



Impact of Nathpa Jhakri hydroelectric power project on farm production systems, income and livelihood status in Kinnaur and Shimla districts of Himachal Pradesh

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Abstract

Himachal Pradesh is extremely rich in hydel resources and the state has about 25 per cent of the national potential in this respect. Nathpa Jhakri Hydroelectric Power Project is the biggest hydroelectric project of the country with a potential of generating 1500 MW electricity is located in Kinnaur and Shimla districts of Himachal Pradesh. The present study was conducted in these two districts of HP. The research investigation was carried out from weir site to the powerhouse. The farming community of the study area was growing cereals, pseudo cereals, pulses and vegetables. Rajmash and potato were traditionally grown cash crops. In fruit crops apple and plum were the major fruit crops grown by the farmers. The contribution of fruit production in terms of income by generating employment had played a very important role in the economy of study area.

Key words: Hydroelectric, agriculture, horticulture, pseudo cereals, production, productivity.

Electricity is the harbinger of the development of an area as it promotes industries, which in term generates employment, raises the income of the people and leads to development and prosperity of the inhabitants. Today, one of the most pressing needs is the growing demand for electric power. For any growing economy, power is a vital input needed to fuel the engine of economic growth and to fulfil the basic needs of the entire population of a country. Energy differentiates the least developed or developing economy from a developed economy. Empirical evidence suggests that lack of energy can whittle down the pace of economic development while its abundance can stimulate the development. India today is the fifth largest consumer of energy in the world, accounting for 3.7 per cent of the world consumption. Its total primary energy demand is expected to be almost double by 2030 (Kumar and Mohan, 2012).

Recently, Himachal Pradesh has been marked as the 'Power State' with a good potential to produce electric energy. The Government of Himachal Pradesh has taken several initiatives to encourage private sector participation in the development of small hydroelectric power plants. Today, emphases are not just to produce electric power, but to generate electric power with good technology use which is less

damaging and more environmental friendly. There are also questions about whether the power generated from these projects would help increase access to electricity for the poor and the vulnerable sections of society, as the location of these projects in remote and difficult terrains, privatization, and the incentives offered will result in a high cost for the electricity generated. The protests in different project sites in the state indicate that the power projects are not taking care of livelihood and environment. It is most unfortunate that man by his failure to live in harmony with nature has brought humanity to the brink of this global environmental catastrophe (Pamecha and Sethi, 2012). To address the discourse of "Benefits versus Losses" which always remains with hydroelectric power projects, an attempt in this research paper has been made to study the impact of Nathpa Jhakri Hydroelectric Power Project on farm production systems, income and livelihood status.

The operational area of the Nathpa Jhakri Power Project is in Shimla and Kinnaur districts of Himachal Pradesh. The weir site of the project is situated in Kinnaur district whereas; power house has been established in Rampur block of Shimla district. Therefore, the study area for the present investigation comprised of the developmental blocks of these two districts in which weir site and power house are located.

Materials and Methods

Multi-stage sampling technique was used for the selection of respondents. Two developmental blocks i.e. Nichar of Kinnaur and Rampur of district Shimla were selected purposively as weir site and power house lie in these blocks. At the first stage of sampling the list of panchayats around the weir site, power house and tunnel was prepared in consultation with block headquarters/ project officers. From the list so prepared a sample of four panchayats comprising three panchayats from Nichar and one panchayat from Rampur block were selected randomly.

At the second stage of sampling, the list of villages falling in the selected panchayats was prepared with the help of panchayat officials. Then, from the list of villages, a sample of 20 affected villages either around the weir/power house site or above and around the tunnel was selected randomly. The sample so drawn consists of 17 villages from Nichar and 3 villages from Rampur block. The major proportion of sampled villages was from Nichar developmental block, which was mainly due to the fact that the major portion of the project affected area (tunnel and weir site) was in Nichar developmental block of Kinnaur district.

At the third stage of sampling the list of households in the selected villages was prepared in consultation with the panchayat secretaries and Pradhans. Finally, a sample of two

hundred households from the list so prepared was drawn randomly i.e. 10 households from each selected village.

In order to meet out the requirements of the specific objectives of the study both primary as well as secondary data were collected. The primary data for the present study were collected on specifically designed and pre-tested interview schedule through personal survey technique. The secondary information from different offices, publications, reports etc. were also collected. The primary and secondary data so collected during the study period were checked, scrutinized, coded, tabulated, analyzed, compiled and presented systematically for both pre-project and post-project periods.

The *ex-ante* (before) and *ex-post* (after) approach was adopted for the collection and analysis of data. The year 1991-92 was taken as the *ex-ante* and the year 2012-13 being the study year represented the *ex-post* scenario.

Results and Discussion

Agriculture is the main occupation of the people of Himachal Pradesh. It is the only state in the country whose 89.96 per cent population lives in rural areas (2011 Census). Therefore, dependency on agriculture/horticulture is evident as it provides direct employment to the workers of the state. It can be seen from the Table 1 that agriculture & horticulture, animal rearing, rural artisan, business, government service, labourer etc. were the major occupations of the sampled

Table 1. Distribution of sampled population according to their main occupation

Sr. No.	Particulars	Male	Female	Total
1	Agriculture & Horticulture	240 (74.53)	256 (88.89)	496 (81.31)
2	Animal Rearing	8 (2.49)	8 (2.78)	16 (2.62)
3	Rural Artisan	5 (1.55)	2 (0.69)	7 (1.15)
4	Business	14 (4.35)	3 (1.04)	17 (2.79)
5	Service/ pension	41 (12.73)	11 (3.82)	52 (8.52)
6	Labourer	14 (4.35)	8 (2.78)	22 (3.61)
	Total active available work force	322 (100)	288 (100)	610 (100)

Note: Figures in parentheses indicate the percentages to total

households for their livelihood. The table indicated that amongst these occupations, agriculture & horticulture was major occupation accounting for 81.31 per cent of the total population of the study area. It was found to be higher (88.89%) in case of female as compared to the male population (74.53%) which was mainly due to the fact that the male counterparts were engaged in off-farm activities like service etc. at distant places usually in big cities. Next to agriculture, government services/pension was found to be major occupation for about 12.73, 3.82 and 8.52 per cent of male, female and total population, respectively. The sampled population was also found to be associated with animal rearing and labour but their percentage was quite low (less than 5%). From the above discussion it can be concluded that for the active work force available in the study area agriculture & horticulture was the major occupation for livelihood followed by service/pension.

Impact of power project on farm production systems, income and livelihood status Land resources

Land is the basic resource, which can be allocated for different farm and non-farm activities for maximization of household income depending upon its nature and type. The farmers with large holdings have more opportunities for land utilization as compared to small holdings; however, there may be problems of management with large holdings. Land inventory and its utilization pattern, before and after project implementation period in the sampled households have been analysed and depicted in Table 2. The table revealed that average size of holding was estimated at 1.00 and 0.99 hectare for before and after the project implementation, respectively. The available land resource was allocated for cultivation of crops, forests, orchards and grazing & pastures lands by sampled households. Among these land uses, the highest proportion of area was put under horticulture plantations, followed by area under cultivation/ growing of agricultural crops during both the periods. The area under horticultural crops and cultivation, accounted for about 51-52 and 23-24 per cent of total area, respectively. The higher proportion of the land under horticulture was mainly due to the fact that the topography and climatic conditions of the study area were congenial for the fruit crops like apple and plum.

The area put under forests, grass/grazing lands and

barren/miscellaneous uses was quite low i.e. less than 1 per cent each. It was reported by the majority of the respondents that they usually allocated less area for these purposes as these facilities like grazing, collection of grasses, fuel wood etc. are availed from the nearby forests and common lands. The current fallows accounted for 3.62 and 2.07 per cent respectively, before and after project implementation in the study area. The table further revealed that before and after project implementation, the land utilization pattern was found to be more or less same except the decrease in area under cultivation and current fallow, which had decreased by 5.82 and 42.78 per cent after the implementation of the project as compared to before project implementation. It is interesting to note that after the project implementation period the extent of irrigation has also been decreased by 7.55 per cent, which may be due to poor management of natural water resources available in the study area and after effects of the project.

Cropping pattern

The cropping pattern indicates the percentage distribution of total cropped area among different crops in a particular agricultural year. The analysis of cropping pattern during an agricultural year indicated the relative importance of crops in a particular region. The main aim of the present investigations was to analyse the changes in the cropping pattern in the study area. The cropping pattern of the sampled respondents had been analysed and compared for the two periods i.e. before and after the implementation of the power project and is presented in Table 3. The table revealed that the farming community of the study area was growing cereals, pseudo-cereals, pulses and vegetables depending on the family consumption needs as well as market requirements. It can be seen from the table 3 that among the different crops wheat, maize, potato and *rajmash* were the main crops of the study area accounting for about 18, 16, 17 and 9 per cent of the total cropped area, respectively during 2013-14. It was reported by the majority of the respondents that wheat and maize were grown for meeting the food requirement of the households as well as for meeting the fodder (wheat straw and maize stalk) requirements of livestock. *Rajmash* and potato were traditionally grown cash crops in study area on account of their quality and higher market demand in different parts of the country. *Kodra*, *Ogla*, *Fafra* and *Cholai* (*Amaranthus*) etc. had been traditional location specific pseudo-cereal crops to

Table 2. Total land holding and land use in the study area

		(ha)		
Sr. No.	Particulars	Before Project	After Project	Change %
1	Cultivated land	0.35	0.33	-5.82
		(22.92)	(24.34)	
	Irrigated area	0.08	0.08	0.00
		(77.08)	(75.66)	
	Unirrigated area	0.27	0.25	-7.55
		(27.44)	(25.39)	
	Total land holding	0.35	0.33	-5.82
		(35.6)	(33.55)	
2	Grassland/ grazing land(unirrigated)	0.08	0.11	41.71
		(8.00)	(11.35)	
3	Forest(unirrigated)	0.01	0.01	0.00
		(0.80)	(0.80)	
4	Current fallow(Unirrigated)	0.04	0.02	-42.78
		(3.62)	(2.07)	
5	Barren Land/ Misc. areas(Unirrigated)	0.01	0.01	0.00
		(0.72)	(0.72)	
6	Orchard	0.51	0.51	
		(51.46)	(51.50)	
	Irrigated area	0.09	0.09	0.00
		(17.07)	(17.07)	
	Unirrigated area	0.42	0.42	0.00
		(82.93)	(82.93)	
	Grand Total	1.00	0.99	-0.08
		(100)	(100)	

Note: Figures in parentheses indicate the percentages to total

be used as staple food on account of their medicinal value. The proportion of total cropped area allocated for different crop groups indicated that among the different groups highest area was allocated to cereals (48.63%) followed by vegetables (25.9%), pulses, pseudo-cereal and oils seeds.

The table further indicated that the total cropped area has been decreased only by 3.58 per cent after the implementation of the power project as well as the cropping intensity decreased from 192 to 185 per cent. This indicated that extent of utilization of net cultivated area had decreased over the time which may be due to the declining interest of

respondents toward agriculture. On an average there had been increase in the area under crops cabbage and cauliflower among vegetables, maize among cereals and *mash* and *rajmash* under pulses. The area under wheat, pseudo cereals, potato was decreased after the implementation of the power project. This might be due to the fact that state Department of Agriculture was motivating them to grow vegetables by providing them technical know-how and also they are getting good income and market for these cash crops after the project.

Average area under fruit crops

Topography and agro-climatic conditions of the study area were suitable for the production of fruit crops like

Table 3. Cropping pattern of study area

S.N.	Name of Crops	Before Project		After Project		Per cent change in area during BPP & AP
		Area (ha)	Per cent	Area (ha)	Per cent	
A	Cereals					
	Maize Local	22.2	16.29	22.84	17.39	2.88
	Paddy	2.76	2.03	2.76	2.1	0
	Wheat Local	24.04	17.65	23.36	17.78	-2.83
	Barley	15	11.01	14.92	11.36	-0.53
	Sub-Total	64	46.98	63.88	48.63	-0.19
B.	Pseudo-Cereals					
	Kodra	11.72	8.6	7.8	5.94	-33.45
	Ogla	3.24	2.38	3.32	2.53	2.47
	Fafra	3.28	2.41	3.4	2.59	3.66
	Cholai	1.16	0.85	1.2	0.91	3.45
	Sub-Total	19.4	14.24	15.72	11.97	-23.87
C	Pulses					
	Rajmash	12.08	8.87	12.2	9.29	0.99
	Mash	1.36	1	1.56	1.19	14.71
	Lentil	2.56	1.88	2.36	1.8	-7.81
	Gram	1.24	0.91	1.12	0.85	-9.68
	Sub-Total	17.24	12.66	17.24	13.13	-1.79
D	Oilseeds					
	Soybean	0.48	0.35	0.48	0.37	0
E.	Vegetables					
	Capsicum	0.04	0.03	0.04	0.03	0
	Tomato	0.32	0.23	0.32	0.24	0
	Cabbage	0.96	0.7	2.48	1.89	158.33
	Cauliflower	0.12	0.09	0.16	0.12	33.33
	Peas	10.08	7.4	9.92	7.55	-1.59
	Potato (Rabi)	11.24	8.25	10.16	7.73	-9.61
	Potato (Kharif)	12.36	9.07	10.96	8.34	-11.33
	Sub-Total	35.12	25.77	34.04	25.9	-3.08
	Total Cropped area	136.24	100	131.36	100	-3.58
	Net cultivated area	70.84		70.84		
	Cropping Intensity	192.32		185.43		

Table 4. Area under different horticultural crops in the study area (ha)

Sr. No.	Crops	Before Project	After Project	Per cent change
1	Apple	0.428 (98.85)	0.505 (98.63)	17.99
2	Plum	0.005 (1.15)	0.007 (1.37)	40
	Total	0.433 (100)	0.512 (100)	18.24

Note: Figures in parentheses indicate the percentages to total

apple, plum etc. The fruit production played an important role in the economy of the rural households in terms of income by generating employment. The changes in the area under fruit crops have been analysed and are presented in Table 4. It can be seen from the table that apple and plum are the major fruit crops grown by the farmers in the study area. The total area under these crops was estimated at 0.43 and 0.51 hectare during before and after project periods, respectively registering an increase of about 18 per cent after the project period as compared to the before project period. It was revealed by the majority of respondents that keeping in view, the topography of the state, it is comparatively easy to maintain fruit crops as compared to field crops. Moreover, the marketing of fruits in the study area were well established and easy as majority of the farmers of the district were growing these crops hence, the marketing facilities were standardized. The traders of the distant markets were paying remunerative prices for the produce as per the grades of the produce. The table further indicated that among the major fruits, apple accounted for the major proportion of the total area under the fruits in the study area i.e. around 99 per cent. The increase in the area under plum was found to be higher (40%) as compared to the apple (about 18%). It is interesting to note that the area under the fruit crops was comparatively higher as compared to the area under crops. It may be due to the fact that the demand and price structure for fruits was reported to be better than that of cereals.

Production and productivity

Food is the basic requirement of any community. The farming communities are wise enough to adopt the cropping pattern which is consistent with their basic household consumption needs as well as capable of generating cash income for miscellaneous household chores. As it was also clear from the land use/cropping pattern adopted by the sampled households of the study area that respondents were growing fruits as well as field crops depending upon the agro-climatic conditions and topography of the land. In addition to these land based farm components farmers were also maintaining livestock and multi-purpose tree species to support crops as well other household needs for fodder, fuel wood and timber. In this section production and productivities of main farm component except multi-purpose tree species have been analysed for both periods and discussed as under:

a) Field crops

Productivity

Production and productivity of crops is influenced by the use of critical inputs like seed, fertilizer, plant protection, irrigation, management etc. The productivity of major crops grown by sampled households of the study area is presented in Table 5. The table revealed that among the food crops other than main cereals, pseudo cereals like *Kodra*, *Ogla*, *Fafra* and *Cholai* were also grown as food crops in the study area. Among the major cereals the productivity varied between 8.36 q/ha in case of barley to 14.77 q/ha in maize in the after project period. These productivities for all the cereals except maize were decreased as compared with the before project period i.e. about 15, 18 and 33 per cent in case paddy, wheat and barley, respectively. It was informed by the respondents that the increase in case of the productivity of maize was mainly due to adoption of high yielding varieties. Similarly the productivity of pseudo cereals (underutilized crops of the region) was also found to be declined by 4 to 25 per cent in different crops. It was about 4 per cent in case of *kodra* where the highest decline was found in *cholai* (*Amaranthus*). The decline in the productivity of these crops was due to the general neglect by the farmers as the food habits of the farmers were changing towards maize and paddy which were available in food security schemes. Some of the respondents were also of the view that the precipitation pattern has been changed due to the impact of the project.

Among the pulses *rajmash*, *mash* in *kharif* season and lentil and gram in *rabi* season were grown by the farmers. The productivity of these crops were estimated at 11.75, 7.63, 7.19 and 6.08 q/ha in case of *rajmash*, *mash*, gram and lentil respectively after the project period. A cursory glance of the table revealed a decline in the productivity of these crops except *rajmash* which increased by about 3 per cent as compared to before project period. The farmers were of the opinion that *rajmash* was the cash crop fetching handsome returns and they gave special attention with respect to management practices as compared to other pulses grown in the area.

The table further revealed that as far as vegetable crops were concerned, their productivities in the present scenario were significantly higher as compared to the before project period. The highest increase in the productivity was in

case of tomato (110%) followed by cauliflower, cabbage, potato, pea and capsicum. The increase was due to the use of hybrid varieties and better management practices being suggested by the experts from time to time. Moreover, demand for vegetables had increased tremendously after the project and thus, giving good returns.

From the above discussion, it can be concluded that in general the productivity of the cereals and pulses after the project periods had declined whereas, the productivity of oilseeds and vegetable crops has increased.

Production

The basic objective of agricultural activities was to provide nutritional security to secure nutritious food (crop and animal products) on sustainable basis. Farming families in general and hilly region in particular allocated the total cropped area among different crop enterprises keeping in view,

the requirement of their food basket irrespective of productivity of crops. The production level of different farm enterprises was managed by variations in the allocation of area. It was expected that over the time the composition of the food basket may have been changed due to the implementation of the project. Thus, the availability of produce of different crops, before and after project period has been analysed and is presented in Table 6. It can be observed from the table that on an average the availability of the produce of different crops was 18.68 q which was around 2.88 q higher than that of before project period. On an average, the total production of all crops had increased by 18.23 per cent. The proportion of total produce of cereals, pseudo cereals, pulses and vegetables to the total produce of all the crops was about 25, 5, 6, 0.14 and 64 per cent, respectively before project period. In the present scenario the proportion in case of cereals, pseudo cereals, pulses had been declined whereas; in case of vegetables it was on higher side when compared to before project period.

Table 5. Productivity of different crops in kharif and rabi seasons in the study area (q/ha)

S.N.	Name of Crops	Before Project Productivity	After Project Productivity	Per cent change
A.	Cereals			
	Maize Local	12.7	14.77	16.3
	Paddy	10.22	8.64	-15.46
	Wheat Local	12.15	9.98	-17.86
	Barley	12.39	8.36	-32.53
B.	Pseudo-Cereals			
	Kodra	7.04	6.78	-3.69
	Ogla	10.68	8.12	-23.97
	Fafra	10.46	9.13	-12.72
	Cholai	10.09	7.56	-25.07
C	Pulses			
	Rajmash	11.41	11.75	2.98
	Mash	10.96	7.63	-30.38
	Lentil	8.79	6.08	-30.83
	Gram	9.84	7.19	-26.93
D	Oilseed			
	Soybean	10.83	11.15	2.95
E.	Vegetables			
	Capsicum	46.07	62.31	35.25
	Tomato	55.67	110.36	98.24
	Cabbage	51.27	85.83	67.41
	Cauliflower	54.58	91.33	67.33
	Pea	52.08	72.58	39.36
	Potato	59.89	80.96	35.18

Table 6. Production of different crops in kharif and rabi season in the study area (q/farm)

S.No.	Name of Crops	Before Project	After Project	Per cent change
A	Cereals			
	Maize Local	1.41	1.68	19.44
	Paddy	0.14	0.12	-15.46
	Wheat Local	1.46	1.17	-19.91
	Barley	0.93	0.63	-32.53
	Sub-Total	3.94	3.60	-8.63
		(24.93)	(19.27)	
B.	Pseudo-Cereals			
	Kodra	0.42	0.26	-36.34
	Ogla	0.17	0.14	-19.22
	Fafra	0.17	0.16	-7.26
	Cholai	0.06	0.05	-25.07
	Sub-Total	0.81	0.60	-25.93
		(5.13)	(3.21)	
C	Pulses			
	Rajmash	0.68	0.72	4.70
	Mash	0.08	0.06	-20.44
	Lentil	0.11	0.07	-36.15
	Gram	0.06	0.04	-26.93
	Sub-Total	0.93	0.89	-4.30
		(5.89)	(4.76)	
D	Oilseeds			
	Soybean	0.02	0.02	0.00
		(0.13)	(0.12)	
E.	Vegetables			
	Capsicum	0.01	0.01	0.00
	Tomato	0.11	0.22	98.24
	Cabbage	0.26	1.03	301.80
	Cauliflower	0.05	0.09	67.33
	Pea	2.60	3.63	39.36
	Potato	7.07	8.58	21.43
	Sub-Total	10.10	13.57	34.36
		(63.92)	(72.64)	
	Total	15.80	18.68	
		(100.00)	(100.00)	

Note: Figures in parentheses indicate the percentages to total

On an average almost similar trend was observed in case of production of different crops as well as group of crops. Among the different crops highest decline was found in case of Kodra followed by lentil and barley. The production of vegetables registered a significant rise where the increase was around 301

per cent in case of cabbage and lowest in case of potato i.e. about 21 per cent as compared to before project period.

Fruit crops

As stated above the area is more suitable for the fruits and major portion of total farm income was derived from the

sale of fruit crops in local as well as distant markets of the country. The farmers of the study area were found to grow apple and plum fruit crops. The detail about the production, productivity and produce utilization with respect to these crops have been examined and is given in Table 7. The table revealed that on an average the productivity of both the fruit crops after the implementation of the project had been decreased. It is about 428 and 71 quintal/ha in case of apple and plum, registering a decrease of about 17 and 11 per cent, respectively as compared to the pre-project period. It was revealed by the majority of the respondents that the decrease in the productivity of these fruits was mainly due to the change in climatic conditions caused by changing pattern of precipitation both rains as well as snow fall. Project interventions were also reported to be as one of the factors as soil strata and underground water sources were disturbed by blasting at the time of excavation of tunnel. This had reduced the water holding capacity of the soils and ultimately reduced the productivities. The table further indicated that the average per household total production of fruits was estimated at about 221

and 217 quintal before and after project period, respectively. In the total production of fruits the share of apple was found to be quite high in both the periods i.e. 92-93 per cent. The utilization of fruits indicated that the home consumption was quite low i.e 2.38 and 3.34 quintal/ household before and after the project, respectively. The major portion of the produce was marketable surplus at the sampled households. The gross value estimated on the basis of the marketable surplus of the fruits indicated an increase during the present situation as compared to the pre project period. It was mainly due to the increase in the prices of the fruits over the time both in local as well as distant markets. Assuming prices of fruits constant, the pattern of gross returns will be consistent with the total production trend.

Thus, from the above discussions, it was clear that both production and productivity of apple and plum in the study area had been declined, in spite of large number of state government schemes. In general, climatic conditions and adverse impacts of project interventions were reported to be the major reasons for the decline in the yield levels by the majority of the respondents.

Table 7. Productivity, production and utilization of horticultural crops in the study area

Sr. No.	Particulars	Crops	Before Project (No.)	After Project (No.)	Change %
1	Productivity(q/ha)	i) Apple	514.94	428.25	-16.83
		ii) Plum	79.06	70.60	-10.70
2	Total Production (q/ household)	i) Apple	220.39 (99.82)	216.27 (99.77)	-1.87
		ii) Plum	0.40 (0.18)	0.49 (0.23)	22.5
		Total	220.79 (100.00)	216.76 (100.00)	-1.83
3	Home Consumption (q)	i) Apple	2.33	3.28	40.77
		ii) Plum	0.05	0.06	20.00
4	Marketed surplus (q)	i) Apple	512.61	424.97	-17.10
		ii) Plum	79.01	70.54	-10.72
5	Gross value of marketed surplus (Rs.)	i) Apple	281935.50	509964.00	80.88
		ii) Plum	79010.00	105810.00	33.92

Note: Figures in parentheses indicate the percentages to total

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