Centralized Automation of Steel Gates for Headgate Structure Using Solar at National Irrigation Administration-Upper Pampanga River Integrated Irrigation Systems Division Vi, Guimba, Nueva Ecija, Philippines

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Abstract: Because the Philippines is an agricultural country, irrigation is essential in the community. According to the National Irrigation Administration (NIA), the country's agricultural lands total 10.3 million hectares. Around 3.1 million ha are considered irrigable and devoted primarily to rice and corn. However, according to a recent World Bank study, about 6.1 million ha are irrigable, including areas that are more difficult to irrigate. Because of its rice and other agricultural products, Nueva Ecija, a province in Central Luzon, is a very powerful province in Region III.Because of its endless rice farms, Nueva Ecija was dubbed the "Rice Granary of the Philippines." Other main crops on its land include onion, mango, calamansi, banana, garlic, and various vegetables. Irrigation has made a significant contribution for many farmers in Nueva Ecija who have made agriculture their livelihood. Automatic irrigation is the use of a device to operate irrigation structures so that water flow from bays can be changed even when the irrigator is not present.

Key Works: - Headgates, Solar Energy, Division Office.

I. INTRODUCTION

The completion of irrigation facilities and structures in Lateral I to Lateral V and its Sub-Laterals covered by the fourteen Farmers Irrigators Association of National Irrigation Administration-Upper Pampanga River Integrated Irrigation Systems Division VI will provide irrigation water during wet and dry season in the area and will improved the present cropping intensity in the barangays of Talugtug, Guimba, Cuyapo, Nampicuan in Nueva Ecija and part of Anao and Ramos in Tarlac.

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NIA-UPRIIS Division VI has a total service area of 20,996.60 ha with a total farmer beneficiary of 11,405.

We come up to the study of automation of lifting mechanism for steel gates using solar as a source of power. Solar gate openers work primarily in the same way as electrical gate openers do, instead of using electricity from NEECO (Nueva Ecija Electric Company) to power the unit we are using solar panels to power the lifting mechanism to lift the gates since our gates are isolated and far from electric power supply and our gates will be remotely controlled from our office (Division VI). The proposed automation of steel gates will compose of sixteen (16) headgates for Laterals I to Lateral V. Division VI operates its water delivery by using a rotational method. Four days for the upstream part of a lateral then another four days for the downstream until the water delivery cut-off for a season. The automation can be used to operate the close and open of the lifting mechanism for the headgates of the laterals along its main canal called Super Diversion Canal.

Because it is automated, NIA can operate without the need for human intervention. With the use of timers, sensors, computers, or mechanical appliances, almost any system (drip, sprinkler, surface) can be automated. It improves irrigation efficiency and allows staff to focus on more vital activities. As a results, NIA can simply regulate water delivery through suitable rotational area allocation to ensure sufficient water delivery to the puddy, prevent water loss due to farmers interfering with gate operation, and accurately cut-off the water when compared to manual operation. It can also save money on vehicles that are used to check irrigation water and labor.

II. Method And Procedure

This is a descriptive study using qualitative research methods to determine the impact of solar power on the automation of Steel Gates of Headgate Structure in the NIA-UPRIIS Division VI service area in Guimba, Nueva Ecija, Philippines. The term descriptive research, according to Knufer & McLellan (ND), refers to the type of research question, design, and data analysis that can be applied to a topic. Quantitative research entails gathering data in order to quantify information and subject it to statistical analysis.

The researchers used a questionnaire to find out how knowledgeable the respondents are about using solar power to automate steel gates for the headgate structures of NIA-UPRIIS Division VI-Guimba, Nueva Ecija. The respondents were asked a series of questions and responded based on their own experiences. This provided the researchers with the necessary data to analyze and respond to the study. The study was conducted at the National Irrigation Administration Interim Division VI, which focuses in irrigation projects and encompasses the service area in the municipalities of Guimba, Cuyapo, Talugtug, and Nampicuan in Nueva Ecija and Anao and Ramos in Tarlac. Farmers and employees in NIA-UPRIIS Division VI who are involved in project planning and implementation, including end-users, were considered by the researcher. The questionnaires were distributed electronically to the respondents using the Google Forms application.

III. Results And Discussion

Based from the data gathered from the Division Office, Table 1 shows the list of Headgates per canal that covered by the Division Office. It provides us the discharge capacity of the Headgates and the sizes weather it's a barrel type or pipe. The Division Office have nine (9) barrel type of Headgate structure and seven (7) pipe type of Headgate Structure.

Table.1. List of Head Gates

CANAL	*Discharge*	*Sizes*
Lateral I	0.08	1-30Ø
Lateral J	0.86	1-100x100
Lateral K	1.02	1-100x100
SDC-1 Extra	0.11	1-46Ø
Lateral L	5.1	2-150x150
SDC-2 Extra	0.29	1-46Ø
Lateral M	0.17	1-46Ø
Lateral N	11.67	2-180x180
Lateral O	0.12	1-46Ø
Lateral P-1	4.94	2-120x120
Lateral Q	1.51	1-100x100
Lateral R	0.52	1-76Ø
Lateral S	1.33	1-100x100
Lateral T	1.15	1-100x100
Lateral U	0.29	1-61Ø
Lateral V	3.2	2-130x130

Table 2 shows the List of Projects of the Division Office implemented from CY 2019 to CY 2022. Total of sixteen (16) contracts were implemented for the Repair of the Canal (Construction of Concrete Lining), three (3) contracts for the Improvement of Service Roads and four (4) contracts for the Establishment of Ground Water Pump Irrigation Project (Construction of Solar Powered Pump). The data gathered tells us that the division office was starting to invest in renewable energy source like solar power.

Table.2. List of Project of Division VI (from CY 2019 to CY 2022)

Calendar Year	*Repair of Canal (Concrete Lining)*	*Improvement of Service Roads*	*Solar Powered Pump*
2019	3 contracts		
2020	5 contracts	1 contract	
2021	4 contracts	1 contract	1 contract
2022	4 contracts	1 contract	3 contracts
TOTAL	16 contracts	3 contracts	4 contracts

The trends of the Division Office's Projects are represented in Figure 1. The graph shows that the division office began investing in renewable energy in 2021, and in 2022, the division

office implemented three Solar Powered Pump projects. Solar-powered pumps typically include a solar panel array, solar charge controller, DC water pump, fuse box/breakers, electrical wiring, and a water storage tank which can also be distributed directly in the field. Solar water pumps can reduce the amount of time and labor required to irrigate crops. Water pumps were powered by the solar panel's energy, with irrigation water as the supply of water. In comparison to fossil fuel pumps, solar pumps require less effort and maintenance.

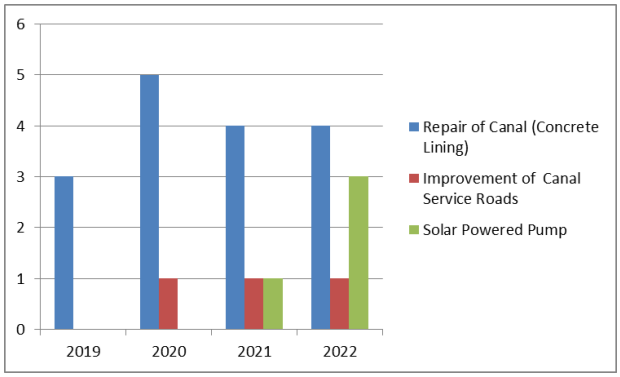

Fig.1. Trends in NIA-UPRIIS Division VI Projects

On the other hand, Figure 2 illustrates the renewable energy that respondents believe will have the greatest impact and be successfully implemented in the division office. Based on the survey results, 86.7% of respondents believe that solar energy will benefit the Division Office the most because the organization has already invested in solar power to operate pumps, while 13.3% of respondents were considering other renewable energy options such as hydro power.

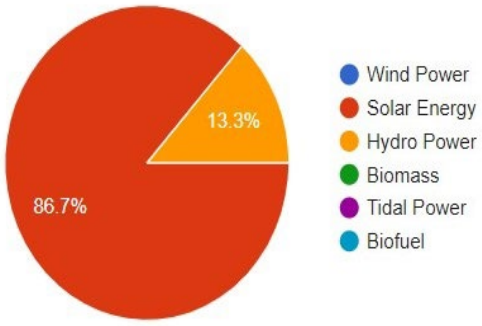

Fig.2. Renewable Energy that has the largest scope to be successfully implemented in the Division Office

Figure 3 shows the current obstacles/hindrances in the installation of solar energy panels. According to the survey results, 48.9% of respondents believe that the primary barrier to using solar to automate steel gates is that it is difficult to install, 26.7% consider the project's cost/budget, and 24.4% consider insufficient knowledge in solar panel installation.

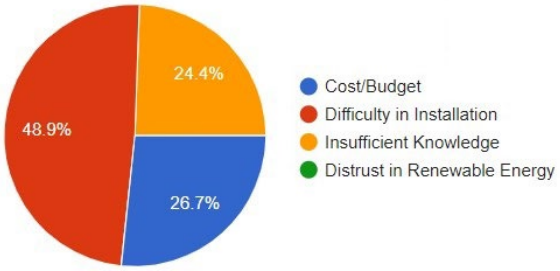

Fig.3. Current obstacles for the installation of solar energy panels

Figure 4 shows the importance for the Division Office to invest in renewable energy to protect the environment. According to the survey results, 68.9% believe it is extremely important for the organization to invest in renewable energy such as solar power, 28.9% believe it is slightly important, and 2.2% are undecided.

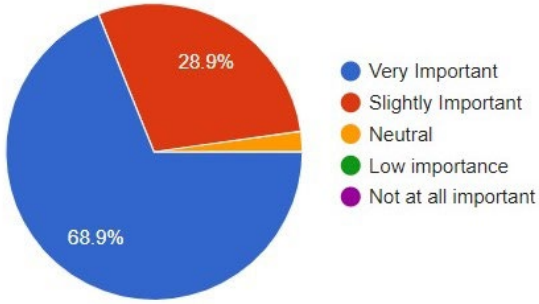

Fig.4. The importance to invest in renewable energy to protect the environment

IV. CONCLUSION

Because of a lack of research and partnership with other technologically prepared industries, automation of headgates of irrigation structures in the NIA-UPRIIS Division VI area utilizing solar energy has yet to be implemented. The automation of irrigation headgates will use a device to operate gates so that the structures's discharge is appropriately

monitored. Solar panels will provide energy to the equipment that will be used to automate gates. The automation of gates was designed to start and cut-off water distribution on time while also reducing the number of workers on the farm. The gate assembly and the actuator, which includes the motor and controls for raising and lowering the gate, are the most important sub-assemblies of gate automation. Furthermore, each gate requires a set of controls; each control box can accommodate many sets of controls. For isolated places without power lines, solar panels generators provide electricity to the actuator.

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