

Irrigation and Production of Rabi Crops in Udalguri District: An Economic Analysis

Papina Basumatary
Assistant Professor,
Tangla College, Tangla.
Research Scholar,
Economics Department, USTM.

Dr. Kandarpa Kumar Barman
Retired Professor of Economics,
Gauhati University,
Professor, Economics Department,
USTM.

Abstract:

The rabi season crops are grown from October and December and harvested from April to June and the crops are important for securing food security and generating income because every year kharif season crops are damaged by flood. Irrigation is one of the most important agricultural inputs for sustaining rabi crops because they are grown during the dry season. Assam heavily relies on agriculture, but unpredictable monsoons damages kharif crops. To counter this, cultivating rabi crops during the dry season is crucial. The Irrigation Department of Assam has implemented various projects to enhance irrigated area. Statistical techniques like Compound Annual Growth Rate (CAGR) and Linear Regression Analysis have been used to examine the data. The present study examined the growth trends of irrigated area and impact of net irrigated area (NIA) on the production of selected rabi crops. In Udalguri district there has been positive growth trend in irrigated areas. The result of the study also reveals that the NIA significantly impacts the production of summer rice and potato, while it has no significant impact on the production of rapeseed and mustard.

Keywords - Rabi crops, CAGR, Linear Regression Analysis, Growth Trends of Irrigated Area, Summer Rice, Potato and Rapeseed & Mustard.

Introduction

The rabi crops are cultivated in October and November and harvested from April to June, is a vital part of India's farming calendar. Growing rabi crops brings many benefits, such as more ways to earn money, better food security, and helps in rotation crops for better growth. Summer rice, wheat, gram, oats, barley, potatoes, and seeds like mustard etc. are the important rabi crops cultivated in India. Yakubu et al. (2019) found from their study that dry season farming had a positive effect on household food security. Donkoh et al.

(2016) noted that dry season farming has a positive impact on farm income. India gets most of its rain during the four-month monsoon period from June to September. Rabi crops flourish during the dry season, so they need irrigation for best growth. Bhandari (2001) highlights that use of shallow tube well (STW) irrigation has significantly enhance the rice productivity, resource-use efficiency, farm income, and employment opportunities. Marina et al. (2017) found from their study that land irrigation has a positive effect on food production. These study underscore the

importance of irrigation, especially during dry seasons, in mitigating the adverse effects of excessive rainfall and enhancing agricultural productivity.

Assam relies heavily on agriculture, with over 70% of its population depending directly or indirectly on this sector for their livelihoods. Excessive rainfall during kharif season results in water logging and worsens flood situations, leading to considerable damage to kharif crops. To mitigate these losses, cultivating rabi crops becomes crucial during the rabi season. Irrigation is the crucial factor for enhancing productivity and sustainability during the rabi season. Irrigation Department of Assam was formed in 1974 with an objective to increase agricultural production by ensuring timely and adequate irrigation to the field to cultivate high yielding variety seeds. Irrigation Department has adopted various Centrally Funded Projects, State Funded Projects and Institutional Funded Project for the growth of irrigation facility.

Objectives:

The studied paper is based on following objectives-

1. To study the growth trends of Gross Irrigated Area (GIA), NIA, Irrigation Potential Created (IPC) and Irrigation Potential Utilisation (IPU) and season wise irrigated areas of Udalguri district.
2. To examine the impact of NIA on the production of selected rabi crops of study region.

Data:

The study is entirely based on secondary data collected from the period 2008-2009 to 2020-21. Among the various rabi crops, summer rice, rape & mustard and potato have been selected as they are the

major rabi crops of Assam. The data have been collected from books, journals, thesis, Statistical Hand Book of Assam, Economic Survey of Assam, District Statistical Hand Book of Udalguri, etc.

Methodology: Compound Annual Growth Rate and Simple Linear Regression in SPSS have been used to analyse the data. The results have been represented by tables and economic analysis has been made.

- i. To analyse the growth trends GIA, NIA, IPC and IPU and season wise irrigated areas of the district, the CAGR has been used.
- ii. Simple Linear Regression in SPSS has been used to examine the impact of NIA and production of selected rabi crops.

Study Area:

Udalguri district in Assam has been selected purposively for study due to its significant irrigated area. Udalguri district was formed on 2004 after the Bodo Accord, it is the 27th district of Assam and part of the Bodoland Territorial Autonomous District (BTAD). It shares borders with Bhutan and Arunachal Pradesh to the north, Sonitpur district to the east, Darrang district to the south, and Baksa district to the west. Agriculture is the main economic activity of Udalguri district. 88 per cent population of Udalguri depends on agriculture and allied activities for their livelihood. Farming is challenged by erratic rainfall, monsoon floods, and pre-monsoon dry spells. To mitigate flood-related losses, farmers have turned to cultivating rabi crops during the winter season. The Irrigation Department has initiated various projects to expand irrigation in the district.

Results and Discussion

1. Growth Trends of GIA and NIA (2008-09 to 2020-21):

The Irrigation Department of Assam has embarked on a comprehensive strategy

to bolster irrigation facilities across the state. Table 1 shows the growth trends of GIA and NIA of Udalguri district.

Table 1: Growth Trends of GIA and NIA (2008-09 to 2020-21)

Area in Hectares

Year	GIA	Percentage Change in GIA	NIA	Percentage Change in NIA
2008-09	9655		9345	
2009-10	21610	55.32	20820	55.11
2010-11	19030	13.55	17620	18.16
2011-12	27274	30.22	24364	27.68
2012-13	31203	12.59	27830	12.45
2013-14	55232	43.50	26358	5.58
2014-15	50656	9.03	23988	9.87
2015-16	96126	47.30	43467	44.81
2016-17	79796	20.46	61903	29.78
2017-18	142028	43.81	66671	7.15
2018-19	97858	45.13	47758	39.60
2019-20	122385	20.04	59935	20.31
2020-21	103654	18.07	51281	16.87
CAGR	21.87		15.24	

Sources: Chief Engineer, Irrigation Department, Assam. (Estimated by scholar)

Table 1 reveals that there has been fluctuation in the growth trend of GIA of study area during the study period. Annually it has creased by 21.87 per cent. The increase and fluctuation in the growth trends of GIA is due to the implementation of schemes. When the implementation of schemes is large, area has become large and vice-versa. Column no. 4, Table no. 1 reveals that there has been fluctuation on the growth trends of NIA during the study period. Annually, it has increased to 15.24 per cent. There is a gap between the growth trends of GIA and NIA and it is due to damage of irrigation canals, depletion of

water table, delay in restoration/ revival of schemes, present of drought, improper field levelling, lack of field drainage, etc.

1. b. Growth Trend of IPC and IPU of Major and Minor Irrigation System of Udalguri:

As irrigation is one of the important agricultural inputs for the rise of agricultural production, the Government of Assam has introduced several major and minor irrigation schemes to increase the irrigated areas in the region. Table 2 highlights the growth trend of IPC and IPU of Major and Minor Irrigation System of Udalguri from 2007-08 to 2020-21.

Table 2: Growth Trend of IPC and IPU of Major and Minor Irrigation System of Udalguri (2007-08 to 2020-21) (Area in Hectares)

Year	Udalguri					
	IPC of Major Irrigation System	IPU of Major Irrigation System	Percentage Change of IPC and IPU of Major Irrigation Area	IPC Minor Irrigation System	IPU Minor Irrigation System	Percentage Change of IPC and IPU of Minor Irrigation System
1	2	3	4	5	6	7
2008-09	31100	2810	9.03%	21817	NA	NA
2009-10	31100	9910	31.86%	27598	NA	NA
2010-11	36258	9550	26.33%	29445	NA	NA
2011-12	45258	9100	20.10%	39882	NA	NA
2012-13	45258	5150	11.37%	47475	NA	NA
2013-14	53258	4750	8.91%	49570	22345	45.07%
2014-15	53258	2230	4.18%	56842	22807	40.12%
2015-16	53258	13250	24.87%	65951	33700	51.09%
2016-17	53258	29595	55.56%	75375	47927	63.58%
2017-18	55258	16195	29.30%	85062	53542	62.94%
2018-19	55258	14560	26.34%	89164	33229	37.26%
2019-20	66230	20570	31.05%	89500	39360	43.97%
2020-21	66230	18332	26.47%	72850	33495	45.97%
CAGR	6.50	16.37		7	5.95	

Sources: Chief Engineer, Irrigation Department, Assam. (Estimated by scholar)

Table 2 highlights that there is an increase and constant growth trends of IPC of major irrigation system during the study period. The annual growth rate is estimated as 6.50 per cent. There has been fluctuation in the growth trend of IPU of major irrigation and its growth rate is estimated as 16.37 per cent.

IPC of Minor Irrigation System of Udalguri district was at an increasing trend from 2008-09 to 2019-20. Thereafter, there was a slight decline in the area of IPC of Minor Irrigation System. The annual growth rate of IPC of Minor Irrigation System is 7%. The growth trend of IPC of Major

irrigation system is lower than the growth trend of IPC of Minor Irrigation system.

The growth trend in the utilisation of Minor Irrigation System of Udalguri District is larger than Major Irrigation System. The annual growth rate of utilisation of Minor Irrigation System of Udalguri is 5.95% during the study period. Column 4 and column 7 of Table 2 shows that the percentage of utilisation of minor irrigation is more than the major irrigation system.

There is a gap between IPC and IPU in the Udalguri district. Natural calamities, change of river course, damage of canal system, general wear and tear of the schemes, etc. are the factors responsible for

the gap between IPC and IPUof Major and Minor Irrigation System.

1. c. Season Wise Growth Trend of Irrigated Area of Udalguri 2007-08 to 2020-21:

In Assam, the government has initiated various schemes aimed at

strengthening irrigation facilities to enable the adoption of multiple cropping systems and enhance agricultural production. Table 3 exhibits the season wise growth trend of irrigated area of Udalguri.

Table 3: Season Wise Growth Trend of Irrigated Area of Udalguri, 2007-08 to 2020-21
(Area in Hectares)

Year	Kharif Season Irrigated Area	Rabi Season Irrigated Area
2007-08	13100	2605
2008-09	9345	310
2009-10	20820	790
2010-11	17620	1410
2011-12	24364	2910
2012-13	27830	3373
2013-14	26358	1258
2014-15	23988	1340
2015-16	43467	4596
2016-17	61903	16874
2017-18	66671	17871
2018-19	47758	1171
2019-20	59935	1295
2020-21	51281	586
CAGR	15.24	5.44

Sources: Chief Engineer, Irrigation Department, Assam. Estimated by Scholar

The irrigated area under kharif season and rabi season in Udalguri district showed a fluctuating growth trends during the study period. The annual growth rate of Kharif season irrigated area is 15.24% and rabi season is 5.44% during the study periods. The growth trend of kharif season irrigated area is more than the rabi season irrigated area. During kharif season due to rainfall the density of water, water level and the flow of water in canal increases.

2. To examine the impact of NIA on the production of selected rabi crops.

Irrigation is important to grown rabi crops, as they are grown during dry season. The subsequent tables provide the findings concerning the impact of NIA on the production of selected rabi crops by using Linear regression analysis.

2. a. Impact of NIA on the Production of Summer Rice from 2008-09 to 2017-18

The cultivation of summer rice holds significant importance due to the annual flooding that affects winter and autumn rice crops. Hence, cultivating summer rice becomes crucial for ensuring food

security in the region. Typically, the cultivation done before the monsoon needs proper irrigation for its successful

growth. Tables 4, 5, and 6 highlight the impact of NIA on the production of summer rice.

Table 4: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.819	.671	.630	.1009873
a. Predictors: (Constant), NIA				
b. Dependent Variable: Summer Rice				

Sources: Statistical Handbook, Assam, Estimated by scholar

Table 4 represents the summary model. The R Square value of .671 indicates that approximately 67.1% of the variance in summer rice production is accounted for by the NIA included in the model. The

ANOVA table 5 shows a significant F-statistic of 16.314 with a p- .004 which is less than 0.01. It indicates that NIA significantly predicts summer rice production.

Table-5: ANOVA

Model	Sum of Squares	Df	Mean Square	F	Sig.	
1	Regression	.166	1	.166	16.314	.004
	Residual	.082	8	.010		
	Total	.248	9			
a. Dependent Variable: Summer Rice						
b. Predictors: (Constant), NIA						

Sources: Statistical Handbook, Assam; Estimated by scholar

Table- 6: Coefficients

Model		Unstandardised Coefficients		Standardised Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.052	.585		1.798	.110
	NIA	.531	.131	.819	4.039	.004
a. Dependent Variable: Summer Rice						

Sources: Statistical Handbook, Assam; Estimated by scholar

The Sig. = .004 indicates in Table 6 shows that NIA significantly predicts

production of summer rice and one unit of increase in NIA brings about .531 increased of production of summer rice.

2. b. Impact of NIA on the Production of Rapeseed & Mustard (R & M) from 2008-09 to 2017-18

Rapeseed and mustard has been sown between September and October and

harvested from February to March. And as it is cultivated during winter, linear regression analysis has been used to examine the impact of NIA on its production.

Table -7: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.546	.298	.210	.1580860
a. Predictors: (Constant), NIA				
b. Dependent Variable: R & M.				

Sources: Statistical Handbook, Assam; Estimated by scholar

Table no. 7 represents the summary model. The R square value of .210 indicates that NIA has weak influence on the production of rapeseed and Mustard. Table 8 ANOVA indicated that regression model

is not significant for the test because $p=.105$ and is greater than the $P=.05$. The NIA has no significant impact on the production of rapeseed & mustard because it requires less water.

Table 8 ANOVA

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	.085	1	.085	3.390	.103
	Residual	.200	8	.025		
	Total	.285	9			
a. Dependent Variable: R & M						
b. Predictors: (Constant), NIA						

Sources: Statistical Handbook, Assam; Estimated by scholar

Table 9 Coefficients

Coefficients						
Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	.962	.916		1.050	.324
	NIA	.379	.206	.546	1.841	.103
a. Dependent Variable: R & M						

Sources: Statistical Handbook, Assam; Estimated by scholar

2. c. Impact of NIA on the Production of Potato from 2008-09 to 2017-18

Potato is an essential vegetable crop, primarily cultivated during the winter season. The linear regression analysis has

been used to measure the impact of NIA on potato production. Table 10, 11 and 12 highlights the impact of NIA on the production of potato.

Table- 10: Model Summary

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.635	.403	.328	.2162152
a. Predictors: (Constant), NIA				
b. Dependent Variable: Potato				

Sources: Statistical Handbook, Assam; Estimated by scholar

Table 10 represents the summary model. The R Square value of .403 indicates that approximately 40.3 % of the variance in potato production is accounted for by the NIA included in the model. The ANOVA table 11 shows a significant F-statistic of 5.394 with a p value .049 which is slight less than p value 0.05. It indicates that NIA significantly predicts potato production

Table- 11: ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.252	1	.252	5.394	.049
	Residual	.374	8	.047		
	Total	.626	9			
a. Dependent Variable: Potato						
b. Predictors: (Constant), NIA						

Sources: Statistical Handbook, Assam; Estimated by scholar

Table 12 Coefficients

Coefficients						
Model		Unstandardised Coefficients		Standardised Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	.918	1.252		.733	.484
	NIA	.654	.282	.635	2.323	.049
a. Dependent Variable: Potato						

Sources: Statistical Handbook, Assam; Estimated by scholar

The Sig. = .0049 from table 12 indicates that NIA significantly predicts production of potato and one unit of increase in NIA brings about .654 increased production of potato.

Conclusion

Irrigation plays a pivotal role in sustaining the growth of rabi crops. Analysis using CAGR reveals a significant increase in several key areas within Udalguri district, including the GIA, NIA, IPC, and IPU of both Major and Minor Irrigation Systems. Moreover, there has been an increase in the irrigated area during both the kharif and rabi seasons. The study also identifies a gap between the IPC and IPU of both Major and Minor Irrigation systems in the study area. This discrepancy might have stemmed from

various factors such as natural calamities, changes in river courses, damage to canal systems, and general wear and tear of the irrigation schemes. Furthermore, Linear Regression analysis indicates that the NIA significantly impacts the production of summer rice and potato, while it has no significant impact on the production of rapeseed and mustard. Through these findings it can be concluded that there is the possibility of the increase of the production of summer rice by expanding irrigation facilities in the study area.

References:

Book

- Dhar, P. (2016). The Economy of Assam Including Economy of North-East India. Kalyani Publishers.

Reports

- Area Development Schemes Udalguri District. <https://www.nabard.org>
- District Statistical HandBook, Udalguri (Various Issues).
- Economic Survey of Assam (Various Issues).
- Gogoi, M. and Bordoloi, R (2011). Potential and Prospects of Rabi Crops Cultivation in Assam. <https://cdms.aau.ac.in>
- Statistical Handbook of Assam (Various Issues).

JOURNALS

- Bhandari H. (2001). Impact of Shallow Tubewell Irrigation on Crop Production in the Rerai Region of Nepal. <https://www.researchgate.net>

- Donkoh, S. A., Kudadze, S., Adzawla, W. and Ansah, I.G.K. (2016). Adoption of Dry Season Vegetable Farming and Its Effects on Income at Golinga and Botanga Irrigation Sites, Northern Ghana. Ghana Journal of Science, Technology and Development. Vol. 4, Issue 1, April 2016. <http://www.gistd.org>
- Manap, N. M. A. and Ismail, N. W. (2017). Land Irrigation and Food Production in Dry-Land Developing Countries). International Journal of Agriculture, Forestry and Plantation, Vol. 5 (June), ISSN 2462-1757.
- Yakubu, D. H., Nwolisa, N., Kehinde, E. A., Muhammad, M. B. Shuaibu, H. and Usman T. (2019). Perceived Effect of Dry Season Farming on Household Food Security in Goronyo Local Government Area of Sokoto State. *Asian Journal of Agricultural Extension, Economics & Sociology*. 35 (1): 1-8, 2019; Article no. AJAEES. 49848. ISSN: 2320-7027.
