

## **Exploration of Ground Water Potential at Eastern part of Panchkhaal Valley**

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### **ABSTRACT**

*Ground water is one of the world's main freshwater supplies, and it is critical for supporting ecosystems and permitting climatic fluctuation and change. The Panchkhaal valley was of particular importance to us. Panchkhaal is a municipality in the Bagmati Zone in central Nepal's Kavrepalanchok District. ERT and VES geophysical methods were employed. Six survey numbers were obtained, five of which were ERT and one of which was VES. The geophysical survey data was computed and analyzed using the RES2DINV and IPI2WIN programs. For ERT interpretation, RES2DINV was utilized, while for VES interpretation, IPI2WIN was employed.*

***Keywords:*** Groundwater, Geophysical survey, ERT, VES, IP2Win, RES2DINV

### **INTRODUCTION**

Groundwater is one of the world's main freshwater sources, and it plays an important role in supporting ecosystems and facilitating climatic fluctuation and change [1]. Groundwater is examined for a variety of reasons. Despite accounting for just around 0.06 percent of the world's total water supply, ground water is one of the most important sources of drinking water. Despite its small size, the quantity is critical because it provides 98 percent of the readily available fresh water supply to humans [2]. Climate change has a significant impact on the quality and quantity of groundwater supplies. Furthermore, climatic variability has a significant impact on the factors determining groundwater recharge. Unreliable monsoons and low quality of surface water supplies likely to exacerbate groundwater level reduction. As a result, identifying and delineating the groundwater potential zone (GWP) that

can be used to supplement the groundwater supply is critical [3].

Surface and groundwater sources are essential components of every development effort, depending on their quality and availability. If surface water is not viable for the required activity, groundwater is the next best option if it has the appropriate volume and quality. As a result, site study and exploration, also known as preconstruction evaluation, must be carried out primarily for the effective and sustainable use of groundwater resources. Groundwater has become extremely significant for many water supply reasons in both developed and developing nations' urban and rural areas. However, if the potential groundwater zones are connected with fractured and fissured media, groundwater research in hard rock terrain and hills is a highly complex and arduous undertaking. The groundwater potential in such an environment is mostly determined by the

thickness of the worn or fractured layer covering the basement [4].

The Panchkhaal valley was of particular importance to us. Panchkhaal is a municipality in the Bagmati Zone in central Nepal's Kavrepalanchok District. The Panchkhaal Valley is one of the intermountain basins east of Kathmandu in central Nepal, with two sets of neo-tectonic lineaments found using satellite photography and aerial pictures. The first, running NW-SE east of the valley, resulting in the ancient Panchkhaal Valley raising along the south during the Pleo-Pleistocene epoch, while the second, NE-SW, eventually uplifts the old valley [5]. The valley is located in the eastern region of the country, around 45 kilometres from Kathmandu. The temperature and soil formation are ideal for agricultural development, but the most crucial aspect, namely water, is insufficient for irrigation. The major purpose of the study was to establish whether there was a probability of uncovering a water reservoir under the surface, and we needed to employ a ground investigation approach to accomplish.

Different approaches can be used to investigate groundwater. The areal technique, surface method, subsurface method, and esoteric approach are the four basic groundwater exploration methods. Among these ways, the esoteric method is based on traditional indications rather than science. Each of the aforementioned groundwater exploration methods has several sub-methods. A geophysical survey is one of the sub surface technique of groundwater investigation. This method is crucial for both groundwater resource mapping and water quality studies. Its application for groundwater research has increased in recent years as a consequence of substantial developments in computer software [4]. Vertical Electrical Sounding

(VES), Electrical Resistivity Tomography (ERT), and Horizontal Profiling are all part of the geophysical study. Vertical Electrical Sounding (VES) is becoming increasingly popular in groundwater studies due to its ease of use. The surface effects induced by the passage of electric current inside the ground are detected using this geophysical survey approach. It specifies the depth and thickness of several subsurface strata, as well as their respective water-yielding capacity.

This study would not have been possible without the cooperation of Kavrepalanchowk's Ground Irrigation Development Division. Following the conclusion of the geophysical survey, a series of data analysis were performed using computer-aided tools such as IPI2WIN and RES2DINV. IPI2WN analyzed and interpreted the VES data, and subsequent software was used to analyze and interpret the data collected from ERT.

## **LITERATURE REVIEW**

### **Ground water Potential**

The entire quantity of permanent storage in the aquifers is referred to as groundwater storage potential. The potential for groundwater storage is determined by the porosity of the rocks and the amount of free space in the rocks that might store water. Groundwater is water found under the Earth's surface in soil pore pores and rock formation fissures. Groundwater potential is calculated as follows:

- Recharge rate and mechanism,
- Aquifer storage and transmission properties
- Suitability of the water from water quality point of view and
- The response of the aquifer to changes such as climate, seasonality, artificial withdrawal and pollution.

### Aquifer

An aquifer is a subterranean layer of permeable water-bearing rock, rock fissures, or unconsolidated materials (gravel, sand, or silt). Water well can be used to extract groundwater [6]. When water enters a reservoir through natural or artificial recharge, it is typically extracted by gravity or by wells. Aquifers are classed as either unconfined or confined based on the existence or absence of a water table [7]. There are probably few really restricted aquifers since experiments have shown that the confining strata or layers, while not rapidly transmitting water, provide considerable amounts of water over time through gradual leakage to augment output from the main aquifer [8].

### An unconfined aquifer

An unconfined aquifer has a water table that varies in undulating shape and slope based on recharge and outflow regions, well pumpage, and permeability [7].

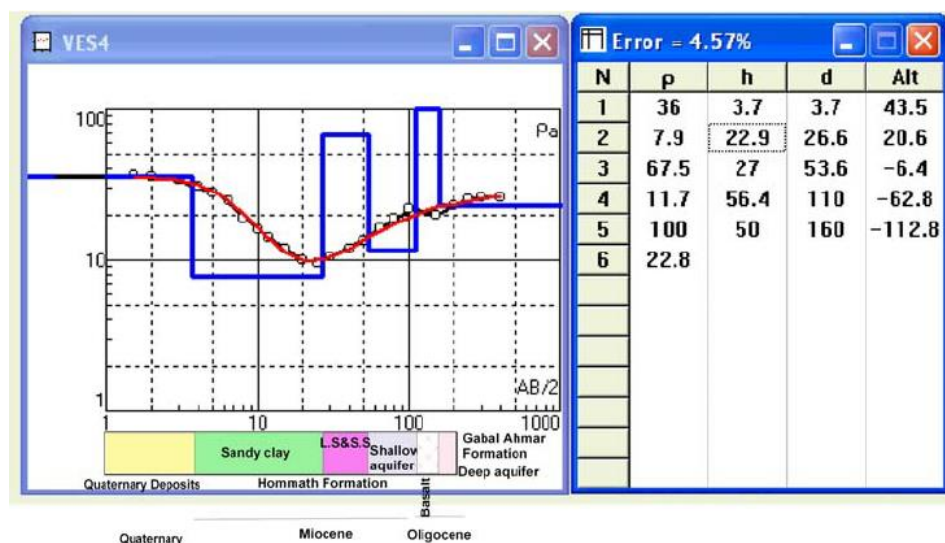
### Confined Aquifer

Confined aquifers, also known as artesian, arise when groundwater is confined under pressures greater than atmospheric pressure by relatively impermeable strata overlying the earth [7].

### Introduction to IP2Win Software

IP2Win is a geoelectrical data analysis program that analyzes data from one or more VES (Vertical Electrical Sounding) sites. IP2 Win can analyze data from induced polarization electrode configurations from Schlumberger and Wenner. The initial stage in using IP Win is data entering, followed by data error correction, adding data points, and finally cross section creation. Data can be entered directly from field data (sounding data consists of AB/2, V, I, and K) or indirectly from field data (sounding data consists of AB/2 and Rho). The resistivity layer, log resistivity graph, resistivity depth table, and pseudo cross section are the results of sounding data analysis using IP2 Win software.

The output can be exported in some data formats. A fundamental flaw in the IP2 Win program is a fault that regularly appears when analysing data. This issue can be resolved by restarting the program. Analyzing the output from IP2 Win software can be done based on Loke's book, Electrical Imaging Survey for Environmental and Engineering Studies [9].



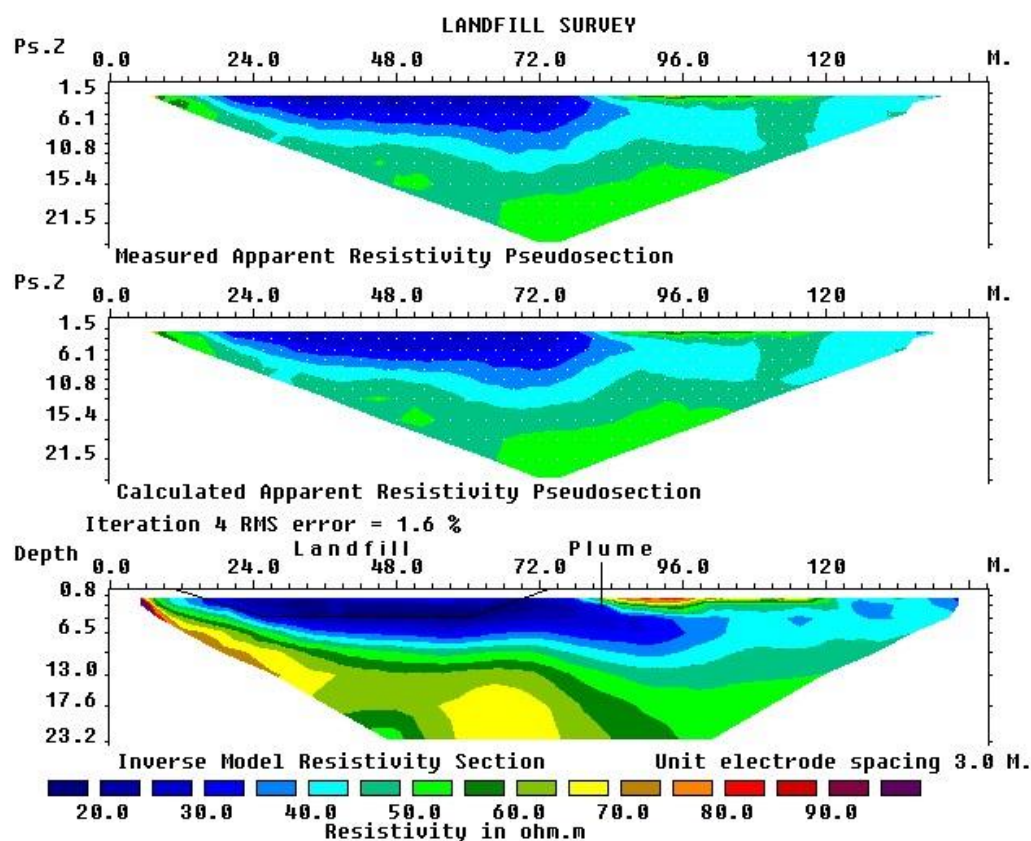
*Fig. 1: Outcome of Inversion Model by using IPI2WIN Software*

### Introduction to RES2DINV Software

RES2DINV is a computer application that calculates a two-dimensional (2-D) resistivity model for the subsurface using data from electrical imaging surveys (Griffiths and Barker 1993). Because it is a Windows-based tool, it automatically supports all Windows-compatible graphics cards and printers. It has been tested with up to 1600 by 1200 pixel video screen modes and 16 million colours.

Figure 2 depicts the 2-D model utilized by the inversion algorithm, which is made up of a number of rectangular blocks. The

block layout is somewhat related to the distribution of data points in the pseudo section. The application generates the distribution and size of the blocks automatically, using the distribution of the data points as a rough guide. The depth of the bottom row of blocks is adjusted to be close to the equivalent depth of investigation (Edwards 1977) of the data points with the greatest electrode spacing. The survey is often conducted using a technique in which the electrodes are positioned along a line with a consistent distance between neighbouring electrodes.



**Fig.2 : Outcome of Inversion Model by using RES2DINV Software**

### METHODOLOGY

This assignment required around 10 weeks of study time. During this time, several issues such as literature review, data collecting (primary and secondary), data analysis, draft report submission, and so on were completed.

The major responsibilities were to conduct a field survey in the eastern Panchkhaal valley and to analyze the survey data using computer-aided tools. During this project, three major tasks were done, and each one is explained in detail below.



### Secondary data Collection

Some facts and statistical data were derived from the Nepal Hydrogeological Association Bulletin (2016 and 2017). We investigated the issues that farmers faced as a result of a lack of irrigation. We also examined the land's yield once sufficient irrigation was installed. In addition to the field trip, we downloaded material from the internet. The majority of the downloaded articles are tables and images. This project illustrates these images and information.

### Primary data collection through field survey

In the Panchkhaal valley, we conducted a geophysical survey. The systematic

collecting of geophysical data for geographical investigations is known as a geophysical survey. Geophysical signal detection and analysis are at the heart of geophysical signal processing. Five surveys were conducted on the ground in the Panchkhaal Region's eastern region.

The map shows the locations of the sites, which were Rampur, Shreeram pati, Shikharpur, Pipaltar, and Tamaghat. Mr. Narayan Krishna Ganesh, Section Officer of Groundwater Irrigation Development Division, Dhulikhel, for his co-operation and advice in performing the survey and assisting with the analysis of the collected information from the survey field, made five ERT and one VES survey feasible.



*Fig. 3: Location of ERT and VES Line*

### FINDINGS THROUGH GEO-PHYSICAL SURVEY

The ERT 1 profile section clearly distinguishes three layers, the first of which is top soil, a combination of clay and silt. The second layer is wet sand, and

the ultimate layer is boulders and bed rock at a depth of 10 to 20 meters.

The ERT 2 profile depicts the three soil layers. The highest layer, between 80 and 120 meters, is wet sand with silt. The second layer is gravel with boulders,

while the last layer is saturated gravel with particles.

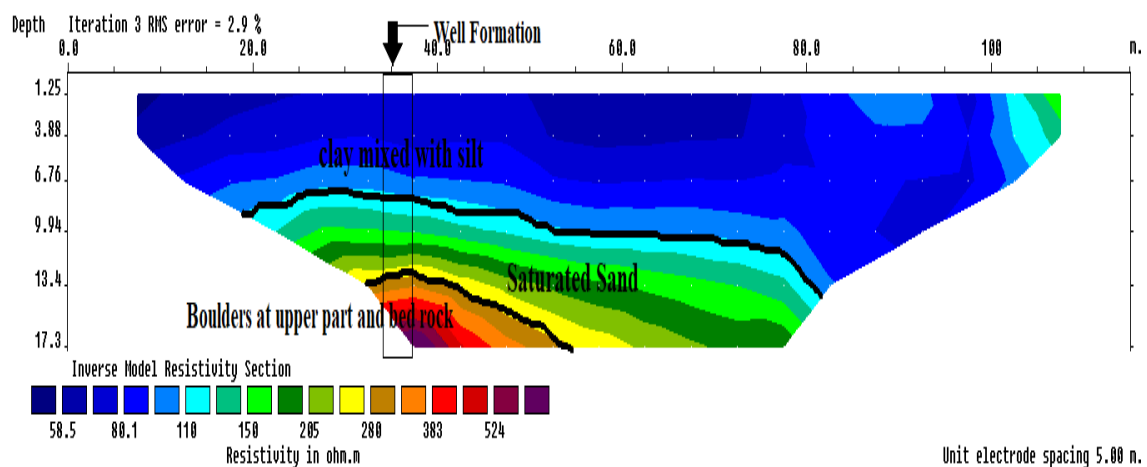
The ERT 3 profile reveals clayey soil with silt as well as cobbles and gravels with fines. up to a particular depth in the center section There is saturated sand in the region under that layer. Boulders and bed rocks are present in the stratum underneath.

The top layer is a mixture of silty and clayey soil, another portion has saturated sands with fines, and the last section has gravels and a small number of boulders with fines.

The ERT 5 depicts three zones: top soil, clayey soil, and bottom soil. Silty clay is present in the stratum underneath. The presence of gravel and boulders with

particles constitutes the last layer. The VES segment may be broadly classified into three zones. There is silty clay soil present up to 3m deep. There are cobbles and stones with high resistivity up to 25m in the area. The last segment displays a moderate resistivity value, which is interpreted as the presence of fine-grained gravel.

We discovered the best planned well in Pipaltar. just 35 meters (Fig. 5) from the survey line's starting location Clay and silt make up the top soil. As we dig deeper, we encounter saturated sand, gravel, and, if we continue digging, regolith, and eventually bed rock with joints and cracks. The data is summarized in the well assembly chart, and the design of a tube well is advised appropriately.



**Fig. 5: Well formation profile**

## CONCLUSION

The exploration of ground water potential and tube well design in the Panchkhaal valley's eastern half has been finished. The following are the objectives that were met throughout this project:

1. The desk study of the Panchkhaal valley was done through books, the internet, and other sources.

2. The ERT and VES methods were adopted for the geophysical survey.
3. A total of six surveys were done, among which five were ERT and one was VES.
4. The geophysical survey data were computed and interpreted with the help of two software programs, RES2DINV and RES2DINV.

5. **RES2DINV** was used for ERT interpretation and **IPI2WIN** was used for VES interpretation.
6. The design of wells, both dug and tube wells, was recommended according to the findings from the geophysical survey and borehole log of the eastern part of the Panchkhaal valley.

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