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Livelihood Promotion Through Irrigated Agriculture-an Emperical Analysis of Supply Shifters and Farms' Productivity

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Abstract : *The present study explored how irrigated agriculture contributes towardsrural livelihood promotion through Gross Domestic Product (GDP) and employment generation based on some field level observation. It was observed that agriculture and allied activities played an important role in livelihood promotion of the rural people living in the project command by means of contributing to the state's GDP and providing livelihood to a significant proportion of the population. Agriculture sector continues to support more than 75 percent population of the State directly or indirectly providing employment of more than 53 percent of the total workforce. Agricultural supply response is one of the most important issues in agricultural development economics since the responsiveness of farmers to economic incentives largely determines agriculture's contribution to the economy (tripathi et.al). Using Nerlovian approachpresent study develops an Agricultural Supply Response Model based on some field level observation. The estimation reveals that agricultural supply is significantly influenced by irrigation ratio (IR), Agricultural Mechanisation (MECH) and agricultural terms of trade (TOT). Apart from agricultural supply response, irrigation ratio also induces cropping intensity. The bivariate analysis between productivity and IR reflects statistically significant co-integration which suggests that a favourable IR alone may not be sufficient in sustaining higher agricultural growth.*

The study concluded that the subsistence economy along with numbers of factors such as lack of an integrated farming approach, weak agricultural research and extension network, inadequate public expenditure on rural infrastructure, etc. resulted in low agricultural production of the state. As such, ensured farmers accessibility to output and input markets, strengthening of agricultural research and extension, removing restrictions on agricultural trade and improving rural infrastructure especially irrigation, transport, education and health facilities are some of the factors that would lead to increase agricultural supply as well improve rural livelihood and mitigate the problem of food deficiency in the state in turn.

Key words:*Livelihood promotion, Supply response, irrigation, Irrigation ratio, Mechanization, Productivity.*

1.1 Introduction

For a sustained development in the agricultural sector availability of assured irrigation facility is undoubtedly the most important prerequisite. The development of agricultural practices vis-à-vis increase in productivity of crops cannot be conceived in absence of assured irrigation facilities. The economy of Assam continues to be predominantly agrarian. Agriculture sector continues to support more than 75 percent population of the State directly or indirectly providing employment of more than 53 percent of the total workforce (2011 census). There is a general mis-conception that since Assam is a heavy rainfall State, there is hardly any need for irrigation in the State. But rainfall in Assam unevenly distributed over time and space and as a result demand for irrigation water is indispensable. During the year 2006-07, the State experienced a drought like situation in almost all districts which stood in the way of agriculture development in the State. Therefore the inclusive development of all the irrigation projects with sustained and assured services has

been emerged as an urgent need of the days for agricultural development and livelihood promotion. Under these circumstances the present study is an attempt to assess the impact of **KOPILI** (F.I.S.) irrigation scheme on livelihood promotion of the peoples living in the project command. The basic research questions to be dealt in this study are as follows:

I. To what extent the scheme can fulfil the water demand of the people.

II. Is the scheme motivating the peoples for double cropping?

III. What is the people's motivation towards this scheme and their level of participation?

IV. What are the local socio-economic consequences of the irrigation scheme?

V. Is there any additional institutional option that ensures increasing access of the poor farmers to local irrigation scheme?

In view of these above mentioned research questions the objectives and hypothesis of the study are set as follows:

Objectives

i. Assess the contribution of agriculture to Domestic Product and employment generation.

ii. Explore the supply shifters of agricultural supply and their level of significance based on Nerlovian Approach.

Hypothesis

1. It is hypothesised that farm productivity is a positive function of irrigation ratio.
2. It is hypothesised that irrigation intensity depends upon irrigated area, Agricultural Dependent Population, etc.
3. It is hypothesise that agricultural mechanization induces irrigation intensity and cropping intensity.

1.2 Research Design and Methodology:

The study is empirical in nature and based on primary survey data collected from the official sources of Kopili FIS and from the peoples living in the project command. As per official record there are 14 numbers of benefited revenue villages under Kopili F.I.S. So at the first step 7 villages were selected randomly. In the next step the available farmers of a particular village were grouped into three different categories viz small, medium and large based on Participatory Rural Appraisal (PRA) techniques. Finally 50-70 percent of the farmers from each group were selected randomly for details investigation.

The tabulation and estimation of the data has been done with the help of computer. Since the study envisages to fit a regression model of output determination, the statistical analysis like regression, testing of hypotheses, ANOVA, etc. were carried out through computer with sophisticated statistical tools and techniques like SPSS.

1.3 Results and Discussion

• Contribution of agriculture to GDP and Employment

An attempt was made to quantify the agricultural contribution to GDP and employment. For that purpose total production of rice is converted into monetary value, multiplying by market price of rice. After that its percentage contribution to GDP is observed. Like-wise, numbers of peoples engaged in agriculture and total work force are calculated separately and then the contribution of agriculture sector to the total work force is observed. Table 3.7 presents this information.

Table 3.7: Share of Agriculture in GDP and Employment

Sl. No	Villages	% share of agriculture in GDP	% share of agriculture in employment	Ratio of worker pdn in agri. to non-agri.
1	Dharampur	79.58	72.99	1:0.34
2	Kaharapara	69.71	74.61	1:0.69
3	Nampara	87.96	87.72	1:0.14
4	Nargaon	81.52	69.44	1:0.30
5	Natun Rani	78.24	74.80	1:0.36
6	Bahupara	95.92	94.44	1:0.04
7	Total	78.58	76.52	1:0.40

Source: Field Survey, 2009.

Data presented in table 3.7 shows that agriculture plays an important role in contributing to GDP and employment in the surveyed area. Agriculture contribution to GDP is accounted for as much as 78.58 per cent of GDP. It is the Bahupara village where the agriculture contribution to GDP is found to the highest being 95.92 per cent and the figure is the lowest in Kaharapara village being 69.71 per cent. While employment is concerned the over all contribution is found to be 76.52 per cent. The contribution of agriculture to employment is the highest in Bahupara village being 94.44 per cent and the lowest in Nargaon village being 69.44 per cent. Thus, it is proved that agriculture play a very important role in providing sources of income and employment to the peoples in the surveyed area. However, the ratio of workers production (agriculture workers: non-agriculture workers) shows that agriculture workers are less productive in comparison to that of non-agricultural workers. It may be due to subsistence type of operation system, non-practice of multiple cropping, lack of technological progress, etc. As such agricultural workers productivity is accounted for 0.40 per cent of the non-agricultural workers productivity.

- **Exploration of Supply shifters_ Nerlovian Approach**

Agricultural supply response is one of the most important issues in agricultural development economics since the responsiveness of farmers to economic incentives largely determines agriculture's contribution to the economy (tripathi et.al,). Agricultural supply response represents change in agricultural output as a result of changes in agricultural output price and as well as supply shifters. The concept of supply response is dynamic and different from simple supply function which is in fact a static concept and describes largely a price quantity relation, where all other factors are kept constant.

The agricultural supply response is estimated in India using time series and panel data. Most of the studies applied Nerlovian framework. However the present study is based on cross section data and the corresponding equations are defined as double-log model and it is based on similar model by Di Falco and Perrings (2003). The reasons for transforming the equations into double-log model is to pull outlying data from a positively or negatively skewed distribution closer to the bulk of the data in a quest to have the variables be normally distributed.

3.7.1 Theoretical Framework and Method of Estimations:

In agriculture, since the observed prices are known after the production has occurred the planting decisions are based on the prices expected to prevail later at the harvest time which is intern depends upon the prices of previous year. Because of this time lag, producer price expectations play a key role in the analysis. There are three alternative agricultural producer price expectations hypothesis commonly found in the literature. These are native expectation, adaptive expectation and rational expectation. Farmers, especially in developing country, are mostly low literate and hence it is difficult to obtain all the relevant information. Therefore rational expectation hypothesis is not relevant in developing countries. The present study believes that farmers learn from their past mistakes, so in such a situation adaptive expectation is more relevant.

There are two approaches to estimation of agricultura supply response: Indirect Structural form Approach and Direct Reduced Form Approach

3.7.2 Indirect Structural Form Approach:

This approach involves derivation of input deman function and supply function from the available data information relation to production function, and individua behaviours. This approach is more rigorous theoreticall but fails to taken into account the partial adjustment i production and mechanism used by farmers in formin expectations.

3.7.3 Direct Reduced Form Approach:

This approach directly estimate supply response t including partial adjustment and expectations formatio This is also known as Nerlovian model. Most of t existing studies on the agricultural supply response in Ind and abroad have applied the Nerlove approach. Accordi to Nerlove, desired output can be expressed as a functi of expected price and exogenous shifters:

$$Q^*_t = a + bP^*_t + c\,Z_t \quad \text{——————} \quad (1)$$

Where, Q^*_t is desired output, $P^*_{t\,is}$ expected price, is a set of exogenous shifters such as technologi changes, weather condition, etc.

Actual output may differ from that of desired out because of the adjustment lags of exogenous variab Therefore, it is assumed that actual production would c

be a fraction ä of the desired output.

$$Q_t = \delta(Q^*_t) \text{ ——————————— (2)}$$

Where, Q_t is actual output in period t and is adjustment coefficient. Its value lies between 0 and 1.

Regarding formation of expectation one can assume that farmers can remember the magnitude of their mistake in the previous period and learn by adjusting the difference between actual and expected price in t-1 time period by a fraction ë.

$$P^*_t = P_{t-1} + (1- \quad) P^*_{t-1} \text{ ——————————— (3)}$$

Solving equations 1, 2 and 3 we get:

$$Q_t = A_o + A_1 P_{t-1} + A_2 P^*_{t-1} + A3Z_t \text{ ——————————— (4)}$$

Where, $A_o = a, \delta; A_1 = b, \delta, \lambda; A_2 = b, \delta, (1-\lambda); A_3 = \delta, c$

Equation 4 gives the basis for empirical works. The model shows that agricultural supply depends upon its actual price in the previous year, expected price and supply shifters, such as weather, mechanisation, soil quality, etc. the equation 4 does not impose any restrictions on functional form and parameters. Again it is not possible to incorporate all of these factors due to non-availability of data and quantification problems. Considering these issues, long-run relationship can be represented as follows:

"$Y_{it} = f(IR_{it}, MECH_{it}, EDN_{it}, FSIZE_{it}, ADP_{it}, TOT_{it}, U_{it})$ ——— (5)

Where,

Y_{it} = Agricultural supply (Dependent variable) in i^{th} households in t-time period

IR_{it} = Irrigation Ratio in t-time period for i^{th} households = total irrigated land/ total cropped area.

$MECH_{it}$ = Agricultural Mechanisation (Cost in terms of Rs. Per bigha)

EDN_{it} = Average years of schooling of the households (average numbers of school years)

$FSIZE_{it}$ = Average size of households (Numbers)

TOT_{it}, = Agricultural terms of trade. It is a ratio of prices received by farmers to price paid by farmers. It was calculated as: TOT= IPD for agricultural sector/ IPD for non-agricultural sector

U_{it} = Disturbance term

I = 1, 2, 3, ——203.

T = 2005-2009

3.7.4 Empirically Emendable form of the Model:

The relationship expressed in 5 can be transform in to an empirical modal as follows:

$$In \sum_{i=1}^{n} Yit = A_o + A_1 \ln IR_{it} + A_2 \ln MECH_{it} + A_3 \ln EDN_{it} + A_4 \ln FSIZE_{it} + A_5 \ln TOT_{it} \text{ ——————(6)}$$

The parameters of log transformation variables like A_0, A_1, A_2, A_3 A_4 and A_5 in the double log model represent different elasticity of the explanatory variables which are measured in different units.

3.7.5: Results of Regression Model:

The results of regression for estimation of Agricultural Supply Response on explanatory variables in the estimated equations are represented as:

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.589[a]	.542	.495	.20251

a. Predictors: (Constant), logIR, logedn, logMECH, logfsize, logtot

ANOVA[b]

Model	Sum of Squares	df	Mean Square	F	Sig.	
1	Regression	4.034	5	.807	19.673	.000[a]
	Residual	7.997	195	.041		
	Total	12.031	200			

a. Predictors: (Constant), logIR, logedn, logMECH, logfsize, logtot

b. Dependent Variable: logpdvty

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-4.081	.584		-6.987	.000
	logtot	-.018	.036	-.056	-.498	.619
	logMECH	.823	.085	.572	9.693	.000
	logedn	-.006	.027	-.016	-.222	.825
	logfsize	.089	.059	.106	1.507	.133
	logIR	.015	.026	.063	.580	.563

a. Dependent Variable: logpdvty

As shown in the estimated equation 7 most of the estimators of the explanatory variables are significant with the expected sign. The R^2 and Adjusted R^2 are found to be 0.75 and 0.74 respectively. The F-statistics for overall goodness of fit of the model is 100.65 which is highly significant (at 0.00 level). The estimation shows that agricultural supply is significantly influenced by irrigation ratio (IR), Agricultural Mechanisation (MECH) and agricultural terms of trade (TOT). The variable IR is found to be positively associated with agricultural supply and it is significant at 0.05 level. It implies that the higher the irrigation ratio the greater is the agricultural supply. So it signifies the fact that the Kopili FIS, which is the only source of irrigation, has played a very important role in determination of agricultural supply response. Apart from agricultural supply response, irrigation ratio also induces cropping intensity. Mechanisation, which indicates overall technological progress in agriculture sector, is found to be significant in determining agricultural productivity. The relationship is as high as 0.10 level.

Another significant variable in determining agricultural productivity response is the agricultural terms of trade (TOT). It represents real output price in a year or the relative price of agricultural output. The result indicates that the variable TOT is negatively associated with agricultural productivity and the relationship is significant at 0.01level. If the relative price of agricultural output goes on increasing peoples found to be less interested to agriculture as a result productivity starts falling. So, th relationship between agricultural supply and TOT is foun to be negative.

It was also observed that the productivity is positivel associated with family size (FSIZE). Households wi more members can spare more family labour f agricultural operation and can concentred on more effecti operation of farm which induces farm productivity. T variable EDN (average years of schooling years) is fou to be negatively associated with productivity. It indicat that educated peoples are less attractive to agriculture. N even accepting it as their profession. Rather in absence other alternative job opportunities there are forced to dependent upon agriculture for sustain living. So, relationship is found to be negative. However, FSIZE a EDU have no significant influence on productivity.

It is to be noted here that though the variables IR found to be significant in determining farm productiv the bivariate analysis between productivity and IR refle no statistically significant co-integration. The non integratedness indicates that the IR is not sole facto determining productivity. This, in turn, would suggest a favourable IR alone may not be sufficient in sustain higher agricultural growth. But when all these varia are included in the model, then it is found that the I co-integrated with productivity. Following table pres the findings of Bivariate analysis between productivity selected variables, the estimated models and the valu R^2

Table: 3.8:Bivariate Analysis.

Relation Between Variables	Estimated Equation	R^2	Interpretation
PDN and IR	$Y_t = 463.59 + 71.18x_t$	0.084	No Co-integration
PDN and TOT	$Y_t = 593.60 - 52.524x_t$	0.375	Co-integration
PDN and MECH	$Y_t = 154.50 + 0.392x_t$	0.392	Co-integration

Source: Field Survey,

The bivariate analysis between productivity and IR, Productivity and TOT and Productivity and MECH along with graph, estimated equation and R^2 value are shown in Figure 1, 2 and 3 respectively given in annexure.

Thus, the estimated equations show that most of the explanatory variables have the expected sign which are statistically significant at different levels

Conclusion :

1. Economic incentives are offered to encourage people to make certain choices or behave in a certain way.
2. This approach directly estimate supply response by including partial adjustment and expectations formation
3. Irrigation intensity is defined here as Gross Irrigated Area (GIA) divided by Net Irrigated Area (NIA) multiplied by 100.
4. Under this exercise the participants (Farmers, GaonBurha, Village Leaders and some educated elder peoples) were asked to categorize the households into two different households groups namely relatively poor and non-poor considering some variables which the villagers consider as important to identify the economic status of the households. These are household income, size of land, livestock and other assets holding, consumer durables, etc.
5. In the present context of study agricultural production is accounted for rice production only. So there is a chance of under estimation of the contribution of agriculture to GDP.
6. Economic incentives are offered to encourage people to make certain choices or behave in a certain way.
7. There are several factors that influence supply such as price of the product, relative prices of the substitute products, climate conditions, technological progress, changes in the institutional and policy variables and even attitude of the producers. In economic terminology these factors are called supply shifters.
8. Nerlove proposed a dynamic distributed lag model in which he introduced a dynamic element into response equation by creating expectation.
9. Di Falco and Perrings in 2003 developed a double-log model to understand the effect of co-operative production on inter-specific crop genetic diversity.
10. Native expectation means that the expected price is the actual price prevailed in the previous period.
11. Adaptive expectation means that people from expectations about what will happen in the future based on what has happened in the past.
12. According to rational expectation, an economic agent forecasts his future events on the basis of all available information.
13. Some variables such as soil quality, farmer's skill, etc. cannot be quantified.