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Wind Power in Improving Foggarat Flows, Preserving Cereal Resources in Oasis and Pastoral Rangelands. Choice of Wind Turbine with Vertical Axis or Horizontal Axis

Research Article

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Summary

The comparative analysis of wind power installations in the horizontal and vertical type can in no way be related since their purposes are very different. Our interest is above all the application of innovative techniques to the agronomic sector by continuously perennial low powers. The lowering of the level of springs and the water table in the Adrar region means that more than 50% of the number of foggarats have dried up. By using wind turbines with low power and low rotation, well adapted and studied, a large part of the obstacles would be better accepted by the community of the ksours and a better preservation of the cereal resources (seeds) of the oases would be born.

We have observed that the improvement of vertical axis wind turbines as well as research in this field are essential. The extensive reflection on vertical axis wind turbines has forced us to deduce that the threshold imposed by Betz's law [1] for any type of wind sensor can be modified. Thus our objective is to find a possibility of exceeding this threshold by improving procedural techniques. It is in this context that our writing fits.

Keywords: Foggarats, Wind energy, Flow improvement, Vertical axis, Albia

Introduction

The idea of using wind turbines in Algeria does not date from today, it is old; the project was aborted following the independence of Algeria and the stock of wind turbines was sabotaged in 1961. For this, the idea today is to continue on the same path - with a more enlightened vision specific to the country - in order to grant this country what it hoped for: modern and adapted agriculture as well as industrialization adequate. Most of Algeria is made up of arid and semi-arid zones. The geographical and climatic data are conducive to a pastoral breeding activity than to an agricultural activity. Rangeland represents 20 million hectares against only 168,200 ha of arable land (PNDA). It is useful and our duty to take an interest in the "useful Sahara" and to propose alternative solutions, where agricultural development is unrealizable. Yet these neglected areas can be exploited at least in part by breeding and for this "useless Sahara", the choice is breeding or nothing. These "empty" areas are not deserted, they can at certain favorable times be a gathering place or passage for very large herds of camels. (CDARS Ouargla). Their need is clear: water. The solution is to draw, using appropriate devices, the optimum quantity of water (max 2 l/s) and to reinject the surplus into the well. The geographical position of Algeria requires us to think twice about the options for adopting wind turbines, those with a horizontal or vertical axis? This place, mainly and practically arid or semi-arid, located between the 17^{th} and the 35^{th} parallel is the seat of rotating winds. For these reasons, it makes sense to select the wind turbine that best suits the situation. Thus for the first fifty meters reliability is obtained by vertical axis wind turbines also rhyming with low powers given their performance. Their low rotation gives them less wear.

Beyond this height, it is preferable to focus on horizontal axis wind turbines given the stability of the wind direction and the option of marketing the resulting energy by injecting it into the public network. The comparative analysis of wind power installations in the horizontal and vertical type can in no way be related since their purposes are very different. Our interest is above all the application of innovative techniques to the agronomic sector by continuously perennial low powers. We observed that the improvement of vertical axis wind turbines is necessary, that research in this field is required and that a more enlightened and country-specific vision must be undertaken. The extensive reflection on vertical axis wind turbines has forced us to deduce that the threshold imposed by Betz's law [1] for any type of wind sensor can be modified. Thus our objective is to find a possibility of exceeding this threshold by improving procedural techniques figure 1.

Figure 1: Wind turbine cemetery: Stock of wind turbines south of Ouaragla sabotaged in.

Wind Energy

The power supplied by the wind turbine varies according to the cube of the wind speed: the choice of site is therefore crucial. As stipulated by Betz (pioneer of technologieswind turbines), the recovery of energy by the wind turbine depends on the slowing down of the fluid particles as they pass through it. This recovery is expressed by the difference of the quadratic wind speeds before and after the wind turbine $\upsilon_1^2 - \upsilon_2^2$. The slowing down results in a decrease in the fluid flow through the wind turbine and thus the recovered power will decrease. For this, the limit of 59.2% reflects the optimal energy percentage to be taken. To take all the energy from the wind, would imply its total stop (it's aberrant. Kind of a traffic jam in road traffic).

The First Device

The first device has been presented several times and is installed in five places. We content ourselves with giving a photo of the exhibition prototype and a photo in operation figure 2.

Figure 2: Eolienne à axe vertical de démonstration (prototype) et celle installée au voisinage de la vétérante d'ADRAR. (INRAA).

The Second Device

What if the wind turbine does not slow down the wind? It is on the basis of this assumption and observation that we are going to make proposals for new perspectives that may be profit-sharing. The innovation lies in the choice of airflow routing. t is a work carried out in collaboration with a foreign company of manufacture and construction of systems of use of ecological energies. It is a wind turbine based on a prefabricated construction. Three of these wind turbines are built in In Salah (1370 km south of Algiers); they are used to draw water. Their pumps operate pneumatically. The remaining two generate electrical current and conventional pumps are connected to them. The orientation of the blades is perpendicular and permanent to the flow of the wind. A strong dependence of the output power is observed considering the operation with the upstream and downstream wind. This system can be used as an independent source of electricity.

It is equipped with basic photovoltaic panels and includes:

Rotor from 1 to 5 kW;

200W photovoltaic panel; DC / AC converter, 220V-380V, 50 Hz power varying from 1 to 5 kW.

Basic Specifications

The characteristics are summarized in the following tables [Tables 1-3].

Table 1: Physical characteristics

Rotor diameter	2.5m
The height of the rotor	2.4m
The height of the mast (can be mounted directly on the roof of a building)	10m
Minimum wind speed	2m/s
Rated wind speed	5m/s
operating wind	2 - 40 m/s
Nominal power	1 – 5 kW
Sustainability	30 years
Return on investment	3 to 5 years
Guarantee	2 years

Table 2: Battery capacity

Battery capacity (Ah)			
Load (W)	120	190	240
200	10.4 a.m.	16.4 hours	20.7 hours
500	3.9h	6.5 hours	8.3 hours
800	2.4 hours	3.9h	5.0 hrs
1,100	1.5 hours	2.6 hours	3.6 hours

Table 3: Inventory of permanent foggarats in the wilaya of ADRAR

Inventory of Perennial Foggarats in the Wilaya of Adrar	
Number	915
Old flow (l/s)	3270
Current flow (l/s)	2,866
Annual flow m3 /year	90 379 495
Old length Km	1,211
Current Length Km	2,324
The number of dry foggarats is 478 in the same WILAYA (more than 50%)	

The Prototype

Use

At the level of the only wilaya of ADRAR, a census established by ANRH gave: Based on this observation, the various constraints that hinder the possibility of renovating, reviving and restoring the dead foggarats will be identified. It suffices to raise the level by a few centimeters at the level of the head well and this by using one or more vertical axis wind turbines. Some people engage in foggarat rehabilitation in more than one capacity, individually at Amguid in Temantit and in groups through local and regional projects. The creation of new agricultural spaces with a view to a better occupation of space would be born.

Conclusion

Installations without energy storage implied that the need for energy and the presence of wind energy were simultaneous. Low power devices (2 or 3 CV) will provide, with a wind of 6 meters per second, daily water flows of 200 cubic meters on average: 72,000 cubic meters per year; they allow the irrigation of 5 hectares per year, at the rate of 15,000 m3 of water per hectare and, by alternating the cultivated areas, the creation of cultivation areas of 10 hectares. For our application, we want the wind turbine to be placed in Adrar, Biskra or Ouargla where there is a wind of 5 m/s, that we can draw water from a depth less than H = 15m and that our need in water is of the order of 0.5 l/s. A quantity largely sufficient to satisfy around twenty herds of ten camels each per day and this for a wind coverage of only 42% corresponding to only 10 hours of wind. We would like to be able to multiply such installations in the South.

The areas where they could be established are unfortunately quite rare: they depend, first of all, of course, on the nature of the water resources in the subsoil and also on the nature of the land, its extent and its ability to receive irrigable crops. In addition, the installations require continuous monitoring and the presence of qualified specialists in agronomy. Wind power is not a factor of erosion, escorted, it improves the flow of foggarats and participates in the development of isolated or desert areas. It is very useful for pastoral routes as well as for the demarcation of territories. The wind turbine also serves as a rallying point and all for a low cost. In this step we gave an idea about the wind power in Algeria, its impact on the water-hungry cereal such as "the pharaoh" which produces 1400 grains per tillering. The only way to achieve this is to use an innovative agricultural technique called "feedback" consisting of "busting" the performance of wind turbines and exceeding the Betz threshold (and it is possible) or using superabsorbents. The last two proposals will be treated in the next writing.

Annexes I

The town of Tamentit is 12km south of Adrar (1543 km from Algiers) and is the largest oasis in Touat. It is classified as a humid region by UNESCO. Its creation dates from the pharaohs and the Copts were its inhabitants, its architects and the promoters of the idea of Fouggarats. HOUNOU (name of one of the Coptic gods) is one of the most famous Fouggarats of Tamentit; its role is to supply the Ksours with water. The number of his Ksours is 366; passengers are invited all year round and spend each day in a different Ksar.

Collecting a Kser requires up to five Fouggarats for adequate water supply (individual needs and irrigation).

A Fouggarat can reach 20 km in length, it is equipped with chimneys (access to the Fouggarat) a distance of about 10 m separates them. This gives us an idea of the power demand to raise the water level of the fouggarats [Annexe 1].

Annexes II

* HBA III / next to Babziz next to OA4 ** H.Ben Abdellah Albien/3PITONS

The 104 CT Albian boreholes in the Ouargla region total a flow rate of 4,416 l/s and the 41 CI boreholes provide a flow rate of 1,938 l/s [Annexe 2].

References

1. Betz: The maximum theoretical power recoverable by a wind sensor is equal to 16/27 of the incident power of the wind. This limit will be reached when the wind sensor slows the wind to 1/3 of its speed upstream of the wind turbine.

Annexe 1: Inventory of permanent foggarats in the wilaya of ADRAR

List of collection points (the 58 ksours of southern Adrar)			
1	El Mergueb	30	Lahmeur
2	Adrour	31	Mahfoud
3	Agil	32	Mehdia
4	Ait Messaoud	33	Mnacir
5	Antar	34	Moulay Ab Waheb
6	Azoua	35	Moulay El Arbi
7	Baamar	40	Takhfif
8	Bab Allah	41	Tamentit
9	Bahou	42	Taourit
10	beriche	43	Tidmaine
11	Bled Moulay Rchid	44	Tilloline Merabtin
12	Bouadj	45	Tilouline
13	Bouali	46	Tilouline
14	Bud	47	Timadanine
15	Boufadi	48	Tinourt
16	Bouyahya	49	TIT
17	Chbani	50	Titaouine Lakhras
18	Ejdid	51	Titawine
19	El Allouchia	52	Tiwririne
20	El Maharza	53	Tmasekht
21	El mansouria	54	Zagloo
22	Erg Fail	55	Zaouia
23	Fenoughil	56	Zaouit Bilal
24	Gaougaou	57	Zaouit-Reggani
25	Gasbet Molay Ali	58	Ztechikh
26	Gasbet Nadjar		
27	Ikis		
28	In Zeglouf		
29	In zegmir		
36	Ouled Arrousa		
37	Sidi El Bekri		
38	Sidi youssef		
39	Taberkane		

List of collection points (the 33 ksours of northern Adrar):	
1	Ain Glou
2	Amerrade
3	Augrout
4	Ayat
5	Badrian
6	Ben Talha
7	Bni Mehlale
8	cherouin
9	Deldoul
10	Elberka
11	Eliad
12	Elnerma
13	Essahla
14	Hemmad

15	Igasten
16	Kaberten
17	Ksar Kadour
18	Lemtarfa
19	Mansour
20	Massine
21	Ouled Abou
22	Ouled Ali
23	Ouled Said
24	Sane
25	Sid Abdullah
26	Talmine
27	Tassefaout
28	Tibergamine
29	Timimoune
30	Tinnerkuk
31	Tsabit
32	Yogurt
33	Zaouiet Debagh