rates arising from macro-economic policies that are not in balance. The private output prices of were higher than their

social prices that probably come from implicit taxes, indicated that farmers had been received an implicit subsidy in producing wheat.

Effective Protection Coefficient (EPC)

EPC is one of the indicators of incentives, is used to measure the degree of policy transfer from product market-output and tradable-input-policies. This ratio is greater than one for wheat in Gezira State only. That shows positive impacts of incentives that represented in subsidy to farmers in outputs prices. Ali (2002) found that NPC and EPC ratios indicated the existence of subsidies on wheat inputs in the Gezira scheme during 1996/97 and 1997/98. NPC ratios were of 1.61 and 1.03 for seasons 1996/97 and 1997/98, respectively. EPC ratios were 2.18 and 1.10 respectively for the same seasons while EPC > NPC ratio revealed that 0.57% and 0.07 taxed wheat inputs in seasons 1996/97 and 1997/98, respectively. NPC and EPC ratios in the Northern Region for season 1999/2000 were 1.60 and 1.72 respectively while EPC > NPC indicated that the government taxed wheat inputs in that season. Hussein (1992) concluded that the nominal and effective protection coefficients implied that wheat faces equal rates of nominal and effective protection, but sorghum is more taxed in real terms than in nominal terms. The subsidy ratio for producers of cereals indicated inefficient subsidy policy. The overall finding is that the price policies of wheat and sorghum provided relative disincentives for their production and resulted in their non-competitiveness in the period between 1986- 1990 in the Gezira scheme. While, in the River Nile and Northern States were less than one which implicated no subsidy of wheat output and that, on contrary of Ibrahim (1993) findings.

The Domestic Resource Cost Coefficient (DRC)

DRC is a measure of relative efficiency of domestic processing by comparing the opportunity cost of domestic processing to the value generated by the product. DRC ratio reflects the country's comparative advantages, not only with respect to capital, land and labor, but also within agriculture. The results of the study in Table (2) shows that the DRC ratios of wheat in all States were less than one; indicating that the value of domestic resources used to produce them were less than their values added in social prices. Production of wheat in these States, therefore, represents an efficient use of the country's resources. This result was consistent with Ali (2002) findings of wheat in the Gezira scheme as well as the Northern States. The DRC ratio values “less than unity” indicated that the crop used its domestic resources efficiently throughout the period studied in the States of the study. The crop was more competitive in the Northern States than in the Gezira State. These results also were consistent with Ibrahim (1993) outcomes in the River Nile and Northern States two decades ago.

Table 2: Indicators of the policy analysis matrix for the States of the Study

Indicator	Gezira	River Nile	Northern	SUDAN
PC	6.214151225	1.247655125	1.247655125	2.12090652

IVA	1,776,402	4,424,428	4,276,974	3,492,601
NPCI	98.72	103.11	314.87	140.33
NPCO	10.64948307	6.19204591	6.532197728	7.09944664
EPC	5.119620441	0.944818027	0.931898112	1.64733835
DRC	0.20842014	0.265018805	0.219786353	0.23799775

Conclusion and Recommendation

The Policy Analysis Matrix (PAM) methodology was used to determine the level of competitiveness in the production of wheat in the three states in the normal season of 2020/21.The study results showed that wheat was more competitive in all states. The results of agricultural policy analysis of the wheat subsector growers in the States of the study showed that wheat generates private profits in all State under the Study namely, Gezira, Northern and River Nile States, indicating wheat had positive private and economic profitability and the private ones were greater than the social ones. They were internationally competitors and realized foreign exchange earnings. The results of NPCI ratios generally showed high cost of private prices of tradable inputs than its social prices, meaning of distorting policies caused due to high taxes or an appropriate exchange rate those lead farmers' losses. While, NPCO ratios results showed that the private output prices of wheat were higher than their social prices that indicted farmers had been received an implicit subsidy in producing wheat. The EPC ratio in Gezira state shows positive incentives effects represented in subsidy to farmers in outputs prices while they were negative in other states and a positive one in an average in Sudan. Production of wheat had comparative advantage in all states; therefore, represent an efficient use of the country's resources. Based on the finding of the study one may recommend the following with regard to wheat subsector:

(1) Credit is necessary to shifts production. So; the government should ease accession to credit and loans to spur agriculture development. Although the Agriculture Bank supply wheat farmers with improved varieties, fuel, fertilizer and help them in land preparations, but most of them came late which result in low productivity that swamps farmers in debts and increases their tendency to migrate to cities in search of wage labor.

(2) The government should decrease indirect taxes (value added, customs and standards fees…etc.) of tradable inputs like fertilizers, chemicals, fuel and spare parts.

(3) If the government wants to persist with its food security policies, higher productivity gains will have to occur in wheat production, or else large wheat imports will take place and because any noneconomic target is inherently costly, the policy makers should use macroeconomic instruments to make wheat production economically attractive.

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