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Twin Boreholes: Solution to Irrigation Problem In Masama Area Of Dambo Dam,Kazaure Local Government, Jigawa

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Abstract

Masama is an area located about two kilometers (2km) in the northern part of Dambo dam in Kazaure Local Government area of Jigawa State. Boreholes drilled in the area by jetting methods cannot exceed a depth of 8. 2 - 9m depth. This is as a result of bedrock reached at this depth. In this research, a borehole drilled to 9m depth was found to have a water discharge rate of 1.31 litres per second. This rate is inadequate for irrigation. Then an identical borehole were drilled two meters (2m) away from the former, which was tested to have a discharge of 1.47 litres per second, still not enough for irrigation. To increase the discharge, the two boreholes (now called "Twin boreholes") were connected to the same pump and the discharge was found to be 2.78 liters per second, which is very encouraging and adequate for good, reliable and effective irrigation in the locality. The result of this research work reveals that irrigation can now be possible in Masama using twin boreholes. The farmers of the area can now farm all year round and this would curtail or eliminate poverty and boost food security in Masama, Kazaure and Jigawa state as a whole. The findings of the research work can still be improved production by using other sources of power for maximum profit, easy maintenance and usage.

INTRODUCTION

The success of any agriculture system whether it is poultry, crop production, livestock, or irrigation solely depends on the availability of good water supply. Nigerian government on its effort to burst agriculture imposes export ban on agricultural products that can be produced in the country(Osazuwa-Peters, 2021). Masama is an area located at the northern part of Dambo dam of Kazaure Local Government Area in Jigawa State.Boreholes drilled in this area cannot exceed nine (9m) meters depth without reaaching a bedrock. This may be the reason for having low water discharge rate, which make irrigation in Masama unreliable. Sequel to the low discharge rate of drilled wells, an attemp was made to get a lasting solution to the lingering problem by drilling two wells and connecting them together (refers to as twin boreholes) to draw water from them using a single water pump. The designed and constructed system used in Masama area is proof to be effective for irrigation as the discharge rate is 2. 78 litres, which is the summasion of the twin boreholes discharge rates. This isvery adequate for moderate type of irrigation in Masama and its surroundings. The twin boreholes system was used successifully to irrigate an acre of rice farm in the area. Each of the twin boreholes has discharge rate of 1.31 l/s and 1.47 l/s. Adding the discharge rates of the two boreholes a total of 2.78 l/s discharge rate of water is obtained and is sufficient for

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irrigation in the area. Groundwater is undeniably a very important freshwater resource for drinking water supply, irrigation and industry, in addition to its natural role of sustaining river flow and aquatic ecosystems. Sustainable groundwater development is fundamental in order to provide universal access to safe drinking water(Huang et al., 2021). The lack of understanding of groundwater resources in much of the societies undermines its potential to contribute to poverty reduction and economic development, and threatens its environmental sustainability (Somalia Wash Cluster, 2020). In the process of explaining the construction of borehole some terms will be use. Therefore, these terms need to be addressed. The term 'unconfined' refers to an aquifer within which the water is open to atmospheric pressure: the so-called piezometric surface (pressure head level) is the same as the static water level (SWL) in the borehole. A borehole extracts water from an unconfined sandstone aquifer, the SWL of which is somewhat lower than the level of flow in the river. This sandstone aquifer is in a good catchment area because of recharge from the river(Sinha, 2021).

A 'confined' aquifer may hold groundwater under greater pressure, so that when punctured by a borehole, the SWL rises to the higher piezometric level. If the piezometric surface happens to be above ground level (which is not uncommon), water will flow out of the borehole by itself. This is known as 'artesian water'. Deep borehole intersects the sandstone aquifer and a deeper confined aquifer in fissured limestone; because of overpressure in the limestone aquifer. The limestone aquifer may have no source of replenishment; so the water in it is ancient, or 'fossil,' and could be exhausted if over-exploited(Mishra, 2023). A water borehole is not just a hole in the ground. It has to be properly designed, professionally constructed and carefully drilled. Boreholes for extracting water consist essentially of a vertically drilled hole, a strong lining to prevent collapse of the walls, which includes a means of allowing clean water to enter the borehole space (screen), surface protection, and a means of extracting water. A water jetting method of drilling (Figure 1) is a system whereby water is pumped down a string of rods from which it emerges as a jet that cuts into the formation. Drilling may be aided by rotating the jet or by moving it up and down in the hole. Cuttings are washed out of the borehole by the circulating water. Again, jetting is useful only in unconsolidated formations and only down to relatively shallow depths, and would have to be halted if a boulder is encountered as in the case of Masama, where a machine drilling rig is used to penetrate the bedrock up to 80m.

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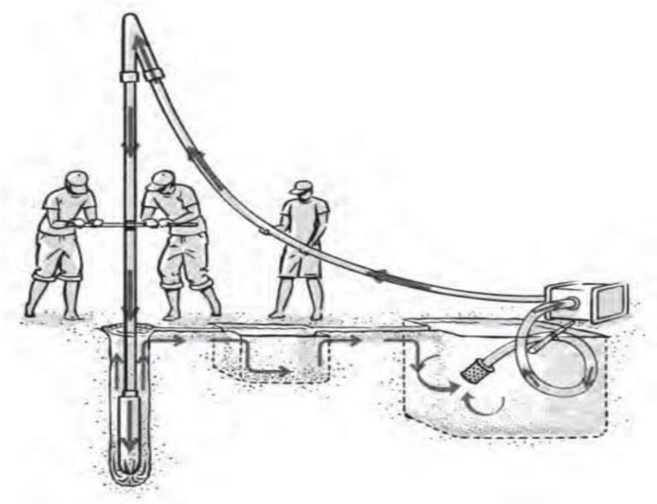

Fig. 1 Hand jetting drilling method

Well-jetting is a simple technique for inserting small diameter well screens into shallow sandy water bearing aquifers. Unlike conventional boreholes which require heavy drilling equipment, well-jetting is carried out by hand using just one or two portable engine pumps to produce a powerful jet of water(Divya & Joji, 2023). Well-jetting is particularly suitable for sandy river beds, wadis or river banks where water can be found close to the surface. In some flood plains it is possible to jet through more than 30 m of silt before reaching a sandy aquifer but most commonly well-jetting penetrates no more than 6 or 10 meters(Divya & Joji, 2023). The finding of the study leads to fabricating/constructing of a system that has contributed immensely towards the development of agriculture with particular reference to irrigation system in Masama area of Dambo Dam.It also create employment and boost the economic standard of the indigenes, thereby reducing poverty and crime in the locality.

STATEMENT OF THE PROBLEM

Masama is an area about two kilometers (2km) by the northern part of Dambo dam in Kazaure Local Government Area of Jigawa State. The area is very vast and fertile which make it very good for irrigation farming.But due to non availibility of enough water from the drilled boreholes, the practice of irrigation become impossible using the boreholes. Borehole drilling in this area is restricted to a depth of 9m below the ground level due to the presence of bedrock layer at the distance mentioned. The discharge rate of the drilled boreholes when tested is found to be between 1.31 l/s to 1.47 l/s which is not enough to be use for good irrigation practice. The discharge rate of any borehole in sudan savannah which the area falls under must atleast reached 1.0 to 5.0 litres/second to be moderately sufficient for irrigation practice(Mohammed, Szabo, & Szűcs, 2023). Once a Drilling rig machine is used to drill a boreholein the area the well's depth when measured is found to be 80m deep and the static water level is 36m below the ground surface. The

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data above indicates that normal water pumps that are availible in the Nigerian markets cannot be used to draw water from the distance of 36m which is above their suction heads (i.e 9m). The system is not practicable in this locality, especially when economic viability, easy maintenance, means of pumping and capital required are of paramount considerations. The research work is carried out to find a lasting solution to the mentioned problems.

PURPOSE OF THE STUDY

The main purpose of the study is to find a lasting solution to the problem of low yield/low discharge rate and high static water level of the drilled boreholes in Masama area of Dambo dam. Specifically the study will seek to achieve the following objectives:-

i. Find out the discharge rate of drilled borehole number one.
ii. Find out the discharge rate of drilled borehole number two.
iii. Find out the discharge rate of twin boreholes.
iv. Find out if the combined discharge rates of the twin boreholes can be sufficient for irrigation farming

SIGNIFANCE OF THE STUDY

Nigerian government in its effort to boost agriculture in the country introduces a lot of policies such as anchor borrowers, survival funds etc; which if properly implemented will lead to achieving food security,poverty eradication and reduction in the rate of crime in the nation(Lokpobiri, 2019). Federal Ministry of Agriculture can use the findings of the research work in the policies implementations and it can also serve as a guide in designing future policies, especially within the study area. The finding of the study can also be useful to the Jigawa State and Federal Ministry of Agriculture in achieving food production and security in the coutry. The finding of the study have direct impact on the farmers, as they provide means of practicing irrigation in Masama using boreholes which was not in existance before the execution of the research work. This will lead to job creation and reduction of poverty level of the farmers in the area(Diallo & Wouterse, 2023).The economic situation of people in Masama will be boosted due to the increase in business opportunities as a result of the findings of this study.

RESEARCH DESIGN

To achieve reliable, effective and profitable irrigation a lot of factors must to be put into consideration.Among them is designing the system. The first and crucial aspect is the designing the source of water. In this case the following should be put into cognisance:

a. Boreholes
b. Wiring pipes
c. Pumping Unit

Borehole:-the twin boreholes in Masama were drilled using manual jetting method, two (2) PVC casings, one (1) PVC screen and three (3) bags of gravels were used. The PVC casing used is four

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inches (4”) in diameter, the 3m by length and the grade of the pipes is ten bars (10b). The measurement and grade of PVC screen is the same as of the PVC casings.

Wiring Pipes:- Two (2) wiring pipes ($1^1/_4$”x 9m) pressure pipes each, one (1) T-Join ($1^1/_4$”x$1^1/_4$” x 2”), one (1) PVC pipe (2” x 40mm) pressure and two (2) PVC elbows ($1^1/_4$”) were used in the piping system. The pipes and accessories were used to connect the centrifugal water pump with the twin boreholes for water pumping (delivery) to be achieved.

Pumping Unit:- A two (2”) in diameter PW20X gasoline powered engine centrifugal water pump is used for suction and delivery of the water from the boreholes to the needed point for irrigation in the farm.

BOREHOLE CONSTRUCTION

The borehole was constructed using the jetting method, the depth of the well is nine (9m) meters and the diameter is four inches (4”). Two (2) PVC casings were used and one (1) PVC screen was also used at the bottom of the well, the last bottom screen was sealed at the lowest end although it is not necessarily required because at this point a bedrock is reached which make further jetting not possible.

Borehole 1: During the drilling process of this well (Figure 2), it was revealed that, from the start down to 6mdepth are within confined aquifer and from 6m down to 9m are unconfined aquifers.

Fig. 2: **Drilled borehole number one**

Gravel is put on the outer circumference of the screen PVC pipe to fill the space that is between drilled well and the screen up to the vertical height of 3m.The remaining 6m is filled with sand/mud to prevent water contamination. The tested discharge rate of this borehole is 1.31 l/s which make it unsuitable for irrigation.

Borehole 2

The total depth of this borehole (Figure 3) is also 9m as in the drilled borehole number one, the

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confined aquifer is from start down to 6m depth below the ground surface, the remaining 3m is the unconfined aquifer where the ground water of the borehole is flowing.

Fig. 3 Drilled borehole number two

Two (2) PVC casings and one (1) screen pipe were used in the borehole construction. Three (3) bags of gravels are used to fill the space between the wall of the drilled well and the screen pipe in order to allow free circulation of water into the pipe and prevent unwanted particles from getting access to the unconfined aquifer of the borehole well. The remaining 6m of the confined aquifer were filled with sand/mud for the purpose of preventing any contaminants from the top ground surface from entering the unconfined aquifer. The tested borehole produces an aquifer yield/discharge rate of 1.47 l/s which make it not adequate for reliable irrigation practice too.

Twin Boreholes

The aquifer production/discharge rates data obtained from the two boreholes (i.e borehole 1 &2) indicates that, when the two rates were combined the result will provide a discharge rate that is sufficient for irrigation system in Masama. Since the two boreholes were connected together using piping system used in drawing (suction head) water from the two wells and deliver same to needed area for irrigation

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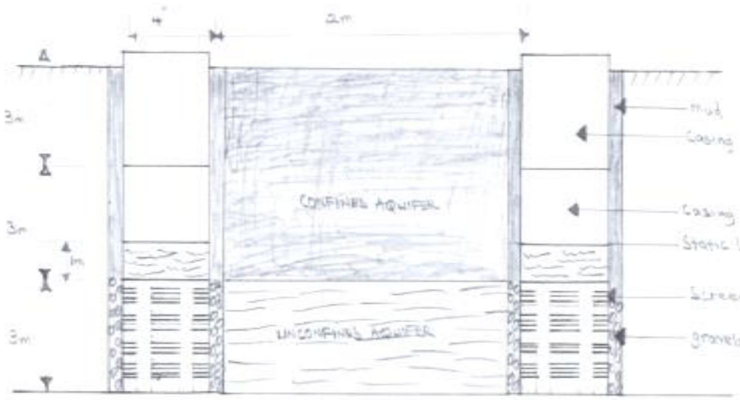

Fig. 4 Twin boreholes

The boreholes were drilled in such away that the distance between them is 2m apart, this is for the purpose of preventing deflection among them, which enable single centrifugal water pump to be used.

PIPING

In the process of piping (Figure 5), two (2) pressure pipes ($1^1/_4$" x 1000mm), two (2) pressure pipes ($1^1/_4$" x 7000mm) plus two (2) pvc elbows ($1^1/_4$") and one (1) PVC T- joint ($1^1/_4$"x $1^1/_4$" x 2'') are required for connecting the centrifugal pump and the twin boreholes together for achieving discharge rates that is enough and sufficient for moderate irrigation. This piping and connections enable the boreholes to join together and use a single pump to draw water from the twin wells, which leads to getting discharge of 2.78 l/s from them as adequate for irrigation in Masama.

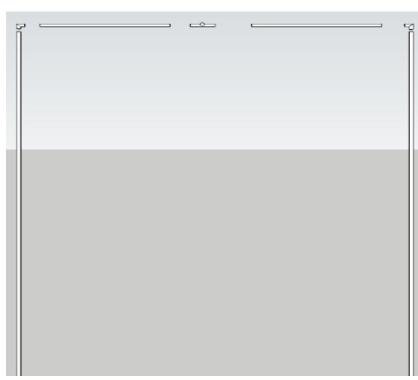

Fig. 5 Exploded wiring system

The above exploded drawing shows the items needed and how they will be connected/assembled for the purpose of attaining suction and delivery of the water from the twin wells by the pump.

ASSEMBLY/CONNECTION

Figure 6 indicates the items assembly and the manner in which the pump was used to achieve the

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purpose for which it is meant to accomplish. The pump used in the system is 2'' diameter with reference no. WP20X. In the next research it is hope that another source or mean of powering the pump would be undertaking for improving, increasing and better way of overall output.

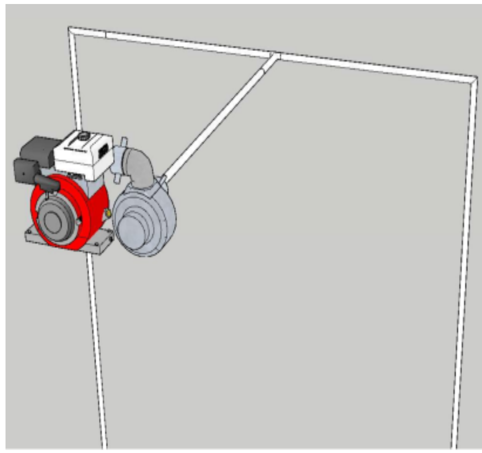

Fig. 6 Assembled Wiring system

PUMPING/DELIVERY

Horizontal centrifugal (Figure 7), pumps are the most common in irrigation systems. They are generally less costly, require less maintenance, and are easier to install and more accessible for inspection and maintenance than a vertical centrifugal.

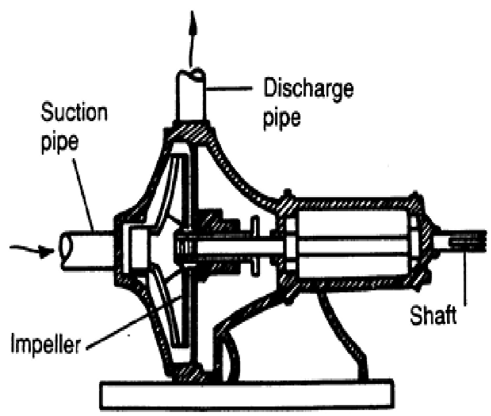

Fig. 7 Horizontal centrifugal pump (source)

Figure 8indicates how the completed system is represented, the position of each item/unit is shown. The pump is used to draw water from the boreholes through pipes wiring and coupling of other plumbing accessories sizes of the wiring pipes that were inserted into the wells were reduced to achieve maximum total head of the pump. T – Joint is made in such a way that the two (2) opposite openings were measured $1^{1}/_{4}$''each, which make it possible for the reduction to be effected. The other opening is 2'' coupled to the pump.

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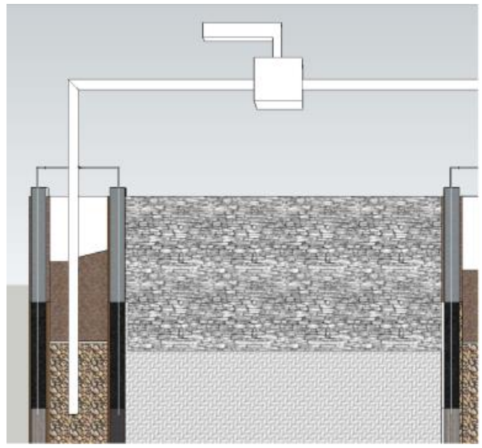

Fig. 8 Twin boreholes delivery system

RESULT

Borehole number one produces an aquifer yield of 1.31 litres/s. From the data obtained that discharge rate of any borehole in Sudan savanna must produce a volume of water between 1.0 --- 5.0 liters in one second before it is regarded viable for moderate irrigation in the region. Since Masama falls under Sudan savanna and the volume is more toward the lowest yield therefore this rate is not sufficient for irrigation.

Well number two aquifer production rate is 1.47 litres per second. The same applies to this borehole, the yield is not enough for irrigation in Masama area. The tested discharge rate of the twin boreholes was found to be 2.78 litres per second. Going by the reference document that a yield of 1.0 --- 5.0 liters per second in Sudan savanna can be regarded as moderate for irrigation in the region and the production yield of the combined boreholes is toward the high level of the moderate, therefore it can be used for moderate irrigation in the locality.

CONCLUSION

Masama area is very vast and very fertile, which make it good for any type of agriculture, especially irrigation system. Agricultural activities only take place during rainy season, this is due to low discharge rate and very high distance of static water level of the drilled boreholes in the locations. The finding of the study reveals that irrigation system can be practice all year round, this is made possible by drilling two boreholes at a distance of 2m away and connecting the together using pipes and other plumbing accessories to produce aquifer yield of 2.47 litres of water in one second which is adequate for moderate irrigation in the locality and neighboring settlements. The system is very reliable, effective and economical for moderate agricultural activities. The outcome of the study can be adopted to increase food production, security and profitable level of the irrigation system in the area of the study. This can be achieved by proving more economical, reliable, efficient and easy handling source of power and other activities that can boost production of agricultural production in the domain.

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RECOMMENDATIONS/SUGGESTIONS

Some recommendations which if considered and implemented may yield good results are hereby submitted:

1. Jigawa State Government should invest more for the mass production of farm produce from this irrigation system in Masama and other areas that have similar problems. This will create jobs and reduce unemployment.
2. Jigawa State Government in collaboration with Kazaure Local Government can use the services of their drilling personnel's for mass drilling of the boreholes and give them as loans at subsidized rate to make all potential farmers embrace the programme, especially as there are numerous agricultural programmes introduced by Government.A good example among them is anchor borrower for civil servants in the State.

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