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# Geophysical Methods, A Foundation for the Study of Drinking Water Supply (Case of the City of Menkao)

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**Abstract:- The water supply in the outlying zones of the city of Kinshasa is becoming a worrying problem these days because the population living in these zones suffer from lack of water or even from poor quality water from well drilling. The problem is that the engineers who do the drilling do not carry out geophysical studies before proceeding to drill in the earth's crust in order to make the right choice of the potential water reservoir located in the deep layers of the earth. Thus, this present work will help to locate, in the city of Menkao, the layer containing a good reservoir of water thanks to the AIDU Prospecting device which is a cutting-edge technology currently in the field of water prospecting. The choice of the pump that will bring the water up to the tank located at a certain distance above the ground will depend on the power required for the pumping, the actual flow rate and the total head of the installation. The energy needed to operate the system will come from a photovoltaic generator with 42 solar panels of 260 WC/24 V.**

***Keywords:-*** *Methods, Geophysics, Supply, Water, AIDU*

## I. INTRODUCTION

The problem of drinking water supply has become a general case lately in many cities around the world. The city of Kinshasa is not spared, especially in its most remote neighborhoods. However, the population living in these neighborhoods faces great difficulties related to water challenges, thus resorting to water from boreholes or manually dug wells. Today, well of water is used much more in several areas of Kinshasa. However, the problem that arises is that of boreholes that do not meet the standards, not only in terms of quality but also the quantity of water necessary for the needs of the City. This Complaint is often due to poor field prospecting studies or pumping interruptions caused by untimely power cuts or even by lack of emergency energy sources such as the generator for a certain class of men who is privileged to have it.

The use of the photovoltaic pumping system therefore appears to be an ideal solution for these types of neighborhoods and more specifically in the Menkao City which is the area interesting our field of study. This present study makes it possible to provide a valid, sustainable and well-adapted solution to local conditions for the supply of drinking water in a continuous manner in order to improve the population life quality as for as this city in concern. The justification of the complaints recorded by the population, which increasingly observes the reduction in the quality of the drilling water, is due to the negligence of the engineers who work on the drilling system. Most of these engineers work without reference to geophysical methods in order to locate the deep layers containing the potential reservoirs of drinking water to calculate the power required to bring the water up to the water tower by means of appropriate methods.

For this reason, in this study, we will use a prospecting system called "AIDU prospecting" which is a cutting-edge technology in the prospecting study, especially in mountainous regions such as the city of Menkao. This new technology is a geophysical method used to prospect the subsoil and the setting of the device depends on what one is looking for, either a source rock, a precious stone or even a compressible or incompressible fluid. In our case, we will use this technology to identify the layers of the subsoil that contain drinking water reservoirs in quantities that can be used for long periods. Then, we will analyze the photovoltaic system capable of supplying drinking water to the city of Menkao. The choice of the pump which will bring the water up to the tank located at a certain distance above the ground will depend on factors such as: the power required for the pumping, the real flow rate and the total manometric head of the instalation.

## II. SEARCH AREA AND METHODS

### *A. Search Area*

Our research area is located in the Menkao City located in the commune of Maluku, between the city of Guma and the city of Panoka, in the district of Tshangu, city of Kinshasa.

The city of Menkao extends over a perimeter of 8.7 km and has an area of 2.8 km$^2$ without taking into account green spaces (uninhabited areas) or 0.027% of the total area of the municipality of Maluku. The image in Fig.(1) represents the Map of the Menkao City which is our research area.

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Fig 1 Map of Menkao City

The relief of the Menkao City consists essentially of a steep hill at an altitude of 1201.38 m (Flouriot, 2005).

The city of Menkao is built on sandy soil with low water retention capacity and is therefore of marginal use for agricultural activities. The climate is tropical, hot and humid. It includes the rainy season lasting 8 months, from mid-August to mid-May; and the 3-month dry season which runs from mid-May to mid-August.

The average annual temperature is 25.3°C and it is influenced by two major wind currents that blow throughout the year in the area. These are the trade winds, very hot and dry, coming from the North-East and a very humid equatorial current, coming from the East. Annual precipitation is around 1390.9 mm/year (METELSAT, 2022). There is no watercourse that crosses the city of Menkao.

*B. Methods and Materials*

The implementation of a simplified drinking water supply system requires several studies beforehand, in particular geophysical studies, the energy system and the sizing of the water supply system.

Thus, to carry out this study, we will collect data on the ground and we will move on to the analysis of various data, in particular those obtained by geophysical prospecting and those from the field survey. The investigation comprises two phases: the first phase concerns the statistics of the population of the Menkao district and the second phase relates to the sizing of the water tower as well as the energy power that can promote the water supply.

The materials used to achieve our objective in this study are:

- A geophysical prospecting system testing the deep layers of the globe land called “AIDU prospecting”;
- An android mobile phone;
- A GARMIN extress 10 GPS;

## III. DATA ANALYSIS

*A. Beneficiary Population*

The beneficiary population is not only made up of the inhabitants of the city of Menkao but also that of surrounding cities who move to Menkao on market days.

However, according to data from the city chief's office, the population of Menkao is experiencing a very high density with an increasing evolution as shown in table (1), statistics taken for a period of 5 years.

Table 1 Evolution of the Population of Menkao

| N° | Year | Population |
|---|---|---|
| 1 | 2017 | 204 |
| 2 | 2018 | 384 |
| 3 | 2019 | 408 |
| 4 | 2020 | 453 |
| 5 | 2021 | 487 |

(Source: Office of the Chief of Neighborhood, 2022) for 5 Years

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To calculate the growth of the population, it is necessary to use the mathematical method known as "Method of compound interest" which assumes a geometric growth due to the fact that the growth rate of the expanding population is assumed to be constant. (Ouedraogo, 2016). This method is given by the formula:

$$Pn = P0\ (1 + r)n \quad (1)$$

With :

Pn: Population of the future year
P0: Population of the initial year
R: Growth rate (%)
N: Number of years of concerned period

However, knowing the estimated population in 2021, we can calculate the population of Menkao from 2022 to 2032, ten years with a growth rate of 3.14% per year, applicable for sanitation studies in Kinshasa (Caroline, 2021) .

Thus, to calculate the population in 2022, we have:

P2022 = P2021 (1 + 0.0314)1 = 487 (1 + 0.0314)1 = 502.29 = 503 inhabitants

The number of inhabitants of this region in 2022 is estimated at 503 inhabitants.

In 10 years the population will experience a gradual increase as shown in Table(2).

Table 2 Demographic Evolution of the Menkao City for 10 Years.

| Year | 2022 | 2027 | 2032 |
|---|---|---|---|
| r (%) | 0.0314 | 0.0314 | 0.0314 |
| Population | 503 | 588 | 686 |

The curve in Fig.(2) shows how the population of Menkao is increasing from 2022 to 2032.

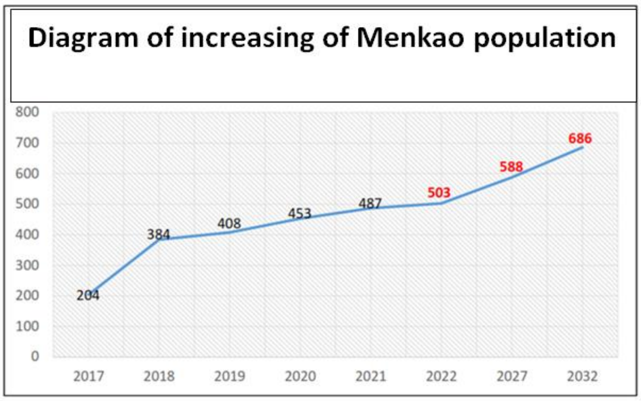


Fig 2 Diagram of Evolution of the Menkao population

The growth of the population of Menkao is increasing starting from a number of 204 inhabitants in 2017, 503 in 2022 and the projection in 10 years shows that the population will be able to reach the number of 686 inhabitants. For this purpose, the water reservoir that must be provided in this city, must take into account this growing increase in population. Thus, the water tower will be built according to the population of 2030 to avoid new expenses in the following 10 years.

*B. Geophysical Data*

- *Prospecting Data*

The establishment of a Simplified Drinking Water Supply System (AEPS) (Zeo, 2020), is accompanied by the construction of a borehole which will be used to supply the system (Zoungrana, 2003). Drilling must be preceded by geophysical prospecting to precisely locate inner layers of the earth containing an inexhaustible drinking water reservoir. The geophysical device used to facilitate the task of this study is the AIDU Prospecting, a new technique which is at the cutting edge of technology with regard to underground studies.

This terrestrial environment detection device called TEDD1 in acronym, will be connected to the mobile phone via the internet connection. Once the device is turned on, the AIDU prospecting application automatically displays on the phone screen and using Bluetooth while activating the phone's GPS to have the exact information of where the measurements are being taken. . The following Fig.(3) represents the AIDU prospecting device.

Fig 3 The AIDU Prospecting Device (https://www.aiduny.com, 12/05/2023)

With this device, groundwater studies can be done only as well as lot of information about the rock formation in the deep layers of the earth can be obtained at the same time. All this information is obtained in a few minutes and several measurements can be taken by a single person in a few time.

- *Determining the Depth of the Aquifer*

The determination of the depth of the groundwater table by the use of the AIDU prospecting, will contribute to make the choice on the potential layer of the ground containing the quantity and the quality of exploitable water. This parameter is essential to determine the depth of the borehole in order to avoid supplying either poor quality of water or in insufficient quantity.

In a nutshell, only one sounding was carried out from this investigation. Thus, the good result was found between 97 and 100 m depth as figures in Table (3).

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Table 3 Data Prospecting from AIDU

ADMT1_800HT2 ROTATE SCREEN

line number Sarah1

Electricity A - B 100 % Drafting X-coordinates 10

| | -10 | -20 | -30 | -40 |
|---|---|---|---|---|
| 0 | 0,129 | 0,255 | 0,499 | 1,346 |
| 10 | 0,001 | 0,244 | 0,503 | 1,328 |
| 20 | 0,002 | 0,256 | 0,508 | 1,393 |
| 30 | 0,001 | 0,259 | 0,532 | 1,376 |
| 40 | 0,001 | 0,245 | 0,502 | 1,351 |
| 50 | 0,002 | 0,251 | 0,507 | 1,396 |
| 60 | 0,001 | 0,254 | 0,531 | 1,488 |
| 70 | 0,006 | 0,254 | 0,523 | 1,462 |
| 80 | 0,001 | 0,253 | 0,513 | 1,379 |
| 90 | 0,002 | 0,279 | 0,551 | 1,467 |
| 100 | 0,003 | 0,283 | 0,563 | 1,692 |
| 110 | 0,004 | 0,302 | 0,603 | 1,852 |

DELETE DRAW MEASURE

The Fig. (4) below represents the 2D and 3D images from different underground layers showing water reservoirs at different levels of the earth's crust that gives us possibilty to make choice on the potential water reservoir of this target area.

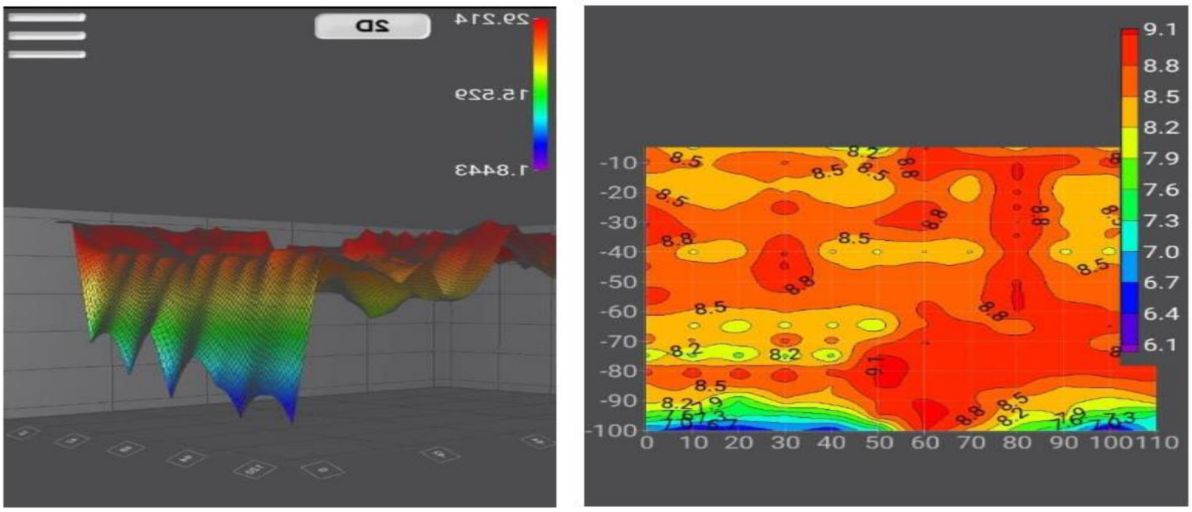


Fig 4 Images of the Different Underground Layers of Water in 2D and 3D (Menkao Zone)

By observing the Fig. (4), we see the presence of water at less than 100 meters. And this water is topped by hard rocks that are little or not permeable. This situation proves that we are in the presence of a captive aquifer. The choice of this water table is due to an important aspect of the environment which is this water protection against pollution. Hence the static level to be considered is 100 meters. With AIDU Prospecting, it is precisely easy to determine the depth at which the drilling can meet all the requirements to supply quality water to the population.

If we know in this way, the depth at which water can be drawn from deep layers of the earth, it will remain to determine the pumping system needed to collect and raise water from the internal reservoir of the earth to the water tower located at a certain height above the ground. Thus, for this study, the pumping system chosen is photovoltaic pumping.

### C. Sizing of the Photovoltaic Pumping System

The choice of the photovoltaic pumping system is for economic and environmental reasons. The operation is done over the sun where the drive motor is directly coupled to the photovoltaic generator. The storage of energy in the accumulators will therefore be replaced by the storage of water in the tanks with an autonomy of 3 days.

This study will use the method of analytical calculation for the dimensioning of our system.

➢ *Analytical Calculation Method*

For a good dimensioning of a PV pumping system, it would first be necessary assessed:

- *The need for water*
- *The total manometric head HMT*
- *The hydraulic energy required*
- *The choice of components.*

- *Assessment pf Water Needs*

According to the socio-economic feasibility study, the village of Menkao does not have neither any industries nor other significant public services, therefore the populations and the livestock are the only consumers to be taken into account for this study.

Determination of water needs for a given population depends basically depends on their way of living. Estimated water needs necessary for rural areas in poor countries are of the order of 25 liters per person but this value could be much lower compared to reality of the field (OUEDRAOGO, 2016). Thus, the volume of water can be calculated by the formula (3.1) such that;

$$V = 25 * Np \qquad 3.1$$

With **V**: Volume of water to consume per person/day

**$N_p$**: Number of people to take care of

As the total population of the Menkao district in 2032 (in 10 years) is estimated at 686 inhabitants, we can determine the volume of the water tower.

Thus the volume of water that will be consumed by the city of Menkao is:

$$V = 25 * 686 = 17150 \text{ littres par jour}$$

$$\boldsymbol{V = 17.15\ m3\ par\ jour} \qquad 3.2$$

Since the project will also concern certain populations from the surrounding towns who travel to Menkao on market days, we will add 15% to the calculated volume, which gives:

$$V_{15\%} = (17.15*15)/100 = 2.5727 \text{ m3 per day} \qquad 3.3$$

Hence, the total volume of the tank:

$$V_{tot} = 17.15 + 2.5722 = \boldsymbol{19.7225\ m3\ par\ jour} \qquad 3.4$$

So we could round this total volume to 20 $m^3$ per day

- *Choice of Tank*

In a photovoltaic pumping system over the sun, energy storage in the accumulators, as mentioned above, is replaced by the storage of water in the water tower to avoid an additional cost of the installation. Thus, the storage capacity of our tank will be 60 $m^3$, which will allow thus supplying the city with drinking water for 3 days even if there is bad weather or a malfunction of the system.

- *Manometric Height*

The total manometric height (TMH) is the force which allows the transport of water.

In the piping and its use at the highest point of the installation. She is expressed in meters. The total head is calculated according to the equation:

$$\boldsymbol{HMT = Hg + Pch} \qquad 3.5$$

Where Hg: is the geometric height between the pumped water table (dynamic level) and the utilization plane

With:

$$H_g = H_R + N_d \qquad 3.6$$

$H_R$ being the height from the ground surface to the tank and $N_d$ being the dynamic level

$$N_d = R_m + N_s$$

With $R_m$: the drawdown;

$N_s$: the static level; and $P_{ch}$: the head loss produced by the friction of the water on the walls of the pipes.

From where:

$$HMT = H_r + N_s + R_m + P_{ch} \qquad 3.7$$

- *Height from Ground to Tank ($H_r$)*

This is the distance from the ground to the place where the water will be stored, called the water tower, after pumping. And this height is estimated at 10 meters above the ground.

- *Determination of Drawdown ($R_m$)*

The drawdown of a well or borehole is the difference between the dynamic level ($N_d$) and the static level ($N_s$).

The dynamic level of the water table must be evaluated by pumping tests carried out on site. At a maximum quantity of water from the city equal to 60 $m^3$ of daily volume and if we consider that our pump should work for 8 hours a day then we will need a maximum flow of 7.5 $m^3$/h. In this case, we consider a drawdown height of

$$H_{ran} = R_m = 0.5 \text{ m.}$$

- *Calculation Of Hydraulic Energy Required*

To do solar pumping, you have to be able to raise a good quantity of water to a certain height, every day. This requires mechanical energy to power the system. The electrical energy that must supply the motor pump must take into account the efficiency of the pump. However for the present study, we will use the yield of 0.55%.

$$E_{Hydraulic} = \frac{\rho * g * HMT * V}{3600 * \eta} \quad 3.8$$

Where:

ρ: Density of water (1000 Kg/$m^3$)
g: Gravity (9.81 m/s2)
HMT: Total manometric head (m)
V: Volume of water (in $m^3$)
ŋ: Pump efficiency (0.55%)

From where,

$E_{Hydraulic}$ = 1000 X 9.81 X 110.526 X60/ 3600 X 0.55 = 32856.3655 Wh/day

Therefore, the hydraulic energy needed to provide for the water supply of this system in the district of Menkao is 32856.3655 Wh/d.

- *Pump Sizing*

The dimensioning of a pump can be carried out by taking into account curves of

Performance which show the operating characteristics of the latter in particular, specific values of sunshine, flow rate and manometric head.

- *Calculation of the Real Flow Required*

The real flow rate of a pump is the quantity of water which can supply during a given interval time.

Regarding to the study for the City of Menkao, the water tank having a volume (V) of 60 $m^3$ and it is considered that the pump should operate for 8 hours per day, the need for the real flow is:

$$Q_{real} = V/t = 60 / 8 = 7.5 \text{ m}^3/\text{h} \quad 3.9$$

For the pump to fill the tank with 60 $m^3$ of water for 8 hours, you must choose a pump with a flow rate of at least 7.5 $m^3$/h.

- *Pump Power*

In general, the nominal flow rate of the installed pump is equal to one-fifth of the daily energy needed (Evain, 2020). We can deduce the power of the pump as:

$$(P_p) = E_{Hydraulic} / 5 \quad 3.10$$

$$(P_p) = 32856.3655 / 5 = 6571.273\text{W}$$

It implies that the pump which is suitable for the city of Menkao is the one with a power of 6571.273 W. It is worth mentioning that the power is lower than that calculated above. So, there can be no doubt that low flows will be recorded as a matter of fact will not meet the real needs of the population of this area.

- *Choice of Pump Type*

Based on the parameters studied above, the type of pump suitable for this system is the LORENTZ "PSk3-7 C-SJ8-30" solar pump submerged with the controller based on the data entered by the user. This solar pumping kit is capable of pumping water up to 160 m in height with a maximum flow rate of 13 $m^3$ per hour.

It has the following characteristics:

- ✓ Maximum power: 8 KW
- ✓ Max current: 13 A
- ✓ Max input voltage: 850 V
- ✓ Integrated MPPT.
- ✓ Cost: 2300$ (Two thousand three hundred US dollars)

- *Sizing the Photovoltaic System*

The water supply system of the Menkao City will need energy to operate. The Menkao City constituting our area of interest being off the electricity grid, the PV system over the sun is adapted to supply the installations. Thus, the necessary energy and power must be calculated to properly size the photovoltaic field.

- *Calculation of the Energy to be Produced*

$$E_p = E_{Hydraulic} / K \quad 3.11$$

With :

Ep: Energy to be produced (Wh)
K: Correction coefficient (K= 0.67)

Thus, the energy to be produced to power our system is:

$$E_p = E_{hydraulic} / K = 32856.3655/ 0.67 = \mathbf{49039, 3507} \text{ Wh}$$

- *Calculation of Peak Power*

The peak power (Pc) is calculated by taking the ratio of the energy produced to the solar irradiation of the environment such that:

$$\mathbf{P_c = E_p / I_r} \quad 3.12$$

With $I_r$: the solar irradiation of the medium

As the peak power of the panels to be installed depends on the irradiation of the place installation, in the DRC, the minimum value of sunshine is 3.34 KWh/$m^2$ and the maximum is 6.73 KWh/$m^2$ according to studies carried out by the National Energy Commission (CNE).

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Since the minimum value for electrification by photovoltaic system is of 1 $KWh/m^2$, we conclude that solar energy offers enormous potential in our Country.

Moreover, according to the solar map of the DRC, the sunshine in the Kinshasa region is worth 4.5 $KWh/m^2$.

Then, the peak power is:

$$P_c = \frac{49039.3507}{4.5} = 10897.6335\ W$$

- *Calculation of Number of Solar Panels*

The number of solar panels depends on the peak power of the panel installation. In this context, as we have chosen the type of Lorentz LC260P60 solar panels which is the polycrystalline type, its characteristics are:

260 WC /24, Voc = 37.9 V and $I_{sc}$ = 8.83.

Note that the price of a solar panel of this type is $250 per piece.

The total number of solar panels needed is:

$$N_{TP} = P_c / P_u \quad 3.13$$

With :

$N_{TP}$: Total number of solar -panels
$P_C$: Peak power (W)
$P_U$: Unit power of the solar panel (W)
So, from the calculation, we find 42 solar panels of 260 WC to produce a peak power of 10920 W.

## IV. PRESENTATION OF RESULTS

- *The Results of this Study are Presented in the following Tables:*

Table 4 Sizing Data Obtained after Calculation

| S No. | Désignation | Value |
|---|---|---|
| 1 | Water needs of the population | 20 $m^3$ |
| 2 | Tank capacity | 60 $m^3$ |
| 3 | Total head | 110.526 m |
| 4 | Daily electrical energy | 32856.3655 Wh/day |

Table 5 Results on the Pump and the Photovoltaic Field

| Submerged solar pump | | |
|---|---|---|
| Désignation | | Value |
| Type | | PSk3-7 C-SJ8-30 |
| **Max power** | | 8KW |
| **Max current** | | 13 A |
| **Max input voltage** | | 850 V |
| **Photovoltaic field** | | |
| **Type** | **Peak power** | **Voltage/panel** |
| LC260-P60 Polycrystalline | 1020 W | 260W/24V |
| Total Number | 42 | |
| **Cable Section** | | |
| Section of the cable that will come out of the box connection to the controller | | 1 $mm^2$ |
| Section of the cable that will come out of the box connection to the controller. (S2) | | 2 $mm^2$ |
| Section of the cable that will come out of the controller towards the pump (S3) | | 4 $mm^2$ |

The Table 4 shows the results of the sizing of water and energy needs as well as the capacity of the tank to facilitate water supply to the City of Menkao. The Table (5) presents all the results on the submerged solar pump which will facilitate the rise of the water, the photovoltaic generator which can supply the system with energy as well as the cable sections.

## V. PROJECT COST

The investment for this project will depend on the availability of materials to be used in the field where the device is to be installed. If the materials must come from a place far from the site or if they are imported, the cost will increase according to these parameters.

The Table 6 Presents The Estimates of the Investment Required to Install this Water Supply System in Menkao.

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Table 6 Quote of Project

| N° | Désignation | Unité | Qté | P.U($) | P.T($) |
|---|---|---|---|---|---|
| 1. | **Site Installation** | | | | |
| 1.1 | Preparation of the drilling workshop, brought in and folded up at the end of the work | | | | 1200 |
| 1.2 | Displacement of the drilling workshop | | | 420 | 420 |
| 2. | **Drilling plumbing supply** | | | | |
| 2.1 | Pressure PVC tube Φ075 | ml | 70 | 28 | 1960 |
| 2.2 | Strainer pressure PVC tube | Ml | 35 | 30 | 1050 |
| 2.3 | Downhole plug | Pc | 1 | 50 | 50 |
| 2.4 | Mud Product (plasticizing polymer) | Sac | 1 | 350 | 350 |
| 2.5 | Filter mass | Tonne | 10 | 300 | 3000 |
| 2.6 | Ciment | Bag | 15 | 11 | 165 |
| 2.7 | Drilling accessories and fixing equipment | Fft | --- | 400 | 400 |
| 2.8 | Well development and chlorination | N/A | --- | 450 | 450 |
| 2.9 | Faucet | | 20 | 3 | 60 |
| 2.10 | Water fountain | BF | 1 | 220 | 220 |
| 2.11 | Valve (1/2) & (3/4) | | 9 & 5 | 3 & 2 | 37 |
| 2.12 | Elbow | | 100 | 0,75 | 75 |
| 2.13 | Drainage work | | 5 | 150 | 750 |
| 3 | **Material Supply** | | | | |
| 3.1 | Solar panel 325W | Pc | 42 | 200 | 400 |
| 3.2 | Electric cable | Ml | --- | 832 | 832 |
| 3.3 | Water tank 60 $m^3$ | $M^3$ | 1 | 1550 | 1550 |
| 3.4 | solar pump | --- | 1 | 2300 | 2300 |
| 3.5 | Protective lightning rod | Pc | 1 | 110 | 110 |
| **Total + 5% Unexpected** | | | | | **16 148** |
| **TVA (16%)** | | | | | **18 733** |
| **(30%) of Total** | | | | | **5 619.9** |
| **Overall Total** | | | | | **24 353** |

(Price Source: EGECO Solar Training)

The cost of the water supply project in the city of Menkao amounts to the sum of $24,353. Considering that maintenance and operating expenses are estimated at 20% of the cost of the project, the total investment of the project will be equal to the sum of $29,223.45.

## VI. CONCLUSION

We proposed to carry out a study based on geophysical methods to precisely determine the potential layer of the basement containing a water reservoir that can be supplied to supply the City of Menkao. A prospecting system called "AIDU prospecting" which is a cutting-edge technology in the prospecting study, especially in mountainous regions such as the city of Menkao, was used for this purpose. The analysis of the components of a photovoltaic system capable of supplying drinking water to the city of Menkao was made as well as the choice of the pump capable of raising the water to the reservoir located 10 m above the floor. As results of this study, water reservoirs were observed at different levels of subsoil layers but the potential layer was found at more or less 100 meters depth.

Knowing Menkao population need for water which is estimated to 20 $m^3$ a day with a system operating over the sun, consisting of a submerged pump with 8KW controller which must be powered by solar energy produced by a generator made up of 42 panels of 260W/24V. A tank of 60 $m^3$ has been planned to allow to have an autonomy of 3 days able to cover the need of the city and that of merchant coming the day of the market. This system will ensure the supply of drinking water to residents while respecting environmental standards and the total cost of the project investment is $29,223.45.

## REFERENCES


[1]. André Labonne, (2004), *Alimentation d'une pompe à Burkina Faso*, Université de Ouagadougou, *Burkina Faso*

[2]. Caroline Voisin, 2021, Arrondissement de Saint-Quentin : une population en repli, exposée à des fragilités économiques et sociales, INSEE 120, Paris

[3]. Delagne FLECHE, (2007), *Energie solaire photovoltaïque*, STI ELT Approche, Marseille, France.

[4]. Elouahab NECHMI ABd, (2015), *Aperçu sur le systeme de pompage photovoltaïque destine pour l'alimentation en eau potable,* Ecole Nationale Supérieure d'Hydraulique -arbaoui abdellah,Alger.

[5]. Evain,2020, Pompage solaire, Conception et réalisation de la partie électrique du pompage, Guide, ACFI, Paris

[6]. Fontain George, (2019), *Manuel de formation pour l'Installation et la Maintenance de petits systèmes photovoltaïques,* fundacion icai • sun-edison, Paris, France

ISSN No:-2456-2165

[7]. Jean Flouriot, **2013**, Trente ans après la publication de l'Atlas de Kinshasa, Atlas de Kinshasa, RDC
[8]. Jean Michel Lionel ZEO, 2020, Réalisation d'un système d'adduction d'eau potable simplifie dans la localité de Piela, Mémoire Master, BETAIC/N° 20100970, Burkinafaso.
[9]. MALJOURNAL Bertrand, (2015), *Etude d'impact environnemental et social du projet solaire photovoltaïque de Tafilalt : Site de Missour*, Rabbat, Maroc
[10]. OUEDRAOGO Issaka, (2016), *conception et dimensionnement du systeme d'alimentation en eau potable simplifie (aeps) de la localite de boulsin au burkina faso*, Ins titut International d'Ingénierie, Ouagadougou, *BURKINA FASO*
[11]. Zoungrana Denis, (2003), *Cours d'approvissionnement en eau potable*, Ecole InterEtats Iingénieurs de I'Equipement Rural, OUAGADOUGOU, *BURKINA FASO*

**Site Web**

[12]. https://www.aiduny.com, geophisical method, 12 /05/2023
[13]. https://www.google.fr/système+de+pompag 13/05/2023
[14]. https://www.universalis.fr/atlas/Densité population 11/06/2023