Assessment on the Status of Development of Irrigation Facilities of NIA-UPRIIS Division I

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Abstract- ***The continuous development of the irrigation facilities and structures of National Irrigation Administration (NIA) is fundamental to cope-up with the fast changing and modernized field of Agriculture, thus there is a need to study the current level of irrigation development. The study aimed to assess the current status of irrigation facilities within NIA-UPRIIS Division I service area. It assessed how lined and unlined irrigation canals affect the water delivery and distribution, and how the current level of development of irrigation facilities affected the farmers in terms of irrigated and planted area, average yield and duration of farming activities. Based on the result of this research, it was found out that the current state of irrigation development of NIA-UPRIIS Division I is relatively low in terms of the status of line and unlined canals; and this greatly affects the irrigation water delivery. It is also noted that the longer the length of lined canals, the higher the irrigated area would be. Thus, the average crop yield would also be higher. And since irrigation water delivery is more efficient in lined canals, the farming activities would be done earlier specially for the tail-end portion of the service area. In addition, there will decrease be a decrease in the water duty of the system, thereby saving irrigation water so that even the tail-end portion of the service area would be irrigated.***

Indexed Terms – Irrigation, Irrigation Facilities, Lined Canal, Unlined Canal, Farming Activities, Yield

I. INTRODUCTION

1.1. RATIONALE

The National Irrigation Administration (NIA) is a government-owned and controlled corporation primarily in charge of managing and developing irrigation systems. Its goal is to promote agricultural productivity and farmer revenue by offering irrigation services to the farmer-clienteles and stakeholders it supports.

Upper Pampanga River Integrated Irrigation Systems (UPRIIS) is an Integrated Irrigation Systems Office of the agency that supplies irrigation water to most part of the Province of Nueva Ecija and a portion of Tarlac. It draws out irrigation water from Pantabangan Dam and other National Irrigation Systems (NIS). UPRIIS has six Irrigation Management Office (IMO), strategically located within the province. One of the six is the Division I IMO, which will be the focus of this paper.

Division I IMO is located at Brgy. Malayantoc, Sto. Domingo, Nueva Ecija. It serves 22, 381.36 hectares of farmlands from six (6) municipalities and two (2) cities; namely the Lupao, Llanera, Talavera, Sto. Domingo, Quezon, Licab, Science City of Muñoz and City of San Jose. There are 17, 013 farmers from 80 different Irrigators' Associations. The farmlands within its service area are served by five different Irrigation Systems – the Talavera River Irrigation Systems (TRIS) Lower with water from Pantabangan Dam, Talavera River Irrigation System (TRIS) Upper that draws out water from Tayabo Dam, Macanae Irrigation System, Pinagquartelan Irrigation System and the partially operational area from the ongoing Balbalungao Small Reservoir Irrigation Project at Lupao, Nueva Ecija.

Moreover, during the early years of Pantabangan Dam, after the completion of its construction and the commencement of the operation of Pantabangan Dam on 1977, the main priority of the agency is the operation of the said dam since the facilities were newly constructed. Continuous operation through the years caused deterioration of the irrigation facilities, whereas its effects in the operation was significant. Since then, there were no major rehabilitation works that commenced. The rehabilitation works through concrete canal lining only started simultaneously with the later phase of the Casecnan Multi-purpose Irrigation Project.

The agency proposes a 10-year masterplan aimed to rehabilitate its facilities, however, due to constraints and different circumstances, budget allocation being the biggest factor, the targets from the said masterplan was not followed. Consequently, the deterioration continues.

This paper aimed to study how the current status of the irrigation facilities within Division I service area affects its operation and the provision of irrigation service to its farmers-clientele, and how the negative effects, if any, may be minimized if not eliminated.

1.2. STATEMENT OF THE PROBLEM

The study aimed to assess the current status of irrigation facilities within Division I service area. Specifically, it aims to answer the following, to wit:

1. What is the current level of development of irrigation facilities of Division I in terms of irrigation canal lining?

2. How lined and unlined irrigation canals affect the water delivery and distribution in terms of irrigation efficiency?

3. With the current level of development of irrigation facilities, how are farmers affected in terms:

a. irrigated and planted area;
b. average yield; and
c. duration of farming activities

1.3. SIGNIFICANCE ON THE STUDY

The continuous development of the irrigation facilities and structures of National Irrigation Administration (NIA) is fundamental to cope-up with the fast changing and modernized field of Agriculture, thus there is a need to study the current level of irrigation development.

This study was very significant to the agency, specifically to the Division I Irrigation Management Office as this will provide a better view on how the irrigation development would be further improve for the improvement of the provision of quality irrigation service to its farmer-clienteles and stakeholders.

In addition, this study was also significant to the student as it allowed the introduction o several theories taught in Master of Engineering Management into practice during the assessment conducted for this study.

And finally, this study was beneficial for the research field as this would open up dialogues, discussions and possible further studies for the improvement and development.

1.4. SCOPE AND LIMITATION OF THE STUDY

The study is limited on the assessment of the current status of irrigation facilities within Division I service area only. It assessed how lined and unlined irrigation canals affect the water delivery and distribution, and how the current level of development of irrigation facilities affected the farmers in terms of irrigated and planted area, average yield and duration of farming activities.

1.5. TIME AND PLACE OF THE STUDY

The study was conducted at NIA-UPRIIS Division I Office, Brgy. Malayantoc, Sto. Domingo, Nueva Ecija, and within its service area specifically at the municipalities of Lupao, Llanera, Talavera, Sto. Domingo, Quezon, Licab, and the cities of Muñoz (Science City) and San Jose for the period June 16, 2023 to July 28, 2023.

II. REVIEW OF RELATED LITERATURE

2.1 NATIONAL IRRIGATION ADMINISTRATION

The National Irrigation Administration (NIA) is a government-owned and controlled corporation primarily in charge of managing and developing irrigation systems. Its goal is to promote agricultural productivity and farmer revenue by offering irrigation services to the farmer-clienteles and stakeholders it supports.

Its mission is to "To plan, construct, operate and maintain irrigation systems consistent with integrated water resource management principles to improve agricultural productivity and increase farmers' income. " (source: Overview of the NIA accessed at the agency's Official Website.)

2.2. NIA-UPRIIS DIVISION I

NIA – Upper Pampanga River Integrated Irrigation Systems (NIA-UPRIIS) Division I is an Irrigation Management Office (IMO) located at Brgy. Malayantoc, Sto. Domingo, Nueva Ecija, that serves 17, 035 farmers in the Municipalities of Lupao, Llanera, Talavera, Sto. Domingo, Quezon and Licab, and the cities of San Jose and Muñoz. It has a total Firmed-up Service Area of 22,381.36 hectares. The said area is served by five Irrigation Systems – the Talavera River Irrigation Systems (TRIS) Lower with water from Pantabangan Dam, Talavera River Irrigation System (TRIS) Upper that draws out water from Tayabo Dam. Macanae Irrigation System, Pinagquartelan Irrigation System and the partially operational area from the ongoing Balbalungao Small Reservoir Irrigation Project at Lupao, Nueva Ecija. Aside from these irrigation systems, the farmers in the high-lying areas uses Solar-powered irrigation pump to draw-out irrigation water from the ground. It also provides support services to the farmers, through the conduct of capability trainings and assistance to avail other services provided by other agencies.

Currently, there are 167 employees that comprise the office. Said employees are divided into two (2) Sections, the Administrative and Finance (AdFin) Section and the Operations, Maintenance and Institutional Development (OMID) Section. The sections are further divided into units. There are six units under the AdFin Section- the Accounting Unit, Personnel and Records Unit, Billing and Collection Unit, Procurement and Property Unit, Cashiering Unit, and General Services Unit. While OMID Section is composed of three units - the Operations Unit, Maintenance Unit and Institutional Development Unit.

2.3. INVENTORY OF LINED AND UNLINED CANALS

Table 1. Inventory of Lined and Unlined Canals

Name of Systems	Total Length of Canal	Length of Lined Canal (km)	Length of Unlined Canal (km)	Percentage of Canal Lining (%)
San Isidro Balbalungao	16.156	16.156	0	100.00%
Macanae	8.412	8.412	0	100.00%
Pinagquartelan	4.95	0	0	0.00%
TRIS Upper	64.234	0.089	64.145	0.14%
TRIS Lower	280.86	60.713	220.15	21.62%
TOTAL	374.61	85.37	289.24	22.79%

Source: Division I Report on Lined and Unlined Canals

2.4. INVENTORY OF LINED AND UNLINED CANALS

Hereunder is the seven-year data on the Operations and Maintenance Performance of the Division Office based on the conducted year-end inventory.

Table 2. Operations and Maintenance (O&M) Performance

Particulars	Year							
	2015	2016	2017	2018	2019	2020	2021	2022
Service Area, Ha.	20,738.84	20,983.34	20,983.34	20,962.21	22,068.92	22,671.78	22,809.92	22,859.79
Firmed-Up Service Area, Ha.	20,651.71	20,896.71	20,821.71	20,774.69	21,642.56	22,245.42	22,361.96	22,381.36
Operational Area, Ha.	20,430.15	20,430.15	20,091.15	20,348.10	21,405.55	22,245.42	22,361.96	22,381.36
Non-Operational Area, Ha.	221.56	221.56	730.56	426.59	237.01	-	-	-
Irrigated								
Wet Season, Ha.	18,486.52	18,096.88	19,274.02	20,581.74	21,958.87	22,245.42	22,361.96	22,381.36
Dry Season, Ha.	15,960.35	18,111.53	18,389.63	19,080.07	20,511.33	21,167.92	21,891.01	22,032.96
3rd Crop, Ha.	-	-	-	1,199.70	-	1,515.65	2,047.40	1,591.00
Cropping Intensity, %	166.80	173.27	180.89	196.69	196.23	201.97	207.05	205.55
Average Yield								
Wet Season, MT/ha	70.50	70.62	101.43	92.47	4.64	4.99	5.00	5.02
Dry Season, MT/ha	126.22	127.34	141.62	132.02	151.56	7.46	7.77	7.81

2.5. CANAL LINING

In the study conducted by Gadde, N., Kiran, V., and Kalyan V., entitled "A Detailed Study on Canal Lining", they said that the primary goal of canal lining is to minimize seepage losses. Water in unlined canals seeps out of some soils between 25 and 50 percent of the entire amount provided. Increased agricultural yield, increased crop area, and increased crop intensity are just a few of the advantages of the project. This ought to have a positive effect on flora, fauna, wildlife, food security, the eradication of poverty, technological transfer, health, and nutrition.

As stated by Xudong Han, et. al., on their study "An Experimental Study on Concrete and Geomembrane Lining Effects on Canal Seepage in Arid Agricultural Areas," in order to decrease seepage loss and improve water use efficiency, canal lining is frequently utilized. Few studies, however, have quantified the seepage control effects of various lining materials at various service times.

A study conducted by Hrozencik, R, Potter, N, and Wallander, S, stated that infrastructure improvements for water conveyance can reduce conveyance losses and support goals for water conservation. With regard to reducing seepage losses and, in the case of piping, evaporation losses, it is possible to upgrade formerly earthen conveyance canals to lined canals.

2.6. IRRIGATED AREA

As defined by the Metadata Glossary of the World Bank Group, irrigated area means an area that is equipped to artificially irrigate its crops with water (by means such as stream diversion, floods, or spraying) is referred to as an irrigated agricultural area. Crop production in non-irrigated agricultural areas is reliant on rain-fed irrigation.

2.7. AVERAGE YIELD

Crop yields, as defined by Organization for Economic Co-operation and Development, are the amount of crop goods that have been harvested per unit of harvested land. Most of the time, yield data are not recorded; instead, they are calculated by dividing production data by harvested area data.

2.8. FARMING ACTIVITIES

Farming activity means the use of farmland for crops, fruits, vegetables production, from land soaking up to harvesting.

Planting of rice starts with land soaking; this takes at least two weeks depending on the condition of the land. During the wet seasons, land soaking usually starts in the first week of June followed by land preparation in the second to the third week of June. Likewise, during the dry seasons, land soaking starts in the first week of December followed by land preparation in the second to the third week of the said month. In addition, it takes (20 to 25) days before transplanting rice depends on the variety of the seedlings to be transplanted. The next activity would be the Normal Irrigation Project which lasts up to 10 weeks, followed by Terminal Drainage and the Harvesting.

2.9. IS/IS NOT MATRIX

Is/Is Not Matrix is a modern quality management tool that is used to conduct root-cause analysis. As stated by Šurinová, Y, and Paulová, I, in the study, "An Easy Way to Detect Problem´S Root Cause: Is – Is Not Analysis", when a problem is being identified, this analysis is used to determine what is within scope and what is not going to be taken into consideration at this time.

III. METHODOLOGY

3.1. RESEARCH DESIGN

This study used the mixed method of research, wherein both qualitative and quantitative approach were be used. This focused on the gathering of farmers' insights and numerical data in relation with the afore-mentioned problems to further assess the effect of the implemented Irrigation Rotation Schedule to the farmers served by TRIS Upper.

3.2. RESPONDENTS AND PARTICIPANTS

The researcher identified that the population for this research will be the farmers within the service area of NIA-UPRIIS Division I. Ten percent of the population will be randomly sampled for data gathering.

3.3. DATA GATHERING TOOLS AND TECHNIQUES

The instruments used by the researcher in gathering data for this study were the questionnaires and the regular reports of the Division Office, i.e., M-Curve, Daily Hydrological Data, List of Irrigated and Planted Areas (LIPA), Weekly Status of Farming Activities (WSFA) and Harvest Report.

The questionnaire was used in the assessment of the effects to the farmers, while the office's reports were used in defining the remaining questions stated above.

3.4. STATISTICAL TOOLS OR METHOD OF ANALYSIS

In this study, the researcher used the descriptive method of analysis in describing the gathered data. The researcher provided summaries about the data gathered from the samples. The statistical tool used in creating these outputs is Microsoft Excel. The quality management tool "Is/Is Not Matrix" was also used for further the assessment.

3.4. ETHICAL CONSIDERATIONS

The study considered the "Data Privacy Act of 2012", which states that "it is the policy of the State to protect the fundamental human right of privacy, of communication while ensuring free flow of information to promote innovation and growth."

It also considered the applicable Memorandum Circulars (MC) issued by the NIA in relation with the study.

IV. RESULTS AND DISCUSSION

4.1. STATUS OF CANAL LINING

Based on the inventory of lined and unlined canals of NIA-UPRIIS Division I, hereunder is the current level of irrigation development, to wit:

Table 1. Inventory of Lined and Unlined Canals

Name of Systems	Total Length of Canal	Length of Lined Canal (km)	Length of Unlined Canal (km)	Percentage of Canal Lining (%)
San Isidro Balbalungao	16.156	16.156	0	100.00%
Macanae	8.412	8.412	0	100.00%
Pinagquartelan	4.95	0	0	0.00%
TRIS Upper	64.234	0.089	64.145	0.14%
TRIS Lower	280.86	60.713	220.15	21.62%
TOTAL	374.61	85.37	289.24	22.79%

Source: NIA-UPRIIS Division I Inventory of Lined and Unlined Canals Report

It can be noted from the above inventory of lined and unlined canals that only 20.13% of the total length of canals of the Division office is lined.

San Isidro-Balbalungao Irrigation System has 100% canal lining since this is a new system and an ongoing irrigation project of the office that is expected to be completed by early 2024. Moreover, Macane Irrigation System is a system that is currently under rehabilitation due to its heavily-silted canals caused by soil erosion from the poor state of its watershed. To attend to this, the Division Office is currently implementing a reforestation program at its watershed area.

Further, for the systems, the TRIS Upper and TRIS Lower, the progress of canal lining is very minimal. It can be noted that for Pinagquartelan Irrigation System, no canal lining was made since its construction and operation.

Most of the canals, 79.69% to be exact, are earthen, causing significant water losses from seepage. By lining the canal cross-section's bed and sides, these losses can be reduced. The expense of operation and upkeep, erosion, and flow velocity are all reduced by canal lining. (Gadde, N., Kiran, V., and Kalyan V.) Thus, the continuous decrease in the system's efficiency.

4.2. STATUS OF CANAL LINING AND ITS EFFECT

Based on its Operation and Maintenance Report, the average water duty of the system as computed is 1.63 liters per second per hectare (l/s/ha) including 20% loss in diversion and 30% loss in distribution for unlined canals.

To further assess the status of canal lining, the "Is / Is Not Matrix" was used as the quality measurement tool. The result is shown in Table No. 9 and is based on the study conducted by Mahendra, U. 2014 on the study "Comparative Study of Canal Design".

Table 3. Analysis using the Is / Is Not Matrix

Deterioration of irrigation canals	Is	Is Not	Therefore
Where	Unlined canals	Lined Canals	Unlined canals or earthen canals deteriorate.
When	Deterioration is continuous over time. However, it greatly occurs when there is a delivery of irrigation water supply and when the embankments are utilized as access roads.	Gradual deterioration.	Canals deteriorate continuously especially for unlined canals when there is a delivery of irrigation water
What kind	Scouring of embankments and slopes, as well as accumulation of undesired sediments and other materials	Minimal accumulation of sediments	Scouring of embankments and slopes, and silting of the canals occur to unlined canals

From the analysis above, it can be noted that deterioration of canals happens for earth canals or unlined canals. Said deterioration is the scouring of embankments and canal slopes, as well as silting or the accumulation of undesired sediments and other materials. Though it occurs overtime and the most notable change occurs during the delivery and distribution of irrigation water. There are also instances when canal embankments were utilized as access road, this causes scouring. Therefore, if canals are lined, deterioration would be minimized. (Ghazaw, Yousry Mahmoud. 2011)

4.3. EFFECTS IN THE FARMERS

4.3.1. EFFECTS IN THE FARMERS

Based on the three-year Operation and Maintenance Performance of the Division Office, it can be noted that since the office starts the rehabilitation projects or the canal lining projects, the trend on the irrigated area is continuously increasing. Table 10 shows the three-year Operation and Maintenance Performance.

Table 4. Three-year Operations and Maintenance Performance

Particular	Year		
	2020	2021	2022
Service Area, Ha.	22,671.78	22,809.92	22,859.79
Firmed-Up Service Area, Ha.	22,245.42	22,361.96	22,381.36
8 Ha and Below, Ha.	20,477.74	20,935.30	21,015.93
Above 8, Ha	1,767.68	1,426.66	1,365.43
Operational Area, Ha.	22,245.42	22,361.96	22,381.36
Irrigated Area			
Wet Season, Ha.	22,245.42	22,361.96	22,381.36
Dry Season, Ha.	21,167.92	21,891.01	22,032.96

Table 4 shows that the there is an increase in the irrigated area for both the wet and dry cropping season. For 2021, there is an increase of 116.54has or 0.52% in the irrigated area for wet season, and 723.09has or 3.42% for dry season. Further, an increase of 19.40has or 0.09% for the wet season of 2022, and 141.95has or 0.65% for dry season. It can be seen that there is an increase in the irrigated area for the past three years.

The three year-data on canal lining is shown in Table 5.

Table 5. Three-year Data on the Canal Lining

System	Year		
	CY 2020 Lenth of Lined Canals (kms)	CY 2021 Lenth of Lined Canals (kms)	CY 2022 Lenth of Lined Canals (kms)
San Isidro-Balbalungao	16.156	16.156	16.156
Macanae	8.412	8.412	8.412
Pinagquartelan	0	0	0
TRIS Upper	0.089	0.089	0.089
TRIS Lower	50.572	57.935	60.713
Total	75.229	82.592	85.37

Table 5 shows the increase in the length of the canals lined for the past three years, in view of the rehabilitation projects implemented by the Division Office. Since San Isidro-Balbalungao and Macanae Irrigation Systems are both 100% lined, there can be no increase in the said systems. However, there are no increase in Pinagquartelan Irrigation System and TRIS upper. Since projects are focused on TRIS Lower, being the biggest system, the increase in the length of canal lining is seen. For the year 2021, there is an additional 7.36km of lined canal, and another 2.778km for 2022.

For 2021, the 7.36km increase in the length of lined canal resulted to an average (average of wet and dry crop) increase of 419.82has of irrigated area. While for the year 2022, the 2.778km increase in the length

of lined canal resulted to an average increase of 80.86has of irrigated area.

4.3.2. AVERAGE YIELD

Table 6 shows the three-year average yield of the Division Office.

Table 6. Three-year data on average yield.

Particular	Year		
	2020	2021	2022
Wet Season, MT/ha	4.99	5.00	5.02
Dry Season, MT/ha	7.46	7.77	7.81

Data shows that there is an increase in the irrigated area for the years 2021 and 2022, there is also an increase in the average yield. For the year 2021, there is an increase of .01MT/ha for wet season and 0.31MT/ ha. While for the year 2022, there is an increase of 0.02MT/ha for wet season and 0.04MT/ha for dry season.

4.3.3. FARMING ACTIVITIES

Based on the data gathered from the conducted interview, farmers who started land soaking on first week of May will be harvesting their palay on the fourth week of September for the first cropping season (wet crop season) Equivalently, those who started land soaking during First week of November second cropping season (dry season) will be harvesting their crops during the fourth week of March. The late onset of their farming activities, as stated by the farmers, is usually caused by the timing of the delivery of irrigation water in their area. Thus, most of the farmers opt to use water pumps to start ahead of their activities.

The broken line in the cropping calendar, as shown in Figure 1 and Figure 2 is the actual activities happening before the programed cropping calendar. With a 30 days staggered, it can be seen that farmers in wet season started land soaking and seedbed preparation ahead of scheduled, since farmers are using water pump to start the activity, this usually starts first week of May and the expected start harvest would be in fourth week of September, while on dry season we can see 30 days also of staggered and the farmers started land soaking and seedbed preparation ahead in the programed cropping calendar too, they also used water pump and the activity started first week of November and the expected first date of harvest will be on fourth of the week of March. In comparison with the actual and programed cropping calendar we can see that the actual cropping calendar is a head of 30days than the programed cropping calendar because some of the farmers used water pumps. However, as mentioned by small-scale farmers, those who are not able to afford the pumps wait for the irrigation water to be delivered at their areas.

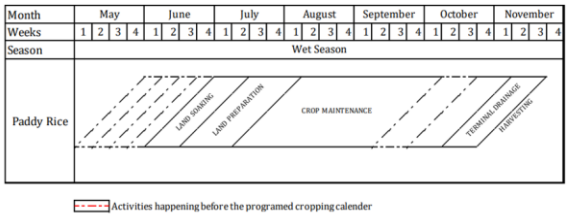

Figure 1. Dry Season Cropping Calendar

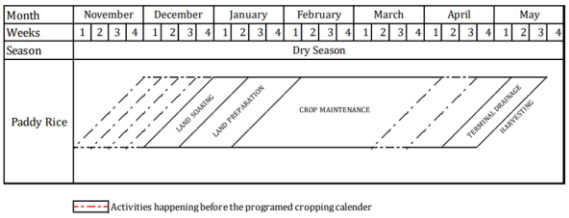

Figure 2. Wet Season Cropping Calendar

V. SUMMARY AND CONCLUSION

5.1. SUMMARY

The study assessed how lined and unlined irrigation canals affect the water delivery and distribution, and how the current level of development of irrigation facilities affected the farmers in terms of irrigated and planted area, average yield and duration of farming activities.

Based on the analysis of data, canal lining greatly affects the irrigated and planted area thereby affecting the average crop yield, as well as the farming activities.

5.2. CONCLUSION

Based on the result of this research, it can be concluded that the current state of irrigation development of NIA-UPRIIS Division I is relatively

low in terms of the status of line and unlined canals; and this greatly affects the irrigation water delivery.

Therefore, it can also be concluded that the longer the length of lined canals, the higher the irrigated area would be. Thus, the average crop yield would also be higher. And since irrigation water delivery is more efficient in lined canals, the farming activities would be done earlier specially for the tail-end portion of the service area. In addition, there will decrease be a decrease in the water duty of the system, thereby saving irrigation water so that even the tail-end portion of the service area would be irrigated.

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