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DESIGN AND FABRICATION OF WIND OPERATED WATER PUMP

RAJESH KUHITE[1]

[1]*Hod, Mechanical Dept. Kamptee Polytechnic Kamptee.*

Abstract - *In India, agriculture plays a vital role in development of food production. Groundwater pumping using electricity is the most prevalent mode of irrigation. Electricity tari foragriculture is low and is free in some states. This leads to multiple problems. Farmers tend to overuse water since electricity is cheap, leading to depletion of groundwater. Farmers also do not invest in efficient pump sets, thus increasing the electricity consumption. For every unit of energy supplied to a farmer, electricity companies face significant loses. Therefore high consumption by farmers leads to higher financial losses for electricity companies. This makes the electricity companies neglect the quality of supply to the farmers, which means that there are frequent power failures and long time to restore supply. Water supplies like wells, dugouts, rivers, canals and other ground water sources are used for agriculture. However, due to limited availability of power supplies or resources in rural areas where agriculture is major occupation of farmers, some alternate form of energy has to be used to supply water from the sources to a point of consumption. Unavailability of electricity is very common in rural areas of India, moreover load shedding also results in the unavailability of water at the consumption point as electric pump stops working in absence of power. Wind energy is an important source of renewable energy that can be an option in remote location where the electricity is not available. Wind is often used an energy to operate pumps and supply water to crop fields. Wind energy can be generated using windmills that provide mechanical energy that is used directly on machinery e.g. water pumps (mechanically wind operated).Vertical axis have the main shaft running. The main objective of our project is to design and fabricate a windmill for pumping water. In this project, we have used vertical axis multi blade wind turbine and single acting reciprocating pump. Windmill is attached to reciprocating pump through two bicycle disc. These discs are bolted and meshed with each other. The blade is placed outside the rim to get a better performance. The wind imposes two driving forces lift and drag on the blades of turbine. When these forces act on the blade, it rotates and this rotating blade converts rotary motion of windmill to reciprocating motion of pump. This is how the water is discharged. Apart from this, we also generate* electricity*. This is applicable in pumping of water for irrigation purpose.*

***Key Words*: Vertical Axis Windmill, Water Pumping Irrigation, Generator.**

1. INTRODUCTION

To begin with, more than 80% of the total water use in India is for irrigation, with the next biggest consumer (drinking water) using around 7%. But why bring in "electricity" as an issue .Most importantly because electricity is one of the major drivers of irrigation, though there are other drivers too. One can never understand any issue without looking at all the major dimensions (in more technical language, state variables!). Just as irrigation is a major dimension of the water conundrum, it is impossible to understand irrigation without also looking at electricity and in fact, a few more variables. Today, 'irrigation and electricity' is caught in a trap with no one having clear ideas on how to break the trap. Like all real-life problems, this issue has many dimensions in addition to the technical dimension and it is a worthy challenge for any of us to work on.

1.1 The multi-dimensional - trap

There are many dimensions to the trap that irrigation and electricity is caught in. I describe three – electricity, water and poverty. It becomes evident that all actors – farmers, electricity companies, state governments and society at large – are unhappy with each other and the trap they find themselves in.

1.2 Electricity Dimension

As noted before, groundwater pumping using electricity is the most prevalent mode of irrigation. Electricity tariff for agriculture is low and is free in some states. This leads to multiple problems. Farmers tend to overuse water since electricity is cheap, leading to depletion of groundwater. Farmers also do not invest in efficient pump sets, thus increasing the electricity consumption. For every unit of energy supplied to a farmer, electricity companies lose around ₹4-5. Therefore high consumption by farmers leads to higher financial losses for electricity companies. This makes the electricity companies neglect the quality of supply to the farmers, which means that there are frequent power failures and long time to restore supply.

2. Water Dimension

As mentioned in the previous section, cheap electricity leads to greater extraction of water. With deepening depth of wells, the quality of water suffers. Considering cheap availability of water and aided by price signals, farmers opt for water-intensive crops (sugarcane or rice) even in dry areas. There is competitive digging of bore wells, with each well going deeper than the other, hoping for better water yield. In most places where groundwater is scarce, this trend depletes the water table. Farmers end up spending a lot of money in digging and repairing wells or pumps, though expenditure on electricity is low. The replenishable

groundwater resources have been estimated and the entire country has been classified by Central Ground Water Board (CGWB) into categories, namely: over-exploited, critical, semi critical and safe blocks, based on the net groundwater stock situation. According to CGWB, the number of over-exploited and critical blocks in India has increased significantly. Their total was 4% in year 1995, but has grown to 19% now. For many states with high percentage of critical districts/blocks, such as the Punjab and Rajasthan, annual draft of groundwater for the state as a whole, 90% of which is for agriculture, is much more than the annual replenishment of groundwater.

3. Poverty Dimension

Agrarian distress and farmer suicides are very much in the news. In the past two decades, there have been around 15,000 farmer suicides every year, sometimes as high as 18,000 per year. This works out to around 15% of all suicides and sometimes as high as 18%. Most suicides are due to high debts, caused by crop failure, repeated bore well digging, etc.

It is to be noted that nearly 85% of the land holdings are marginal or small (less than 2 hectares) and these farmers own 63% of the wells. Small farmers are typically in a tight financial situation (with limited access to low interest credit and high discount rates) and will not be keen to invest in efficiency or pump protection devices. State governments provide subsidy for power supply, irrigation, etc., but our studies show that a high amount of this subsidy is unfortunately cornered by big farmers, due to the faulty design in subsidy policy. Another shocking point to note is that around 10,000 people die every year due to electricity shocks, most of them in rural areas, and most of them farmers. This is due to poor enforcement of safety norms by the electricity companies, poor quality of supply and risk taking by the people. In these times of growing penetration of high technology and plans for smart cities, this is indeed a matter of concern.

With the rise in understanding of global warming due to Carbon Dioxide produced by burning of fuels, the use of natural energy resource is coming into picture. Now a days researcher have started to concentrate their studies to develop ways of using natural sources like wind, hydro, solar energy to produce electricity and providing power to the various power consuming units. The use of wind mills is one of the most popular methods of using the energy from natural source. It is clear that 'Irrigation and Electricity' is caught in an ever-tightening trap due to neglect and half-hearted single dimensional efforts. The situation is indeed grim, but it is heartening to see that there are many people doing many things to improve the situation. A concerted, sensitive effort with an integrated, consensus-building approach can surely solve the problem. To illustrate this, I mention some of the initiatives under way and my suggestions on how to improve on them.

The main objective of our project is to build vertical axis wind turbine in which wind energy can be used to run centrifugal pump by converting it into mechanical energy. It is used directly for pumping as well as to produce electricity. Rotational energy by means of vanes called blade. In meteorology, winds are often referred to according to their strength, and the direction from which the wind is blowing. Short bursts of high speed wind are termed gusts. Strong winds of intermediate duration (around one minute) are termed squalls. Long-duration winds have various names associated with their average strength, such as breeze, gale, storm, hurricane and typhoon. Wind occurs on a range of scales, from thunderstorm flows lasting tens of minutes, to local breezes generated by heating of land surfaces and lasting a few hours, to global winds resulting from the difference in absorption of solar energy between the climate zones on earth. The two main causes of large-scale atmospheric circulation are the differential heating between the equator and the poles, and the rotation of the planet (Carioles)

1.2 Objectives:

1) To design wind operated water lifting (mechanically) pump without using electricity and fossil fuel.
2) For pumping surface water from lake, well and canal used in irrigation purpose.
3) The implementation of such model which have low cost and will be eco-friendly.
4) For pumping surface water from lake, well and canal used in irrigation purpose.

1.3 Need of Windmill

In today's world we need to move away from burning limited fossil fuel reserves to more sustainable and renewable sources of energy. Wind power is a well proven and cost effective technology and expected to be the main way in which industry responds to the government's targets- so becoming and important source of electricity and water pumping in years to come.

There are two primary physical principles by which energy can be extracted from wind; these are through the creation of either lift or drag force.

Drag forces provide the most obvious means of propulsion, these being the forces felt by a person (or object) exposed to the wind. Lift forces are the most efficient means of propulsion but being more subtle than drag forces are not so well understood.

The basic features that characterise lift and drag are:

1) Drag is in the direction of air flow.
2) Lift is perpendicular to the direction of air flow.
3) Generation of lift always causes a certain amount of drag to be developed.

4) With a good aerofoil, the lift produced can be more than thirty times greater than drag.

Fig -1: Vertical Axis Wind Mill

2. Constructional detail:

Stand is of adjustable type. A 4-way connector is secured on stand. On the horizontal side of it a vertical gear is attached by a shaft which will be rotated using bearing. On the top of this connector another horizontal gear is attached which is then connected to hub of a bicycle rim with tyres. The rim is then connected to other rim which is without spoke by four thin plates.

2.1) Assembly of wind foil:

To install wind foils drilled 4 holes big enough to fit a bicycle spoke into-in both bicycle wheel rims. The spokes are inserted from inside of rim and secured with fastener

2.3) Making of gear:

Gears so used are not actually a gear but a disc brake we turned them into gears by adding bolts into every other holes of brakes.

2.4) Assembly of Reciprocating pump:

On a vertical gear a bearing is fit which joined a pipe via elbow, that pipe is placed on top of T pipe. Among the remaining side of T Pipe one is attached to storage tank and other is used for water discharge.

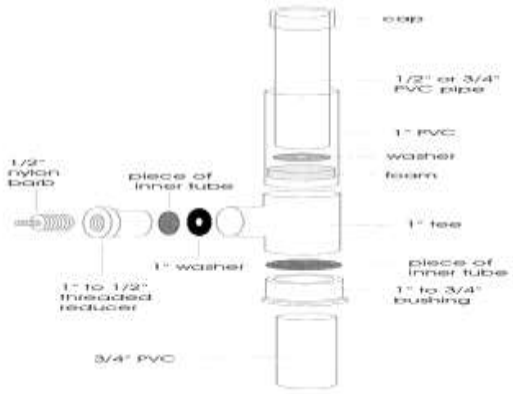

Fig.2 Reciprocating pump

2.5) Generator:-

It is incorporated on the bottom rim, for the generation of power a DC Generator is used.

Specification of windmill

Sr. no.	Parts	Material	Dim.
1	Stand	Mild steel	L=200 cm
2	Wind foil	PVC	D=30cm L=50cm
3	Reciprocating pump	PVC	L=100cm
4	Gear	Stainless Steel	D=16cm
5	Rim	Mild steel	D=60cm

3. Working:-

Wind energy causes rotation of wind foil thus horizontal gear rotates in anticlockwise direction thereby vertical gear rotates in clockwise direction. Gears are placed perpendicular to each other hence functions as bevel gear. This rotation of gear causes reciprocation in pump and therefore water is sucks from storage tank and discharge takes place. The energy in the wind turns two or three propeller –like blades around a rotor. The rotor is connected to main shaft, which spin a generator to create electricity.

4. Conclusion:-

Wind energy is a renewable energy resource. It reduces green house gas emission thus it offers a sustainable option in the pursuit of renewable energy. The biggest wind turbines generate enough electricity in a year (about 12 megawatt-hours) to supply about 600 U.S. homes. Vertical axis windmill is generally can work at much lower speed of wind hence they are more efficient in producing power. This windmill design has less weight and less mechanical linkages which reduces losses.

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