

Impact of Micro Hydropower Projects on Household Income, Expenditure and Diversification of Livelihood Strategies in Azad Jammu and Kashmir

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The study examines the impact of Micro Hydropower (MHP) projects on households' income, consumption and diversification of livelihood strategies in District Hattian Bala, Azad Jammu and Kashmir. A multinomial logistic model is used to investigate the possible role of MHP and other control variables on households' adoption of livelihood strategies. The Results show that MHP-micro hydropower has a positive significant effect on household's adoption of non-farm and diversified livelihood strategies. These findings suggest that MHP projects in Northern areas of Pakistan could help in improving household's income and consumption through adoption of high income livelihood strategies.

Keywords: Micro Hydropower (MHP), Livelihood Strategies, Income and Expenditures, Poverty Alleviation, Multinomial Logistic Model

1. INTRODUCTION

Energy is a prerequisite and vital part of agricultural, industrial and services sectors. It is a fundamental need of human life. Still, more than 1.6 billion people in different parts of the world are living without electricity [Greenstone (2014)]. Most of the developing economies have been using fossils fuel for their energy needs, which has damaged our environment and is considered the main cause of global warming and climate change. That is why in most of the economies, governments and international donors have initiated projects to produce renewable energy¹ for commercial and domestic uses. Renewable energy provides economic and social benefits with minimum human and environmental hazards. Sources of renewable energy include solar radiations, wind, biomass gases and hydropower, such as large freshwater reservoirs and micro hydropower units (MHP). Among renewable energies, hydropower energy is less costly and environment friendly; is an alternative to fossils fuel energy [REN21 (2010); Frey and Linke (2002)] and is produced by machines that are powered by moving water [Maier (2007)].

A number of countries² have highlighted the importance of MHP resources in national energy policies [Li, *et al.* (2009); Zhou, *et al.* (2009); Purohit (2008); Karki (2007); Yuksel (2007); Dudhani, *et al.* (2006); Benstead, *et al.* (1999)]. International

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¹Renewable *energy* is collected from resources which are naturally replenished on a human timescale, such as water sunlight, wind, tides, waves, and geothermal heat.

² China, India, Turkey, Latin America and Caribbean.

energy and development policies, such as the Kyoto Protocol's Clean Development Mechanism (KPCDM), have designed incentives to encourage MHP development against fossil fuel energy and large freshwater reservoirs. In developing areas with growing demands for electricity, these policies are made with an aim to foster the development of renewable energy, along with the realisation of low carbon pollution and avoiding the undesirable social and environmental consequences, connected with large dams [REN21(2010); UNFCCC and CCNUCC (2006)]. In developing economies the benefits of MHP can be reaped at micro level, by fulfilling the energy requirements for small businesses development [Calderon (2005)] and creating employment opportunities in government and private sectors [Kirubi (2009); Rai (2000)]. It helps in increasing agricultural and livestock production, along with their processing and exports. In rural areas, MHP can meet the energy requirements for providing health, education and telecommunication services.

In Pakistan, about 64 percent of electricity is generated from thermal power while only 32 percent is generated from hydropower. Pakistan's Northern areas have huge potential for MHP production. Investment in MHP production can overcome the energy crisis and can help in reducing poverty as well [Umar, *et al.* (2015); Noor (2002)]. Currently, people in Northern areas are dependent on agriculture and they need additional sources of income to secure their wellbeing. Diversification of their livelihood strategies is only possible through development of non-farm sectors. The growth and development of non-farm sector in Northern areas is impossible without sufficient provision of electric power supply, and thus MHP production is the single best option. This study is designed to investigate the impact of MHP projects on rural households' livelihood diversification and increase in their income and consumption in Azad Jammu Kashmir (AJK). AJK has a potential of generating 8830.82 MW of electricity by using its freshwater resources, and government has launched a number of MHP projects with the objectives of socio-economic development and poverty alleviation [AJK at glance (2015)].

A number of studies have investigated the importance of MHP [eg Joshi (2011); Korkeakoski (2010); ADB (2010); Dhungel (2009); Sarala (2009); Sternberg (2008); ESMAP (2002)] however, only few studies have analysed its impact on livelihood diversification, income and expenditure of rural households in Pakistan [Saqib, *et al.* (2013); Noor (2002)]. This study aims to examine the impact of MHP projects on households' income and consumption in district Hattian, AJK; investigate the impact of MHP projects on diversification of households' livelihood strategies; and offer recommendations for improvement in household's welfare. The paper is divided into five sections. Section 2 provides a review of literature. Section 3 consists of methodology adopted for data collection and analysis. Section 4 presents results from data analysis. Section 5 spells out conclusions.

2. REVIEW OF LITERATURE

A sizeable literature is available on the contribution of MHP to productivity and economic growth. Dhungel (2009) concluded that MHP can be a highly effective means to increase the economic welfare of the people in rural areas of Nepal. Paish (2002) highlighted the importance of MHP for long term income generating activities in Nepal. He found that most of the activities that were mechanical, such as milling, grinding and

rice processing, were easily performed through small MHP projects. This enhanced the livelihood opportunities and provided services for the welfare of community. MHP is one of the most cost-effective energy technologies for rural electrification in developing countries, thus supporting rural livelihoods [Paish (2002)].

In a study of small hydropower projects in rural areas of Laos, Korkeakoski (2010) highlighted that modern, safe and affordable energy from hydropower has a great potential to reduce poverty and to support the livelihoods of local communities. In a study by ESMAP (2002), a number of countries were analysed, using data from household surveys to find correlations between electrification and the increase in number of small business activities. It was found that households in electrified areas were more probable to run home businesses as compared to households in non-electrified areas. Cockburn (2005) studied the benefits of MHP in the development of home level textile production, grocery shops, workshops and other businesses in Tamborapa Pueblo. It was found that textile producers had more opportunities to deliver and trade in close urban communities, before the hydropower development. Additionally, the bakeries in the locality had been equipped to make more products, which they had been previously importing from other towns. Thus, this socio-economic progress made the area more appealing for future development.

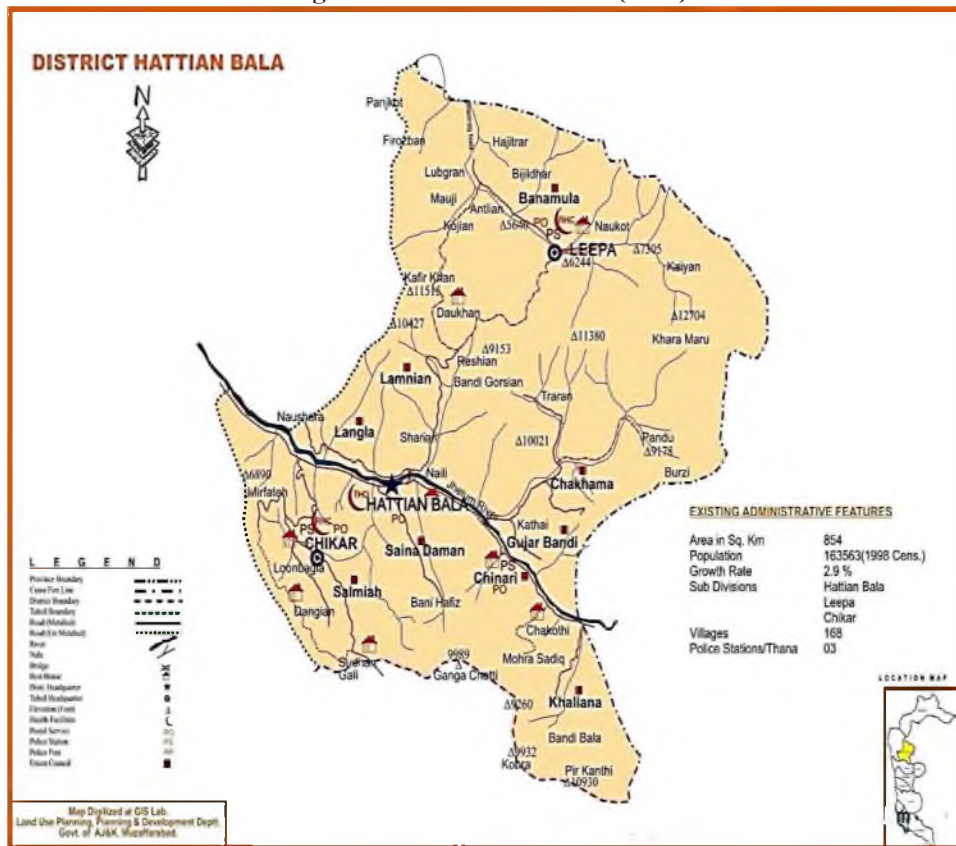
Noor (2002) examined the impact of MHP projects, installed by Aga Khan Rural Support Program (AKRSP), on the local communities in district Chitral of Pakistan. He found several social and economic benefits of MHP for local people. Due to electrical power supply, quality of life improved at a household level. Saqib, *et al.* (2013) conducted research on the impact of micro hydropower project on jobs creation in district Mardan of Khyber Pakhtunkhwa province. The study found that MHP project created a number of direct and indirect jobs. They also found increase in households' income that was attributed to diversification of livelihood strategies in MHP project area. A study conducted by Asian Development Bank [ADB (2010)] in Bhutan found a positive effect of electrification on households' income. The livelihood strategies of the electrified households were found more diversified and their incomes were 50-72 percent higher than those of un-electrified households.

3. METHODOLOGY

3.1. Study Area

District Hattian is located in AJK under the geographic limit of 34.1686 degrees North Latitude and 73.7934 degrees East Longitude. In the Northwest of the district, Neelum district is located, whereas in the West and South, Muzaffarabad and Bagh districts are situated. The total area of the district is 854 square kilometres, and total human population is 163563, having a growth rate of 3.6 percent (Census report 1998). The district is blessed with beautiful valleys and most of them are drained by Jehlum River and its tributaries. Jehlum River flows from Chakoti in the East to Naushera in the Northwest (see Figure 1). In sub valleys where altitudinal variations are high, electricity can be generated through MHP stations on fast flowing streams. Some MHP stations are working in Kathai, Leepa and Sharian areas. These areas and others, having potential for MHP are located on the upper northern side of the Jehlum River.

Fig. 1. District Hattian Bala (AJK)



3.2. Sampling and Data Collection

A multistage sampling technique was used to select a sample of 346 households. District Hattian consists of 12 union councils and 168 villages. Four union councils, Sharian, leepa, Kathai and Hattian were selected purposively. Sharian, Leepa, Kathai were electrified through MHP, whereas Hattian was electrified through national grid. From each of the three union councils, electrified through local MHP stations, two villages were randomly selected. Four villages were selected randomly from union council Hattian. Details on total number of households for selected villages were collected from the Revenue office of the district and State Earthquake Reconstruction and Rehabilitation Authority. Those details were used as sampling frame to decide about sample size and number of households from each village, using Sekaran's sampling table [Sekaran (2003)] and proportional allocation sampling technique. Lists of selected villages and number of sampled households from each village are given in Table 1. Simple random sampling technique was used to select the required number of households from each village.

Data was collected at household level, through face to face interview with the head of the household. A well-designed questionnaire was used to collect the required information from selected households.

Table 1

Distribution of the Sampled Respondents in the Study Area

	Union		Total	Sampled
	Councils	Villages	Households	Households
Villages Connected to Small Hydropower Projects	Langla	Sharian	290	32
		Gohraabad	250	28
	Gujar bandi	Kathai	260	29
		Ghrthama	305	34
	Leepa	Leepa	436	49
		Nakot	256	29
Villages Not Connected to Small Hydropower Projects	Hattian Bala	Saran	346	39
		Chathea	336	38
		Kaneena	250	28
		Dhanni	355	40
		Total		3084

Sources: Hydroelectric Board, District Muzaffarabad and Revenue Dptt., District Hattian (2015).

3.3. Analytical Tools

3.3.1. Independent Sample *t*-test

An independent sample *t*-test was used to examine the impact of MHP on households' income and expenditures. Sampled households were divided into beneficiaries and non-beneficiaries of MHP, and data on their income or consumption expenditures was used to calculate *t*-statistic value, using the following formula. Then, the probability of getting the calculated *t*-statistic value (p-value) was derived from *t*-table. The p-value shows significant difference for that indicator across beneficiaries and non-beneficiaries of MHP.

$$t = \frac{(\bar{X}_1 - \bar{X}_2)}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}} \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad (1)$$

$$d.f. = \frac{(s_1^2/n_1 + s_2^2/n_2)^2}{(s_1^2/n_1)^2/(n_1-1) + (s_2^2/n_2)^2/(n_2-1)} \quad \dots \quad \dots \quad \dots \quad \dots \quad (2)$$

Where *t* is *t*-statistic; n_1 and n_2 are number of households in sub sample beneficiary and non-beneficiary, respectively; \bar{X}_1 and \bar{X}_2 are mean income or expenditures of the beneficiary and non-beneficiary; and S_1^2 and S_2^2 are the unbiased estimator of the variance for sub sample beneficiary and non-beneficiary.

3.3.2. Multinomial Logistic Model

Following Gecho, *et al.* (2014), a multinomial logistic model (MLM) was used to estimate household's probability of choosing a livelihood strategy. MLM is a powerful tool that makes it possible to analyse factors influencing household's choice of a livelihood strategy in the context of multiple choices.

Based on different livelihood strategies, adopted by the sampled households, MLM was designed to estimate household's probability of choosing a livelihood strategy. Furthermore, to examine the possible role of MHP projects on household's adoption of a livelihood strategy, a dummy variable was added with other important variables (control variables) in the model.

MLM can be specified as follows;

$$P_r(y_i = j) = \frac{e^{x_i B_j}}{1 + \sum_{j=1}^{j=4} e^{x_i B_j}} \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad (3)$$

Where

i (1, 2, 3, ..., 346) is i th households;

j (1,2,3,4) is j th livelihood strategy;

P_{ij} is the probability of i th household for choosing j th livelihood strategy;

X is a vector of variables affecting probability of choosing a livelihood strategy;

e is the natural base of logarithms; and

β s are weights or coefficients of X variables.

In fitting such a model, $J-1$ set of regression coefficients are estimated using maximum likelihood estimation method (MLE). The marginal effects (ME_i) of a variable X_i on the probability of choosing j th livelihood strategy is specified as

$$ME_i = \frac{\partial P_{ij}}{\partial x_i} \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad (4)$$

4. RESULTS AND DISCUSSION

4.1. Socio-economic Characteristics

Traditionally, most households in Pakistani culture are headed by male; particularly the senior male member holds command and control of most of the material resources of a family. Table 2 shows that 87 percent of the sampled households are headed by male and only 13 percent are headed by female. On average they are 44 years old and are educated up to 8 years of schooling. The same table shows that average household size is 7 individuals and their average monthly income is Rs 25327. They practice agriculture, non-farm and off-farm activities as their primary³ sources of income generating livelihood strategies. Some farmers are engaged in diverse activities as livelihood strategies.

Agricultural activities included both crop production and animal husbandry. In the study area some of the major crops grown are maize, wheat and rice. Livestock products which are valuable in the area are milk products like butter, yoghurt. Off-farm activities are agricultural activities which take place outside the person's own farm. These

³In rural communities, households engage in more than one livelihood activity at a time [Ellis, *et al.* (2003); Bryceson (2000)]. The primary livelihood activity of the household is defined as the activity that generates the highest proportion of the household's overall income.

activities include local daily labour work at village level or the neighbouring areas, in return for cash payment or the agricultural work at another person's farm in return for part of the harvest in kind. Natural resource based activities like firewood collection for own consumption or for sale were other non-farm activities in this study. Non-farm activities include government services, business, handicraft activities (weaving, spinning, carpentry, remittance, etc.), petty trade (grain trade, fruits and vegetables trade) and trading of small cattle. Survey data on income generating sources show that 63 percent of the households have adopted non-farm livelihood strategy (NFLS), 15 percent have adopted agricultural livelihood strategy (ALS) and 11 percent are engaged in off-farm livelihood strategy (OFLS) and diversified livelihood strategy (DLS). Table 2 lists these livelihood strategies and the amount of average monthly income, generated by each strategy.

Average monthly income per household, generated from DLS and NFLS is significantly higher than NFLS and ALS. Conventional and marginalised farming could be the possible reasons for low income from agriculture and off-farm activities. In the study area open plain fields are limited and average land holding per household is 1.76 acres. Low income, smaller farm size and irregular topography cannot support the modernised intensive agricultural practices.

Table 2

Socioeconomic Characteristics of the Sampled Households

Variable	Mean Value	Standard Deviation
1. Head Characteristics		
1.1. Gender (1 for male otherwise 0)	0.87	0.33
1.2. Age(years)	44.68	10.97
1.3. Education(years of schooling)	8.33	4.53
2. Households Characteristics		
2.1. Size	7.00	2.67
2.2. Total monthly income (Pak. Rs.)	25326.88	11502.66
2.3. Income of households involved in		
a. Agriculture only (15 %)	12615.38	5375.70
b. Non-farm activities (63%)	27595.87	10694.05
c. Off-farm activities (11%)	18121.62	6256.42
d. DLS ¹ (11%)	38284.62	9057.87
2.4. Landholding size(acres)	1.76	0.77

Source: Sampled Survey Data (2015).

4.2. Impact of MHP on Household's Income

The survey data show that the average monthly income of beneficiaries and non-beneficiaries is Rs 27703 and Rs 22033 respectively (Table 3). The average income of beneficiaries is greater than average income of non-beneficiaries by Rs 5067. Similarly, the average consumption expenditure of beneficiaries and non-beneficiaries is Rs 26166 and Rs 20861 respectively. Average consumption expenditure of beneficiaries is greater than average consumption expenditure of non-beneficiaries by Rs 5305. Table 2 provides results for the independent sampled *t*-tests. It is shown that beneficiaries' monthly income

and consumption expenditures are significantly greater than income and consumption expenditures of non-beneficiaries. These results reveal that in the study area MHP projects have positive and significant impact on household's welfare.

These results reveal that in the study area, MHP projects have a positive and significant impact on household income and consumption expenditure. One of the reasons is that the use of MHP electricity was cheaper than the cost of kerosene and gas cylinders so the respondents were able to save money from unproductive expenditure. Furthermore the total cost of small hydropower energy was less than per unit cost of energy from national grid. The increase in income was found in those households that were using MHP energy for business and other livelihood activities. Anup and Ian (2009) in Nepal and Kirubi (2009), in Kenya also found that the MPHs improved family income significantly.

Table 3

<i>Income and Expenditures across Beneficiaries and Non-beneficiaries of MHP</i>			
	Beneficiaries	Non-beneficiaries	T-test (p-value)
Monthly Income	Rs.27703	Rs.22033	2.29 (0.00)
Monthly Cons. Expenditures	Rs.26166	Rs.20861	4.80 (0.00)

Source: Survey Data 2015.

4.3. Determinants of Choosing a Livelihood Strategy

To identify important determinants of households' choice of a livelihood strategy, factors such as the MHP and households socioeconomic characteristics were used as explanatory variables in MLM. Statistical analytical software STATA was used to estimate the parameters of the model. Agriculture livelihood strategy is used as a base category⁴ in the coefficient of the variables. The likelihood ratio test statistics, indicated by the chi-square statistics (given in Table 4), is highly significant (p-value= 0.00) suggesting strong explanatory power of the model. The predicted probabilities⁵ for choosing agriculture livelihood strategy (ALS), nonfarm livelihood strategy (NFLS), off farm livelihood strategy (OFLS) and diversified livelihood strategy (DLS) are 0.15, 0.63, 0.11 and 0.11 respectively.

The estimated model was tested for multicollinearity,⁶ and the test failed to detect the problem. Moreover, the model was tested for the validity of the independence of the irrelevant alternatives⁷ (IIA) assumption, using Hausman test for IIA. The test failed to

⁴STATA use maximum likelihood estimation (MLE) method for estimation of the parameters in MLM. It takes one of the livelihood strategies as a base category and report results for the others. Coefficients for each explanatory variable are estimated in reference to its effect for the base category. For this study, agriculture was taken as a base category because it is the primary sector of the district economy.

⁵Theoretically, the estimated mean values (probabilities) for dependent variable(s) from regression analysis must be equal to the actual mean values (probabilities).

⁶Correlation matrix was used to estimate for explanatory variables used in MLM to check for multicollinearity. The estimated correlation values suggest that the estimated model have no multicollinearity problem.

⁷IIA test is required for finalising categories of dependent variable for final multinomial regression analysis. Detection and utilisation of remedial measure for multicollinearity helps in reducing possibility of type 1 error

Table 4

MLE Results for Multinomial Logistic Model

Determinants	NFLS			OFLS			DLS		
	Coef.	t value	ME	Coef.	t value	ME	Coef.	t value	ME
MHP	4.27	5.11	0.30	1.20	1.49	-0.13	3.48	3.1	0.00
Age of the head									
40 to 50 years	0.47	0.65	0.06	-0.75	-0.92	-0.06	0.28	0.22	0.00
Above 50 years	4.02	3.63	0.05	3.95	3.47	0.07	5.24	3.69	0.05
Education level									
5 to 8 years	3.11	3.19	0.37	0.90	0.82	-0.08	1.33	0.91	-0.03
9 to 10 years	2.60	3.42	0.24	1.16	1.41	-0.06	3.29	2.65	0.05
11 to 12 years	5.97	5.53	0.41	3.25	2.92	-0.10	6.73	4.50	0.07
>12 years	5.60	5.58	0.39	3.21	3.08	-0.08	6.39	4.41	0.07
Gender ¹	-1.38	-1.83	-0.91	17.73	0.01	1.35	-0.19	-0.12	0.15
Household size	-3.9	-4.06	-0.35	-1.75	-1.77	0.05	14.21	0.02	0.15
Landholding²									
Medium	-1.79	-2.78	-0.18	-0.34	-0.45	0.08	-0.59	-0.42	0.01
Large	18.11	0.01	-0.20	17.91	0.01	-0.03	23.04	0.01	0.36
Foreign Remit.	2.26	2.20	-0.19	0.52	0.37	-0.07	1.06	0.67	-0.03
Constant	-0.61	-0.87		-19.00	-0.01		-24.08	-0.03	

LLR χ^2 value: 400.48 (p-value=0.00).

$P_{(ALS)} = 0.15$, $P_{(NFLS)} = 0.63$, $P_{(OFLS)} = 0.11$, $P_{(DLS)} = 0.11$.

- (1) Gender of the head is a dummy variable (1 if male otherwise 0).
- (2) In the study area average land holding is 1.76 acres and based on the distribution of land holding agricultural farms, are categorised into;
 - (i) Small farms (<1 acres).
 - (ii) Medium farms (1 to 2 acres).
 - (iii) Large farms (>2 acres).
 - (iv) Marginal Effects (ME).

reject the null hypothesis of independence of the livelihood strategy options, suggesting that the MLM specification is appropriate to model household's adoption of a livelihood strategy.

The estimated coefficient for explanatory variables, their z-statistics and marginal effect values are given in Table 4. Estimated model shows that MHP, age and education level of the household head are important and consistent determinants of household's choice of a livelihood strategy. The effects of other variables are inconsistent.

4.3.1. Micro Hydropower (MHP)

Electricity and water supply are the most important assets [Ellis (2000)]. In general, access to these assets has an important impact on the choice of livelihood strategy. Thus MHP is used as a dummy variable (1 for beneficiaries and 0 for non-beneficiaries), with the expectation of having a positive significant impact on the adoption of high income generating DLS and NFLS.

MHP has positive significant coefficients for NFLS and DLS. This signifies a positive impact of MHP on households' choice of NFLS and DLS over ALS. The

marginal effect value for MHP is 0.30 for NFLS, which shows that beneficiaries of MHP are 30 percent more likely to choose NFLS over ALS as compared to non-beneficiaries. The marginal effect of MHP on probability of adopting the DLS is 0.10. These results indicate that beneficiaries of MHP have adopted the NFLS and DLS. As the income for these two categories is greater than income from NFLS and ALS (see Table 4), we can say that households are better off with MHP projects.

4.3.2. Age of the Head

In rural areas, livelihood decisions are generally taken by the household head. That is why the age of the household head is used as explanatory variable in the following three categorical forms: (1) Households headed by individuals below 40 years of age; (2) Households headed by 40-50 years old individuals; and (3) Households headed by individuals older than 50 years. The table shows that the 3rd age category has positive significant coefficients. These indicate a positive relationship between age of the household head and choice of DLS, NFLS and OFLS over ALS. Agricultural activities, such as land preparation, plantation, weeding and harvesting are labour intensive. The geophysical characteristics of the study area and households' weak economic conditions do not support mechanised agricultural practices. Older individuals are physically unfit to perform labour intensive agricultural activities and are likely to choose other livelihood strategies.

4.3.3. Educational Level of the Household Head

Educational level of the household head is expected to have a positive impact on household adoption of NFLS and DLS. An educated head can easily get job for himself and other members of his family in non-farm sector. The following 5 dummy variables for educational level of the head are used in the model: 0-4 years, 5-8 years, 9-10 years, 11-12 years and 13 plus years. Results indicate that education is highly important determinant of households' choice of other livelihood strategies over ALS. The coefficient values for the last two educational levels are consistently positive and statistically significant at 1 percent level of significance. The marginal effect values for education levels are very high for NFLS as compared to DLS and OFLS. These results indicate that a household headed by an educated member is likely to choose NFLS.

4.3.4. Gender

Gender influences diversification choices including, the variety of income-generating activities due to ethnically defined roles, social mobility restrictions and discrepancy in possession of access to assets [Ishaq and Memon (2016); Galab, *et al.* (2002)]. In our model gender is used as a dummy variable (1 for male headed households and 0 for female headed households). The estimated coefficient for NFLS is negative and statistically significant. This indicates that female headed households are more likely to choose NFLS over agricultural livelihood strategy (ALS). The marginal effect of gender is -0.91. It means that holding other factors constant, such as the likelihood of adopting the NFLS in favour of female headed households', increases by 91 percent and the opposite is true for male headed households. Female non-farm activities include teaching, trading, and selling of firewood.

4.3.5. Household Size

Large sized families are more likely to choose ALS and DLS. Results show that coefficients for family size are negative and significant for NFLS and OFLS and positive but insignificant for DLS. These coefficients indicate that small families are more likely to choose NFLS and OFLS over DLS.

4.3.6. Farm Size

Households having large farm size are expected to choose ALS or DLS. However, the estimated coefficients for different farm categories are inconsistent and insignificant. These results imply that landholdings have no significant role in household adoption of a livelihood strategy.

4.3.7. Foreign Remittances

Foreign remittances have a positive and statistically significant effect on household's adoption of nonfarm livelihood strategy (NFLS). The marginal effect value is 0.19, which means that the probability of choosing NFLS is 19 percent more for households receiving foreign remittances.

5. CONCLUSION

This study has explored the benefits of MHP at micro level in terms of diversification of households' livelihood strategies, their income and consumption expenditures. Results indicate that income and consumption expenditures of beneficiaries of MHP are significantly higher than non-beneficiaries, suggesting that launching such types of project would be helpful in bringing positive change to rural households' wellbeing.

In the study area, households are involved in agriculture, non-farm, off-farm and diversified activities as their livelihood strategies. Income from diversified livelihood strategy and non-farm livelihood strategy is significantly higher than from other two strategies. Results from multinomial logistic model further reveal that MHP has a positive significant effect on household's adoption of non-farm and diversified livelihood strategies. These findings suggest that increase in household's income and consumption occurred because of adopting non-farm and diversified livelihood strategies, and all these were made possible due to MHP projects.

Households in Northern areas of Pakistan are mostly poor farmers [Shah (2014); Shah, *et al.* (2015)], and they are not able to make a living from agriculture income alone. Based on findings from this study we can conclude that improvement in their wellbeing is only possible through livelihood diversification and that MHP projects can help in diversification of their livelihood strategies, thus raising their income and fulfilling their consumption requirements.

QUESTIONNAIRE

**THE IMPACT OF SMALL HYDROPOWER PROJECTS ON
SOCIOECONOMIC CONDITIONS OF LOCAL COMMUNITIES
IN RURAL AREAS OF AJ&K (DISTRICT HATTIAN).
HAVING HYDROPOWER PROJECT(A)**

1. **Name of the respondent.....**
2. **Age**
3. **Literacy status.**
 - i. Educated ii. Uneducated

If Educated, Literacy Level

 - a. Primary b. Middle
 - c. Secondary d. Higher secondary
 - e. Above
4. **Family size.....**

Adults.

 - i. 1-3 ii. 5-6 iii. above 6

Children.

 - i. 1-3 ii. 5-6 iii. above 6
5. **Family type**
 - i. Joint ii. Nuclear iii. Extended
6. **No. of children going to school.**
 - i. 1-3 ii. 5-6 iii. above 7
7. **Do you own land.....**

Yes..... No.....

If yes landholding size

 - i. Less than 1 acres
 - ii. 1 to 2 acres
 - iii. Greater than 2 acres
- 8i. **What is your main Occupation?**
 - i. Govt services ii. Agriculture
 - iii. Cattle raising iv. Business, industry, etc
 - v. Other (specify).....
- 8ii. **What is your Subsidiary Occupation.**
 - i. Business ii. Agriculture
 - iii. Cattle raising iv. Business, industry, etc
 - v. Other (specify).....
9. **Is there seasonal variation in the activities?**
 - i. Yes ii. No

If yes specify (activities)

 - i. _____
 - ii. _____
 - iii. _____
 - iv. _____

10. Did you find any employment due to SHP project

- i. Yes
- ii. No

If yes, type of work

- i. Skilled work
- ii. Labour
- iii. Technical work
- iv. Administrative work
- v. Others

11. Monthly income _____

- i. How much you spend on energy monthly _____
- ii. Any Foreign remittances-----

12. Have your family income improved due to hydroelectric project?

- i. Yes
- ii. No

If yes then specify the nature of job from which income has increased?

- i. Cottage industries
- ii. Job opportunity
- iii. Saving from crop/livestock production
- iv. Other

13. Diversification in livelihood strategies due to Small hydropower Project.

Livelihood Activities	Before	Due to SHP
Agriculture Activities		
Off Farm Activities		
Non-Farm Activities		
Diversified Livelihood strategy		

14. Do you use energy source other than SHP including energy from all sources such as

- i. Candles
- ii. Kerosene oil
- iii. Biomass
- iv. Wood
- v. Any other Please specify

15. If wood How much time is used to collect fuel wood

Before the project.....
 After the project.....

16. Do you work or do other activities after sunset

- i. Yes
 - ii. No
- Any economic activities.....
 Any social activities.....

17. Does Small hydro projects helped in increasing working efficiencies?

- i. Yes
 - ii. No
- If Yes, please explain how.....

18. Is there any increase in monthly saving due to hydro electric project

- i. Yes
 - ii. No
- If Yes. Then what are the reasons for that.....

- 19. What is the approximate saving in Rupees You get for the following facilities per month due to near station**
 BHUs/Hospitals
 Schools
 Markets
 GPO/Post offices
 Banking systems
- 20. Where did you utilise this savings?**
 i. Nothing
 ii. Business
 iii. Livestock
 iv. Agriculture
- 21. What are the main sources of energy for**
 i. Cooking
 ii. Heating
 iii. Lighting
 iv. Other activities
- 22. Is there increase in use of home appliances after the project.**
 i. Yes
 ii. No
 If Yes what type of home appliances.
 i. Refrigerator
 ii. TV
 iii. Oven
 iv. Iron
 v. Electric cattle
 vi. Washing machine
- 23. Do you see any change in education facilities due to hydro electric project?**
 i. Yes
 ii. No
 What change you see in education facilities due to hydroelectric project
 i. Increase in number of school
 ii. Increase in children enrolment
 iii. Increase in Quantity and Quality of teachers
 iv. Improved audio/video equipment
 v. All of Above.
- 24. Do you see any change in Health facilities due to hydroelectric project.**
 i. Yes.....
 ii. No.....
 What change you see in Health facilities due to hydroelectric project.
 i. Increase in number of Health clinics
 ii. Awareness about diseases
 iii. Modern equipment
 iv. Sanitation
 v. All of above
- 25. What are the most important uses of electricity?**
 i. Lighting
 ii. TV/radio
 iii. Water pumping
 iv. Refrigerator
 v. Washing machine
 vi. Other

26. **How do you see the access to communication and entertainment services after electrification?**
 i. Telephone ii. Internet iii. TV
 iv. Radio v. Others
27. **What is your opinion for such type of project to be launched more in future?**
-
-
-

QUESTIONNAIRE

**THE IMPACT OF SMALL HYDROPOWER PROJECTS ON
 SOCIOECONOMIC CONDITIONS OF LOCAL COMMUNITIES
 IN RURAL AREAS OF AJ&K (DISTRICT HATTIAN).**

WITHOUT SMALL HYDROPOWER PROJECT(B)

1. **Name of the respondent** _____
2. **Age** _____
3. **Literacy status.**
 i. Educated ii. Uneducated
 If Educated, Literacy Level
 a. Primary b. Middle
 c. Secondary d. Higher secondary
 e. Above
4. **Family size.....**
 Adults.
 i. 1-3 ii. 5-6 iii. above 6
 Children.
 i. 1-3 ii. 5-6 iii. above 6
5. **Family type**
 i. Joint ii. Nuclear iii. Extended
6. **No. of children going to school.**
 i. 1-3 ii. 5-6 iii. above 7
7. **Do you own land.....**
 Yes..... No.....
 If yes landholding size.....
- 8i. **What is your main Occupation?**
 i. Govt services ii. Agriculture
 iii. Cattle raising iv. Business, industry, etc.
 v. Other (specify).....
- 8ii. **What is your Subsidiary Occupation.**
 i. Business ii. Agriculture
 iii. Cattle raising iv. Business, industry, etc.
 v. Other (specify).....

9. Is there seasonal variation in the activities?

- i. Yes
- ii. No

If Yes Specify (activities)

- i. _____
- ii. _____
- iii. _____
- iv. _____

Monthly income _____

10. Diversification in livelihood strategies

Livelihood Activities		
Agriculture Activities		
Off Farm Activities		
Non-Farm Activities		
Diversified Livelihood strategy		

How much you spend on energy monthly _____

11. Have your family income affected due to shortage of electricity?

- i. Yes
- ii. No

(ii) If yes then specify the nature of job from which it has been effected?

- i. Cottage industries
- ii. Job opportunity
- iii. Saving from crop/livestock production
- iv. Other

12. Your alternative energy source during load shedding hours?

- i. Candles
- ii. Kerosene oil
- iii. Biomass
- iv. Wood
- v. Any other Please specify

13. Do you work or do other activities after sunset

- i. Yes
- ii. No

Any economic activities.....

Any social activities.....

14. Does load shedding affect your working efficiencies?

- i. Yes
- ii. No

If Yes, please explain how.....

15. Is there any increase in monthly expenditure for using alternate energy sources?

- i. Yes
- ii. No

If Yes. Then what are the reasons for that.....

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