CHAPTER I

INTRODUCTION

Irrigation plays a vital role in the process of agricultural development. The water resources are limited and unevenly distributed; resulting in seasonal abundance in some areas and scarcity in other areas. There is a large gap between the net available water for irrigation, and the amount required for intensive crop production. It is, therefore, essential to narrow this gap by improving the irrigation efficiency, and by tapping the unexplored water resources.

1.1 Groundwater

Groundwater is the most vital and dependable source of supply for irrigation. The major advantages of groundwater source are its wide availability and reliability. The groundwater is less prone to seasonal fluctuations and moreover, its extraction can be continued long after the droughts have depleted ponds and rivers.

According to Lal (1979), the average annual precipitation, excluding evapotranspiration and soil moisture storage, in India can be placed at 179 million hectare-metres, resulting in surface runoff and groundwater recharge. The recent estimate shows that only 67 million hectare metres of the surface water and 26.5 million hectare metres of groundwater can be utilized for irrigation purposes.

Ancient historical records indicate that during the Vedic period (400 BC) farmers used to irrigate their crops with dug wells or inundated water. Exploitation of groundwater through shallow and deep tube wells is receiving increasing attention for the last one decade. Michael (1978) estimated that in India the number of shallow tube wells, deep tube wells and dug wells in operation in 1978-79 would be in the proximity of 1.158, 0.013, and 6.751 million respectively.

Deep tube wells require a large investment, which is beyond the capacity of an average Indian farmer. Therefore, the farmer would prefer a system which requires low investment such as shallow tube well or dug well or the combination of the two.

1.2 Cavity Well

As the agricultural development progressed, the demand for irrigation water increased. This provided an impetus to the farmers to explore the possibility of increasing the discharge from the dug well. The sound and the natural instinct of the farmer led ultimately to the development of cavity wells in the Indian subcontinent.

Cavity well is a strainer less tube well and draws the water through a cavity created below the well pipe. This type of well is suitable only in geological formations where the top confining layer is of hard clay. The cavity wells are very common in Indo-Gangetic planes. The well boring is carried out through the entire clay layer upto the water bearing formations. Some amount of sand is removed with the help of sand bailer, and thus an initial cavity is developed. Pumping is started with a high capacity pump, and the drawdown in the well is gradually increased. As the drawdown is increased, sand begins to come out along with water. If pumping is continued for a sufficiently long time a stable cavity is created. The well should be operated to obtain sand free water at a drawdown which is lower than the drawdown at which cavity well was developed.

For a sufficient discharge, it is necessary to remove as much sand as possible and thus forming the cavity of the largest possible size. However, a large cavity may cause collapse of the well due to sinking of the confining layer. Sanghi (1953) observed that in the failed wells, the ground surface in the vicinity of the wells had slumped down over a circular area having a radius of 8 to 10 m. Therefore, the material and thickness of the confining layer are the limiting factors which determine the optimum viable size of the cavity.

1.3 Research Need and Objectives

In spite of the spectacular progress made on groundwater utilization front, the design of cavity well is still a trial and error process based on local experience and individual guess work. Scientific methods for design of cavity well have not yet been developed. Several researchers have developed theoretical equations for hydraulics of cavity well , considering aquifer to be confined, nonleaky and cavity of the form of frustum of a sphere. These assumptions,however, are not plausible as they greatly differ from the real situation. Therefore, models developed based on these assumptions fall short of characterizing the actual conditions. Furthermore, none of the proposed models has been exhaustively verified either by laboratory or field studies. Therefore, there exists a tremendous scope for investigations into the problems of cavity well. Keeping in view this potentiality, a study was designed and conducted to investigate the performance of cavity well. The specific objectives of this study are as follows:

1. To study the mechanics of cavity development.
2. To study the effect of radial channel on discharge through cavity well.
3. To develop a finite element model for steady state and transient flow to cavity well in leaky confined aquifer.
4. To verify the finite element model under laboratory and field conditions.