The Nature and Extent of Income Generation by the Borrower Households of Grameen Bank

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Abstract

This paper focuses on the nature and extent of self-employment and income generation by the households of the Grameen Bank borrower. Attempt has been made in the study to measure the socio-economic changes of the borrower households and to disentangle the contribution of Grameen Bank credit from the contribution of other factors of income generation available to the borrower households. The study is based on primary survey data and both qualitative and quantitative tools have been used to measure and express the findings. Although the proponents of Grameen Bank have shown tremendous success of the bank in their early studies, the present study shows that the contribution of Grameen Bank loan in the total income generated by the borrower households is very insignificant.

Introduction

The Grameen Bank (henceforth mentioned below as GB) came to scene as group-based micro-credit institution in 1983 with a very high promise to eliminate rural poverty. The proponent and appointed consultants of GB have shown excellent positive impacts of the loan on the borrower households in the realm of self-employment creation and income generation. On the other hand, some renowned development experts have expressed their apprehension about the long run impact of GB credit in the rural economy because of insignificant size and utilization period of loan, high rate of interest and slower progress of non-farm sector in rural area. The proponents of GB show more than 500 activities; mainly non-farm activities for the rural borrowers to be accomplished by GB loan through which the widespread poverty can be reduced. In the present study the change and extension of the economic activities of the GB borrower households (after their

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joining the GB) and the actual contribution of GB loan in the total income generated have been explained..

Methodology

The study is based on primary survey data collected from GB borrower households under the Rajshahi zone of GB. A total of 188 households of active GB borrowers were selected by using random sampling method. The households that received GB loan for less than 5 years till the survey time were not taken under consideration. The data were numerically computed and shown in tables. It deserves mentioning here that along with the primary data a number of relevant studies done by some eminent experts were reviewed as the secondary source of information. The quantitative estimation was done through computer using MS Excel and SPSS tools. GB credit, Labour force, property and grants were considered as the explanatory factors of income generation. And the function of income were formed as:

$$Y= f(X_1, X_2, X_3, X_4)$$

where , Y= income, X_1 =credit, X_2=labour, X_3 =grants and X_4 =property.

Model Selection

The stepwise regression, least squares techniques, auto correlation and multi co-linearity techniques were taken as the model of estimation.

Section of the study

The study has been divided into two sections. The economic profile of the borrower households are examined in section A and the contribution of GB credit in the total income generation by the households are disentangled in section B.

Section A: The socio-economic profile of the borrower households

The socioeconomic conditions prevailing in the selected borrower's households before and after their joining the GB are examined here to consider whether the micro-credit of GB actually and effectively reached the households of the poor borrower's in terms of self-employment and income generation.

1. Cultivable Land Ownership Pattern of the Respondent Households: GB claims that it considers the land-less and asset-less i.e, the extreme poor of the rural area as their borrowers. Table 1 shows the cultivable land ownership pattern of the selected borrowers.

Table 1 shows that at present 14.89 percent households have no cultivable land but before their enrollment in the GB 10.11 percent of the selected households had no cultivable land. It is also seen from the table that before joining GB 9.57%. 17.55%, 22.87%, 17.02%, and 22.87% households of the selected borrowers had

Table 1: Cultivable Land owned by the Respondent Households

Amount of cultivable land (in decimals)	At present		Before enrolled	
	No. of respondents	Percentage	No. of respondents	Percentage
00-00	28	14.89	19	10.11
01-25	15	07.98	18	09.57
26-50	38	20.21	33	17.55
51-75	42	22.34	43	22.87
76-100	24	12.77	32	17.02
101 and above	41	21.81	43	22.87
Total		.00	188	100.00

Source: Field Survey

01-25, 26-50, 51-75, 76-100, and more than 100 decimals of cultivable land respectively. At present the 7.98%, 20.21%, 22.34%, 12.77% and 21.81% households have 01-25, 26-50, 51-75, 76-100, and more than 100 decimals of cultivable land respectively. Therefore the above table reveals that 62.77% of the borrower households were not functionally land-less at the time of joining the GB. On the other hand 5.86% of the borrower households became land-less and most of the households lost some of their cultivable land during use of GB loan.

2. Total Number of Labourer in the Respondent Households: The number of laborer in the households of the borrower before and after joining the GB is shown in the following table.

Table 2 shows that the number of young laborers has significantly increased among the borrower households in the period of GB borrowing. It is seen that at present 25%, 29.26%, 34.04%, and 11.70% borrower households have more than five, four, three and two laborer respectively. Before their enrollment in the GB this percentage was 3.72%, 08.51%, 54.79% and 32.98% respectively. As the poor families of the rural area depend mainly on daily labour the children of those families instead of attending educational institution are engaged in some sort of

Table 2: Total Number of Labourer in the Respondent Households (Aged above 13 Years)

Total number of laborers	At present		Before enrolled in the GB	
	Number	Percentage	Number	Percentage
02	22	11.70	62	32.98
03	64	34.04	103	54.79
04	55	29.26	16	08.51
05 and above	47	25.00	07	03.72
Total		.00		.00

Source: Field Survey

income earning not related to household micro-credit, gross income of the borrower households increases and supplements borrower's ability to repay the installments.

3. Main Occupation

Table 3 shows that at present the principal occupation of 43.09% of the borrower households is agriculture, 13.30%, 16.49%, 08.51%, 04.79%, 03.19%, 01.06%, 01.60%, 01.06%, 01.06%, and 05.85% borrower households are engaged in petty business, daily labour, rickshaw or van pulling, service, fishing, small poultry, small manufacturing, husking, money lending and informal business respectively.

Table 3: Main Occupation of the Respondent Households

Main occupation of the respondent households	At present		Before enrolled	
	No. of respondents	Percentage	No. of respondents	Percentage
Agriculture	81	43.09	95	50.53
Petty business	25	13.30	21	11.17
Daily laborer	34	16.49	42	22.34
Rickshaw/Van pulling	16	08.51	12	06.38
Service/Field worker	07	04.79	04	02.13
Fishing	06	03.19	06	03.19
Small poultry	02	01.06	01	00.53
Small manufacturing	03	01.60	02	01.06
Husking	02	01.06	03	01.60
Money lending	01	01.06	00	00.00
Informal business	11	05.85	02	01.07
Total		.00		.00

Source: Field Survey

Before enrollment in the GB, respective percentage for these occupations were 50.53%, 11.17%, 22.34%, 06.38%, 02.13%, 03.19%, 00.53%, 01.06%, 01.60%, and 01.06%. From the above table it is clearly seen that the GB programme could not create self-employment for the borrower households remarkably.

4. Subsidiary Occupation of the Respondent Households: Majority households in the rural areas have subsidiary occupations alongside main occupations. The subsidiary occupations of the households of selected borrowers before and after their joining the GB are shown in the following table.

Table 4 shows that at present 77.66% of the selected borrower households have some subsidiary occupations in addition to the main one. Before enrollment in the GB this position was 59.57%. Percentage of subsidiary occupations at present is for agriculture 15.07%, for petty business 17.12%, for daily laboring 32.19%, for rickshaw or van pulling 06.16%, for service 00.68%, for fishing 01.37%, for small manufacturing 00.68%, for money lending 04.11% and for illegal border trade 22.60%. Before the borrowers enrollment in the GB the respective percentages for this subsidiary occupations were 17.86%, 24.11%, 41.07%, 03.75%, 00.89%, 01.79%, 02.68% and 08.04%. It is seen from the table that only illegal border trade has increased notably after the borrower enrollment in the GB, which is not authorized by the government. On the other hand some of the borrowers have started informal money lending with the loan of GB. So the loan of GB has created a new class of usurer in the rural areas.

Table 4: Subsidiary Occupation of the Respondent Households

Subsidiary Occupations	At present N=146		Before enrolled N= 112	
	No. of respondents	Percentage	No. of respondents	Percentage
Agriculture	22	15.07	20	17.86
Petty business	25	17.12	27	24.11
Daily laborer	47	32.19	46	41.07
Rickshaw/Van pulling	09	06.16	04	03.57
Service/Field worker	01	00.68	00	00.00
Fishing	02	01.37	01	00.89
Small manufacturing	01	00.68	02	01.79
Husking	00	00.00	03	02.68
Money lending	06	04.11	00	00.00
Informal business	33	22.60	09	08.04
Total		100.00		100.00

Source: Field Survey

5. Capital Goods Owned by Respondent Households: It is seen during the field survey that except one shallow tube-well and two sewing machines, main capital goods of the respondent households consist of country-carrier like Rickshaw, van and carts etc. The amount of capital goods is shown in the following table.

Table 5 shows that at present 10.64% and 3.72% households have one and two capital goods respectively. Before joining the GB 7.45% and 01.06% households

Table 5: Capital Goods Owned the Respondent Households

No. of capital goods	At present		Before enrolled	
	No. of respondents	Percentage	No. of respondents	Percentage
00	161	85.64	172	91.49
01	20	10.64	14	07.45
02	07	03.72	02	01.06
Total		.00		.00

Source: Field Survey

had one and two capital goods respectively. It is also seen that only 5.85% households have become the new owner and 2.66% have increased the their capital goods during the use of GB loan.

6. Amount of annual Investment of the Respondent Households in Farming

The amount of annual investment of the respondent households in farming is shown in the following table.

Table 6 shows that at present 14.89% selected households have no investment in farm activities but before joining GB 7.45% households had no investment in

Table 6: Total Investment of the Respondent Households in Farming

Amount (in TK.)	At present		Before enrolled	
	No. of respondents	Percentage	No. of respondents	Percentage
No Investment	28	14.89	14	07.45
Upto 4000	60	31.91	74	39.36
4001-6000	22	11.70	26	13.83
6001-8000	16	08.51	15	07.98
8001-10000	24	12.77	23	12.23
More than 10000	38	20.21	36	19.15
Total	188	100.00		.00

Source Field Survey

farm activities. It is also seen from the table that at present 31.91%, 11.70%, 8.51%, 12.77% and 20.21% households invest upto TK.4000, TK. 4001-6000, TK. 6001-8000, TK. 8001-10000 and more than TK. 10000 respectively. Before joining the GB the respective percentage for these amount of investment were 39.36%, 13.38%, 7.98%, 12.23% and 19.15%. From this statistics it is seen that the amount of investment of the sample households in farm activity has not significantly increased. Moreover, some of the households have stopped investment in farming after joining the GB.

7. Total Investment of the Respondent Households in Non-farm Activities

The success of the borrowers of GB obviously depends on creation and extension of non-farm activities for self-employment as well as on increasing income earned from borrowings. Table 7 shows total investment on non-farm activities or petty business of the borrower households before and after joining the GB.

Table 7 shows that at present 62.23% of the selected borrowers have no investment, 32.45% have a total investment of less than Tk. 10000 and rest 05.32% have more than Tk. 10000 investment in non-farm activities. Before enrollment in the GB respective percentages for these level of investments were 68.62 percent, 28.19 and 03.19%. It is clear from the table that the number of investors as well as volume of investment among the selected households in non-

Table 7: Total Investment of the Respondent Households in Non-farm Activities

Total Investment in non-farm activities (in TK.)	At present		Before joining	
	No. of respondents	Percentage	No. of respondents	Percentage
No Investment	117	62.23	129	68.62
Bellow – 5000	26	13.83	22	11.70
Up to 6000	13	06.91	07	03.72
Up to 8000	06	03.19	08	04.26
Up to 8000	08	04.26	08	04.26
Up to 9000	02	01.06	04	02.13
Up to 10000	06	03.19	04	02.13
More than 10000	10	05.32	06	03.19
Total		100.00		100.00

Source: Field Survey

farm activities has not increased significantly after their joining the GB. So GB's claim of the creation of self-employment in non-farm activities is not substantiated in the study area.

8. Type of Non-farm Activities of the Respondent Households

The nature of non-farm activities i.e, petty business activities in which the borrower households done is shown in table 8

Table 8 shows that the nature of non-farm activity or petty business activities in which the borrower households are engaged remain almost the same except illegal border trade and vegetable sale before and after joining the GB. The illegal border trade has increased from 06.15% to 10.64% and the business of vegetable sale has increased from 05.85% to 09.04%. We see that only 06.38 percent of the total respondents started petty business after their enrollment in the GB. It is seen that

Table 8: Type of Non-farm Activities of the Respondent Households

Type of non-farm or petty business activity	At present		Before enrolled	
	No. of respondents	Percentage	No. of respondents	Percentage
Grocery shop	06	08.45	05	08.48
Tea, betel-leaf etc selling	04	05.63	04	06.78
Hawkery / fari	05	07.04	07	11.86
Paddy/wheat husking and selling	03	04.23	05	08.48
Vegetable and fruits selling	17	23.94	11	18.64
Tailoring and clothing	03	04.23	02	03.39
Milk-selling	01	01.41	02	03.39
Fish-selling	05	07.04	05	08.48
Poultry	02	02.82	01	01.69
Pottery	02	02.82	02	03.39
Illegal border business	20	28.17	13	22.03
Motor workshop	01	01.41	01	01.69
Transport business	02	02.82	01	01.69
Total		100.00		100.00

Source: Field Survey

the progress of petty business and entrepreneurial activities among the borrower households by GB credit is insignificant, although GB claims that almost 500 activities are done by its credit.

9. Length of Borrowing of the Respondents in GB

The length of membership of the respondents in GB credit program is shown in the following table.

Table 9 shows that 2.66%, 10.11%, 22.34%, 21.81%, 23.40%, 14.89% and 4.79% of the total respondents used GB loan for the period of ten years or more, 9 years, 8 years, 7 years, 6 years, 5 years and 4 years respectively. It is also seen that 67% of selected borrowers have used GB loan for a period between 6 and 8 years. The average length of membership is 6.87 years.

Table 9: Length of Borrowing of the Respondents in GB

Length of membership	Number of respondents	Percentage
10 Years and above	05	02.66
09 Years	19	10.11
08 Years	42	22.34
07 Years	41	21.81
06 Years	44	23.40
05 Years	28	14.89
04 Years	09	04.79
Total		.00
Average use	6.87 years	

Source: Field Survey

10. Total Amount of Loan taken by the Respondents from GB till Interview

Total amount of GB credit taken by the respondent's households is shown in the following table.

It is seen from table 10 that majority of the respondent's households had already received more than sixty thousand Taka before the field survey.

11. Purpose of taking GB loan:

The purposes of taking loan cited by the selected borrowers at the very first year and in the present year are shown in the following table.

Table 10: Total Amount of Loan Taken by the Respondents from GB till Interview

Amount of GB loan taken till interview (in TK.)	Number of respondents	Percentage
Below-30000	02	01.06
30001-40000	12	06.38
40001-50000	13	06.91
50001-60000	23	12.23
60001-70000	28	14.89
70001-80000	32	17.02
80001-90000	34	18.09
90001-100000	16	08.51
100000 and above	28	14.89
Total		100.00

Source: Field Survey

Table 11 shows that most of the respondents have cited non-farm activities as purpose of taking GB loan.

Table 11: Purpose of Taking Loan

Activities shown as purposes of loan	In the present year/season		In the first year/season	
	Number of respondents	Percentage	Number of respondents	Percentage
Husking and Trading	10	05.32	08	04.26
Cultivation	20	10.64	27	14.36
Milch-cow rearing	05	02.66	22	11.70
Cattle fattening	22	11.70	18	09.57
Fishing and trading	11	05.85	09	04.79
Processing and manufacturing activities	03	01.60	05	02.66
Trading and shop-keeping	66	35.11	61	32.45
Rickshaw/Van purchase	22	11.70	14	07.45
Tailoring and cloth trading	03	01.60	02	01.06
Poultry raising	16	08.51	03	01.60
House building	02	01.06	11	05.85
Sinking Tube-well	03	01.60	01	00.53
Constructing sanitary latrine	02	01.06	00	00.00
Purchase of homestead	00	00.00	02	01.06
Lease-in of cultivable land	00	00.00	02	01.06
Seasonal business	02	01.06	03	01.60
Transport business	01	00.53	02	01.06
Total		.00		100.00

Source: Field Survey

12. Utilization of loan by the Respondent Households

Utilization of GB credit taken by borrower households is shown in the following table.

Table 12 shows that in the survey year/season 60.11% of the total respondents do not use their loan for purposes mentioned at the time of taking loan. A total of

Table 12: Utilization of GB Credit by the Respondent Households

Utilization pattern	In the year/season		First year/season	
	Number of respondents	Percentage	Number of respondents	Percentage
Full amount invested in the mentioned field	14	07.45	18	09.57
Partly invested in the mentioned field	61	32.45	85	45.21
Not used in cited/ productive purposes	113	60.11	85	45.21
Total		.00		100.00

Source: Field Survey

7.45% borrower households used full amount and 32.45% used a part of loan on productive purposes, which were shown at the time of taking loan. In the first year/season of taking loan these percentages were 45.21%, 9.57% and 45.21% respectively.

13. Annual Gross Income of the Respondent Households: The annual gross income of the respondent households before and after their joining in the GB is shown in the following table.

Table 13: Annual Gross Income of the Respondent Households

Amount of income	At present		Before enrolled	
	No. of respondents	Percentage	No. of respondents	Percentage
Upto-15000	06	03.19	16	08.51
15001-25000	56	29.79	74	39.36
25001-35000	72	38.30	52	27.66
35001-50000	34	18.09	36	19.15
50001-65000	16	08.51	08	04.26
65001 and above	04	02.13	02	01.06
Total		100.00		.00

Source: Field Survey

Table 13 shows that at present 03.19 percent households of the selected borrowers belong to the income group up-to 15000, 29.79%, 38.30%, 8.09%, 08.51%, and 02.13% belong to the income groups of Tk. 15001-25000, Tk. 25001-35000, Tk.35001-50000, Tk. 50001-65000, and Tk. 65001 and above respectively. Before enrollment in the GB the percentage for these income groups were 08.51%t, 69.36%, 27.66%, 19.15%, 04.26% and 01.06% respectively.

14. Changes in Total Income of the Respondent Households according to Poverty Groups:

The changes in total income of the respondent households according to poverty groups are shown in the following table.

Table 14: Changes in Annual Income of the Borrower Households According to Poverty Groups

Poverty groups	Income change						Total number of Households	
	No change		Decrease in income		Increase in income			
	Number	Percentage	Number	Percentage	Number	Percentage		
Extreme poor Households (Annual Per capita income upto Tk.3560)	1	0.53	27	14.36	9	4.79	37	19.68
Moderate poor Households (Annual Per capita income Tk. 3560-6287)	22	11.70	23	12.23	65	34.57	110	58.51
Vulnerable non-poor Households (Annual per capita income more than TK. 6287)	2	1.06	4	02.13	35	18.62	41	21.81
Total								.00

Source: Field Survey

From the above table it is seen that most of the households in which income has increased have come from moderate and vulnerable non-poor groups. On the other hand the amount of income has decreased in most of the poorest households.

Section B: The Contribution of GB Credit in Total Income Generated by the Borrower Households: A Quantitative Estimation

It is seen in the field survey that total income of the households of poor borrowers is generated mainly by four factors, which are labour, property, credit and grants. An attempt has been made here to disentangle the contribution of GB credit from the contribution of other factors of income of the borrower households. The income, which is generated by labour, property and grants without any influence of GB credit is compared with the income, generated by GB credit so to asses the actual contribution of GB in the total income generated by the borrower households. The function of income of the sample households is

$Y= f(X_1, X_2, X_3, X_4)$

where , Y= income, X_1 =credit, X_2=labour, X_3 =grants and X_4 =property.

1. Model Selection

The stepwise regression model of Katheleen care has been taken as the technique for solution. Least squares techniques, auto correlation, multi co-linearity are also studied here.

2. The Kathleen Carey Model

The model follows as

$$e^y = f(x_i, \beta_i).e^{\in} \quad i = 1, 2, 3, 4 \qquad \text{..... (1)}$$

Where, $f(x_i ;\beta_i) = C\ X_1\beta^1\ X_2\beta^2\ X_3\beta^3\ X_4\beta^4$ and $\in$ is an error term which is assumed to be normally distributed with mean zero and variance ^{2} ; $_i$ are some unknown constants, which are estimated by the method of least squares techniques and C is a constant.

3. Estimation of Unknown parameters β_i (i = 1, 2, 3, 4) : The model (1) can also be written as

$Y = k + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \in$

Where, $x_i = \text{In } X_i$ and $k = \log C$

By least $\frac{d(\in^1 \in)}{d\beta_1}$ chniques

$= 0$ gives

$\hat{\beta} = (X^/ X)^{-1} X^/ Y$ with least variance $\sigma(X^/ X)^{-1}$ and $\hat{k} = \bar{y} - \hat{\beta}_1\bar{x}_1 - \hat{\beta}_2\bar{x}_2 - \hat{\beta}_3\bar{x}_3 - \hat{\beta}_4\bar{x}_4$

The estimated model is

$$e^{y} = C\, x_1^{1.033}\, x_2^{0.610}\, x_3^{-0.101}\, x_4^{-0.108}.\ ^{\in} e \quad \text{..... (2)}$$

The regression equation is

$$Y = k + 0.320\, x_1 + 0.610 x_2 - 101\, x_3 - 0.108\, x_4 + \in \quad \text{..... (3)}$$

Since it is assumed that the income of the sample households depends mainly on the explanatory factors x_1, x_2, x_3 and x_4, it is necessary to conduct Analysis of Variance (ANOVA) techniques to verify the significant variation in Y due to the variations in X_i.

The calculated value of F is 13714.17 and the tabulated value of F with (4,183) degrees of freedom (df) at 5% level of significance is 2.37. Since the calculated value of F is greater than the tabulated value, so the value is significant at 5% level.

Table 1: Analysis of Variance (General)

Source of variation (SV)	Degrees of freedom (df)	Sum of squares (SS)	Mean sum of squares (MSS)	F-ratio
Due to X_1, X_2, X_3, X_4	4	569961.76	142490.44	13714.17
Residual	183	1901.37	10.39	
Total	187	571863.14		

In order to analyze the individual and combined effects of the explanatory factors, the contribution of each factor is estimated here by using the regression techniques. Let β_i = Coefficient of X_i in the simple regression of Y on X_i

The explained sum of squares due to X_i alone is $\beta_i YX_i$. From these quantities the following ANOVA tables are set up.

Table 2: Analysis of Variance- Due to X_1 alone

Source of variation (SV)	Degrees of freedom (df)	Sum of squares (SS)	Mean sum of squares (MSS)	F-ratio
Due to X_1 alone	1	373743.25	373743.25	2875.13
Addition of X_2, X_3, X_4	3	503295.18	251647.59	1935.88
Due to X_1, X_2, X_3, X_4	4	377307.16	125769.05	
Residual	183	23918.45	129.99	
Total	187	401225.61		

The significance of X_1 alone can be tested by computing the residual sum of squares giving F=2875.13 with (1, 183) df, which is found significant at 5% level. Similarly the additional effect due to X_2, X_3, X_4 is tested by F= 1935.88 with (3, 183) df, which is also significant at 5% level.

The significance of X_2 alone can be tested by computing the residual sum of squares giving F=41981.29 with (1, 183) df, which is found significant at 5%

Table 3: Analysis of Variance- Due to X_2 alone

Source of variation (SV)	Degrees of freedom	Sum of squares (SS)	Mean sum of squares (MSS)	F-ratio
Due to X_2 alone	1	436185.59	436185.59	41981.29
Addition of X_1, X_3, X_4	3	503797.46	167932.49	16162.90
Due to X_1, X_2, X_3, X_4	4	569961.76	142490.44	
Residual	183	1901.37	10.39	
Total	187	571863.14		

level. Similarly the additional effect due to X_1, X_3, X_4 is tested by F= 16162.9 with (3, 183) df, which is also significant at 5% level.

For testing the significance of X_3 alone, the calculated value of F is 242.615 with (1, 183) df, and is found highly significant at 5% level. Similarly the additional effect due to X_1, X_2, X_4 is tested by F= 18102.94 with (3, 183) df, which is also significant at 5% level.

Table 4: Analysis of Variance - Due to X_3 alone

Source of variation (SV)	Degrees of freedom	Sum of squares (SS)	Mean sum of squares (MSS)	F-ratio
Due to X_3 alone	1	2520.77	2520.77	242.615
Addition of X_1, X_2, X_4	3	564268.65	188089.55	18102.94
Due to X_1, X_2, X_3, X_4	4	569961.76	142490.44	
Residual	183	1901.37	10.39	
Total	187	571863.14		

For testing the significance of x_4 alone, the calculated value of F is 2875.13 with (1, 183) df, and is found highly significant at 5% level.

For testing the additional effect due to X_1, X_2, X_3 the calculated value of F is 1935.88 with (3, 183) df, which is verified significant at 5% level.

The results obtained from above discussion are assumed up and shown in the following table.

In the model (6.1), the net effects of the factors X_i (i = 1,2,3,4) are also tested with the help of t-test, after framing the suitable null hypothesis

$$Ho : \beta_i = o \; ; \; i = 1,2,3,4.$$

Table 5: Analysis of Variance- Due to X_4 alone

Source of variation (SV)	Degrees of freedom	Sum of squares (SS)	Mean sum of squares (MSS)	F-ratio
Due to X_4 alone	1	373743.25	373743.25	2875.13
Addition of X_1, X_2, X_3	3	503295.18	251647.59	1935.88
Due to X_1, X_2, X_3, X_4	4	377307.16	125769.05	
Residual	183	23918.45	129.99	
Total	187	401225.61		

The test statistic is $$t = \frac{\hat{\beta}_i - \beta_i \,(NH)}{\sum_{i=1}^{12} e_i^{\,2} / n - k \sqrt{a_{ii}}} \quad \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Where a_{ii} is the appropriate diagonal element in $(X^{/}X)^{-1}$ matrix and

$$\hat{e}_i = Y_i - k - 1.003\, X_1 - 0.989 X_2 + 0.928\, X_3 + 1.002\, X_4$$

Below are the values of standard errors and corresponding test statistics of the estimators β_i

Table 6: Percentage Contribution of Factors

Factors	X_1	X_2	X_3	X_4	Total
% contribution	03.86	86.09	01.33	09.79	100.00

4. The Regression Line based on 3

From the model (3), the least-squares estimates of the coefficient β_i are calculated by using the formula.

$\hat{\beta}_i = (X^/X)^{-1} X^/ Y$ and denote residual (5)

$\hat{e}_i \quad y_i - k - \hat{\beta}_1 x_{1i} - \hat{\beta}_2 x_{2i} - \hat{\beta}_3 x_{3i} - \hat{\beta}_4 x_{4i}$

According to least square line, we have

$y_i = \hat{y}_i + \hat{e}_i$

$y_i^2 = \sum \hat{y}_i^2 + \sum \hat{e}_i^2$ since, $\sum \hat{y}_i \hat{e}_i = 0$

Table 7: Standard Error and T-value of the Coefficient

Coefficient	$\hat{\beta}_1 = 1.003$	$\hat{\beta}_2 = 0.989$	$\hat{\beta}_3 = 0.928$	$\hat{\beta}_4 = 1.002$
SE($\hat{\beta}_i$)	0.064	0.013	0.112	0.021
t-values	15.74	78.13	8.28	47.48

In other words, the total variation of y values about their sample mean is split into two parts. The first is the variation of the y values about their mean. This is often referred to as the sum of squares "due to" or "explained by" the linear influence of X_i. The second component is the residual or unexplained variation of y values about the least – squares line.

5. The coefficient of Multiple Correlation

In the four variables (Y: X_1, X_2, X_3, X_4), the coefficient of multiple correlation in terms of residual variation about the regression plane based on (1.3) is

$$R^2 = 1 - \frac{\sum e_i^2}{\sum y_i^2} = 0.99 \quad 67 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots .. (6)$$

Adjusted multiple correlation coefficient, $\overline{R}^2 = [1 - (1 - R^2)(n - 1)/(n - k)] =$ 0.9966 and both are verified 'significant'.

6. Auto-correlation study

To examine the relationship between the successive values of different explanatory variables and test the statistical validity of the estimation the auto-correlation is also studied as follows.

Hence, Cov $(\in_i \in_j) = E[\in_i - E(\in_i)][\in_j - E(\in_i)]$

$= E(\in_i \in_j) = 0$ for $\in i \in j$

$= \sigma^2 I$ for i = j.

A simple case of linear relationship between any two successive values of is

$$\in_t = \rho_{t-1} + v_t \quad \text{.....} \quad (7)$$

Where, $E(v_t) = 0$; $E[v_t, v_{t'}] = \sigma^2 I$

The formula of auto-correlation coefficient () is

$$\rho = \frac{\sum_{t=2}^{n} e_t e_{t-1}}{\sum_{t=2}^{n} e_{t-1}^2} \quad \text{..... .... (8)}$$

To test the significance of auto-correlation coefficient, the Durbin -Watson – test statistics is

$$d = \frac{\sum_{t=2}^{n} (e_t e_{t-1})^2}{\sum_{t=2}^{n} e_t^2} \quad \text{..... .... (9)}$$

Here the null hypothesis Ho: $\rho = 0$. The approximate relation between d and ρ is $d = 2(1 - \rho)$.

From this expression it is obvious that the value d lies between 0 and 4.

Firstly, if there is no auto-correlation i.e, $\rho = 0$ then d = 2 and if $\rho = +1$, Then d = 0. From this it is inferred that there is perfect positive auto-correlation. If $\rho = -1$, then d = 4; and it is concluded that there is perfect negative auto-correlation.

Secondly, based on the range of d statistic, Durbin-Watson have calculated upper (d_u) and lower (d_l) value of d.

When $d < d_L$, the null hypothesis will be rejected.

$d > d_u$, the null hypothesis will be accepted.

and as long as $d_L < d < d_u$, the test is inconclusive.

So, from the result of the above test it is clear that our estimation is unbiased and valid.

7. A study based on multi-collinearity

A crucial condition for the application of Least Squares to obtain estimators of the model (1.1) is that the explanatory variables are not perfectly linearly related. i.e. $\rho (X_i X_j)$ 1. The term multi co-linearity is used to denote the presence of linear relationship among explanatory variables. If the explanatory variables are perfectly linearly related, the parameters become indeterminate and it is impossible to obtain exact numerical values for each parameter separately and the method of least-squares breakdown. Multi co-linearity is not a condition that either exists or does not exist in economic functions but rather a phenomenon inherent in most relationships due to the nature of economic magnitude. There is no conclusive evidence concerning the degree of co-linearity, which, if present, will affect seriously the estimates. Further the standard errors of the estimates become infinitely large.

In order to verify the presence of multi-co-linearity and the extent of its influence on the estimators, a simple correlation matrix based on the variables (Y: X_1, X_2, X_3, X_4) is calculated and the values obtained are presented in Table 8.

Table 8: A Correlation Matrix based on the Determinants (Y; X_i)

	Y	X_1	X_2	X_3	X_4
Y					
X_1	0.654**				
X_2	0.879**	0.368**			
X_3	-0.062	-0.120	-0.092		
X_4	0.810**	0.627**	0.457**	-0.127*	

** Correlation is significant at the 0.01 level and * Correlation is significant at the 0.05 level

From the above table it is clear that the explanatory variables (Y, X_2), (Y, X_4) and (Y, X_1) are highly multi-collinear since r (Y, X_2) = 0.879, r(Y, X_4)= 0.810 and r (Y, X_1) = 0.654.

8. Reliability of Estimators

By a 'perfectly reliable' measurement means that it is completely accurate, free from error or no bias. But in practical survey work, it is very difficult to obtain a total reliable data and hence the estimates or conclusions expected from the collected data may lead to some errors. There are several operational conceptions of reliability of estimates, depending upon how it is estimated from collected data. The total variance (σ_y^2) can be written as

$$\sigma_y^2 = + e\hat{y}^2 ; \quad \text{.....} \qquad (10)$$

Hence σ_y^2 denote the true variance and σ_e^2 denote the error variance.

Thus the measurements as having two components, a true measurement ($\hat{y}$) and Error term (e) satisfy an equation

$$y = \hat{y} + e$$

Reliability was defined as the proportion of the total variance to the true variance. Dividing (1) by σ_y^2, we have

$$\frac{\sigma_{\hat{y}}^2}{\sigma_y^2} + \frac{\sigma_e^2}{\sigma_y^2}$$

The reliability of these measurements is given by the ratio

$$\sigma_{\hat{y}}^2 / \sigma_y^2 \text{ or in other term } \quad 1- \sigma_e^2 / \sigma_y^2$$

Letting r_{ii} stand for the coefficient or reliability, we have two alternative equations as

$$r_{ii} = \sigma_{\hat{y}}^2 / \sigma_y^2 \qquad \text{or} \qquad r_{ii} = 1- \sigma_e^2 / \sigma_y^2$$

The summary of results from the above study is presented in the following table.

From the above estimation the following conclusions can be drawn

1. The coefficient of multiple determination in the group (y: x_1, x_2, x_3, x_4) is 0.9967 This implies that 99.67% of the total income of the respondents' households is being generated from combined participation of the mentioned four factors.

2. A high multicollinearity between credit income (X_1) and property income (X_4); labour income (X_2) and property income (X_4) is seen.
3. The autocorrelation coefficient is least and insignificant.
4. Among four explanatory variables considered in this study, it is observed that contribution of the variable x_3, i e. grant income towards income generation is least significant.

9. Stepwise Regression: Stage- I

Excluding the variable x_3 i.e the grant income, whose contribution towards income generation is insignificant, the Kathleen Carey model is used considering the other three variables viz. X_1, X_2 and X_4.

$$e^Y = C\, X_1^{1.007}.\, X_2^{0.985} X_3^{\,0.987}.\, e \text{ ..... (11).}$$

In order to analyze the significant contribution of these explanatory variables, the ANOVA techniques are applied for the group (Y: X_1, X_2, X_4).

Table 9: Summary of Estimators, Corresponding Test Statistics for Model 1

Least Square Estimates	$\hat{\beta}_1$ **= 1.003**	$\hat{\beta}_2$ **= 0.989**	$\hat{\beta}_3$ **= 0.928**	$\hat{\beta}_4$ **= 1.002**
SE($\hat{\beta}_i$ **)**	0.064	0.013	0.112	0.021
t – value	15.74	78.13	8.28	47.48
F-value	24079.47	41981.29	242.615	35971.44
Multiple correlation coefficient	$R^2 = 0.9967$			
Adjusted Multiple correlation coefficient	$\overline{R}^2 = 0.9966$			
Auto correlation coefficient & d-statistics	$\hat{\rho} = 0.436$	d= 1.128		
Coefficient of reliability	$r_{tt} = 0.856$			

The calculated value of F is 140.11 for (3, 184) df and is verified significant at 5% level.

The individual and combined effects of each explanatory variables in the group (Y: X_1, X_2, X_4) are analyzed with the help of appropriate ANOVA and regression techniques.

For testing the significance of X_1 alone, the calculated value of F is 264.69 for (1, 184) df and is significant at 5% level. In testing of the additional effect due to X_2 and X_4 in the group (Y: X_2, X_4), the calculated value of F is 198.11 for (2,184) df which is also significant at 5% level.
The calculated value of F, in testing of the significance of x_2 alone is 461.47 for (1, 184) df which is evidently significant at 5% level. Similarly the calculated value of F for testing the additional effect due to X_1 and X_4 in the group (Y: X_1, X_2, X_4) is 209.77 for (2, 184) which is significant at 5% level.

For testing the significance of X_4 alone, the calculated value of F is 395.41 for (1, 184) df which is highly significant at 5% level of significance and testing the additional effect due to X_1 and X_4 in the group (Y: X_1, X_2, X_4), the calculated value of F is 266.23 for (2, 184) df which is verified insignificant at 5% level.

After omitting the variable x_1 i.e. credit income, which is found highly insignificant, the share of each of the given explanatory variables X_1, X_2 and X_4 in the total contribution towards income generation of my study area is estimated

Table 10: Analysis of Variance Based on (Y: X_1, X_2, X_4)

Source of variation (SV)	Degrees of freedom	Sum of squares (SS)	Mean sum of squares (MSS)	F-ratio
Due to X_1, X_2, X_4	3	397307.16	132435.72	140.11
Residual	184	173918.45	945.21	
Total	187	571225.61		

as 4.11 percent (X_1), 88.67 percent (X_2) and 8.22 percent (X_4). Even among these three, X_2 has been found more significant than the other two variables.

In the model (6.10), the effects of the factors X_1, X_2 and X_4 are also tested with the help of student t-test statistic, by framing the following null hypothesis i.e., Ho : $_i = 0$, i = 1, 2, 4 and results are presented in the following table.
From the above statistics, the following inferences are drawn.

Table 11: Analysis of Variance- Due to X_1 alone

Source of variation (SV)	Degrees of freedom	Sum of squares (SS)	Mean sum of squares (MSS)	F-ratio
Due to X_1 alone	1	250185.72	250185.72	264.69
Addition of X_2, X_4	2	374511.40	187255.70	198.11
Due to X_1, X_2, X_4	3	397307.16	132435.72	
Residual	184	173918.45	945.21	
Total	187	571225.61		

1. The coefficient of multiple determination in the group ((Y: X_1, X_2, X_4) is 0.958 This implies that the three factors jointly influence 96% of income generation of the sample.
2. The autocorrelation coefficient is negative and is insignificant.
3. Among these three variables considered for the study, it is observed that the factor X_1 -the credit income is observed to be least significant. Though variables such as X_1, X_2 and X_4 combinedly influence the income, X_3 the grant income is found insignificant and are excluded in the following analysis.

Table 12: Analysis of Variance - Due to X_2 alone

Source of variation (SV)	Degrees of freedom	Sum of squares (SS)	Mean sum of squares (MSS)	F-ratio
Due to X_2 alone	1	436185.59	436185.59	461.47
Addition of X_1, X_4	2	396550.34	198275.17	209.77
Due to X_1, X_2, X_4	3	397307.16	132435.72	
Residual	184	173918.45	945.21	
Total	187	571225.61		

Table 13: Analysis of Variance- Due to X_4 alone

Source of variation (SV)	Degrees of freedom	Sum of squares (SS)	Mean sum of squares (MSS)	F-ratio
Due to X_4 alone	1	373743.25	373743.25	2875.13
Addition of X_1, X_2	2	503295.18	251647.59	1935.88
Due to X_1, X_2, X_4	3	547307.2	182435.72	
Residual	184	23918.45	129.99	
Total	187	571225.61		

10. Stepwise Regression Techniques: Stage II

Excluding the insignificant contribution of x_3, the income determinant model stands as

$$e^y = C\ X_2^{1.018}\ X_4^{1.168}\ e^{\in}$$

$$e^y = C\ X_2^{1.018}\ X_4^{1.168}\ e^{\in} \quad \text{..... (12)}$$

To analyze the significant contribution of these two explanatory factors, the following ANOVA tables are formed.

The calculated value of F is 3717.42 for (2. 185) df, which is significant at 5% level. The individual and combined effects of each explanatory variable viz. X_2 and X_4 are tested with the help of the following ANOVA table.

Table 14: Percentage Contribution of Factors

Factors	**X_1**	**X_2**	**X_4**	**Total**
% contribution	04.11	88.67	08.22	100.00

It is observed from the Table 18 that excepting the additional effect due X_2 and X_4, all other cases prevalent in course of preceding analysis are significant.

Table 15: Standard Error and T-value of the Coefficient

Coefficient	$\hat{\beta}_1$ **= 1.007**	$\hat{\beta}_2$ **= 0.985**	$\hat{\beta}_4$ **= 0.987**
SE($\hat{\beta}_i$ **)**	0.075	0.015	0.025
t-values	13.520	66.602	40.158

Table 16: Summary of Estimators, Corresponding Test Statistics for Model 2

Least Square Estimates	$\hat{\beta}_1 = 1.007$	$\hat{\beta}_2 = 0.985$	$\hat{\beta}_4 = 0.987$
SE($\hat{\beta}_i$)	0.075	0.015	0.025
t – value	13.520	66.602	40.158
F-value	264.69	461.47	395.41
Multiple correlation coefficient	$R^2 = 0.958$		
Adjusted Multiple correlation coefficient	$\overline{R}^2 = 0.957$		
Auto correlation coefficient & d-statistics	$\hat{\rho} = 0.5085$	d= 0.983	
Coefficient of reliability	$r_{tt} = 0.702$		

The following table provides details regarding the percentage contribution of each explanatory variable X_2 and X_4 with the help of R^2 in the group (Y: X_2, X_4).

The coefficient of multiple determination in the group ((Y: X_2, X_4) is 0.9343. This implies that the two explanatory factors jointly influence 93% of income generation of the sample households. So, it can be concluded from the above discussion that income primarily depends on labour and next depends on property. So the impact of the loan of the GB on income generation of the households of sample borrowers is not as large as it in claimed to be.

Table 17: Analysis of Variance based on (Y: X_2, X_4)

Source of variation (SV)	Degrees of freedom	Sum of squares (SS)	Mean sum of squares (MSS)	F-ratio
Due to X_2, X_4	2	557356.97	278678.49	3717.42
Residual	185	13868.64	74.97	
Total	187	571225.61		

Table 19: Percentage Contribution of Factors

Factors	X_2	X_4	Total
% contribution	89.21	10.79	100.00

Table 20: Standard Error and T-Values of the Coefficients

Coefficient	$\hat{\beta}_2$ **= 1.018**	$\hat{\beta}_4$ **= 1.168**
SE($\hat{\beta}_i$ **)**	0.021	0.029
t-values	49.490	40.204

Table 21: Summary of Estimators; Corresponding Test Statistics for Model 3.

Least Square Estimates	$\hat{\beta}_2$ **= 1.018**	$\hat{\beta}_4$ **= 1.168**
SE($\hat{\beta}_i$)	0.021	0.029
t – value	49.490	40.204
F-value	5818.14	4985.24
Multiple correlation coefficient	$R^2 = 0.9355$	
Adjusted Multiple correlation coefficient	$\overline{R}^2 = 0.9348$	
Auto correlation coefficient & d-statistics	$\hat{\rho} = 0.3585$	d= 1.283
Coefficient of reliability	$r_{tt} = 0.978$	

Conclusions

This study discusses various individual and household information of the GB borrowers, their assets and liabilities, expectations and achievements. Comparing their socio-economic conditions before and after joining GB, it is seen that after the use of GB loan for a period of 7 years on an average the socioeconomic condition did not significantly improve. No sustainable entrepreneurial activities have created by the borrower households. From the quantitative analysis regarding the contribution of GB credit in the total income generation of the sample household it is seen that the contribution of GB credit in the total income is not very significant. The income generations of the households were found to be dependent mainly on labour, which is independent of credit affairs. So GB's assertions of creating self-employment and income generating activities for the borrower households is mostly hypothetical and by no means GB credit can be considered as a magic key to poverty alleviation.

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