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Power and water resources in center pivot irrigation system in Sudan

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Abstract

This study talks about the water resources on the world, availability of using water on the world, availability of using water in Sudan, modern irrigation system in Sudan, the number of center pivot irrigation system in Sudan, explained the consumption of water by these irrigation systems and the importance of using the water from the rivers. Also, this study explained the power resources for the center pivot and the cost of this power.

The results showed that, one unit of center pivot irrigation system consumes about 6532m^3 of water per day during 22 days per month to irrigate 120fed, this estimation for grass in Sudan and the power sources using the diesel engine (80% of pivots), the rest is by general electricity and solar energy. The cost of diesel is about 400USD per day for the engine pull from the river and 1000USD per day for the engine pull from the well, but the cost of electricity is about 200USD per day for one pivot.

Keywords: Water resources, water amount, water consumption, general electricity, diesel engine, diesel cost.

المستخلص:

ناقشت هذه الدراسة مصادر المياه في العالم وامكانية استخدامات تلك المصادر، كما ناقشت مصادر المياه في السودان وإمكانية استخدامات تلك المصادر، تحدثت هذه الدراسة أيضا عن أنظمة الري الحديثة في السودان بصورة عامة وعن نظام الري المحوري بصفة خاصة وبينت عدد

أجهزة الري المحوري في السودان، كما أوضحت مقدار استهلاك المياه في أنظمة الري وأهمية التوجه لاستقلال مياه الأنهار، كما بينت أنواع الطاقة المستخدمة في أجهزة الري وتكاليفها مع ضرورة التوجه لاستخدام الكهرباء العامة المتولدة من مياه الخزانات.

أظهرت نتائج هذه الدراسة أن جهاز الري المحوري الواحد يستهلك حوالي 6532متر مكعب من المياه عند التشغيل 22 ساعة خلال اليوم لري 120فدان، هذا التقدير لري محصول البرسيم والذي يمثل 80% من جملة أجهزة الري المحوري في السودان. بالنسبة للطاقة المستخدمة لتشغيل أجهزة الري المحوري فان استخدامات الكهرباء العامة الطاقة الشمسية يعد استخداماتها على نطاق ضيق جدا حتى الان. بينما يمثل استخدام الوقود حوالي 80% من جملة أجهزة الري المحوري في السودان، وتقدر تكلفة الوقود لتشغيل جهاز ري محوري خلال اليوم من مياه النيل بحوالي 400دولار بينما تقدر التكلفة لتشغيل محور خلال اليوم من الابار بحوالي 1000دولار وتقدر تكلفة الكهرباء لتشغيل نفس المحور خلال اليوم بحوالي 200دولار.

كلمات مفتاحية: مصادر المياه، كمية المياه، استهلاك المياه، الكهرباء العامة، مكينات الوقود، الطاقة الشمسية وتكلفة الوقود.

Introduction:

Amount of water all over the world estimated by 1520 million milliard cubic meters, 1% of this amount is used for each activity, so the people must be tacking more care when using the water. Amount of using water in Sudan estimated by 34.3 milliard cubic meters. (Adam& Adeep.2006- ch2 pg4)

Irrigation systems should have the capability to apply the amount of water needed by the crop in addition to precipitation. Irrigation applications should occur in a uniform and timely manner while minimizing losses and damage to soil, water, air, plant, and animal resources. Some irrigation systems also include water supply and delivery. Any irrigation system design requires adjustment in the field. Designs must be tailored to the skills and willingness of the irrigation decision maker to properly manage the system and make the adjustments. Center pivot irrigation system is best system for the crop on big area with limit amount of water. The power resources of center pivot are the general electricity, diesel engine and recently using the solar energy in this field. (NEH, (210-vi) September 1997-ch9.pg1)

Sudan has suffered from limited water resources, such as low annual rainfall of less than 300mm across most of the country, which constrains economic development and the daily life of its people. Water resources exist unevenly in regions in Sudan; the Non-Nile area has suffered from water shortages compared to the Nile area. It is one of the main reasons why there is a low access rate of safe water and the water allocation to each water-use sector. (Bashir, E. M.2020. WIMEK. PhD Thesis.2020.)

The existing heavily sectorized policies in Sudan are ineffective or even counterproductive for the long-term, sound use of the resource base. Instead, management and usage of water resources need to reflect the fundamentally interconnected nature of a hydro-logical unit, such as a catchment area. An Integrated Water Resource Management (IWRM) approach is therefore needed. It balances the different water requirements for domestic, livestock, crop, grazing land and other uses with the total availability of water within the catchment area. (Hess. T.M, et al (2016) 181–194.)

Materials And Methods:

Irrigation application method and system selection should result in optimum use of available water. The selection should be based on a full awareness of management considerations, such as water source and cost, water quantity and quality, irrigation effects on the environment, energy availability and cost, farm equipment, product marketability, and capital for irrigation system installation, operation, and maintenance. (Multsch. S, et al. 2017.pg1)

Recently in Sudan the Center pivot irrigation system considered is appropriate selection and estimated with more than 5000 unit (600000fed); all take the water from the rivers or wells, majority of center pivot in Sudan using the diesel engines for the power and just few farms using the general electricity and water from the rivers (20% of all area). The success of agriculture in Sudan depends on using water from the rivers and general electricity.

The performance evaluation of center pivot systems. For this, data from different sources (previous studies, Ministries of Agriculture records, personal contact, remote sensing and (GPS) were collected. The procedure for evaluating the performance of center pivot irrigation systems was based on the American Society of Agricultural and Biological Engineers (ASABE, 2007), in randomly selected locations. Catch-cans test was used to evaluate the actual application depth.

The center pivot system is best choice for agricultural irrigation because it’s low labor and maintenance requirements, convenience, flexibility, performance, and easy operation. When properly designed and operated, and equipped with high efficiency water applicators, a center pivot system conserves three precious resources water, energy, and time. Manufacturers have recently improved center pivot drive mechanisms (motors, gears, and shafts), control devices, optional mainline pipe sizes and outlet spacing’s, span lengths, and structural strength



Plate of Deasil Engen

Results & Discussion:

The results show that, one unit of center pivot irrigation system consumes about 6532m^3 of water per day during 22 days per month for three years; stopped about eight days per month for cutting, maintenance and other agricultural activities, this estimation for grass in Sudan (80% of pivots).

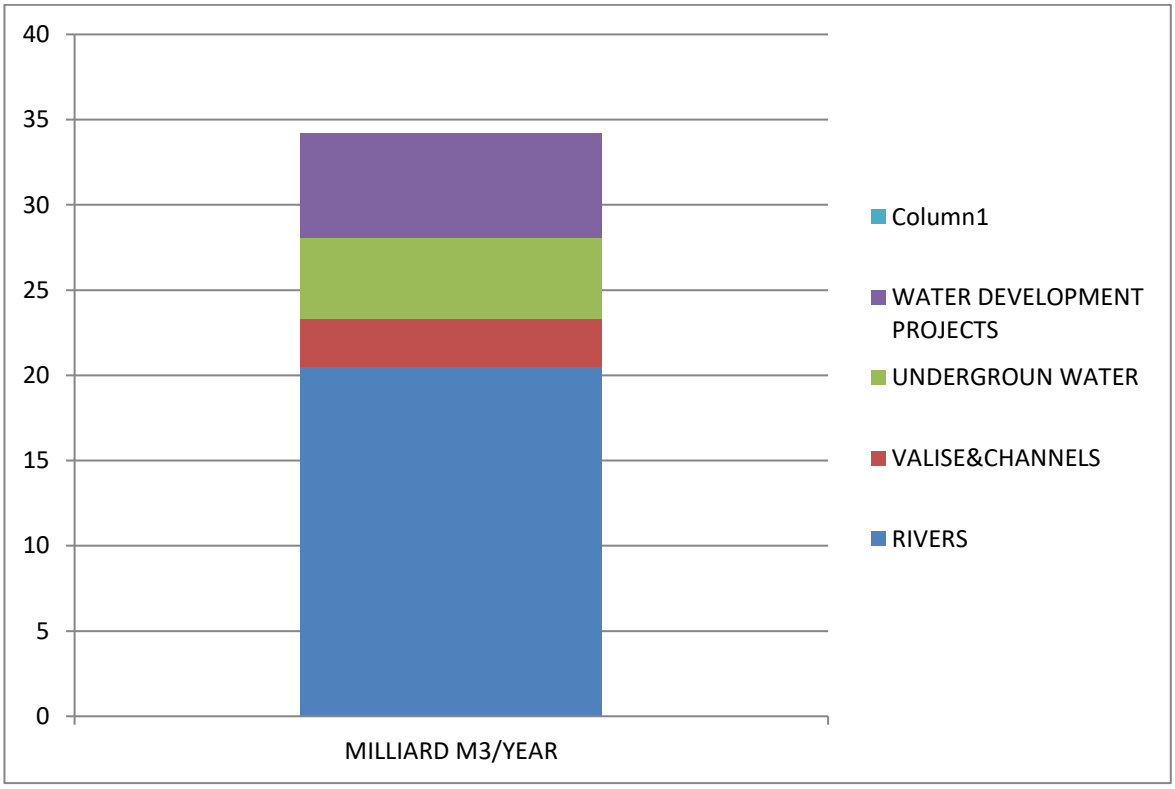
The power resources in Sudan for center pivot system using the diesel engine (80% of pivots), general electricity and solar energy but using as study tell now.

The cost of diesel is about 400USD per day for the engine on the river and 1000USD per day for the engine on the well, but the cost of electricity is about 200USD per day for one pivot.

Blat of water resources in Sudan

NO	Water resource	The amount milliard m^3/year
1	Rivers	20.5
2	Valise and channels	2.8
3	Underground water	4.8
4	Water development projects	6.1
5	Total amount	34.3

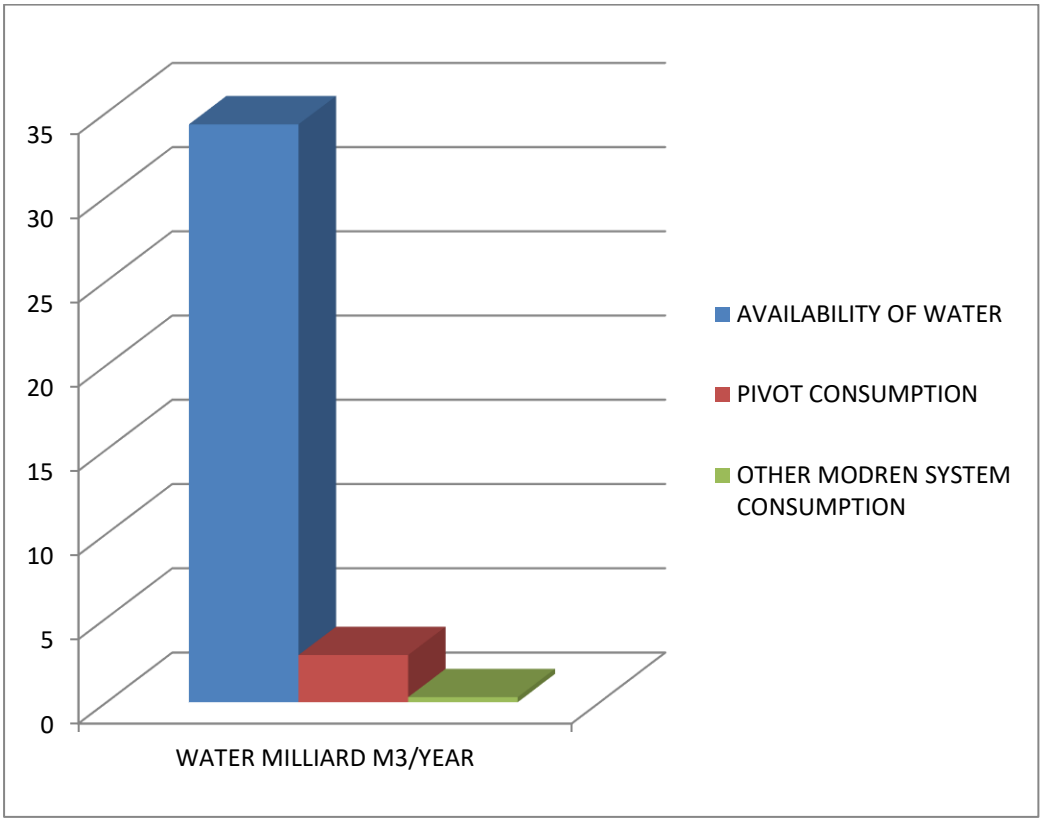
Fig of water resources in Sudan



Blat of water availability and consumption in Sudan

NO	Water	Amount milliard m3/year
1	Available amount	34.3
2	Center pivot water consumption	2.8
3	Other modern irrigation system consumption	0.3

Fig of water availability and consumption in Sudan



Conclusions:

This study concluded to:

1. The center pivot irrigation system is appropriate selection in Sudan.
2. one unit of center pivot irrigation system consumes about 6532m^3 of water per day during 22 days per month.
3. The majority of power sources in Sudan for center pivot system using the diesel engine (80% of pivots), while the rest using general electricity and solar energy.
4. The cost of diesel is about 400USD per day for the engine pull from the river and 1000USD per day for the engine pull from the well, but the cost of electricity is about 200USD per day for one pivot.
5. The majority of center pivots grow fodder crops in addition to some other crops.

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