CHAPTER FIVE

RESULTS AND FINDINGS

5.1 Agricultural Performance Index and Human Development/ Quality of Life Index

Both agricultural performance and human development performance in Barak Valley have been studied along with thier component variables or dimension indices. The linkage or interrelationship between the two has been analysed by using the following equation-

The multiple regression model is $Y=aX_1^{b1}X_2^{b2}X_3^{b3}X_4^{b4}U_1$

Here Y=Quality of Life Index-QLI, X_1=Land Fertility Index-LFI, X_2= Market Index-MI, and X_3= Technology Achievement Index-TAI and X_4= Labor Productivity Index-LPI. U_1 is the random disturbance term. b_1, b_2, b_3 and b_4 are parameters to estimated for the explanatory variables. The estimated results are shown in table 5.1.

Table-5.1
Model Summary and Parameter Estimates

Dependent variable-QLI

Variables	Un-standardized B-value	Standardized β coefficient	Standard errors	t-dist.	Sig.
(Constant)	0.351		0.020	17.192	0.000
LFI	0.155	0.228	0.035	6.099	0.000
MI	0.162	0.334	0.024	6.527	0.000
TAI	0.213	0.275	0.026	6.319	0.000
LPI	0.147	0.142	0.049	.959	0.010
Diagnostic Statistics		Adj. R^2=0.465	F-Value=98.565 (Sig=0.000)		N=450

Source: calculated by the author

We have used our data sets for multiple regressions. In this data set, required parameters like LFI, MI, TAI and LPI have been used to predict human

development or quality of life index-QLI which is a composite measure of wealth, education and health. From left to right, we use the variables y, x1, x2, x3 and x4. In the Model Summary, we see that the un-standardized B values show the marginal effects of the independent variables while the β coefficients explain the relative strength of the regressors. The adj. R^2 shows the better estimate for the population than R^2. It depicts that 47% of the variation in quality of life index can be explained by the variation in agricultural performance indicators.

So the sample regression equation is $\hat{y}=.351x1^{.228}\ x2^{.334}\ x3^{.275}\ x4^{.142}$ with standardized β coefficients. All the variables are highly significant. Among the explanatory variables, market index and technology achievement index are stronger than the land fertility index and labour productivity index.

Chart-V.1

Relation between Human Development/Quality of life (QLI) and Agricultural performance index (API)

Scatter matrix plot

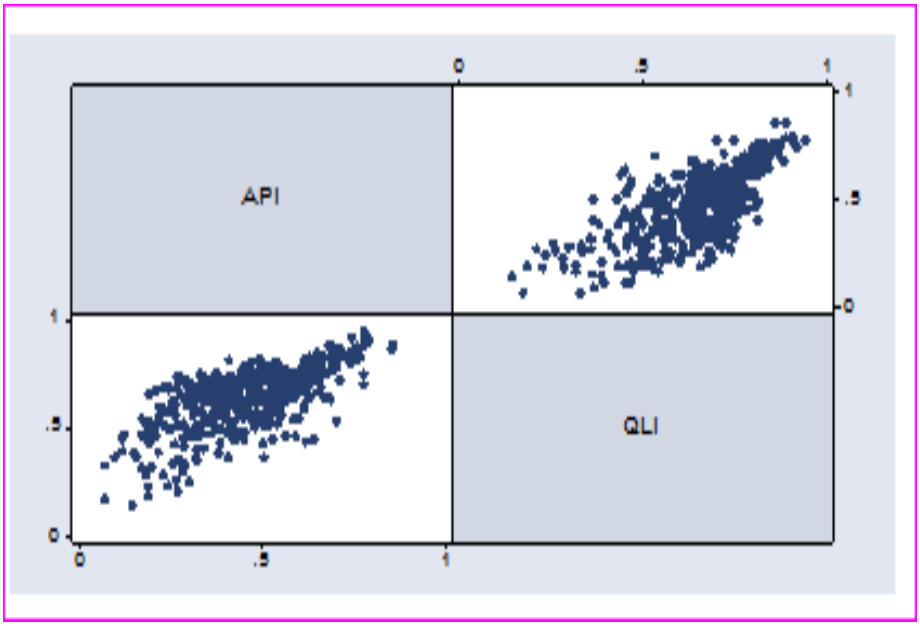


Chart-V.2

Added variable plot shows the respective contribution of the predictors in the model

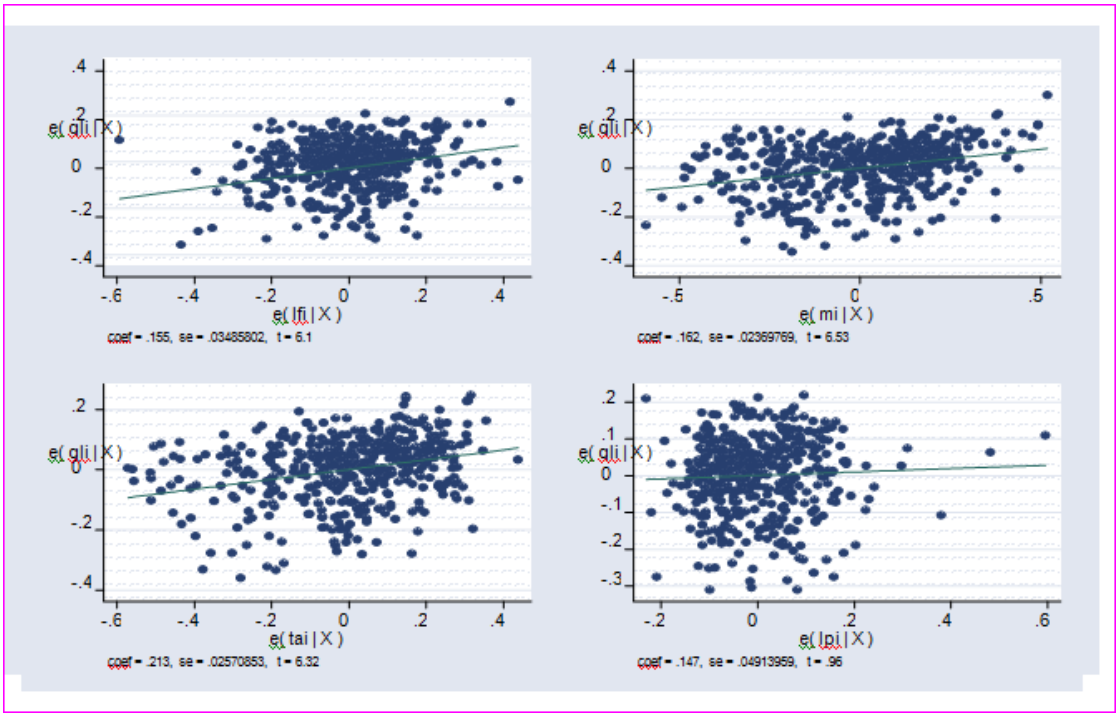


Table-5.2

Multicollinearity test for regression model

Variables	Partial correlation	Part correlation	Tolerance	VIF	Eigen value	Condition Index
LFI	0.278	0.211	0.851	1.175	0.164	5.311
MI	0.296	0.225	0.454	2.200	0.089	7.222
TAI	0.287	0.218	0.631	1.584	0.080	7.600
LPI	0.045	0.033	0.617	1.621	0.032	11.960

Source: calculated by the author

Partial correlation is that correlation remains between two variables after removing the correlation that is due to their mutual association with the other variables. It has shown the correlation between the dependent variable and an independent variable when the linear effects of the other independent variables in the model have been removed from both.

Part correlation is the correlation between the dependent variable and an independent variable when the linear effects of the other independent variables in the model have been removed from the independent variable. It is related to the change in R-squared when a variable is added to an equation. Sometimes it is called the semi partial correlation.

The tolerance is the percentage of the variance in a given predictor that cannot be explained by the other predictors. Thus, the high tolerances show that 60%-80% of the variance in a given predictor cannot be explained by the other predictors. When the tolerances are close to 0, there is high multicollinearity and the standard error of the regression coefficients will be inflated.

Variance Inflation Factor-VIF greater than 2 is usually considered problematic, and the smallest VIF in the table is 1.175 and the highest one is 2.200.

This is the undesirable situation when one independent variable is a linear function of other independent variables. Eigen values of the scaled and cross-products matrix, condition indices, and variance-decomposition proportions are displayed along with variance inflation factors (VIF) and tolerances for individual variables.

The condition indices are computed as the square roots of the ratios of the largest Eigen value to each successive Eigen value. Values greater than 15 indicate a possible problem with collinearity and greater than 30, a serious problem. But here all values are less than 15. The highest one is 11.960.

Thus it can be concluded that the model does not suffer from multicollinearity problem.

5.2 Agricultural Performance and Multidimensional Poverty

The multiple regression model estimated is $Y=aX_1^{b1}X_2^{b2}X_3^{b3}X_4^{b4}U_1$

Here Y=Multidimensional Poverty Index, X_1=Land Fertility Index-LFI, X_2= Market Index-MI, and X_3= Technology Achievement Index-TAI and X_4= Labor Productivity Index-LPI. U_1 is the random disturbance term. b_1, b_2, b_3 and b_4 are parameters to be estimated for the explanatory variables.

Table-5.3
Model Summary and Parameter Estimates

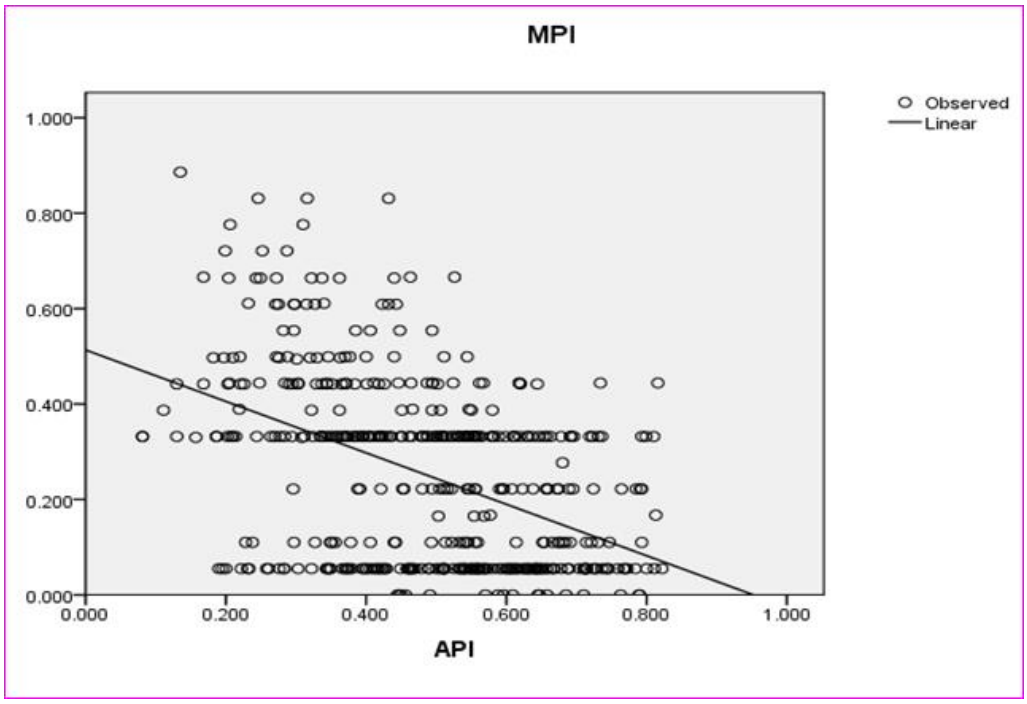
Variables	Un-standardized B-value	Standardized β coefficient	Standard errors	t-dist.	Sig.
(Constant)	0.428		0.033	12.817	0.000
LFI	-0.091	-0.115	0.057	-1.242	0.001
MI	-0.231	-0.434	0.039	-8.817	0.000
TAI	-0.201	-0.323	0.042	0.402	0.000
LPI	-0.123	-0.217	0.080	1.282	0.000
Diagnostic Statistics		Adj. R^2=0.252	F-Value=38.73 (Sig=0.000)		N=450

It is found that the Adjusted R Square as a better estimate for the population i.e 0.252 which means that 25% of the variation in the dependent variable-Multidimensional Poverty Index in Barak Valley can be explained by the components of the Agricultural performance.

So the sample regression equation is $\hat{y}=.428\ x1^{(-.115)}\ x2^{(-.434)}\ x3^{(-.323)}\ x4^{(-.217)}$ with standardized β coefficients.

Since the factors determining quality of life index and multidimensional poverty index are same, it can be concluded that the model does not suffer from multicollinearity problem.

Chart-V.3



5.3 Determinants of Agricultural Performance Index in Barak Valley

The General Linear multivariate Analysis

The GLM procedure provides regression analysis and analysis of variance for multiple dependent variables by one or more factor variables or covariates. The factor variables divide the samples into groups. Using this general linear model procedure, one can test null hypothesis about the effects of factor variables on various groupings of a joint distribution of dependent variables.

Table-5.4

Multivariate Analysis

Variables	Statistic	Value	F	Sig.	Partial Eta Squared
Intercept	Pillai's Trace	.929	8.5022	.000	.929
	Wilks' Lambda	.071	8.5022	.000	.929
	Hotelling's Trace	13.031	8.5022	.000	.929
	Roy's Largest Root	13.031	8.5022	.000	.929
WI	Pillai's Trace	.846	2.023	.000	.211
	Wilks' Lambda	.340	2.314	.000	.236
	Hotelling's Trace	1.442	2.674	.000	.265
	Roy's Largest Root	1.061	8.002	.000	.515
EI	Pillai's Trace	.911	3.245	.000	.228
	Wilks' Lambda	.289	3.978	.000	.267
	Hotelling's Trace	1.832	4.953	.000	.314
	Roy's Largest Root	1.468	16.150	.000	.595
HI	Pillai's Trace	1.339	1.071	.082	.335
	Wilks' Lambda	.192	1.078	.061	.338
	Hotelling's Trace	2.074	1.085	.041	.342
	Roy's Largest Root	.754	1.605	.001	.430

a. Design: Intercept + WI + EI + HI

b. Dependent Variables are Land Fertility, Market, Technology Adoption and Labour Productivity Indices

c. Independent Variables Wealth, Education and Health Indices

The table 5.4 shows the role of social sector variables in API. If more than one dependent variable is specified, the multivariate analysis of variance using Pillai's trace, Wilks' lambda, Hotelling's trace and Roy's largest root criterion with approximate F statistic are provided.

1. **Pillai's trace** is a positive-valued statistic. Increasing values of the statistic indicate effects that contribute more to the model. On the above model land fertility index, market index, technology achievement index

and workers productivity index are contributed highly by wealth, education and health indices of Barak Valley.

2. **Wilks' Lambda** is a positive-valued statistic that ranges from 0 to 1. Decreasing values of the statistic indicate effects that contribute more to the model. Here education and health contribute more than wealth index.
3. **Hotelling's trace** is the sum of the Eigen values of the test matrix. It is a positive-valued statistic for which increasing values indicate effects that contribute more to the model. Hotelling's trace is always larger than Pillai's trace, but when the Eigen values of the test matrix are small, these two statistics will be nearly equal. This indicates that the effect probably does not contribute much to the model. But here they differ largely and do contribute to the model.
4. **Roy's largest root** is the largest Eigen value of the test matrix. Thus, it is a positive-valued statistic for which increasing values indicate effects that contribute more to the model. In Barak Valley wealth and education contribute more than health index.
5. Roy's largest root is always less than or equal to Hotelling's trace. When these two statistics are equal, the effect is predominantly associated with just one of the dependent variables, there is a strong correlation between the dependent variables, or the effect does not contribute much to the model. Each multivariate statistic is transformed into a test statistic with an approximate or exact F distribution.
6. The hypothesis (numerator) and error (denominator) degrees of freedom for that F distribution are shown. The significance values of the main effects, WI, HI and EI are less than 0.05, indicating that the effects contribute to the model.
7. A more straightforward way to see this is to look at partial eta squared. The partial eta squared statistic reports the "practical" significance of each term, based upon the **"**ratio**"** of the variation accounted for by the effect to the **"**sum**"** of the variation accounted for by the effect and the variation left to error.

8. Larger values of partial eta squared indicate a greater amount of variation accounted for by the model effect, to a maximum of 1.

Chart-V.4

Variation in LFI + MI + TAI + LPI explained by the wealth index-

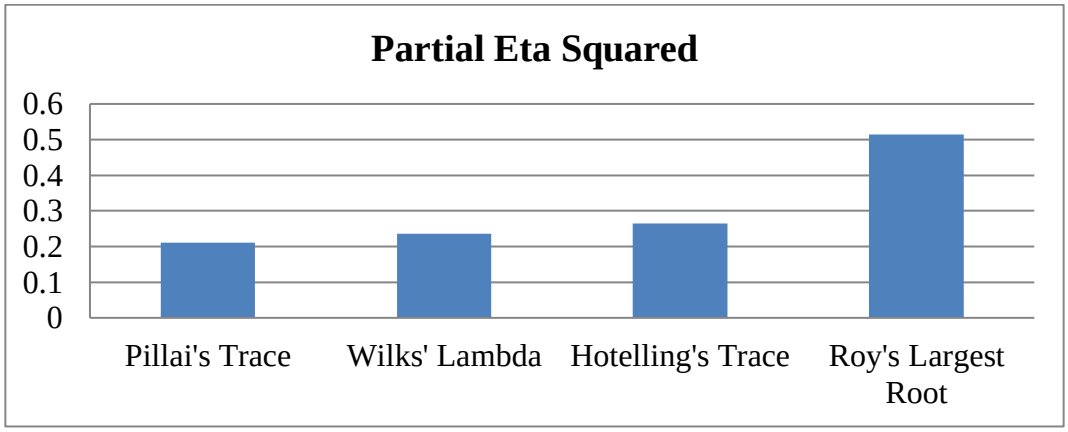


Chart-V.5

Variation in LFI + MI + TAI + LPI explained by the variation in education index

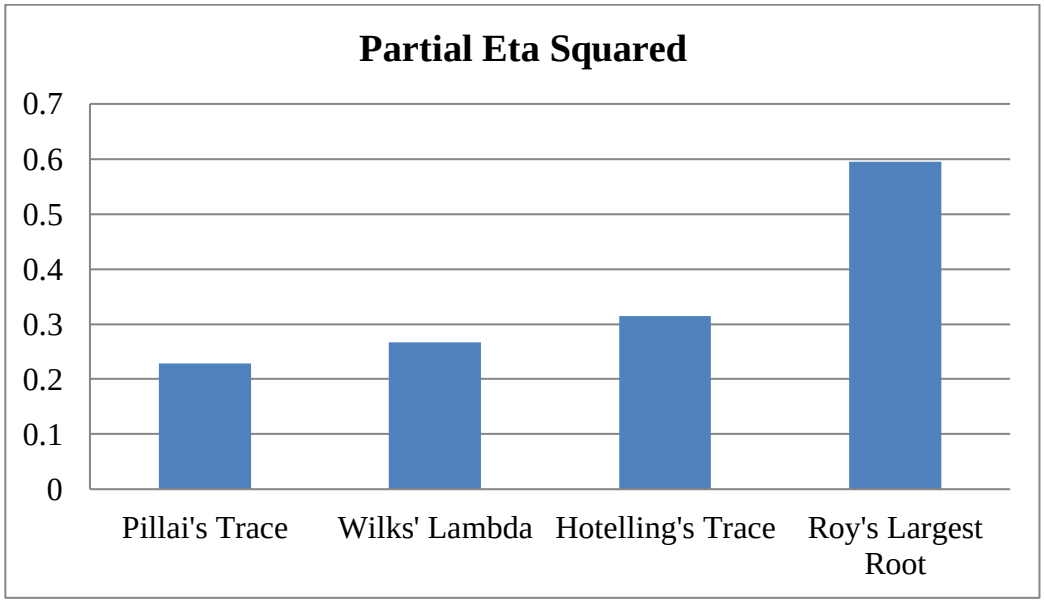
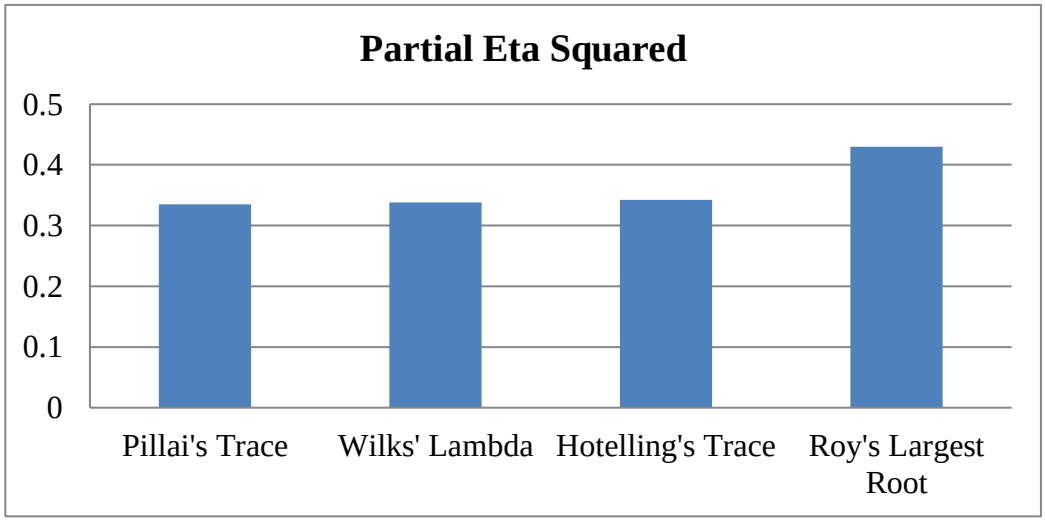


Chart-V.6

Variation in LFI + MI + TAI + LPI explained by the health index



Thus the determinants of Agricultural Performance Index in Barak Valley has been analysed with help of multivariate analyses where a number of predictors have been found to determine or influence API largely. These predictors are both agrarian and social in nature as follows:

1. The variables like WI- Wealth Index, EI- Education Index, HI- Health Index are found to make much impact on Agricultural performance of Barak Valley region of Assam and are highly significant.
2. Labour productivity is highly significant with wealth, schooling and health. Health and schooling promote the efficiency level of the farmer while contribute to agricultural performance. Technology Achievement in farming and marketing of agricultural produce are significantly influenced by health, wealth and education.

5.4 Determinants of Human Development in Barak Valley

The Role of Agriculture Towards Human Development- A Cobb-Douglas Production Function Approach

The impact of agricultural componenets on major parameters of Human Development has been studied- Education by Literacy Level and Standard of Living/Wealth made of 28 vital factors-1) House type 2)Separate room for

cooking/Kitchen 3) Ownership of house 4) Flooring 5) Toilet facility 6) Source of Electricity/Lighting 7) Main fuel for cooking 8) Source of Drinking Water 5) Car or Tractor 9) Moped or Scooter 10) Telephone 11) Refrigerator 12) Colour TV 13) Black and white TV 14) Bicycle 15) Electric fan 16) Radio 17) Sewing machine 18) Mattress 20) Pressure cooker 21) Chair 22) Cot or bed 23) Table 24) Clock or watch 25) Ownership of livestock 26) Water pump 27) Bullock cart 28) Harvester/Thresher. Wealth is calculated by summation of scores of respective indicator.

We have measured the output elasticity with respect to factors. The output is Standard of Living and School Education while the factors are Agricultural components- Output per Hectare, Percentage of Output Sold, Technology Adoption and Output per Worker.

We have estimated following two equations to test the output elasticity with respect to factors.

$$Y_1 = A\, X1^{\beta 1}\, X2^{\beta 2}\, X3^{\beta 3}\, X4^{\beta 4}\; U_i$$

$$Y_2 = A\, X1^{\beta 1}\, X2^{\beta 2}\, X3^{\beta 3}\, X4^{\beta 4}\; U_i$$

Where,

Y_1= Living Standard of the Farmers

Y_2= School Education of the Farmers

A= Constant, X1= Output per bigha, X2= % of the Output Sold, X3= Technology Adoption and X4= Output per Worker. The U_i is the Disturbance factor.

β1, β2, β3 and β4 are elasticity coefficient for factors- Output per hectare, Percentage of Output Sold, Technology Adoption and Output per Worker.

The estimated results are shown in table 5.5 and table 5.6.

Table-5.5
Model Summary and Parameter Estimates

Dependent variable-Living Standard

Variables	B	Standardized β coefficient	Standard errors	t-dist.	Sig.
(Constant)	.535		.161	3.315	.001
Output per hectare- X1	.110	.236	.104	7.169	.000
Percentage of Output Sold- X2	.137	.274	.018	6.954	.000
Technology Adoption- X3	.271	.410	.015	11.695	.000
Output per Worker- X4	.106	.202	.028	5.540	.000
Diagnostic Statistics		Adj. R^2=0.609	F-Value=302.531 (Sig=0.000)		N=450

The estimated equation is

$$Y_1 = .535\ X1^{.236}\ X2^{.274}\ X3^{.410}\ X4^{.202}$$

The impact of Agriculture on Standard of living is huge. There is enough stimulus in Agriculture for Human Development. The Cobb-Douglas production function results show that 1% increase in Output per hectare increases Standard of living by 23% while 1% change in Commercialization or percentage of the output sold improves the Living condition by 27%. The access to modern technology improves the standard of living by 41% while 1% change in output per worker increases the standard of living by 20%.

We found that the coefficients are highly significant indicating a strong positive relationship between the predictors and the dependent variable. The coefficient of determination adj.r2 (R Square) of 0.609 indicates that for the sample, 61% of the variation in living standard can be explained by the variation in Agriculture. The F-statistic is 302.531 which are highly significant for the model.

Table-5.6
Model Summary and Parameter Estimates

Dependent variable-Schooling

Variables	B	Standardized β coefficient	Standard errors	t-dist.	Sig.
(Constant)	2.02		.270	7.491	.000
Output per hectare- X1	.109	.213	.170	6.192	.000
Percentage of Output Sold- X2	.231	.411	.030	9.921	.000
Technology Adoption- X3	.226	.311	.024	8.503	.000
Output per Worker- X4	.101	.136	.047	3.535	.000
Diagnostic Statistics		Adj. R^2=0.571	F-Value=406.531 (Sig=0.000)		N=450

The estimated equation is

$$Y_2 = 2.023\ X1^{.213}\ X2^{.411}\ X3^{.311}\ X4^{.136}$$

The Cobb- Douglas Production function estimates shows that there is vital linkage between Agricultural components and Access to School Education. The output- Access to Education increases by 21% due to 1% increase in Output per hectare. When percentage of output sold increases by 1% then it makes 41% impact on education. Technology Adoption improves the social condition of the farmers as it impacts 31%. The impact is 13% for the Labour Productivity Index. The results can be interpreted vice-versa.

The coefficients of agricultural performance are highly significant indicating a good positive relationship between the predictors and the dependent variable. The coefficient of determination adj.r2 (R Square) of 0.571 indicates that for the sample, 57% of the variation in Education can be explained by the variation in Agricultural factors. The F-Value is 406.531and highly significant for the model.

5.5 Access to Socio-economic Resources and Performance

Access to natural and other resources is an important pursuit for development. Land is the most important economic resource for the farmer while education can be taken as a proxy for social capital. Economic wealth promotes the farmer to have access to more social benefits. Land is the most important resource for the farmer as agriculture is basically a land based activity. Access to land and the size of land sometimes make huge impact on the performance of a farmer as well as his socio-economic benefits also. The quality of life or human development is associated with access to resources by the farmers. The table 5.7 shows how access to land and the size of land affect the standard of living of the farmers in Barak valley region.

Table-5.7
Mean performance by land holding

Type of Farmer	LFI	MI	TAI	LPI	API	WI	EI	HI	QLI	MPI
Large	0.573	0.980	0.964	0.587	0.777	0.903	0.938	0.909	0.882	0.142
Marginal	0.447	0.030	0.367	0.135	0.244	0.409	0.491	0.548	0.522	0.395
Medium	0.567	0.873	0.783	0.402	0.656	0.725	0.805	0.839	0.762	0.143
Semi Medium	0.543	0.693	0.568	0.303	0.527	0.582	0.675	0.819	0.667	0.186
Small	0.470	0.274	0.414	0.244	0.350	0.474	0.476	0.734	0.575	0.342
Total	0.514	0.527	0.543	0.291	0.468	0.561	0.617	0.771	0.643	0.250

Source: calculated by the author

Chart-V.7

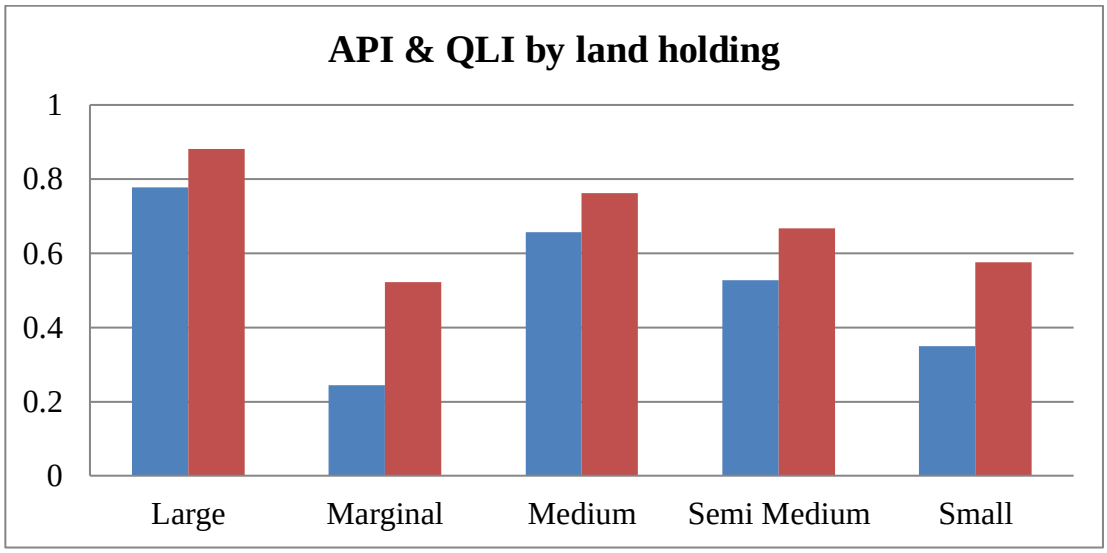
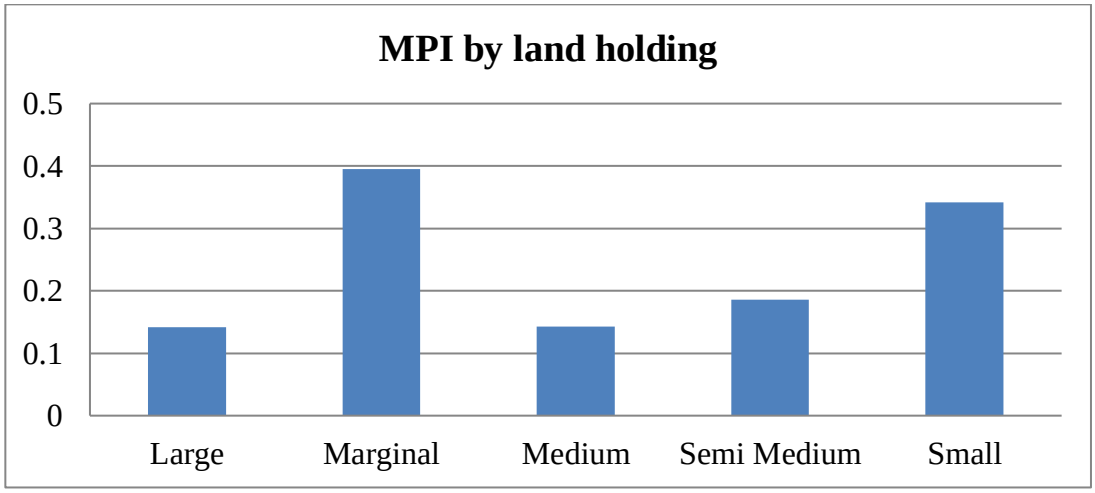


Chart-V.8



1. The table 5.7 and charts V.7 and V.8 shows that access to land and the size of land makes an important impact on the performance of farmers of Barak Valley.
2. The Agricultural Performance index and Quality of Life Index are both affected by the access to land resource. The large farmers are the highest, the 2nd is the medium land holders, the 3rd is the semi-medium, the 4th is the small farmer and the last is the marginal farmer.
3. The Multidimensional Poverty Index reduces as the size of land has increased for the farmers.

Table-5.8

ANOVA

			Mean Square	F	Sig.
API * Type of farmer	Between Groups	(Combined)	2.068	282.118	.000
	Within Groups		.007		
	Total				
QLI * Type of farmer	Between Groups	(Combined)	.745	55.217	.000
	Within Groups		.013		
	Total				

Source: calculated by the author

The above analysis of variance results show that the F-statistic is highly significant with the different groups of farmer while the grouping is done on the basis of access to land and land size. Both API and QLI are significant with changes in land holdings; however the F-statistic for API and QLI is 282.118 and 55.217 respectively.

Table-5.9

Mean Performance by Schooling

Years of Schooling	LFI	MI	TAI	LPI	API	WI	HI	QLI	MPI
0	0.247	0.085	0.212	0.175	0.180	0.342	0.404	0.432	0.370
1	0.468	0.053	0.133	0.199	0.213	0.383	0.413	0.488	0.387
2	0.372	0.106	0.370	0.172	0.255	0.410	0.577	0.520	0.332
3	0.450	0.121	0.326	0.201	0.275	0.397	0.640	0.530	0.362
4	0.433	0.228	0.436	0.220	0.329	0.466	0.717	0.565	0.425
5	0.481	0.241	0.384	0.207	0.328	0.452	0.792	0.584	0.271
6	0.463	0.422	0.328	0.220	0.358	0.502	0.829	0.648	0.323
7	0.511	0.448	0.441	0.266	0.416	0.519	0.789	0.600	0.287
8	0.527	0.581	0.537	0.299	0.486	0.564	0.803	0.659	0.218
9	0.551	0.667	0.591	0.294	0.526	0.575	0.822	0.663	0.210
10	0.582	0.748	0.672	0.339	0.585	0.632	0.823	0.706	0.175
11	0.597	0.827	0.798	0.438	0.665	0.755	0.848	0.758	0.173
12	0.560	0.904	0.915	0.431	0.702	0.792	0.816	0.790	0.143
15	0.651	0.912	0.919	0.494	0.744	0.852	0.931	0.828	0.129
Total	0.514	0.527	0.543	0.291	0.468	0.561	0.771	0.643	0.250

Source: calculated by the author

The schooling of the farmers is an important tool for increasing their performance in both agriculture and human development. The table 5.9 show that as the schooling has increased the API and QLI have gone up. But there is decline in multidimensional poverty of the farmers. Thus it is proved that building up social capital for the development of the farmers shall ensure not only recovery from vicious circle of poverty but also promotes their efficiency in both economic and social parameters of development.

Table-5.10

ANOVA

			Mean Square	F	Sig.
API * schooling	Between Groups	(Combined)	.674	105.759	.000
	Within Groups		.006		
	Total				
QLI * schooling	Between Groups	(Combined)	.244	18.355	.000
	Within Groups		.013		
	Total				

The table 5.8 depicting ANOVA test indicates that education of the farmers can play a positive role in the improvement of both agricultural performance and human development. Different level of schooling makes huge differences in the performance of the farmers. Thus it can be concluded that both land holdings and education of the farmers are really economic and social capital respectively for the farmers and exert heavy influence in the determination of their living condition.

5.6 Findings

Agriculture and Human Development Performance have been studied along with their component variables while different statistical tools, techniques and econometric models have been used. Now the major findings of the study made so far-

(1) Linkage between Agricultural Performance and Human Development in Barak Valley

1. The regression analysis and other econometric tests show that there is strong positive relationship between the predictors- Land Fertility Index (LFI), Market Index (MI), Technology Achievement Index (TAI) and Labor Productivity Index (LPI) and the dependent variable-QLI. The coefficient of determination adj. $r2$ (R Square) of 0.465 indicates that, for the sample, 47% of the variation of QLI can be explained by the variation in LPI, LFI, TAI, MI.

2. The general linear multivariate estimation of factors determining agricultural performance in Barak Valley has been found to be significant with their four test effects and F-test. The linkage between the two broad aspects of development has been tested differently and it is found that our hypothesis of positive role of agriculture for human development and human development for agriculture is highly significant.

3. The Cobb-Douglas Production function estimates shows that there is positive linkage between predictors- Output per hectare, % of Output sold, Technology Adoption and Output per Worker and dependent variable- Living Standard/ Wealth score and Schooling of the farmers.

4. The pattern of land holding and the level of education have been found very significant in the determination of both API and QLI.

Thus the 1st Hypothesis of positive linkage between Human Development and Agricultural Performance is accepted.

(2) Linkage between Multidimensional Poverty and Agricultural Performance

The regression analysis for multidimensional poverty denotes a good negative relationship between the predictor Agricultural Performance Index and the dependent variable- Multidimensional Poverty Index in Barak Valley.

The multidimensional poverty index is based on 10 indicators of 3 dimensions of deprivation in education, health and standard of living and is found to have inverse relation with agricultural performance index. It is marketing and technological achievement which makes more impact on poverty than that of land fertility and labour productivity. Thus agricultural development can play a vital role in reducing poverty and improving the quality of life.

The 2nd Hypothesis is accepted.

(3) Determinants of Agricultural Performance and Human Development in Barak Valley

1. The multivariate analysis of variance using Pillai's trace, Wilks' lambda, Hotelling's trace, and Roy's largest root criterion with approximate F-statistic show that social sector variables play a significant role in the determination of agricultural performance.
2. The variables like WI- Wealth Index, EI- Education Index, HI- Health Index are found to make much impact on Agricultural performance of Barak Valley region of Assam and are highly significant.
3. Labour productivity is highly significant with wealth, schooling and health. Health and schooling promote the efficiency level of the farmer while contribute to agricultural performance. Technology Achievement in farming and Marketing of agricultural produce are significantly influenced by health, wealth and education.

Thus the 3rd Hypothesis of direct relation between Social sector and Agriculture is accepted.