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Implementation of Effective Water Harvesting and Management System for Agriculture

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Abstract: ***Development of any country is purely based on its economic growth. The economy growth majorly depends on the development in agriculture sector. Innovative water harvesting and management is one of the main factors involved in the development of agriculture. This work is an attempt to implement efficient water management system for rural area. The system includes air compressor, gate valves and microcontroller based controlling panel boards with communication facilities for monitoring. The designed setup is efficient and provides better results in harvesting more amounts of water (14.23% higher than existing methods), reducing man power and time consumption. Comparison shown that this semi-automated water management is more efficient than the existing method followed for water management.***

Keywords: Agriculture, Air compressor, Microcontroller, Water management.

I. INTRODUCTION

In many countries agriculture plays major role in economic growth. Food is the main factor for survival for both Human being and animal. Agriculture serves not only money it also provides food for every living being. Agriculture sector of India has occupied around 47% of area from its total area [2]. Countries having more population are in very much need of Cereals, Vegetables and pulses for current and future usage [3]. Production of above said food items are slowly reduced because of three main factors as follows, irregular weather conditions, poor agriculture policies and quality of products harvested because of poor water management. Irrigation system for water management is not properly used in many countries. Water is wasted much and it is not given in the required quantity because of semi-automated and manual methods of water utilization in agriculture. Poor water management leads to reduction in the yielding and reduction in the quality [1]. There are plenty of irrigation systems available for agriculture. The traditional method of canal irrigation, drip irrigation, micro drip irrigation and sprinkler irrigation are the important irrigation systems followed by farmers in various countries [5]. Due to the improper monsoon water scarcity is a major issue in many countries [6]. To overcome the water scarcity and to cultivate the crops and plants farmers are in need of support from water sources like river, pond, well and bore well. Reduction in the amount of rain fall stops the water recharge completely in river, pond and particularly in well. Hence, farmers are very much depends on the bore well for water supply [4]. Bore well can be categorized in to three types based on the depth, they are low level, high level and very high level bore wells. Low level bore wells having the depth of around 150 meters, high level bore wells having the width of around 300 meters and bore wells with the depth over 300 meters can be called as very high level bore wells. High level and very high level bore wells are providing more amount of water but not all the times. The water can be harvested from such depth with the help of heavy submersible pumps. Erection of such pumps is a tedious process and the initial cast for the implementation is also huge. Due to the continuous harvesting of water, the underground water level may go down during poor rain seasons [7]. The same water harvesting can also be done effectively by a simple set up of air compressor. For that one the bore well depth can be only in the low level or high level. In this article, the utilization of smart air compressor set up for low level bore well for the efficient water management has been discussed.

II. MATERIALS AND METHODS

Effective water management system has been implemented by using air compressor, gate valves, two to four low levels bore wells and microcontroller based controlling panel board for motor and compressor management. The performance has been evaluated by comparison with existing method in terms of amount of water harvested, man power utilized and power consumption for motor setup.

III. PROPOSED METHOD

The proposed method of water harvesting and management system is the remedy for the existing system. In the existing system high and very high level bore wells are utilized for most of the cases. Also the bore wells are utilized continuously without allowing it to recharge. More salt sedimentation and power consumption resulted in the existing system because of continuous utilization.

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Most of the farmers doesn't taking care about the bore well and the amount water coming out of it all the times instead they taking more care about whether compressor setup is running or not. This also leads more and unnecessary power consumption for harvesting even very small quantity of water. The proposed method uses only low level bore wells having the depth of around 150 meters. It is mainly preferred because of very easy erection comparing to other bore wells and initial cost is also less.

The main advantage of this method is effective water harvesting with low power consumption and comparatively less salt sedimentation. Because of the air compressor system the bore well is not engaged all the time. And the air from compressor can be split from the head of the compressor according to the needs and given to more number of low level bore wells with around 500 feet. The split air is controlled by gate valves, by opening and closing the valves any one or two bore wells will be utilized one time and the remaining bore wells will be allowed for restoring. Allowing the bore wells for restoring will increase the underground water level. The block diagram of proposed system is shown in figure 1.

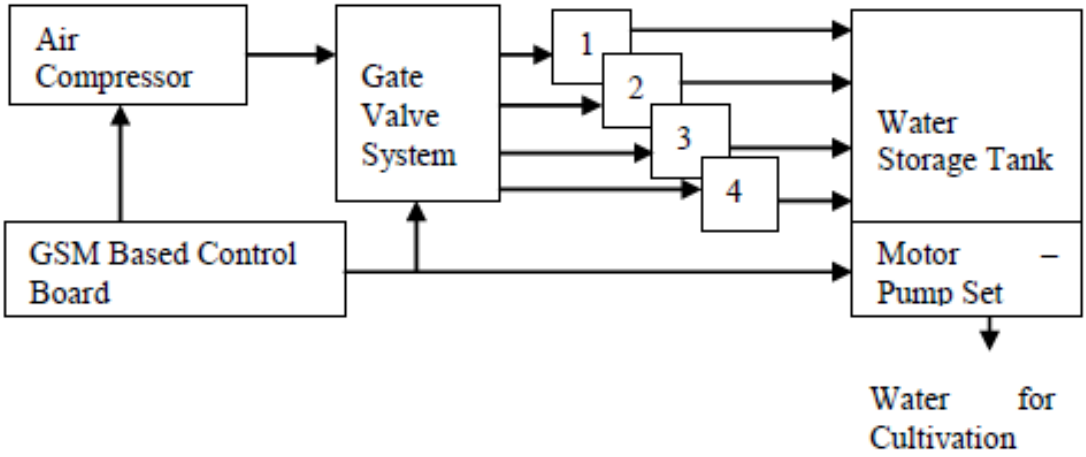

Fig.1. Smart Water Cultivation Setup

The system in figure 1 has been implemented and tested in the village Dhasanaickenpalayam which is in the Coimbatore district of Tamilnadu, South India, India. This new system for water management is similar to the existing systems except few important changes. They are, bore well with small depth is utilized, small quantity of air is required for bore well water harvesting since the depth is low, single motor setup with two to four air compressor system with four to eight possible air separation for four to eight individual bore well can be done and the motor setup is controlled by microcontroller board. The blocks with number 1,2,3 and 4 are for bore four wells. Single motor with two air compressor setup for four low level bore wells have been implemented and tested in this research. This smart setup allows the bore wells to recharge since all the bore wells are not used in all the time.

Gate valve set up is used to control the air flow by manually on and off the valve. This can also be done by full automation with microcontroller operated motor controlled valve set up in future. Water harvested from above process is stored in a concrete tank and has been utilized for irrigation.

IV. RESULTS AND DISCUSSION

The pictures of proposed set up and comparison between proposed and existing methods are as follows. Figure 2 shows the Air Compressor with Single Motor Setup, figure 3 shows the Water Storage Tank with Bore Well Outlet and figure 4 shows the Air Separation with Control Gate Valve Setup

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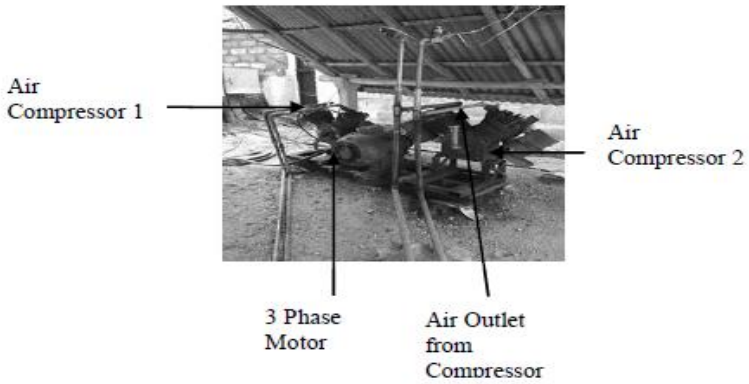

Fig.2. Two Air Compressor with Single Motor Setup

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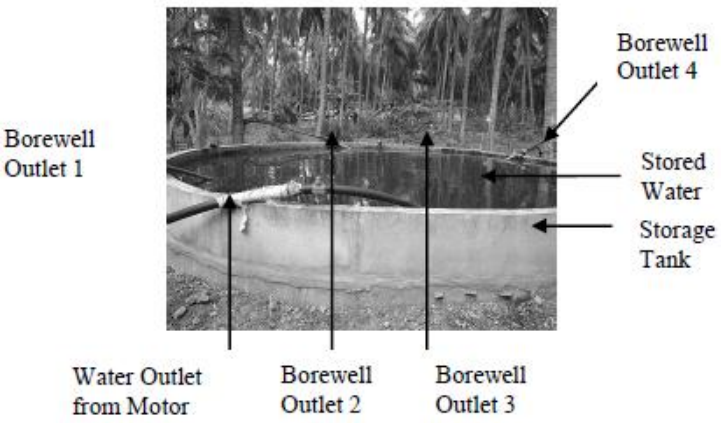

Fig.3. Water Storage Tank with Bore Well Outlet

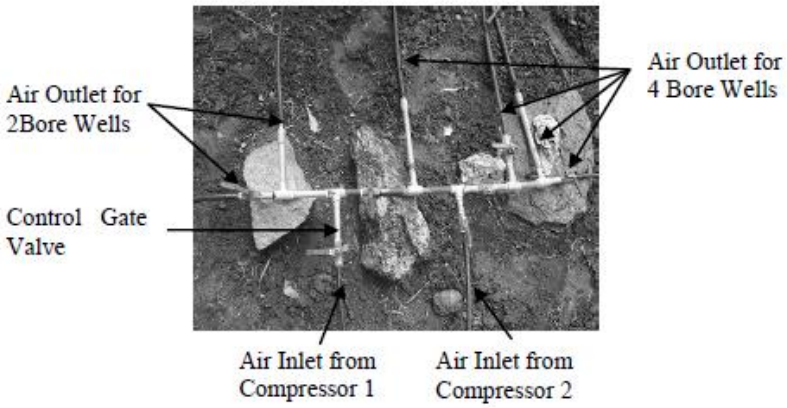

Fig.4. Air Separation with Control Gate Valve Setup

Table- I: Comparison between existing and proposed method for a Whole Year

Month	Rainfall Status	Average Water Harvested per Day (Liters)		Average Power Consumed per Day (Watts – Units)	
		Traditional Method	Proposed Method	Traditional Method	Proposed Method
January	No	15850	18800	57	67.5
February	No	10200	18700	44	67
March	Moderate	10350	19800	45	70
April	Heavy	12000	21750	50	76
May	Heavy	18250	22800	65.5	79
June	Very Heavy	24000	24650	77.5	84.5
July	Very Heavy	28000	26500	87	90.5
August	Moderate	32000	28000	99	95
September	No	25000	27500	77	94.5
October	Moderate	25150	27500	77.5	94.5
November	Moderate	25200	27500	77.5	94.5
December	No	20000	23300	63	83

Table 1 clearly shows the differences between the existing and proposed methods. And the resulted value shows that the proposed method is more effective in water harvesting and management with 14.23% increase in the water harvested with the 17.67% increase in power consumption.

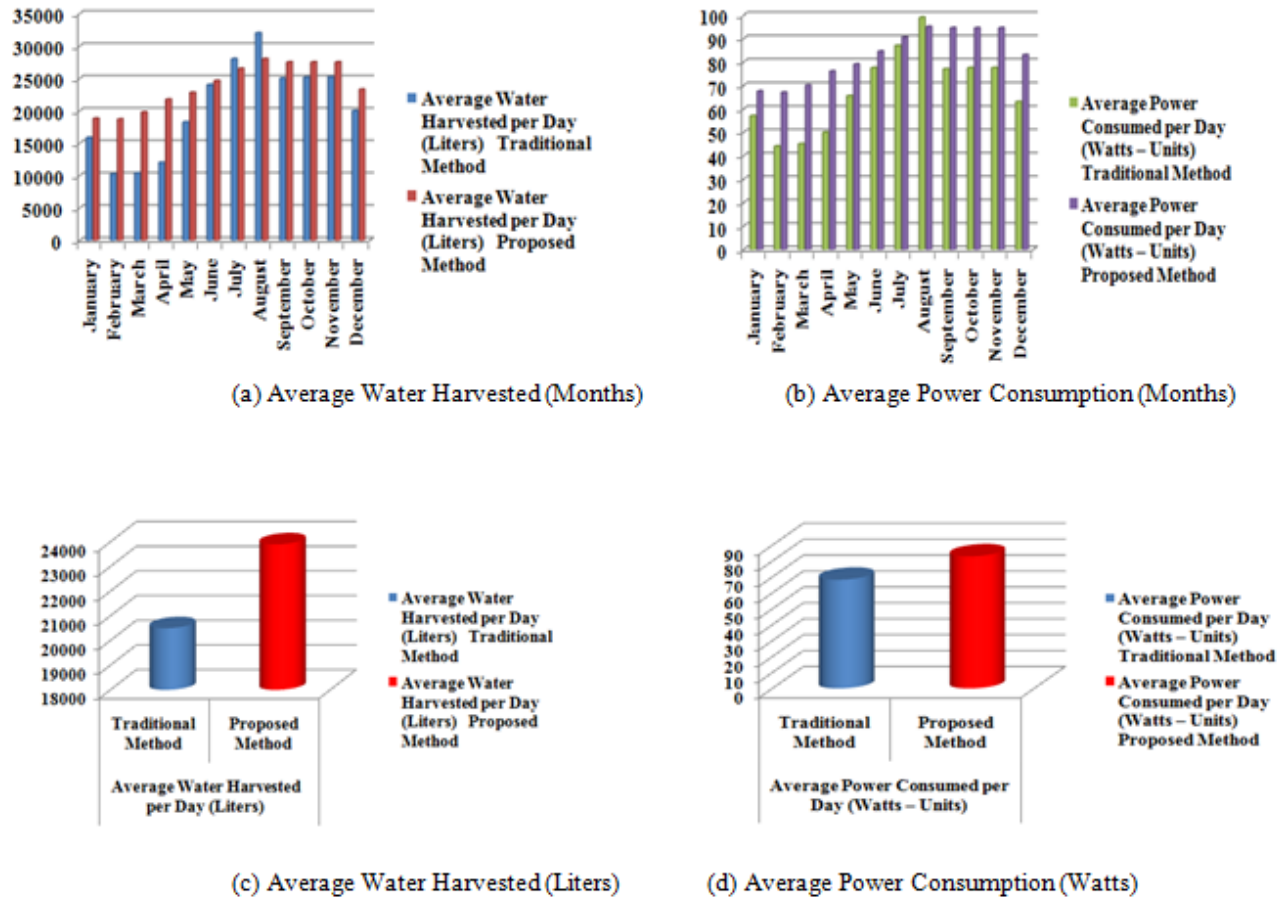

Fig.5. Month Wise Performance Comparison

The figure 5 shows about month wise analysis of the year 2018 by considering water harvested and average power consumed by the traditional and proposed methods.

V. CONCLUSIONS

A new method for the water management has been implemented and tested. Semi automated microcontroller based setup helps to switch on and off the entire system as per the mobile phone instruction given by the farmer. The complete automation can also be done for controlling the gate valves automatically. Cost of digging a high level/depth bore well can be used to dig three to four lower level/depth bore wells. The initial cost for setting up the accessories in the proposed system is very low and the efficiency in water harvesting is also very good when comparing to the existing systems. The power utilization has been found 17.67% increase than the existing setup. But the average quantity of water harvested from existing system in the year 2018 is 20,500 liters per day and for proposed system it is 23,900 liters per day, which is 14.23% higher than the yield of existing method. Total cost for the whole setup of four bore well systems is 2.5 lakhs which is only the 50% expenditure of single or double bore well existing submersible pump or compressor setup. Handling the entire setup is easy because of low depth bore wells and the amount of salt deposit in the hose is also less. Further, the underground water level is maintained because of allowing the bore wells to recharge frequently by the application of gate valve setup.

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