ANALYSIS OF THE IMPACT OF PRAGANNA IRRIGATION PROJECT (PIP) ON INCOME AND EMPLOYMENT IN DANG DISTRICT OF NEPAL

Y. Padhyoti[1], J.P. Dutta[2], P.P. Regmi[3], N.K. Chaudhary[4]

ABSTRACT

A survey research was conducted to assess the performance of Praganna Irrigation Project with respect to farm income and employment in Dang district of Nepal. Simple random sampling was used to select 60 beneficiaries and 30 non-beneficiaries as sampling units to comprise a sample size of 90. Representatives of WUGs and officials of PIP were interviewed through checklists. Altogether there were 75 WUGs, which are responsible for distribution of irrigation water equitably and collection of irrigation charges effectively. A comparative study was made between the beneficiaries and non-beneficiaries under PIP. The total farm assets of beneficiaries were estimated at NRs. 1,150,975 and differed significantly with the non-beneficiaries with total farm assets of NRs. 875,185. A significant difference was observed between on farm income of beneficiaries (NRs.183,260) and non–beneficiaries (NRs. 31,453). The net farm income of the beneficiaries and non-beneficiaries were estimated at NRs. 79,993 and NRs. 13,077 respectively and the difference were significant among the categories of respondents. The total farm income was significantly affected by landholding, total variable cost, cropping intensity, and employment in case of beneficiaries whereas only employment significantly affected total farm income in case of non-beneficiaries. Gini coefficients for gross household and gross farm income were calculated at 0.37 and 0.44 respectively for beneficiaries and 0.44 and 0.27 respectively for non-beneficiaries. So, there existed inequality in distribution of gross household and gross farm incomes within both categories. The study also indicated the huge potentiality of PIP for increasing farm income in the command area of PIP.

Key words: Employment, Farm Income, Irrigation, Income inequality

INTRODUCTION

Agriculture is the main stay of majority of Nepalese people and irrigation is the major input for agriculture. Because of its rugged terrain, only 17 percent of Nepal's total land area is suitable for farming (CARE, 2001). Of the total geographical area, the land suitable for arable agriculture is estimated at 2,641,000 ha. Of this land, the potential irrigable area under surface and groundwater sources is about 1,766,000 ha (NPC, 2008). However, till the end of the Ninth Plan the total irrigation facility achieved both by surface and ground water irrigation is around 1,121,441 ha owing to the rugged topography and landform (NPC, 2002).

[1] *Yadav Padhyoti, Agricultre Economist, Ministry of Agricultural Development*
[2] *Jay Prakash Dutta, Associate Professor, Agriculture and Forest University*
[3] *Punya Prasad Regmi (Ph.D), Professor, Tribhuwan University*
[4] *Narendra Kumar Chaudhary, Professor, Tribhuwan University*

Irrigation permits the use of land throughout the year by way of producing two or three crops and by cultivating long duration crops. In other words, it facilitates the intensive use of scarce land resources and it is also essential for increasing the use of yield increasing inputs and enhancing the cropping intensity and crop productivity (Moorhty, 1997).

According to Khanal (2003) irrigation management is the mechanism, processes and institutions involved in getting water to farmer's field. Roth (1999) defines it as a wide variety of task that guarantees sufficient, timely and equitable water distribution to users. Development of irrigation is a complex socio-technical phenomenon. It involves collective action by the people and includes multiple activities including the maintenance of irrigation infrastructure, organizing local community, and delivering water to users for meeting crop water requirement. Varying demand and supply of irrigation water over time and space has further increased complexity in managing irrigation systems (WECS, 2001).

The objective and goals of irrigation sector is to develop controlled and year-round irrigation in a sustainable way through proper utilization of available water resources for increasing the agricultural productivity thereby raising livelihoods of rural community (HMG, 2002). The target set for the development of irrigation infrastructure during the Tenth Plan period was 193,600 ha, through development of new irrigation schemes in 129,600 ha and rehabilitation and improvement of FMISs in 64,000 ha, that included 52,600 ha under surface and 77,000 ha ground water schemes (NPC, 2002). At the end of the Plan period, the achievement in the development of irrigation infrastructure was in 87,485 ha, including development of new schemes in 73,187 ha and rehabilitation and improvement of FMISs in 14,298 ha that include surface (25,504 ha) and groundwater (47,683 ha) schemes (NPC, 2008). The basic function of irrigation is to compensate for permanent water deficits and to smoothen the climatic variations of local precipitation (AFEID, 2008).

Alam (1991) examined the impact of irrigation on income distribution in Gazipur District, Bangladesh, focusing on farmers in Sador and Kapasia Upazilas. Data from 80 respondents, of whom half had access to irrigation, showed that irrigation reduced income inequalities slightly. Smaller farmers benefited more because they did not need to incur costs in hiring labour. Generally, access to irrigation facilities was considered satisfactory.

Silliman and Lenton (1985) reviewed evidence from 45 micro-studies, 25 of them from India, and with few exceptions they confirmed a positive relationship between irrigation and employment. Studies from India in the mid 1980s showed that the increase in days worked on irrigation schemes, compared to rainfed conditions, was over 100 percent in the Damodar valley canals in West Bengal, over 150 percent in Ferozepur (Punjab), 61 percent on the Dantiwada canal in Gujarat, and over 100 percent under the Kakitiya canal in Andhra Pradesh (Chambers, 1985).

Irrigation can play a central and dynamic role in the improvement of rural livelihoods, but is often subject to criticisms of inefficiency in water use, high capital and recurrent costs, lack of sustainability, and association with inequity in the distribution of both land and water (Hasnip et. al., 2001).

METHODOLOGY OF STUDY

To study the performance of PIP on employment and farm income, 90 respondents (60 beneficiaries and 30 non-beneficiaries) were selected by random sampling technique from the households who use water of PIP as beneficiaries and not using the water from PIP as non-beneficiaries. The primary data were generated directly from the farmers-beneficiaries and non-beneficiaries, officials of DOI, DANG and PIP, Chailahi and representatives of WUGs by using pretested questionnaire and PRA tool and checklist whereas secondary data were collected through various government and non-government agencies like office of selected VDCs namely - Chailahi, Sonpur, Sisania, and Lalmatia, DADO and DIO DANG.

The collected data were coded, processed, classified, and organized into various tables in order to facilitate the analysis from which meaningful inference could be drawn. The data was analyzed by using EXCEL and SPSS softwares. Conventional analysis was used for understanding the sample characteristics such as farm income and employment.

To study the income inequality, Lorenz curve was used. The curve below the egalitarian line indicates the existence of inequality. The more unequal the income distribution, the Lorenz curve lies further below the egalitarian line.

Gini concentration ratio, developed by Corrado Gini in 1913, was used as a measure of relative distributional inequality.

Gini Ratio = Area between curve and diagonal/Area under diagonal and is given by the formula,

$$\text{Gini Coefficient (G.C.)} = \frac{1}{100^2}\left[\sum x_i y_{i+1} - \sum x_{i+1} y_i\right]$$

where,

x_i = Cumulative % of X variable, and

y_i = Cumulative % of Y variable.

$0 \leq G.C \leq 1$, 0 denoting completely equal distribution (Kanel, 1993).

Income of both the beneficiaries and non-beneficiaries was regressed with the selected variables. Coefficient of multiple regressions (R^2) was calculated for finding the variation in income explained by the included independent variables. Similarly, statistical test for the

values of coefficients of explanatory variables was tested at five and one percent level of significance.

$$Y = a_o + a_1X_1 + a_2X_2 + a_3X_3 + a_4X_4 + a_5X_5 + a_6X_6$$

where,

Y = Farm income (in '000 NRs)
X_1 = Economically active family members (in number)
X_2 = Land holding (in hectare)
X_3 = Cropping intensity (in percentage)
X_4 = Total asset (in '000 NRs)
X_5 = Total variable cost (in '000 NRs)
X_6 = Total employment (in mandays)
$a_{0 =}$ Intercept
a_j= regression coefficients (i=1,2,3,……..)
X_1……..X_6 = Explanatory variables.

RESULT AND DISCUSSION

Gross Household Income

On- and off-farm incomes constituted the gross household income. Here, on-farm income referred to the value of both total products and byproducts and the land rent. Off-farm income included incomes of rented out labour, service, business, and other professional works.

The study revealed that the total annual gross household income of NRs. 442,400.13 was significantly high for beneficiaries as compared to NRs. 126,803.21 of non-beneficiaries (p value <0.01). The average gross household income of beneficiaries (NRs. 183,260.11) was also found significantly higher than that of beneficiaries (NRs. 31,453.12).

In totality, sample farmers obtained the average annual gross income of NRs. 337,198.95. On the basis of composition of gross household income sample farmer received 65 percent of income from farm and 35 percent from off-farm sources (Table 1).

Table 1. Sources and average annual household income by category of respondent

Respondent Category	(Amount in NRs.)		
	On-farm Income	Off-farm Income	Total
Beneficiaries	183260.11**(41.42)	259140.02(58.58)	442400.13**(100)
Non-beneficiaries	31453.12 (24.80)	95350.09(75.20)	126803.21(100)
All farmers	132658.02(64.86)	204540.93 (35.14)	337198.95 (100)

*** indicates significant at 1 percent level of significance.*

Gross Farm Income

Income from both crop and livestock activities such as sale and consumption of crop and livestock products and byproducts along with land rent constituted the gross farm income. The study revealed that the income from the crop is significantly higher than that from livestock in both the case of beneficiaries and non-beneficiaries (p value <0.01). It also revealed that the income from crop is significantly higher in case of beneficiaries (NRs. 154,568.70) as compared to non-beneficiaries (NRs. 25,436.67) (p value <0.01). However, the income from livestock to beneficiaries (NRs 28,691.67) was not significantly higher than non-beneficiaries (NRs 6,016.67).

Table 2. Distribution of gross farm income by respondent category

Respondent Category	Crop	Livestock	Total
Beneficiaries	154568.70**(84.34)	28691.67(15.66)	183260.37(100)
Non-beneficiaries	25436.67**(80.87)	6016.67(19.13)	31453.34(100)
All farmers	111524.68(84.06)	21133.33(15.94)	132658.01(100)

*** indicates significant at 1 percent level of significance.*

Net Farm Income and Management and Investment Income (MII)

Net farm income referred to the gross farm income less the total variable cost incurred in the farm. Management and investment income was realized by deducting total fixed cost and total variable cost. The study revealed that the average total variable cost of the beneficiaries (NRs. 103,267.63) was significantly higher than that of non-beneficiaries (NRs. 18,376.57) (p value <0.01). Net farm income of beneficiaries (NRs. 79,992.48) and non-beneficiaries (NRs. 13,076.55) were significantly different (p value < 0.01). The management and investment income were also significantly different between the beneficiaries (NRs. 61,878.94) and non-beneficiaries (NRs. 9,759.91).

Table 3. Net farm income and MII by category, 2009

Respondent Category	Gross Farm Income	Average Total Variable Costs	Net Farm Income	MII
Beneficiaries	183260.11	103267.63**	79992.48**	61878.94**
Non-beneficiaries	31453.12	18376.57	13076.55	9759.91
All farmers	50603.61	25049.66	25553.94	21840.99

*** indicates significant at 1 percent level of significance.*

Regression Analysis for Beneficiary Households

In order to analyze the influence of various factors responsible for farm income of beneficiary households who had access to irrigation and farm income of non-beneficiaries who did not have access to irrigation, regression model was run considering total farm income as dependent variables and total variable cost, land holding, cropping intensity, economically active family members, total assets and farm employment as independent variables. This was done to find whether or not the irrigation had played significant role in farm income. The model specification is shown below:

$Y = b1X1 + b2X2 + b3 X3 + b4X4 + b5X5 + b6X6$

where,

Y = Gross household income (in '000 NRs.)
X_1 = Land holding (in hectare)
X_2 = Total variable cost (in '0000 NRs.)
X_3 = Total asset (in '000 NRs.)
X_4 = Cropping intensity (in percentage)
X_5 = Total employment (in mandays)
X_6 = Economically active family members (in number)

Table 4. Estimates of income function for beneficiary households, 2009

Variables	Specification	Unit	Unstandardized Coefficient	Standard Error	Standardized Coefficient	t-value	P-value
'Y'=Farm income in NRs., a dependent variable							
Constant			473.703	254.026		1.865	.068
X1	Land holding	ha	12.49	12.84	.121	1.99	.o50*
X2	TVC	'000 Rs.	0.974	0.460	.922	2.168	.035*
X3	Total assets	'0000 Rs.	0.077	.165	.197	1.810	.053
X4	Cropping Intensity	%	0.688	.179	.332	3.841	.00**
X5	Employment	MD	.262	.102	1.105	2.168	.03*
X6	EAFM	No.	13.72	6.17	.198	1.70	.07

$R = 0.81$, $R^2 = 66.2$

Durbin – Watson statistics = 2.11

The regression analysis showed that the independent variables namely landholding, total variable costs, employment, and cropping intensity had significant effect on farm income whereas total assets and EAFMs did not have significant role in farm income. Details of effects of independent variables on dependent variable are discussed below.

Landholding

Landholding had significant effect in farm income i.e. increase in landholding had increased the farm income significantly ($p < 0.05$). This could be due to large landholding leading to higher production with the availability of irrigation facility which ultimately lead to increase in total farm income.

Total Variable Cost

Significant effect of total variable cost was observed on gross farm income. So, increase in farm income was associated with the increase in variable cost i.e. increase in use of variable resources in farm ($p < 0.05$). In other words, use of various inputs in the farm including effective management of irrigation in the farm lead to higher production which ultimately results in increased farm income.

Total Assets

The assets possession had positive effect on farm income of the beneficiaries but not significant ($p>0.05$). This means increase in total assets of respondents did not increase the farm income significantly. This could be due to farmers had not paid their attention towards acquiring more assets related to farming. They had rather acquired assets which were not related to agriculture.

Cropping Intensity

Increase in cropping intensity leads to increase in total cropped area and production which generally results in increase in gross income (given that the current market price of products do not drop significally as compared to the previous or base year). It means that increase in cropping intensity would lead to increase in total farm income. Such result was found in this study too i.e. increase in farm income was observed with the increase in cropping intensity ($p < 0.01$).

Total Employment

The effect of on-farm employment on total farm income was found significant ($p<0.03$). That means increase in no. of employee in the farm also increased the farm income. This could be due to better management on cultivation practices and other farm operation as a result of increased farm employment

Economically Active Family Members

Positive relationship was found between farm income and economically active family members. But, this relationship was non significant ($p >0.05$). That means increase in EAFM would not increase total farm income significantly. This was because the employment opportunity in the study area was quite less. So, increase EAMs did not increase the total income of the household.

Table 5. Estimates of income function for non-beneficiary households, 2009

Variables	Specification	Unit	Unstandardized Coefficient	Standard Error	Standardized Coefficient	t-value	P-value
'Y'=Farm income in NRs., a dependent variable							
Constant			-13.829	4.684		-2.952	.006
X1	Land holding	ha	10.22	6.22	.121	1.50	.09
X2	TVC	'000 Rs.	0.66	0.34	.799	1.69	.06
X3	Total assets	'0000 Rs.	0.077	.165	.197	1.810	.053
X4	Cropping Intensity	%	.087	.033	.110	1.61	.08
X5	Employment	MD	.112	.97	.8765	2.22	.021*
X6	EAFM	No.	8.77	3.11	.123	1.66	.09

$R = 0.76$, $R^2 = 0.69$, Durbin – Watson Statistics = 1.91

Regression Analysis for Non-beneficiary Households

The regression analysis for non-beneficiary households showed that the independent variables namely landholding and employment had significant effect on farm income whereas total assets, total variable costs cropping intensity and EAFMs did not have significant role in farm income. Details of effects of independent variables on dependent variable are discussed below:

Landholding

Land holding had no significant effect in farm income i.e. increase in land holding would not significantly increase the farm income ($p>0.05$). This could be because of non availability of irrigation facility which is very important from crop cultivation point of view.

Total Variable Cost

Significant effect of total variable cost was not seen on farm income ($p>0.05$). So, increase in farm income was not significantly associated with the increase in variable cost i.e. this could be due to no or very less availability of assured irrigation water without which use of inputs will have less effect on production and ultimately on farm income.

Total Assets

The effect of total assests on farm income among non-beneficiary households was simailr to beneficiary households. In other words, the effect of total assets possession had positive effect on farm income of the beneficiaries but not significant ($p>0.05$). This means increase in total assets of respondents did not increase the farm income. This could be due

to farmers had not paid their attention towards acquiring more assets related to farming. They had rather acquired assets which were not related to agriculture.

Total Employment

The effect of total employment engaged in farm on total farm income was found significant ($p<0.03$). That means increase in no. of employee in the farm also increased the total farm income. This could be due to better management on cultivation practices and other farm operation as a result of increased involvement of farm employment

Economically Active Family Members

The positive relationship was found between farm income and economically active family members. However, this relationship was non-significant ($p>0.05$). That means increase in EAFM would not increase farm income. This was because people of non-beneficiaries category had very less land holding and thus people would be engaged in other off-farm instead of farm activities. This would ultimately decrease the farm income.

Income Distribution

Information on gross incomes per household and per farm were collected in order to acquaint the state of inequality in income distribution. The study showed that the gross income per household per year of the beneficiary households varied from NRs. 68,100 to NRs. 2,638,500. Poorest 10 percent of beneficiary households earned a mere 2.09 percent of gross household income. In contrast, the richest 10 percent households earned 36.05 percent of gross household income. Similarly, the lower 50 percent households earned only 20.51 percent of gross household income in comparison to 79.49 percent earned by upper 50 percent. It revealed that there exists wide disparity in distribution of gross household income among the beneficiaries (Table 6).

Table 6. Distribution of gross income per household of beneficiary households, 2009

Value in '000 NRs.

Income Level per Year	No. of HH	Percent of Household	Income Percent	Cumulative	
				Percent of HH	Percent of Income
68.100-124.351	6	10	2.09	10	2.09
124.352-151.850	6	10	3.24	20	5.33
151.851-192.700	6	10	4.02	30	9.35
192.7001-233.479	6	10	4.87	40	14.22
233.478-293.700	6	10	6.29	50	20.51
293.701-332.863	6	10	7.05	60	27.56
332.864-459.884	6	10	9.37	70	36.93

459.885-576.800	6	10	11.68	80	48.61
576.801-749.500	6	10	15.34	90	63.95
749.501-2638.500	6	10	36.05	100	100

As shown in Table 7, gross income per farm per year of beneficiary households varied from NRs. 46,500 to NRs. 101,015,000. Poorest 10 percent of beneficiary households earned only 2.92 percent of total farm income whereas the richest ten percent earned 28.63 percent of that income. Similarly, lower 50 percent of beneficiary households earned only 25.01 percent of farm income in contrast to 74.99 percent earned by upper 50 percent. Therefore, it could be said that there exists a wide inequality in farm income distribution among the beneficiaries.

Table 7. Distribution of gross income per farm of beneficiary households, 2009

Value in '000 NRs.

Income Level per Year	N. of HH	Percent of HH	Percent of Income	Cumulative	
				Percent of HH	Percent of Income
46.50-62.0	6	10	2.92	10	2.92
62.001-73.65	6	10	3.78	20	6.7
73.651-96.690	6	10	4.73	30	11.43
96.691-126.825	6	10	6.11	40	17.54
126.826-146.150	6	10	7.47	50	25.01
146.151-167.700	6	10	8.56	60	33.57
167.701-191.900	6	10	9.72	70	43.29
191.901-238.500	6	10	12.2	80	55.49
238.501-346.392	6	10	15.88	90	71.37
346.393-1010.150	6	10	28.63	100	100

Gross income per family of the non-beneficiary households varied from NRs. 47,250 to NRs. 371,500. Poorest 20 percent of them earned 10.22 percent of gross household income in contrast to 35.28 percent earned by richest 20 percent (Table 8).

Table 8. Distribution of gross income per household of non-beneficiary households, 2009

(Income in'000 NRs.)

Level of Income per Year	No. of HH	Percent of HH	Percent of Income	Cumulative	
				Percent of HH	Percent of In come
47.250-86.800	6	20	10.22	20	10.22
86.801-103.200	6	20	15.11	40	25.33

103.201-124.450	6	20	17.85	60	43.18
124.451-148.100	6	20	21.54	80	64.72
148.101-371.500	6	20	35.28	100	100

Farm income per family of the non-beneficiary households varied from NRs. 2,700 to NRs. 146,600. Poorest 20 percent of them earned 4.59 percent of gross household income in contrast to 48.81 percent earned by richest 20 percent (Table 9).

Table 9. Distribution of gross income per household of non-beneficiary households, 2009

(Income in'000 NRs.)

Level of Income per Year	No. of HH	Percent of HH	Percent of Income	Cumulative	
				Percent of HH	Percent of In come
2.700-11.450	6	20	4.59	20	4.59
11.451-20.250	6	20	10.26	40	14.85
20.251-27.000	6	20	15.17	60	30.02
27.001-38.200	6	20	21.17	80	51.19
38.201-146.600	6	20	48.81	100	100

The pattern of income distribution of beneficiary and non-beneficiary households is presented in Figures 1 and 2 respectively. As inequality line of per farm income of beneficiary households is closer than the inequality line of their household income, it could be stated that the disparity in distribution of household income is greater than farm income. Whereas, in non-beneficiary households, per farm income varied widely than per household income implying the greater inequality in farm income.

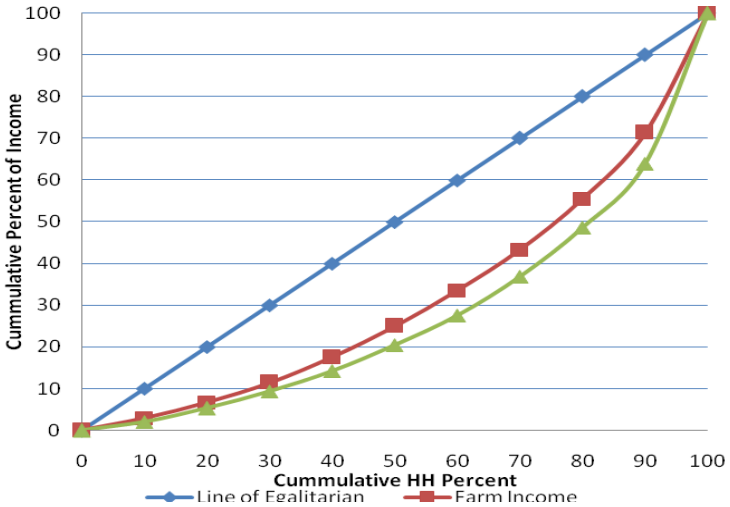

Figure 1. Lorenz Curve for distribution of gross incomes per farm and household of beneficiary households

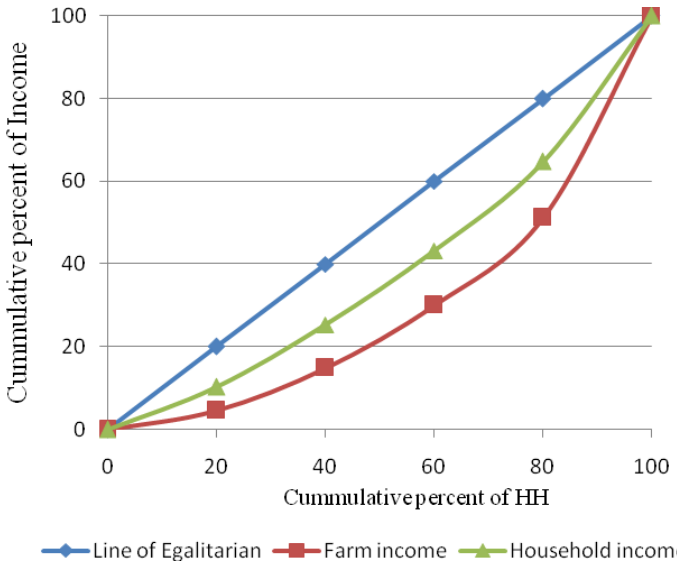

Figure 2. Lorenz Curve for distribution of gross incomes per farm and household of non-beneficiary households

Gini Coefficients for gross income per household and per farm of beneficiaries and non-beneficiaries are presented in Table 10. These coefficients revealed that disparity prevail in both the categories for both the household and farm incomes which were almost similar to their counterparts between the categories. From this study it is inferred that gross income was widening the disparity, while farm income was helping in reducing that disparity among the beneficiary households. In contrast to beneficiaries, it was just reverse for non-beneficiaries.

Table 10. Gini coefficients for gross incomes per household and farm by category of respondents

Category of Respondent	Total Farm Income	Total Gross Income
Beneficiaries	0.37	0.44
Non-beneficiaries	0.44	0.27

CONCLUSION

Praganna Irrigation Project lying in Deukuri valley of dang district, Nepal was implemented by the Department of Irrigation of Government of Nepal. The main aim of the project was to develop irrigation infrastructure to irrigate 5,799 ha agricultural land of four VDCs of Deukuri valley namely Chailahi, Sonpur, Sisania and Lalmatia. Major part of the project was focused on to upgrade the traditional irrigational system developed by the farmers covering 5,130 ha. In the impact study of PIP on farm income 73.33 percent of the beneficiaries said that there is increase in cereal production whereas 38.33 percent said that there is increase in vegetable production. However, only 53.33 percent of them addressed on increased farm income. The total annual gross household income of NRs 442,400.13 was significantly high for beneficiaries as compared to NRs 126,803.21 of non-beneficiaries ($p < 0.01$).

The income from the crop is significantly higher than that from livestock in both the case of beneficiaries and non-beneficiaries ($p<0.01$). it also revealed that the income from crop is significantly higher in case of beneficiaries (NRs. 154,568.70) as compared to non-beneficiaries (NRs. 25,436.67) ($p<0.01$). The management and investment income were also significantly different between the beneficiaries (NRs. 61,878.94) and non-beneficiaries (NRs. 9,759.91). Among 60 beneficiaries, majority of respondents (56.67%) were moderately satisfied with present level of operation and management of PIP followed by high and very high, indicating average performance of the PIP.

From regression analysis it was found that there was significant effect of total variable cost on farm income ($p<0.05$), The assets possession had positive effect on total farm income of the beneficiaries but not significant ($p>0.05$), farm income was found with the increase in cropping intensity ($p<0.01$). The effect of total employment engaged in farm on farm income was found significant ($p<0.03$), this could be due to better management on cultivation practices and other farm operation as a result of increased involvement of farm employment.

The gross income per household per year of the beneficiary households varied from NRs. 68,100 to NRs. 2,638,500. Poorest 10 percent of beneficiary households earned a mere 2.09 percent of gross household income. In contrast, the richest 10 percent households earned 36.05 percent of gross household income. Gini Coefficients for gross income per household and farm of beneficiaries and non-beneficiaries revealed that disparity prevail in both the categories for both the household and farm incomes which were almost similar to their counterparts between the categories. It is inferred that gross income was widening the disparity while farm income was helping in reducing that disparity among the beneficiary households. It was just reverse for non-beneficiaries.

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