

Policy Options for Maximizing the Potential of Sudan's Date Palm Sector

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Original Article

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ABSTRACT

The date palm sector in Sudan is facing numerous challenges, including climate change, peace and economic revitalization, pests and diseases, lack of investment, poor market access, and weak institutional support. These challenges have resulted in low productivity and poor quality of produce. To address these challenges, Sudan needs to invest in the date palm sector by implementing targeted interventions, supported by relevant legislations in food security. This includes enhancing agricultural infrastructure and support, prioritizing research and development, promoting market promotion and export development, implementing quality control and certification measures, providing financial support and incentives, investing in data collection and analysis, investing in water management, promoting partnerships between different actors, providing farmers with access to finance and technology, enacting and enforcing legislation, strengthening marketing and quality control systems, promoting environmental sustainability, and developing and implementing policies and programs to support the sector. These efforts should be aligned with existing legislations in food security in Sudan. This comprehensive approach, which also focuses on peace and economic revitalization, is essential for the long-term sustainability of the date palm sector in Sudan. Without action, Sudan may face severe consequences such as worsened food security, economic decline, loss of competitive advantage, and increased poverty. Therefore, investment in infrastructure, market access, adoption of new technologies, political stability, and support for small-scale farmers, in line with relevant legislations, is crucial to maximize the sector's potential and ensure Sudan's food security, economic growth, and environmental sustainability. By taking these steps, Sudan can position itself as a leading producer and exporter of high-quality dates while improving the livelihoods of its farmers and contributing to sustainable agricultural development.

Received: 19 September 2023, **Accepted:** 16 November 2023

Key Words: Date palm, economic growth, food security, environmental sustainability, legislation, market access, policy options.

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ISSN: 2682-4310, Vol. 4, 2023

INTRODUCTION

Phoenix dactylifera L., or date palm, is a particularly important crop in Sudan. It plays a crucial role in food security and provides a vital source of income for many farmers. However, despite its importance, accurate data on cultivated areas, number of trees, and annual production is lacking. This hinders efforts to effectively develop and manage this valuable sector. The available data is primarily estimates used by the Ministry of Agriculture and Forestry and international organizations (FAO, 2021).

Sudan ranks seventh in the world in terms of date production, accounting for approximately 5% of global date production (FAOSTAT, 2020). Despite the fact that Sudan ranks seventh globally among date-producing

countries with an annual production of over 450,000 tons, the date marketing and services system is considered very traditional and does not keep up with marketing innovations in developed countries (AOAD, 2018). Sudan is a major player in the global date market, ranking seventh in the world in terms of production, contributing approximately 5% of the world's total date output (FAOSTAT, 2021). This is a significant achievement, showcasing Sudan's potential as a major date producer. Despite its impressive production volume, Sudan's date marketing and services system remains outdated. It fails to keep pace with the innovative marketing practices employed by developed countries. This poses a challenge to further developing the sector and maximizing its potential. Sudan is focused on developing the palm tree and dates sector, and enhancing its economic, social, and environmental role (FAO, 2021).

The Sudanese government acknowledges that date palm security is a complex issue with many interconnected factors. This policy paper aims to identify the root causes and challenges that Sudan currently faces in securing date palms. It also suggests a list of effective policy alternatives. To do this, the paper first explores the factors that may promote or hinder the country's ability to secure dates for all its citizens by 2030. Second, the paper investigates the major challenges that Sudan may face during this trajectory. Finally, the paper develops alternative policies to enhance the country's ability to secure food for all by 2050.

OVERVIEW: A VITAL CROP FACING CHALLENGES

Problem Statement and Background

The date palm sector in Sudan is facing a number of challenges, including climate change, pests and diseases, lack of investment, poor market access, and weak institutional support, resulting in low productivity and poor quality of produce. These challenges are undermining the sustainability of the sector and Sudan's food security, economic growth, and environmental sustainability. A comprehensive approach is needed to address these challenges, focusing on climate resilience, peace, and economic revitalization. This includes investment in research and development, sustainable agricultural practices, market linkages, financial services, and infrastructure.

Situational Overview

The date palm is one of the oldest cultivated crops in the world and is native to the Middle East and North Africa. It is a versatile crop that can be grown in a variety of climates and soil types, and its fruit is a nutritious and delicious food source. Date palm cultivation has a long history in Sudan, dating back to at least 3000 BC. The majority of Sudan's date palms are grown in the northern part of the country, along the Nile River and in the oases of Darfur and Kordofan. Date palms are an important crop for Sudan's economy and society. They provide a source of food, income, and employment for millions of people. Date palms are also used to make a variety of other products, such as date syrup, date vinegar, and date honey (FAO, 2010).

In the world, the date palm is grown in over 100 countries, with the top producers being Egypt, Saudi Arabia, Iran, and Iraq. Dates are a popular food source in many parts of the world, and are consumed fresh, dried, or processed into a variety of products. Dates are a good source of fiber, vitamins, and minerals. Dates are a healthy and nutritious snack that can be enjoyed by people of all ages.

Therefore, date palm trees are the main source of income for families in the areas where they are cultivated in Sudan. They are a source of food for them and their livestock *Khairi, et al, (2010)*. They are also a source of building materials for their homes, as well as for the manufacture of

their furniture, household supplies, and other necessities. In addition, they are a source of trade (UN COMTRADE, 2018; FAO, 2017). Date palm cultivation is mainly concentrated in the Northern State, River Nile State, North Darfur State, and Khartoum State, and to a lesser extent in the Red Sea, Kassala, Gezira, White Nile, and North Kordofan States (Figure 1). The total number of palm trees is estimated at approximately 16,098,550, representing more than 50 varieties. It is clear that the Northern State ranks first in terms of the number of date palms in Sudan, accounting for 49.8%. This is followed by the River Nile State (31.5%), North Darfur (7.2%), and Khartoum (6.3%), with the remaining states accounting for 5.2%. As for data on the area of date palm cultivation in the states, it is not available. However, the general estimate for the total area in Sudan is around 46,000 hectares (FAO, 2020b). The absence of accurate statistics and data in this regard is an important fact that must be taken into consideration when developing implementation plans for the strategy. The annual increase in the number of palm trees in the states is a strong support for the development of this sector, which is increasingly playing a role in food security. Khartoum State is the fastest expanding in date palm cultivation since 2015, with an increase of 6.3% in 2020.

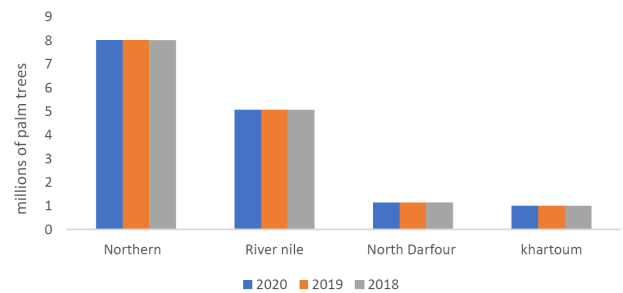


Fig. 1: The annual evolution in the number of palm trees in the states during the period (2018 AD - 2020 AD) in millions of palm trees.

SWOT analysis of date palm production in Sudan

The date palm sector in Sudan has a number of strengths and opportunities, but it also faces a number of weaknesses and threats. To maximize the potential of the date palm sector, it is important to address the weaknesses and threats, and to capitalize on the strengths and opportunities (Figure 2). This can be done by investing in research and development, improving extension services, strengthening institutional support, and promoting sustainable agricultural practices.

<p>Strengths</p> <ul style="list-style-type: none"> Favorable climate Abundant land Long history of date palm cultivation Diverse varieties of dates Competitive advantage 	<p>Weaknesses</p> <ul style="list-style-type: none"> Low productivity Poor quality Limited market access Weak institutional support Competitive advantage
<p>Opportunities</p> <ul style="list-style-type: none"> Growing demand for dates Expanding export markets Investments in the date palm sector Competitive advantage 	<p>Threats</p> <ul style="list-style-type: none"> Climate change Pests and diseases Economic crisis Conflict

Fig. 2: SWOT analysis of date palm

Challenges in Date Palm Cultivation

The underlying challenges of date palm in Sudan can vary, but some common issues include:

1. **Climate change and environmental factors:** Sudan's date palm sector is vulnerable to climate change, including droughts, heatwaves, and desertification, which can affect the growth and productivity of date palm trees.
2. **Water Management:** Sudan is primarily an arid and semi-arid country, making water scarcity a critical challenge for date palm cultivation. High evaporation rates, inefficient irrigation methods, and limited access to water resources hamper the productivity and sustainability of date palm plantations. Addressing water management issues through improved irrigation techniques, water conservation strategies, and investment in water infrastructure is crucial.
3. **Limited Research and Innovation:** An inadequate research and development framework hinders the advancement of date palm cultivation in Sudan. The absence of modern practices, pest control measures, and improved date palm varieties limit the sector's growth. Investments in research institutions, collaboration with international experts, and encouraging public-private partnerships would provide the necessary support for innovation and knowledge transfer.
4. **Lack of Infrastructure and Technology:** The limited availability of processing facilities, storage infrastructure, and modern technology poses significant challenges to the date palm industry in Sudan. Inefficient post-harvest practices, transportation constraints, and outdated processing techniques result in quality deterioration, wastage, and reduced export potential. Developing appropriate infrastructure and adopting advanced technologies such as solar drying, mechanized harvesting, and value-added processing would enhance productivity and market competitiveness.
5. **Quality Control and Standards:** The absence of standardized grading systems, quality control mechanisms, and certification processes affects the marketability of Sudanese dates. Inconsistent quality and non-compliance with international food safety standards lead to limited access to export markets. Establishing stringent quality control measures, adhering to international standards, and acquiring necessary certifications are imperative to enhance market access and ensure consumer satisfaction.
6. **Pests and diseases:** Date palm trees in Sudan are susceptible to various pests and diseases, such as the Parlatoria Date Scale, red palm weevil and bayoud disease, which can cause significant damage and reduce yields.

Opportunities for date palm cultivation in Sudan

There are several opportunities for date palm cultivation in Sudan due to the country's favorable climate and conditions for this type of agriculture. Some potential opportunities include:

1. **Large cultivatable land:** Sudan has a considerable amount of cultivatable land suitable for date palm cultivation, especially along the Nile River and its tributaries. This provides ample opportunities for expansion and establishing commercial date palm plantations.
 2. **Favorable climate:** Sudan has a hot and arid climate, which is ideal for date palm cultivation. The combination of high temperatures, low humidity, and minimal rainfall create ideal conditions for the growth and fruit production of date palms.
 3. **Water resources:** Sudan has access to ample water resources, primarily from the Nile River, which can be used for irrigation purposes. Date palms require substantial water supplies, and Sudan's proximity to the Nile provides an advantage in ensuring sufficient water for cultivation.
 4. **Genetic diversity:** Sudan is known for its rich genetic diversity in date palm varieties. This diversity presents opportunities for both research and the commercial cultivation of various date palm cultivars, which can lead to niche markets and export opportunities.
 5. **Export potential:** Sudan is one of the major producers of dates globally. Expanding date palm cultivation can lead to increased production and export opportunities, especially considering the high demand for dates in both regional and international markets.
 6. **Employment and income generation:** Date palm cultivation can create employment opportunities, particularly in rural areas where job prospects may be limited. It can also generate income for farmers, contributing to poverty reduction and improved livelihoods.
 7. **Value-added products:** Aside from selling fresh dates, there are numerous value-added products that can be derived from date palms, such as date syrup, date-based sweets and confectioneries, and even date-based cosmetics. Developing and diversifying these products can open up new market opportunities.
 8. **Sustainable agriculture:** Date palm cultivation in Sudan can be an environmentally sustainable practice, as this crop is well-adapted to arid regions and requires fewer agrochemical inputs compared to other crops. Implementing sustainable agricultural practices can also improve soil fertility and conserve water resources.
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Overall, the SWOT analysis shows that there is significant potential for the development of the date palm sector in Sudan. However, it is important to address the challenges and weaknesses identified in the analysis in order to maximize the sector's potential and ensure sustainable and equitable development.

Date Palm Plantations, Production, and Productivity in Sudan

Sudan ranks seventh globally in date palm production, accounting for approximately 5% of the world's date production (FAOSTAT, 2020). The total annual date production in Sudan is estimated at around 465,323 tons (FAO, 2019; FAOSTAT, 2020). The cultivated area has also increased by 1.6%. Despite the annual increase in production, it is evident that this increase is very low compared to global levels.

The productivity of date palm trees in Sudan varies significantly depending on the variety, region, and agricultural practices used. On the other hand, in some producing countries, the average date palm production per tree exceeds 100 kilograms (Figures 3,4,5). These data clearly reflect the weakness in production in this sector, which may weaken its contribution to the national economy. Sudan's date exports account for only 5% of the total production, and this can be attributed to several reasons, the most prominent of which are the low vertical production of date palm trees and the limited availability of desired varieties in international markets, despite the abundant natural resources represented by the suitable environment, lands, and water, along with a large cultivable area.

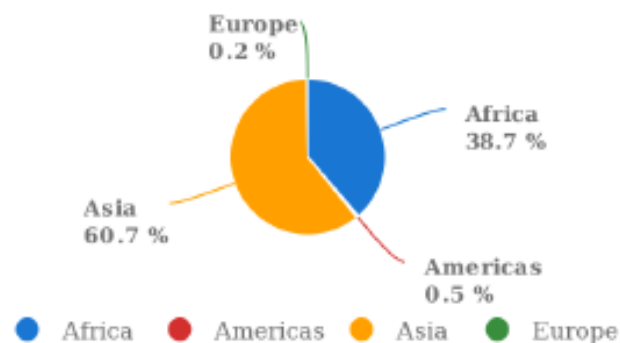


Fig. 3: Production share of dates by region 1994-2021

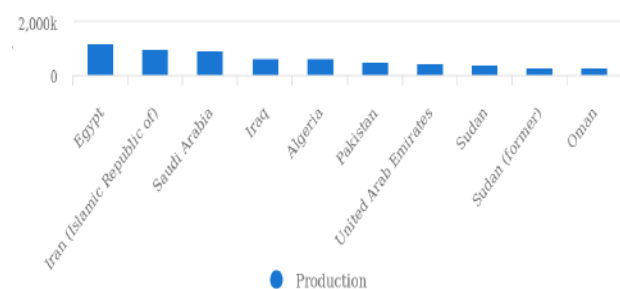


Fig. 4: Production of dates: top 10 producers – average 1994-2021

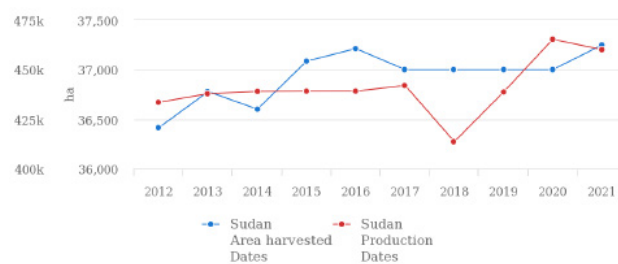


Fig. 5: Production/ yield quantities of dates in Sudan 1994-2021

Marketing, Manufacturing, and Exporting

Despite Sudan being ranked seventh globally among countries that produce dates, with an annual production exceeding 450,000 tons, the marketing and services system for dates is considered very traditional and does not keep up with the marketing innovations in advanced countries in this field (FAO, 2021).

This may be attributed to the dry nature of the main Sudanese dates, which leads to a decrease in their acceptance in international markets that heavily rely on fresh dates. Sudanese dates are primarily marketed in local markets, Khartoum and some state capitals are considered central markets (FAO, 2020; Elgilany et al., 2016). The marketing chain includes the producer, wholesalers, central markets, and retailers and the export percentage to some countries such as Egypt, Libya, and some African countries does not exceed 5% (Figures 6,7). It is worth noting that the absence of quality standards, systems, and associated laws, in addition to modern central markets and advanced processing industries, has led to a high percentage of loss and a decrease in marketing value, especially with traditional methods of sorting, packaging, transportation, and storage.

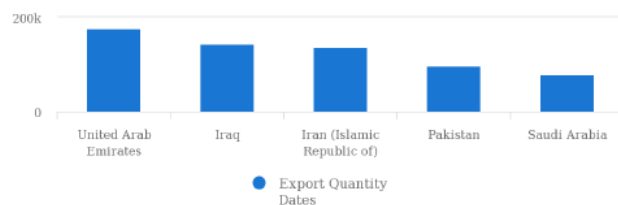


Fig. 6: Exports of top 5 exporters of dates 1993-2021

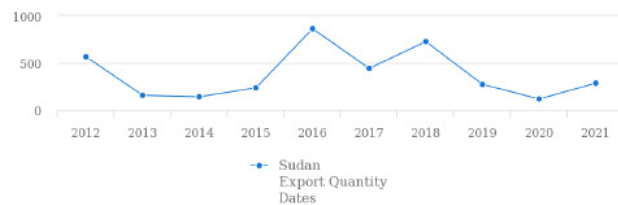


Fig. 7: Sudan exports of dates 2012-2021

The presence of processing industries and date factories is an important path to enhance and maximize the added marketing value of date palms. However, processing industries and date factories in Sudan are very limited, with the number of factories not exceeding 15 and scattered in

River Nile, Northern, and Khartoum states. The capacity of these factories is limited compared to the annual date production. In addition, there are no controls and standards for quality during the manufacturing processes, including refrigerated storage, sorting, cleaning, grading, packaging, and other manufacturing outputs such as jams. It is unfortunate that there are no strategic targets in the industrial sector in Sudan for such an important agricultural sector that plays a significant and growing role in food security and environmental sustainability.

Utilization of date and palm waste and maximizing added value

Over the past decade, Sudan has witnessed an increase in date palm waste due to the larger amounts generated from fruit production. There are no accurate statistics to estimate the percentage of waste from dates to the total production, but this percentage can be estimated at around 20 to 30 percent (FAO, 2020). With a significant concentration of date palm trees along the Nile and in other regions covering 32,000 hectares, the waste from dates, estimated to be around 20 to 30 percent of total production, presents numerous opportunities for utilization. All parts of the palm tree, including the trunk, leaves, leaf stalks, fronds, remains of the bunches, and fibers, contribute to the abundance of date waste. These waste materials, along with significant quantities of wet dates and seed dates, can be transformed into various products such as date powder, biscuits, cakes, date juice, molasses, jams, and marmalade. Moreover, they can be used to produce liquid sugar, baker's yeast, alcohol, acetic acid, citric acid, acetone, and fodder. Additionally, waste materials like palm leaves can be repurposed for the production of wood, paper, compost, crates, mats, and bricks (Zafar, 2021). Traditional uses of date palm waste, such as rope making and firewood, are declining due to urbanization, leading to waste accumulation and fire risks. To address this issue, alternative uses such as fuel production through combustion and gasification, as well as applications in pulp and paper production, composite panels, furniture, and bio-based products, should be explored (Lattieff, 2016). By tapping into the energy potential of date palm waste and developing handicraft industries using secondary products like palm fronds and date pits, Sudan can maximize the value of this crop, create new job opportunities, and contribute to the national economy while reducing the dependence on imported goods.

Date Palms: A Potential Solution to Child Malnutrition in Sudan

The percentage of child malnutrition in Sudan is 43.9%, according to the 2021 Global Nutrition Report. This means that over 4.3 million children under the age of five in Sudan are malnourished (Mbaga *et al.*, 2012; Mohamed *et al.*, 2014; FAO, 2020). Malnutrition is a major public health problem in Sudan, and it is caused by a variety of factors, including poverty, food insecurity, poor sanitation, and lack of access to healthcare (Figure 8).

Date palm is an important food crop in Sudan, and it can play a role in reducing malnutrition. Date palm fruits are a good source of vitamins, minerals, and fiber, and they can help to improve children's overall health and development. However, date palm fruits are not a complete food, and they should be supplemented with other nutritious foods.

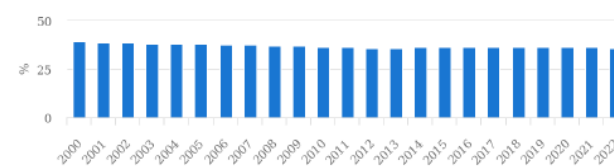


Fig. 8: Percentage of children under 5 years of age who are stunted in Sudan

THE DATE PALM INDUSTRY

A Driver of Economic Growth in Sudan

The GDP per capita, PPP of Sudan is lower than the average for Sub-Saharan Africa, which is 4,300. It is also lower than the world average, which is 10,200 (Figure 9). The date palm is an important crop in Sudan, and it can play a role in improving the economy. Date palms are grown in all regions of Sudan, and they are a major source of food, income, and employment. The date palm industry is worth billions of dollars, and it is a major contributor to the GDP of Sudan. The date palm industry can be further developed to help improve the economy of Sudan. This can be done by increasing productivity, improving marketing, and developing new products and services. The date palm industry can also play a role in reducing poverty and improving food security (FAO, 2020a).

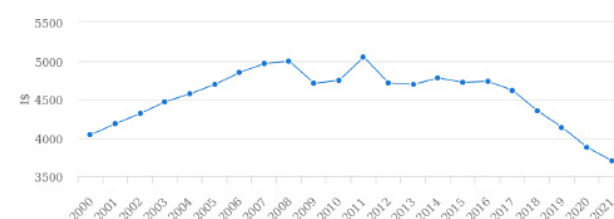


Fig. 9: Gross domestic product per capita, Sudan

Import Trends of Date Palms

From 1993 to 2021, India has been the leading importer of date palms, followed by the United Arab Emirates, as shown in (Figure 10).



Fig. 10: Imports of top 5 exporters of dates 1993-2021

When comparing the import quantities of date palms in Sudan, Egypt, and Libya, it was found that Egypt had the

highest import quantities, followed by Libya, while Sudan had the lowest (Figure 11). In terms of import value and quantity, Egypt demonstrated the highest import value and quantity of date palms compared to Sudan, as depicted in (Figure 12).

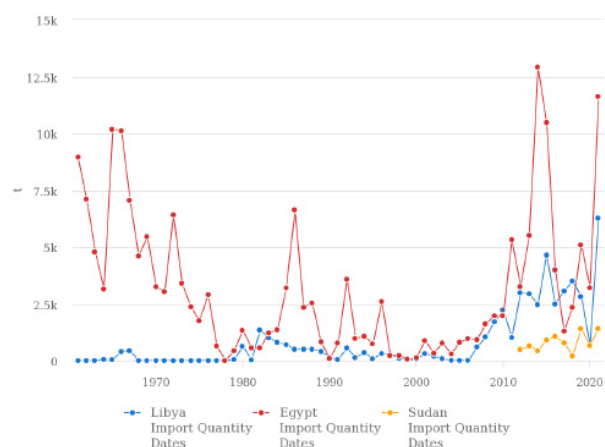


Fig. 11: Comparing Date Palm Import Quantities: Sudan, Egypt, and Libya

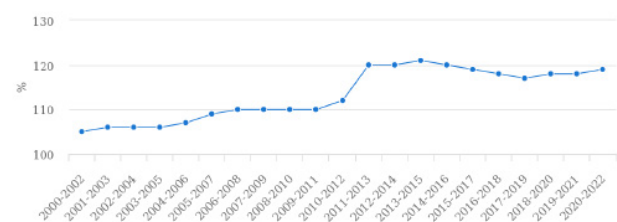


Fig. 12: Comparison between Sudan and Egypt in import value and quantity of date palm

The consumption and supply/demand balance of date palm in Sudan can be understood by considering the following patterns

1. **Traditional Consumption:** Date palm has been a staple food in Sudan for centuries. It is consumed both fresh and dried, and is a common ingredient in various traditional dishes and desserts. Locals consume dates as a snack and use them in cooking, baking, and making beverages.
2. **Economic Importance:** Date palm cultivation plays a significant role in Sudan's economy. The country has vast areas of fertile land suitable for date palm cultivation, providing employment opportunities and generating income for farmers. Sudan is among the top date producers globally.
3. **Local Demand:** The domestic demand for date palm products in Sudan is high due to the cultural significance of dates and their availability. Additionally, dates are rich in nutrients and provide a good source of energy, making them a popular food choice. The demand is primarily met through local production (Figure 12).

4. **Export Potential:** Sudan has the potential to export date palm products due to its large-scale cultivation. However, the export market for dates is not fully developed, and a significant portion of the produce is consumed domestically. Expanding the export market and value-added processing can help balance the supply and demand of date palm.
5. **Seasonal Production:** Date palm cultivation in Sudan follows a seasonal pattern. The harvest season typically begins in September and lasts until December. During this time, the supply of fresh dates significantly increases, leading to a higher consumption rate. Other times of the year, dried dates are consumed, ensuring a consistent supply throughout the year.
6. **Challenges:** Despite the abundance of date palm cultivation in Sudan, there are challenges that impact the supply and demand balance. These include suboptimal post-harvest practices, limited value addition, insufficient infrastructure, and inadequate marketing channels. Addressing these challenges can enhance the overall consumption and supply/demand balance.

Dates consumption and supply/demand balance - Sudan

To ensure a balance between consumption and supply/demand, Sudan can focus on improving post-harvest practices, investing in value addition and processing technologies, developing better infrastructure, and promoting domestic and international marketing strategies (Figure 13). By addressing these aspects, Sudan can further capitalize on its date palm resources and achieve a more balanced consumption and supply/demand pattern (FAO, 2020).

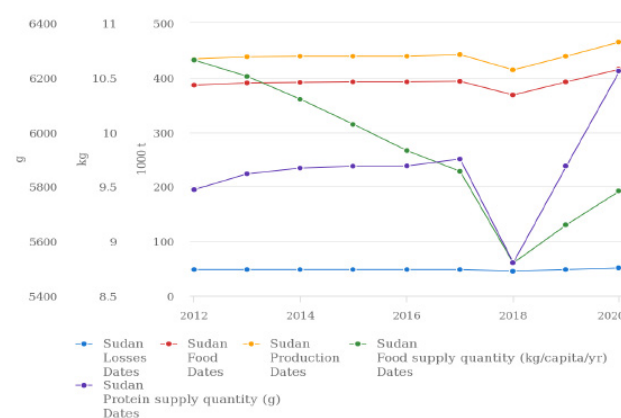


Fig. 13: The consumption and supply/demand balance of date palm in Sudan

Role of date palm cultivation in Sudan's food security and environmental sustainability

Date palm cultivation plays a crucial role in Sudan's food security for several reasons:

1. Staple food source: Dates are a staple food in Sudan, particularly in the northern regions, where they constitute a significant portion of the local diet. The fruit is rich in essential nutrients such as carbohydrates, proteins, minerals, and vitamins, making it an important source of nutrition for the population (Figure 14).

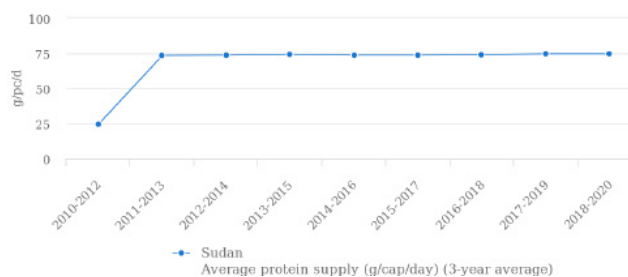


Fig. 14: Average protein supply (g/cap/day) (3 years average) Sudan

2. Drought tolerance: Date palm trees are well adapted to Sudan's arid and semi-arid climate. They can withstand high temperatures, limited water availability, and poor soil conditions, making them an ideal crop for cultivation in the country. Since Sudan experiences frequent droughts and water scarcity, the cultivation of date palms provides a stable food source during times of low agricultural productivity.
3. Economic contribution: Date palm cultivation is a significant source of income for many rural communities in Sudan. The sale of dates and date-related products, such as date syrup, date paste, and date confections, provides a livelihood for thousands of farmers. This economic contribution helps improve household incomes and reduces poverty levels, contributing to overall food security in the country.
4. Employment opportunities: Date palm cultivation requires labor-intensive activities throughout the year, including planting, pruning, pollination, and harvesting. This creates employment opportunities for the local population, particularly in rural areas where alternative job prospects may be limited. The availability of employment helps to alleviate unemployment and poverty, improving food security at the individual and community level.
5. Export potential: Sudan is one of the largest producers of dates in Africa, with significant export potential. The country exports dates and date products to several regional and international markets, generating foreign exchange and contributing to the national economy. The revenue generated from date exports can be used to invest in agricultural development, infrastructure, and other sectors, ultimately improving overall food security in Sudan.

Date palm cultivation can play a significant role in Sudan's environmental sustainability. Date palms absorb carbon dioxide from the air, conserve soil, promote biodiversity, and conserve water. Additionally, date palm cultivation can generate significant economic benefits for Sudan (Khairi *et al.*, 2010).

Social and economic impact of date palm cultivation

Date palm cultivation is a major social and economic driver in arid regions, but it faces challenges such as water scarcity, salinity, and soil degradation. Efficient management practices are needed to sustain its production and benefits (Alabdulkader *et al.*, 2016).

Date palm cultivation in Sudan has a significant social and economic impact on the country. Here are some key aspects of its impact:

1. Employment: Date palm cultivation provides employment opportunities for a large number of individuals in Sudan. From planting to harvesting and processing, the entire value chain of date palm cultivation involves various labor-intensive activities. This creates income and job opportunities for rural communities, especially during peak seasons.
2. Income generation: Date palm cultivation is an important source of income for farmers in Sudan. The sale of dates, by-products such as date syrup, and other value-added products contribute to the farmers' livelihoods and economic well-being. The income generated from date palm cultivation can be reinvested in education, healthcare, and other basic needs, improving the standard of living in rural areas.
3. Food security: Dates are a staple food in Sudan, and the cultivation of date palms plays a crucial role in ensuring food security. Locally produced dates meet the demand for nutritious food, especially in rural areas where other food sources may be scarce. The availability of dates helps to diversify the diet and provide essential nutrients to the population.
4. Export potential: Sudan is one of the major exporters of dates in Africa. The cultivation of date palms provides an opportunity to generate foreign exchange through exports. The export of dates and date products contributes to the national economy and balances the trade deficit. Sudan's dates have a good reputation in international markets due to their quality and taste.
5. Rural development: Date palm cultivation contributes to the development of rural areas in Sudan. Farmers invest in infrastructure such as irrigation systems, storage facilities, and processing units, which benefit the entire community. The development of date palm plantations also

encourages investment in related sectors such as food processing, packaging, and transportation, leading to overall economic development.

6. Environmental benefits: Date palm cultivation has environmental benefits as well. The cultivation of date palms helps in soil conservation and prevents desertification, as the trees protect the soil from erosion and retain moisture. Date palms also act as a carbon sink, absorbing carbon dioxide from the atmosphere and mitigating climate change.

In conclusion, date palm cultivation in Sudan has a significant social and economic impact, providing employment, income generation, food security, export potential, rural development, and environmental benefits. The government and stakeholders should continue to support and promote this sector to harness its full potential for sustainable development.

Trends in Date Production in Sudan from 2012 to 2020

According to the FAO, the area harvested, production, and yield of dates in Sudan from 2012 to 2020 are as follows: As you can see (Figure 15), both the area harvested and production of dates in Sudan have increased steadily from 2012 to 2020 (Figure 15). The yield of dates has also increased, but at a slower pace except in 2018 (FAO, 2020).

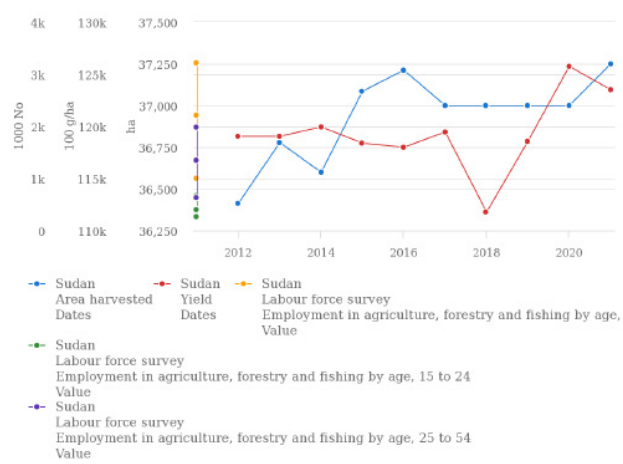


Fig. 15: Trends in Date Production in Sudan from 2012 to 2020

RESEARCH AND DEVELOPMENT

Many problems are also raised at all levels in the date palm sector, starting with production and agricultural practices, then pre-harvest operations, and reaching post-harvest operations, packaging, processing, and also the market, marketing, and exports. Therefore, it is necessary to link scientific research to all these loops to find and implement successful economic solutions to efficiently exploit these huge quantities of dates, their waste, and secondary palm products in the production of other products with economic returns and the development of

new products, with a focus especially on producing good dates of varieties desired by the local and global market and more interest in all agricultural operations and technical techniques. The scientific research can play a big role in develop date palm fields these include:

- Improving the quality and yield of date production.
- Reducing post-harvest losses.
- Developing new products from date waste and secondary products.
- Improving agricultural practices and techniques.

An innovative approach to Date palm in Sudan

I. One innovative approach to date palm cultivation in Sudan could be the use of modern technology and techniques such as precision agriculture. Precision agriculture involves the use of sensors, drones, and data analysis to optimize crop production while minimizing resources. Drones can also be utilized to monitor the health of the date palm trees. High-resolution imaging cameras on drones can capture detailed images of the plantation, allowing farmers to identify any signs of diseases or pest infestations early on. This enables targeted interventions and reduces the need for broad-spectrum pesticides, making the cultivation process more environmentally friendly.

II. Furthermore, data analysis can be employed to analyze historical weather patterns, market trends, and other factors affecting date palm cultivation. By analyzing this data, farmers can make informed decisions regarding planting schedules, crop rotation, and selecting suitable date palm varieties that are in high demand in the market.

III. Another innovative approach could involve the use of vertical farming techniques. Vertical farming allows for the cultivation of crops in vertically stacked layers, using artificial lighting and controlled environments. By implementing vertical farming methods for date palm cultivation, farmers can overcome the limitations of land availability and climate. This approach can also help protect the date palm trees from extreme weather events, pests, and diseases.

IV. Overall, implementing modern technology and techniques such as precision agriculture and vertical farming can revolutionize date palm cultivation in Sudan. These approaches have the potential to increase productivity, conserve resources, reduce environmental impact, and improve the quality of the date fruits, leading to a more sustainable and profitable date palm industry in the country.

KEY PERFORMANCE INDICATOR (KPI) FOR DATE PALM IN SUDAN

1. Yield: The total weight of harvested dates per palm tree is a key performance indicator. This metric helps in evaluating the productivity and efficiency of date palm cultivation.

2. **Quality:** The quality of dates produced, including size, taste, texture, and overall appearance, is an important KPI. Higher-quality dates command better prices in the market and reflect the success of the cultivation and post-harvest processes.
3. **Fruit set percentage:** This KPI measures the proportion of flowers on a date palm that successfully develop into fruits. It indicates the fertility of the palm and the effectiveness of pollination and fertilization practices.
4. **Pest and disease incidence:** The occurrence of pests and diseases in date palm orchards is a significant KPI. Monitoring and reducing the impact of these issues is crucial for maintaining tree health and ensuring optimal date production.
5. **Water consumption:** The amount of water required per palm tree is an essential KPI for sustainable date farming practices. Efficient irrigation systems and water management strategies help minimize water consumption and ensure the long-term viability of date palm cultivation.
6. **Cost per ton of dates produced:** This KPI helps evaluate the production cost efficiency of date palms. It combines factors like labor, fertilizers, pesticides, and other inputs to highlight any inefficiencies in the production process.
7. **Harvesting and processing efficiency:** The time taken to harvest and process dates from the palm tree to the final product is an important KPI. Improving efficiency in these processes can increase productivity and reduce post-harvest losses.
8. **Return on Investment (ROI):** This KPI assesses the profitability of date palm cultivation. It compares the financial returns generated from date sales to the initial investment made in land, palm tree plantation, irrigation systems, and other infrastructure.
9. **Crop load:** This KPI measures the number of bunches or fruits per palm tree. It helps in determining the optimal number of fruits to be retained on each tree to achieve the desired fruit quality and size.
10. **Export volume:** For date palm cultivators involved in international trade, the volume of dates exported serves as a key performance indicator. Increasing export volume can indicate successful market access and demand for the product.

CAUSAL LOOP DIAGRAM OF DATE PALM

The diagram shows that the demand for date products is a major driver of the date palm sector in Sudan (Figure 16). When demand increases, it leads to more cultivation of date palms, more investment in production, and improved production practices. This, in turn, leads to higher yields and lower prices, which further stimulates demand. However, the diagram also shows that the date palm sector is vulnerable to fluctuations in demand. If demand decreases, it can lead to a decline in cultivation, investment, and production practices. This, in turn, can lead to lower yields and higher prices, which can further dampen demand. The causal loop diagram can be used to understand the dynamics of the date palm sector in Sudan and to identify potential interventions that could be used to improve the sector's resilience to shocks and stresses. For example, the diagram suggests that interventions that can increase demand for date products, such as promoting date palm products in new markets, could help to stabilize the sector.

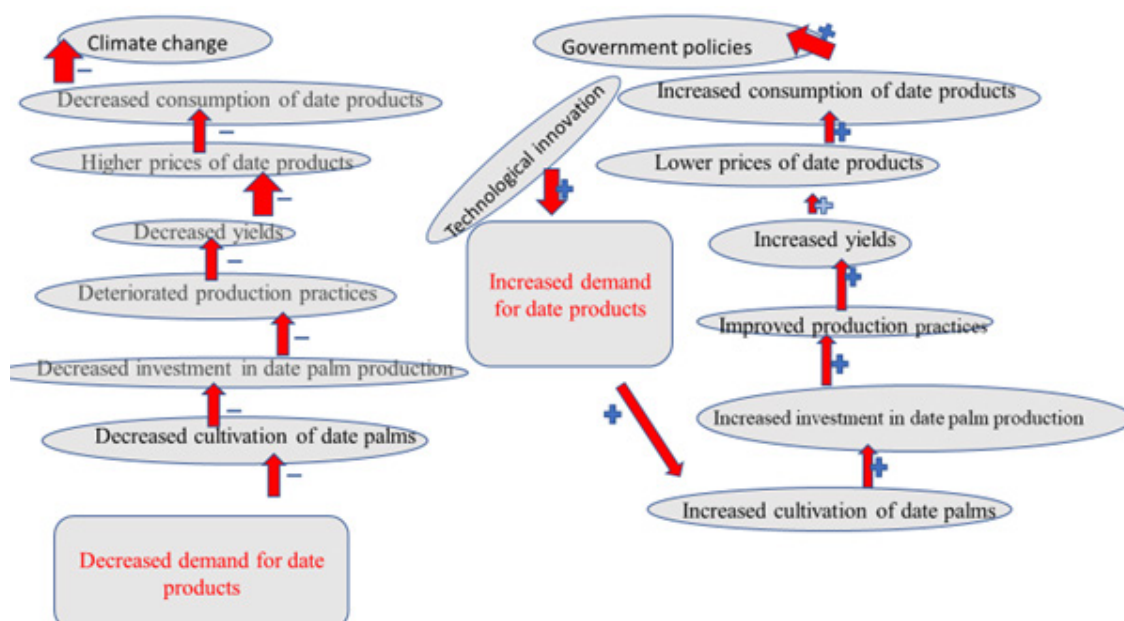


Fig. 16. A causal loop diagram of the date palm in Sudan

IMPROVING THE PERFORMANCE AND SUSTAINABILITY OF THE DATE PALM SECTOR IN SUDAN

There are several ways to improve the performance and sustainability of the date palm sector in Sudan:

1. **Enhancing data collection and analysis:** Improving the accuracy and reliability of data on the date palm sector is crucial for informed decision-making and effective planning. This can be achieved through comprehensive data collection systems, regular surveys, and analysis of production, yield, market trends, and other relevant indicators.
2. **Strengthening cooperation and coordination:** Collaboration and coordination among different actors involved in the date palm sector, including farmers, government agencies, research institutions, and private sector entities, are essential. This can be achieved through the establishment of platforms, networks, and partnerships that facilitate knowledge sharing, technology transfer, and joint initiatives.
3. **Quality control and certification:** Implementing robust quality control measures for dates at the marketing level is vital to maintain product integrity and meet international standards. This involves setting up quality control laboratories, training inspectors, and implementing certification systems to ensure that dates meet the required quality and safety standards.
4. **Developing organized and efficient date markets:** Establishing well-organized and efficient date markets can enhance market access, facilitate fair trade, and ensure better prices for farmers. This includes improving infrastructure, storage facilities, transportation systems, and market information systems. Additionally, promoting market linkages and supporting value-added processing and marketing initiatives can help diversify product offerings and increase market competitiveness.
5. **Promoting sustainable practices:** Encouraging sustainable agricultural practices in date palm cultivation is crucial for long-term productivity and environmental conservation. This can include promoting efficient water management techniques, adopting organic farming practices, minimizing pesticide use, and implementing integrated pest management strategies. Furthermore, raising awareness among farmers about sustainable practices and providing training and technical support can contribute to the overall sustainability of the sector.

By implementing these measures, Sudan can enhance the performance and sustainability of its date palm sector, leading to increased productivity, improved market access, and better livelihoods for farmers.

A HISTORICAL OVERVIEW OF DATES POLICIES

Date palm cultivation has a long history in Sudan, but formal policies specifically targeting the sector were not prominent until the 1950s-1960s. The government recognized the economic potential of the sector and initiated efforts to promote its development, including establishing research centers and experimental farms, and providing subsidies, access to credit, and technical assistance to farmers. In the 1970s-1980s, the government introduced policies to incentivize farmers to expand date palm cultivation, with the aim of increasing production and meeting domestic demand. However, Sudan experienced a period of economic challenges in the 1990s, which affected the date palm sector, and government support and investment in the sector declined (*FAOSTAT, 2020; FAO, 2017, 2020*).

In the 2000s, the Sudanese government recognized the need to revive and modernize the date palm sector. Policies were introduced to promote private sector participation, attract investment, and improve value chain development. Efforts were made to enhance quality control, promote exports, and establish partnerships with international organizations and research institutions. In recent years, more recent policies have focused on addressing challenges such as climate change, water scarcity, and market access. The government has invested in research and development, introduced improved irrigation techniques, and implemented measures to combat pests and diseases (*Khairi et al., 2010; Alabdulkader, 2016*).

Overall, the historical overview of date palm policies in Sudan reflects a recognition of the sector's importance and a commitment to supporting its growth and development. The government's approach has evolved from direct intervention to a more facilitative role, encouraging private sector participation and market-driven.

Stakeholders

In Sudan, key stakeholders for date palm policies include government entities, NGOs, academic institutions, financial institutions, trade associations, and implementing partners. Primary policy influencers are government entities and regulatory bodies that directly influence policy formation, while secondary policy influencers are government entities with some policy influence. Implementing partners are relevant stakeholders with expertise that can contribute to policy recommendations and implementation. These partners include agricultural research institutions, agricultural extension services, farmer cooperatives and associations, NGOs, private sector entities, and financial institutions. By collaborating with the government, these stakeholders can play a crucial role in shaping and implementing effective date palm policies in Sudan (*FAO, 2018*).

The primary policy influencers in the development of date palm policies in Sudan can be categorized into the following groups

i. Government: The Sudanese government plays a crucial role in shaping date palm policies. It formulates and implements policies, provides financial support, establishes regulatory frameworks, and invests in research and development. The Ministry of Agriculture and Natural Resources, Ministry of Industry and Trade, and Ministry of Finance are among the key government agencies that influence date palm policies.

ii. Research institutions: Research institutions, such as the Agricultural Research Corporation (ARC) and the Sudanese Agricultural Bank, contribute to the development of date palm policies through their research findings, technical expertise, and recommendations. They provide valuable insights on cultivation techniques, pest and disease management, and overall knowledge enhancement in the date palm sector.

iii. Private sector: The private sector, including date palm farmers, processors, and exporters, also have a significant influence on date palm policies. Their input and feedback on challenges, market trends, and value chain development shape the policies implemented by the government. Private companies and entrepreneurs play a vital role in processing, packaging, and marketing date palm products, and their involvement is crucial for the sector's growth and development.

iv. International organizations: International organizations, such as the Food and Agriculture Organization (FAO), the International Fund for Agricultural Development (IFAD), and the World Bank, provide technical expertise, research collaboration, and market access opportunities for Sudanese date palm products. They influence date palm policies through their support, recommendations, and funding for development projects in the sector.

v. Consumers: Consumer preferences and market trends also influence date palm policies. Meeting domestic demand and expanding export markets require understanding consumer preferences and ensuring product quality. Consumer feedback and market research play a role in shaping policies related to product standards, quality control, and market access.

vi. Civil society organizations: Civil society organizations, such as farmers' associations and agricultural cooperatives, advocate for the interests of date palm farmers and contribute to policy discussions. They provide a platform for farmers to voice their concerns, share knowledge and best practices, and influence policy decisions through advocacy and lobbying efforts.

Secondary policy influencers in the development of date palm policies in Sudan include

i. Non-governmental organizations (NGOs): NGOs working in the agricultural sector, particularly those focused

on sustainable development and rural livelihoods, can influence date palm policies through research, advocacy, and capacity-building initiatives. They provide valuable expertise and recommendations for policy formulation and implementation.

ii. Academic institutions: Universities and research centers contribute to date palm policy development through their research findings, academic publications, and training programs. They provide scientific evidence, technical knowledge, and human resource development in the date palm sector.

iii. Financial institutions: Banks and financial institutions play a role in shaping date palm policies by providing loans, credit facilities, and financial support to farmers, processors, and exporters. Their lending criteria and interest rates can impact investment decisions and overall sector development.

iv. Trade associations: Industry and trade associations representing date palm farmers, processors, and exporters have a voice in policy discussions. They advocate for the interests of their members, provide market information, and contribute to the formulation of policies that promote the growth and competitiveness of the sector.

v. International donors: Donor agencies and development partners provide financial assistance, technical expertise, and capacity-building support to the date palm sector. They influence policies through their funding priorities, project requirements, and policy recommendations.

vi. Environmental and conservation organizations: Organizations focused on environmental conservation and sustainable agriculture can influence date palm policies by advocating for sustainable practices, biodiversity conservation, and climate change adaptation and mitigation measures.

Implementing partners are organizations or entities that work in collaboration with the government to implement and execute policies and programs related to the date palm sector. In Sudan, some potential implementing partners for date palm policies could include

i. Agricultural research institutions: Research institutions such as the Agricultural Research Corporation (ARC), National Center for Research and agricultural faculties can collaborate with the government to conduct research, develop new technologies, and provide technical expertise for the implementation of date palm policies.

ii. Agricultural extension services: Extension services play a crucial role in disseminating information, providing training, and offering technical support to date palm farmers. These services can be provided by government agencies, NGOs, or specialized extension organizations.

iii. Farmer cooperatives and associations: Farmer cooperatives and associations can play a key role in implementing policies by organizing and mobilizing farmers, providing training and capacity-building, and facilitating access to resources and markets.

iv. Non-governmental organizations (NGOs): NGOs working in the agricultural sector can partner with the government to implement policies and programs related to date palm development. They can provide technical expertise, resources, and support for capacity-building activities.

v. Private sector entities: Private companies involved in date palm cultivation, processing, and marketing can be important implementing partners. They can contribute to the implementation of policies by investing in infrastructure, providing technical assistance, and facilitating market access for date palm products.

vi. Financial institutions: Banks and financial institutions can partner with the government to provide financial support, including loans and credit facilities, to date palm farmers and businesses. They can also offer financial literacy programs and advisory services to support the implementation of policies.

POLICY OPTIONS/ ALTERNATIVES ANALYSIS

Alternative 1

Policy Option: Expanding Export Opportunities for Sudanese Date Palm Production

To capitalize on Sudan's competitive advantage in date palm production, policymakers should prioritize the development of trade agreements and the implementation of strategies to promote and facilitate date palm exports. This can be achieved by establishing and strengthening trade partnerships, investing in market research and promotion activities, providing financial incentives and support to date palm farmers and businesses, and implementing quality control measures and adherence to international standards. By expanding export opportunities for Sudanese date palm production, policymakers can harness the country's competitive advantage and drive economic growth, job creation, and increased revenue in the agricultural sector.

Alternative 2

Enhancing agricultural infrastructure and support

Enhancing agricultural infrastructure and support for date palm production in Sudan can significantly increase productivity, reduce post-harvest losses, improve efficiency, and enhance the overall competitiveness of Sudanese dates in the global market. This can be achieved by investing in irrigation systems, modern farming technologies, training and capacity-building programs, storage and processing facilities, and providing access to finance and markets. However, policymakers need to carefully consider the financial implications and ensure the

long-term sustainability of these investments. Additionally, this policy option should be complemented with other strategies, such as research and development, market promotion, and quality control, to ensure a comprehensive approach to promoting date palm production in the country. The Pros of this policy are increased productivity, reduced post-harvest losses, improved efficiency, enhanced competitiveness. However, the Cons: Financial implications, long-term sustainability.

Policy Option 3: Research and Development

Investing in research and development (R&D) in the date palm sector is a promising policy option to promote its production in Sudan. R&D can lead to improved crop varieties, enhanced pest and disease management, better post-harvest handling, and knowledge dissemination, all of which can significantly enhance the productivity and profitability of date palm production. However, policymakers need to consider the financial implications, ensure the effective transfer of research findings to farmers, and establish mechanisms for sustainable funding and collaboration between researchers, farmers, and other stakeholders. This policy option should be complemented with other strategies, such as infrastructure improvements, market promotion, and capacity-building, to ensure a comprehensive approach to promoting date palm production in the country. The Pros of this policy are improved crop varieties, enhanced pest and disease management, better post-harvest handling, knowledge dissemination. However, the Cons are time-consuming process, high costs, limited access to technology.

Policy Option 4: Market Promotion and Export Development

Market promotion and export development is a promising policy option to promote date palm production in Sudan. It can help increase domestic and international demand for Sudanese dates, diversify markets, add value to date products, create job opportunities, and enhance the competitiveness of the country's date industry. However, policymakers need to address market access barriers, ensure quality control and certification, tackle competition, and invest in infrastructure and logistics to fully realize the potential of this option. Additionally, this policy option should be implemented in conjunction with other strategies, such as infrastructure improvements, research and development, and capacity-building, to create a holistic approach to promoting date palm production in Sudan. The Pros of this policy are: increased market demand, diversification of markets, value addition and product differentiation, job creation and economic growth. However, the cons are market access barriers, quality control and certification, competition from other date-producing countries, infrastructure and logistics.

Policy Option 5: Quality Control and Certification

Another policy option to promote date palm production in Sudan is to focus on quality control and certification.

This involves implementing measures to ensure that Sudanese dates meet international quality standards and obtain necessary certifications, thereby enhancing their market competitiveness and facilitating access to global markets. The pros of this policy option include enhanced market reputation, facilitated market access, increased consumer confidence, and value addition. By meeting international quality standards and obtaining certifications, Sudanese dates can gain a positive reputation in the global market, leading to increased demand and higher prices. Compliance with quality standards can also facilitate market access by reducing trade barriers and opening up new export opportunities. Additionally, quality control and certification provide assurance to consumers that the dates they are purchasing meet certain quality and safety standards, building trust and increasing demand. Furthermore, focusing on producing high-quality dates can lead to value addition and product differentiation, enabling Sudan to develop a niche market for premium-quality dates. However, there are cons to consider, such as compliance challenges, cost implications, enforcement and monitoring requirements, and the risk of potential market rejection. Policymakers need to provide support and capacity-building programs to help farmers and processors comply with quality standards, manage the costs associated with quality control and certification, establish effective enforcement and monitoring mechanisms, and conduct market research to understand specific market preferences and requirements. Overall, this policy option should be implemented in conjunction with other strategies to create a comprehensive approach to promoting date palm production in Sudan.

Policy Option 6: Financial Support and Incentives

Another policy option to promote date palm production in Sudan is to provide financial support and incentives to farmers and processors. This can include access to affordable credit, grants, subsidies, tax incentives, and technical assistance to support the development and expansion of date palm cultivation and processing activities. The pros of this policy option are that it can attract investment in the date palm sector, encouraging farmers and processors to expand their operations and adopt modern technologies and practices, leading to increased productivity, improved quality, and higher yields. It can also help farmers and processors mitigate risks associated with date palm cultivation, provide capacity-building programs to enhance their knowledge and skills, stimulate job creation and rural development, and contribute to poverty reduction and improved livelihoods. However, there are cons to consider, such as the cost implications for the government, the risk of dependency on financial support, potential equity issues in the distribution of benefits, and the need for effective monitoring and evaluation mechanisms to ensure the funds are being used effectively and achieving the desired outcomes.

Policy Option 7: Promote Environmental Sustainability

Date palm cultivation can play a significant role in environmental sustainability in Sudan, as it can help reduce greenhouse gas emissions, conserve soil, promote biodiversity, and conserve water. To promote environmental sustainability in the date palm sector, Sudan can implement policy measures such as providing financial incentives to farmers for adopting sustainable practices, investing in research and development, and promoting awareness and education. Sudan can also encourage the use of renewable energy sources, recycled and sustainable materials, and improved post-harvest handling and storage practices. The Pros of this policy are Carbon sequestration, soil conservation, biodiversity promotion, water conservation, economic benefits. However, the Cons are limited awareness, lack of resources, technical expertise.

Policy Option 8: legislation

To strengthen the date palm sector in Sudan, implementing effective legislation is crucial. This can include enacting laws and regulations that govern the registration, licensing, and compliance requirements for small-scale farmers and traders. Legislation should also address quality standards, certification processes, and fair-trade practices. Additionally, the government should establish mechanisms to enforce these laws and ensure compliance, such as inspection systems, penalties for non-compliance, and monitoring and evaluation frameworks. Implementing legislation for the date palm sector in Sudan has pros and cons. On one hand, legislation can establish clear guidelines for registration, licensing, and compliance, promoting transparency and accountability, set quality standards and certification processes, enhancing the reputation and marketability of Sudanese date palm products. Legislation can further protect the interests of small-scale farmers and traders, ensuring fair trade practices and market access. However, challenges may arise, including the need for sufficient resources and capacity to enforce the legislation effectively. Additionally, bureaucratic processes and administrative burdens may be a concern, particularly for farmers and traders with limited resources. Striking a balance between regulatory requirements and practical considerations will be crucial to maximize the benefits of legislation while minimizing potential drawbacks.

POTENTIAL BENEFITS, HARMS, ASSUMPTIONS AND WILD CARD FOR STAKEHOLDERS

Date palm production and export in Sudan has the potential to benefit stakeholders through increased productivity, reduced post-harvest losses, improved income, increased market demand and sales, increased access to regional and global markets, increased economic growth, job creation, increased tax revenue, and improved food security and nutrition. However, potential harms such as increased competition and market saturation, increased costs, market rejection, mismanagement of funds and resources, and dependency on external funding also exist.

Assumptions include demand for Sudanese dates, sufficient infrastructure and resources, willingness to adopt new technologies, and political stability. Wild cards include climate variability, emergence of new pests and diseases, and changes in global trade policies and regulations.

RECOMMENDATIONS

1. Develop a comprehensive national strategy for date palm cultivation: should include measures to increase productivity, improve quality, expand production areas, and establish marketing channels.
2. Provide financial support and incentives for private investors to invest in date palm farms and processing facilities.
3. Enhance research and development
4. Improve infrastructure of irrigation networks, roads, and transportation facilities in date palm-growing regions.
5. Enhance value addition and processing and develop marketing strategies to promote Sudanese date palm products domestically and internationally.
6. Prioritize climate change adaptation in the Dates sector.
7. Collaborate with regional and international organizations and research institutions to improve Dates sector.
8. Establishing a dedicated date palm development agency.
9. Providing training and capacity building for date palm farmers and processors.
10. Promoting the consumption of date palm products domestically.
11. Enact and enforce legislation to ensure compliance with date palm sector guidelines in Sudan.

CONFLICT OF INTERESTS

There are no conflict of interests.

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الملخص العربي

خيارات السياسات: تعظيم إمكانيات قطاع النخيل في السودان

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قطاع نخيل التمر في السودان يواجه العديد من التحديات، بما في ذلك التغيرات المناخية والسلام وإحياء الاقتصاد والآفات والأمراض ونقص الاستثمار وسوء دخول الأسواق وضعف الدعم المؤسسي، مما أدى إلى انخفاض الإنتاجية وسوء جودة المنتجات. لمعالجة هذه التحديات، يحتاج السودان إلى الاستثمار في قطاع نخيل التمر من خلال تنفيذ تدخلات مستهدفة ودعمها بالتشريعات ذات الصلة في الأمن الغذائي. ويشمل ذلك تحسين البنية التحتية الزراعية والدعم، وتحديد الأولويات في البحث والتطوير، وتعزيز الترويج وتطوير التصدير، وتنفيذ إجراءات مراقبة الجودة والتصديق، وتوفير الدعم المالي والحوافز، والاستثمار في جمع البيانات والتحليل، والاستثمار في إدارة المياه، وتعزيز الشراكات بين مختلف الجهات، وتوفير الدعم المالي والتكنولوجي للمزارعين، وإقرار وتنفيذ التشريعات، وتعزيز أنظمة التسويق ومراقبة الجودة، وتعزيز الاستدامة البيئية، وتطوير وتنفيذ السياسات والبرامج لدعم القطاع. يجب أن تكون هذه الجهود متوافقة مع التشريعات القائمة في الأمن الغذائي في السودان. هذا النهج الشامل، الذي يركز أيضًا على السلام وإحياء الاقتصاد، ضروري للحفاظ على استدامة قطاع نخيل التمر في السودان على المدى الطويل. بدون عمل، قد يواجه السودان عواقب وخيمة مثل تفاقم الأمن الغذائي، والتراجع الاقتصادي، وفقدان الميزة التنافسية، وزيادة الفقر. لذلك، فإن الاستثمار في البنية التحتية ودخول الأسواق واعتماد التكنولوجيات الجديدة والاستقرار السياسي ودعم المزارعين الصغار، وفقًا للتشريعات ذات الصلة، ضروري لتحقيق الحد الأقصى لإمكانيات القطاع وضمان الأمن الغذائي والنمو الاقتصادي والاستدامة البيئية في السودان. من خلال اتخاذ هذه الخطوات، يمكن للسودان أن يتمتع بمكانة كمنتج ومصدر رائد للتمور عالية الجودة، مع تحسين معيشة المزارعين والمساهمة في التنمية الزراعية المستدامة.