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Power Sector Development in Pakistan and Economic Policy Issues

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RETROSPECT OF POWER SECTOR DEVELOPMENT PART-I

Introduction

A study of power sector development in Pakistan is like other essential infrastructure and basic social overhead facilities. The provision of electricity is a pre condition for the advancement of other services to accelerate economic development. Of the total consumption, households is 41 percent, agriculture 15 percent; industry 27 percent; others 12 percent includes railway traction.

Financial Constraint and Capital Intensiveness

Pakistan has made a great stride to build a self-sustained and viable power system. The overall financial constraint in Pakistan and, consequently, inadequate availability of funds for new power generation facilities etc. was the major constraint. About 50 to 60 percent of the total capital outlay is foreign exchange. Viewed in this sub-optimal financial scenario, the development may be applaused but should not cause complacent.

Installed Generation Capacity (Public)

In 1947 the total installed generation capacity, hydro and thermal was 70 MW, 60 MW in now WAPDA system and 10 MW in Karachi. It is 13228 MW in 1998, hydro 4825 MW; thermal 8403 MW which includes conventional steam and combined cycle power plants and nuclear 137 MW owner Pakistan atomic energy commission. Detail is given in Table 1.

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Table 1

Addition in Installed Generation Capacity in Pakistan (Megawatt)

	Public Sector				
	WAPDA		KESC		Total
Year	Hydel	Thermal	Total	Thermal	Pakistan
1959–63	267	130	397	135	532
1964–68	300	361	661	132	793
1969–73	100	96	196	116	312
1974–78	900	438	1338	247	1585
1979–83	980	339	1319	225	1544
1984–88	350	1245	1595	390	1985
1989–93	864	1782	2646	630	3276
1994–98	1064	2350	3414	210	3624
	4825	6741	11566	1872	13438
Average Annual Increase	123.72	172.85	296.57	48.00	
Percentage to Total	41.72	58.28	100.00	100.00	

Source: WAPDA AND KESC Power System Statistics.

Installed Generation Capacity (Private)

By 1997, private entrepreneurs had built 2527 MW. HUBCO 1292 MW; AES Lalpir 362 MW, AES Muzaffargarh 365 MW; Kohinoor 131 MW, SEPCOL 115 MW; Tapal 126 MW; Gul Ahmed 136 MW.

The total installed generation capacity in Pakistan is 15850 MW in 1998. Of which, public sector is 75 percent and private 25 percent.

Economic Beneficiaries

By mid 1998, the beneficiaries were 10.36 mln. Of this 9.53 mln were domestic consumers or 92 percent. Taking the 1998 census figure 130.58 mln and 6.63 persons/household, 48.4 percent of population had electricity. Industrial consumers were 0.216 mln; agriculture tubewells (pumping/irrigation) 0.171 mln; commercial 1.71 mln. On an average 400000 new consumers are added annually in the power system.

Agriculture, Rural Development, and Electric Power Development

The population living in villages and rural areas is 67.5 percent, which is dependent on their livelihood on farming or farm related activities. Agriculture contributes 25 percent to national income and agrobased products 65 percent of total foreign exchange earnings.

The country wide village/rural electrification programme is an integral part of the power sector development; let alone the economics and financial implications for the utilities.

Out of total 125083 villages and abadies (1981 Census villages in NWFP; Punjab; Sindh and Balochistan are 7809; 25399; 5764; 6111 and abadies 13932; 40,000; 13135; 12933 respectively), by June 1998, 65951 were supplied electricity from the national grid. It has opened new vistas of gainful employment opportunities to rural unemployed labour near their homes. The province-wise progress is in Table 2 NWFP 10524 (16 percent); Punjab 34904 (53 percent); Sindh 14131 (21 percent); Balochistan 3005 (5 percent); FATA 3387 (5 percent).

Table 2

Progress of Village Electrification in Pakistan

Year	NWFP	Punjab	Sindh	Balochistan	FATA/ PATA	Total	Cumulative Total
1997–98	253	85	176	85	10	1383	65951
1994–97	3051	10439	4539	710	185	18924	64568
1989–93	2667	10233	3660	611	782	17953	45644
1984–88	1719	5638	2691	1178	1226	12452	27691
1979–83	1044	4111	1377	253	837	7622	15239
1974–78	609	2341	1240	154	347	4691	7617
1969–73	243	248	224	4	0	719	2926
1964–68	152	242	153	10	0	557	2207
1960–63	277	693	71	0	0	1041	1650
Pre-WAPDA	509	100	0	0	0	609	609
	10524	34904	14131	3005	3387	65951	

Source: WAPDA Power System Statistics.

The electrification of villages manifests transformation of the rural economy in checking the influx of rural workforce in search of work to the already populous cities and towns where the essential services supplied by the utilities are already over capacitised.

Power Demand

The power demand in the country grew due to increased activities in all sectors of the economy. Table 3 shows its trend.

Table 3

Growth of Power Demand in Pakistan
(Megawatt)

Year	WAPDA	Increase	KESC	Increase	Total Country	Increase Country
1960	131	–	53	–	–	–
1965	447	316	129	76	576	–
1970	834	387	254	125	1088	512
1975	1396	562	375	121	1771	683
1980	2076	680	520	145	2596	825
1985	3791	1715	797	277	4588	1992
1990	5680	1889	1123	326	6803	2215
1995	8252	2572	1442	319	9694	2891
1998	8825	573	1729	287	10554	860
	–	8694	–	1676	–	10370
Annual Increase (1960-98)	–	222.92	–	42.97	–	265.89

Source: WAPDA AND KESC Power System Statistics.

Energy Sources Employed to Meet Demand

Table 4 gives supply of electricity from hydro and thermal power plants and their respective contribution.

Table 4

Electricity Production by Technology Type in Pakistan
(Mln Kilowatt Hours)

Year	Hydro	(percent)	Thermal	(percent)	Total	(percent)
1959-60	507	46.43	585	53.57	1092	100
1964-65	1362	43.25	1787	56.75	3149	100
1969-70	2915	44.52	3633	55.48	6548	100
1974-75	4359	45.97	5124	54.03	9483	100
1979-80	8718	58.56	6170	41.44	14888	100
1984-85	12245	52.54	10060	47.46	23305	100
1989-90	16925	44.96	20720	55.04	37645	100
1994-95	22858	41.65	32028	58.35	54886	100
1997-98	22060	34.68	41547	65.32	63607	100
AACGR		10.44		11.87	11.29	

Source: WAPDA AND KESC Power System Statistics.

Hydro Power Production and Its Inherent Constraints

During the period 1960–98, in the generation mix, on an average annual, hydro contributed was 45.84 percent and thermal 54.16 percent. The production of electricity from hydro power stations does not remain constant which varies with the river flows due to changes in the hydrological conditions and irrigation needs. It is pertinent to state that the primary function of multipurpose dams is to provide water for irrigation and electricity production is a secondary benefit. On the other, thermal power plants can supply a sustained output throughout 365 days with in-built facility to produce power as and when demanded. The role of thermal power plants is deemed crucial but equally essential in the generation mix.

Trend of Power Consumption

The pattern of consumption underwent a gradual transformation during the period 1960–98 (Table 5). The major beneficiaries of power sector development in Pakistan were the general populace, i.e., the households. Its share went from 12.81 percent in 1960 to 42.08 percent in 1998.

Table 5

Electricity Used By Consumers Category
(Mln Kilowatt Hours)

Year/Percent	Domestic	Commercial	Industry	Agriculture	Others	Total
1959-60	120	66	531	76	77	860
(%)	12.81	7.67	61.74	8.83	8.95	100
1964-65	258	179	1409	277	278	2401
(%)	10.75	7.45	58.67	11.55	11.58	100
1969-70	546	337	2299	965	590	4737
(%)	11.53	7.11	48.54	20.37	12.45	100
1974-75	917	468	3056	1539	851	6831
(%)	13.42	6.85	44.74	22.53	12.46	100
1979-80	2012	595	4056	2067	1069	9799
(%)	20.53	6.07	41.39	21.09	10.91	100
1984-85	5091	1375	6317	2795	2030	17608
(%)	28.92	7.81	35.88	15.87	11.53	100
1989-90	9402	1964	10333	5027	2469	29195
(%)	32.20	6.73	35.39	17.22	8.46	100
1994-95	15583	1941	12528	6252	5360	41664
(%)	37.40	4.66	30.08	15.00	12.60	100
1997-98	18724	2333	12297	7004	4143	44501
(%)	40.08	5.24	27.63	15.14	9.31	100

Source: WAPDA & KESC Power System Statistics.

Industry/Manufacturing

The share of industry in 1998 ranged 30 percent against 62 percent in 1960. This should not create illusion that industrial development did not take place during this period. Medium, small and cottage (households) industries were established in the sixties and seventies. As the power facilities grew, end-use also increased from 531 mln kWh in 1960 to 12296 mln kWh in mid 1998 at an average annual growth rate 8.62 percent against 03 percent population and 5.63 percent GDP.

Agriculture

Its comparatively low share of 15 percent indicates that ground water resources are efficiently and effectively employed for optimising agricultural production for sustained supply of raw materials for the predominantly agro-based added value industries. Besides, Pakistani farmers are becoming more aware of the economics and financial gains from improved on-farm irrigation management practices.

Per Capita Consumption

The power sector development can also be gauged by per capita generation and consumption. The per capita consumption was 339 kWh in 1998 rising from 51 kWh in the sixties (Table 6), which may be taken as a good proxy of economic progress and individual's welfare.

Table 6

Trend of Per Capita Generation and Consumption

Year	Per Consumer Generation	(kWh) Sales	Per Capita Generation	(kWh) Consumption
1959-60	–	–	26	21
1964-65	–	–	66	51
1969-70	4691	3393	122	90
1974-75	4685	3375	133	78
1979-80	4611	3035	180	106
1984-85	4464	3373	245	155
1989-90	4795	3719	341	234
1994-95	5299	4022	429	293
1997-98	5448	3923	471	339

Source: WAPDA and KESC POWER System Statistics.

ECONOMICS POLICY ISSUES
PART - II

The ad-hoc increases in electricity price was not able to achieve a sustained bettering of the financial position of WAPDA and KESC. The former's performance on self-financing, for some years, is worth mentioning. Inflation, the utilities internal inefficiencies and non-responsive culture, capacity payments to IPPs, aggravated further by currency depreciation has continued to weaken financial profile. The getting of a reasonable rate of return concerns more to disguised subsides granted by the government to the users. The added value per kWh in agriculture and industry is substantial, which consume 50–55 percent of the total end-use. Collection of revenue from indirect taxation on products, commodities and services in which electricity is used as an input, the subsidy given in electricity prices may offset the deficit of the utilities indirectly. There is no study which has proved or otherwise the underlying hypothesis.

Value-added and Electricity Pricing

Employing the FBS census of manufacturing data, added value of electricity/kWh is Rs 8-9. This should hold viewed from the macro impact in the economy. As regards grant of subsidy, it is not a long term economic measure to advance growth vis-à-vis efficiency, production potential and unfair allocation of scarce resources resulting into a vicious circle of social inequity and disturbing net economic welfare, the presently known economic index of development strategy.

It is suggested that tariff increase may be once for 02-03 years. A comprehensive study is required to evaluate the effects and implications on cost of production, and its incidence on consumers. Alternatively, a tariff increase on annual basis equivalent to inflation (CPI) as declared by the government plus a mark up.

Perspective on Hydro Development

The economically exploitable hydroelectric potential in Pakistan is about 20000 MW. As of 1998, 4825 MW or 24 percent stands developed at Warsak 240 MW; Tarbela 3478; Mangla 1000 MW; small hydels on canals 107 MW. The under construction project are Ghazi Barotha 1450 MW (6586 mln kWh) and Chashma low head 184 MW (1081 mln kWh). This 1634 MW (7667 mln kWh) capacity will be available by the year 2002, which will save the national exchequer US$ 229.18 mln annually, and US$ 7875.30 mln which would otherwise have been spent on import of residual furnace oil to produce equivalent thermal electricity (current exchange rate US$ 1 = Rs 46.00) for 30 years useful economic life of project. It will be pertinent to state that planning of hydro electric stations require very detail techno-geological, hydrological, economic and financial feasibility studies involving a long time and also

money coupled with expertise, not wholly, available within the country. To illustrate, the pre-feasibility study of Tarbela was started in 1954 and the first stage 700 MW was completed in 1977 or 23 years, and another 16 years to complete the last units 11–14 by end 1993.

The Hydro in Waiting

The highly politicised hydro power project Kalabagh's feasibility study was completed in 1972, and reviewed by independent consultants in February 1975 declaring the project techo-economic viable and the detail engineering study in June 1998. But the project execution continues to be at the altar. The benefit to Pakistan's economy from this multipurpose project is saving of foreign exchange for import of oil (residual furnace oil as fuel in thermal power station) taking 30 years, 40 years and 50 years project life, will be US$ 10.24 billion; US$ 13.65 billion and US$ 17.06 billion respectively.

Private Investment in Hydro Development

With the induction of private sector, by the government's policy May 1995, hydro power development is expected to pace-up. The progress on the Neelum-Jhelum hydro power project in Azad Kashmir 960 MW and 75 MW on Swat river in NWFP are mentioned. NWFP has taken a lead in establishing a dedicated hydro development organisation SHYDO for undertaking the necessary investigation and project preparation work. Punjab should follow NWFP in letter and spirit.

Energy Policy/Option of Fuels Natural Gas

Natural gas is an efficient fuel for power generation. The government's policy in its use in power plants was debilitating and un-sustained during the past era. Sui in Balochistan province is the oldest gas field discovered in 1952 followed by gas fields in Sindh and Punjab. Upto June 1997, 10.95 trillion cubic ft. gas was estimated production or 17.92 trillion cubic ft. stood recoverable.

In the earlier years, the large scale use of natural gas in power plants was due to indigenous energy source, and more important its lower price against crude oil coupled with optimistic reserve assessment. With time the realisation came that natural gas price was not economic price and was higher than oil which increased from US$ 1.80 per barrel in pre-October 1973 to US$ 34 per barrel in October 1981; declining to US$ 29 per barrel in March 1983; in January 1987 US$ 16 per barrel; and in 1998 oscillating US$ 13–15 per barrel.

Natural gas has a very high efficiency about 80 percent in production of petro-chemical products and fertiliser. The direct added value attributable to natural gas was higher than electricity production.

These economic and other compulsions perpetuated a gradual rationalisation of natural gas prices since 1973. These were increased in 1976 and, subsequently, the government also banned its use in power plants and cement industry, which will use furnace oil instead.

Natural Gas Price

With this major energy policy, the process of adjustment of natural gas prices to international oil prices was started as given:

Year	Rs/1000 Cft	Year	Rs/1000 Cft
1975-76	7.10	1990-91	54.57
1981-82	12.00	19-08-93	62.75
1982-83	19.63	05-12-94	67.77
1984-85	23.94	14-06-95	84.05
1985-86	38.54	01-01-97	102.46
1986-87	47.45	AACGR (%)	14.28

Source: WAPDA Power System Statistics.

The use of indigenous natural gas has contributed very significant to energy mix, both in the pre and post-shock periods of international oil crisis in supporting natural fossil fuel requirements and alleviating BOP burden. The role of natural gas and hydro energy resources in Pakistan was of a critical value in the achievement of policy goal of self-reliance.

The use of natural gas of low calorific value in power generation was permitted by the government in 1988-89. This decision was an adjustment in the total energy resources scenario, the stepped-up programme of exploration and development of new natural gas fields, and the optimal utilisation of the existing reserves.

The policy modification can be interpreted in view of the added value benefit of electricity in the manufacturing and agriculture sectors where greater exports earn additional foreign exchange and increased food and cash crops alleviate imports vis-à-vis foreign exchange saving.

The Uch combined cycle power plant MW 586 will use dedicated Mari gas, and Fauji Kabirwala combined cycle plant 157 MW Nandpur/Panjpir gas.

Coal

Coal is another comparatively economic priced energy source for power production. Pakistan's 16 coal mines are estimated 2928 mln metric tonnes of inferred, indicated, hypothetical reserves. The average heating value is 9082 Btu/lb. Balochistan five zones coal average heating value is 10151 Btu/lb; Punjab two zones 9852 Btu/lb;

Sindh eight zones 7918 Btu/lb; NWFP Hangu 11500 Btu/lb.

The coal found at Lakhra in Sindh province is highly volatile and susceptible to combustion. Its quick oxidation to exposure creates problems of storage when stacked in 4-5 feet for a long time and transportation too. About 80 percent of supply is used in brick kiln industry and miscellaneous uses.

Coal was first used in power generation in 1964 in 15 MW plant (2x7.5MW) at Quetta in Balochistan.

Nuclear Power, Its Peaceful Use for Economic Development

The non-conventional installation is the PAEC 137 MW nuclear power plant at Karachi built in November 1977 with Canadian technical cooperation for imparting research, development and training facilities of nuclear power technology. PAEC had developed a comprehensive programme indicating the probable timing and size of nuclear power plants. But the realisation did not come due to international non-proliferation dogma.

It is worth to state that the first big nuclear power plant 600 MW was planned to be completed/in commercial operation at Kundian near Chashma in January 1981, and later its size was increased to 900 MW to be constructed in post 1990. This did not mature, but 325 MW capacity under construction with Chinese technology and financial assistance will be completed by the year 2000. The economics of nuclear power generation is sustained operation and availability 70–80 percent; not available from conventional power plants and combined cycle technology.

The Thermal Policy—A Critique

The Pakistan's March 1994 thermal power policy was the culmination of the policy reform initiation which started in November 1985 to induct private sector in power generation to augment financial resources and organisational capabilities to solve the chronic problem of power load shedding. To furbish the financial constraint, the World Bank created private sector energy development fund (PSEDF) managed by National Development Finance Corporation on behalf of government of Pakistan. The general terms of purchase from private parties were: (a) Calculate the bulk purchase price (BPP) of electricity from a power station, at a specified location basis, to be if the investment was made by WAPDA and KESC with suitable return on equity to the investor. (b) Suitable escalation for the key inputs i.e. fuel, labour and spare parts etc. (c) The project will involve limited recourse financing and funds raised without any direct sovereign guarantee of repayment and custom duty etc. (d) exemption from corporate tax as to the industries in general.

The government of the time endeavoured to make the policy transparent by giving BPP at Bus Bar; US 6.5 cents (in Pak Rupee for first 10 years with indexation) on first come first basis, choice of site, fuel/energy source and technology was kept free

(including hydro); for hydro projects exceeding 20 MW, the tariff will be decided on project to project basis on a 25 percent return on equity; IPPs are free to opt either take PSO oil or self import; free repatriating equity alongwith dividend; no bar on local investor.

The critique revealed that this free for all policy was technical, economic and financial mis-led without evaluation of the inherent inconsistencies and consequential effects of such mushroom development of capacity and financial debacle. In the author's opinion, the first intellectual blunder was the size of power plant which was left to the investor. Besides, why an investor will take all the strenuous labour to mobilise large capital when he obtains the same economic and financial gains, profits, benefits, with lesser investment, and lesser risks.

The second was the government's avowed deregulation/*laissez faire* policy; equitable and judicious, otherwise, that an individual, and by pooling resources can install both captive and co-power generation facilities. Some individual manufacturing firms were forced to install their own power plants to rid off load shedding, uncommercial and un-ethic practices in the utilities. The government's *laissez faire* policy came to the individual big consumers as a golden egg which freed them from the many encumbrances to optimise their production capacities with minimal losses. It may be mentioned that it were the export-based industry, predominantly, earning as much as 65 percent of total export earnings which were effected by power load shedding.

The option of import of fuel by the private investor was not permitted. The investor would have procured fuel at competitive price but as PSO remains the monopoly entity for import of all kinds of oil and oil products, the facility did not see the light of day. Besides the ensured revenue from taxes on oil products to the state exchequer. The BPP would be substantially less as fuel cost alone accounts for 70–75 percent of the total unit generation cost.

The mushroom growth of private power plants in Pakistan could have been averted by the government by permitting and granting fiscal and tax incentives to the individual industry to install generators in order to over come power load shedding. The government policy planners should have thought as the least cost alternative of supplying electricity. In 1998, about 700 MW capacity is owned by private individuals who are meeting their power requirements from within.

Managing Power Demand at Least Cost

The under construction power plants under the March 1994 thermal policy are 974 MW capacity to be available in 1999. The total available installed generators including private (IPPs) will be 19912 MW in the year 2003. The bulk generators (IPPs) and the individual owned facilities have created problems of surplus power. This state will remain as long as a comprehensive programme of industrial development does not materialise in entirety.

The data of power demand given in Part-I of the paper is the peak demand which is the highest instantaneous power requirement in a given time period. For equivalent electricity consumption, power demand may be radically different. For instance a 100 watt bulb used for 10 hours consumes the same amount of electricity as such ten bulbs used for one hour (1kWh). However the demand for power in the former case is 100 watt (0.1 kilowatt) over 10 hours, while in the latter case it would be 10 times i.e. 1 kilowatt over one hour. Similarly peak/maximum demand for a year is the highest demand registered at any time in the year.

In Pakistan the deficit in power was really shortage of peaking capacity or the inability to meet peak demand. This implied power cuts in certain periods when the peak demand is high and consequently shortfalls, while at other periods surplus in power. In such a case, if the installed capacity is higher, the peak availability in the system is also higher.

The planning for power in Pakistan has concentrated almost entirely on increasing installed generation capacity making supply side oriented. This becomes an economic issue as building of power generation and associated transmission and distribution facilities is highly capital intensive. It might be possible to look at demand and see whether it could be possible to lower the peak demand through better demand management by installing Time of Day (TOD) meters.

In WAPDA system 279 meters were installed, but all are not in operation due to the utility's inhibition. The users of bulk electricity are required to be comprehensively educated of the economic benefits of TOD meters. The author is confident that all of them will opt. The other measure that could be taken was to improve the peak availability in the system making it easier to meet peak demand.

The Likely 2010 Scenario of Per Capita Consumption

The comparison of per capita consumption with the developed economies should be avoided as their per capita income is higher. The higher is the income, the higher is consumption of goods and services. Pakistan's per capita consumption should be seen with reference to countries with equally developed/developing stage of economic growth per capita income range US$ 500. In the coming decade, the author's estimate is 375 kWh in FY 2003; 414 kWh in FY 2008 and 430 kWh in FY 2010. The rounding/allowance in estimation will give 380 kWh; 420; and 440 kWh for the respective years (a high scenario case 399 kWh; 440; and 460 kWh).

Capital Investment Requirement

The requirement of investment in generation; transmission, sub transmission and distribution of power to end users for the period 1998-99 to 2009-10 is estimated US$ 7 to 8 billion or US$ 0.7/0.8 billion annually at exchange rate 1 US$=Rs 46.00.

Note: Base 130.58 population in 1998 is blown at 2.61 percent P.A to 2002-03 and onward at 2 percent P.A to 2009-10. Sales projection at 4 percent P.A for the total period.

RECOMMENDATIONS
PART - III

(1) Ban on establishing thermal power plants based on residual furnace oil upto the year 2010. (2) Phased out conversion of RFO based power plants on indigenous natural gas, if available, or imported from Central Asian States/Gulf region. (3) IPPs be permitted to import fuel oil as per the thermal policy. (4) Establishment of industrial zones near coal fields to facilitate its use; fiscal and tax incentives to investors who establish manufacturing concerns in these special coal demarcated zones. (5) Power demand management measures through efficient domestic lighting and gadgets etc. Florescent tube-lights only be installed. Standardise and stringent measures for quality control of production of chokes etc, a basic device. (6) Energy conservation chapter in educational curricula at all levels. (7) Government procurement standards for all equipment and construction be revised to include energy efficiency. (8) Establish energy development fund dedicated to energy conservation. (9) Continuation of the peaceful uses of nuclear energy, to meet the energy requirements in 21st century. (10) Adjustment of inter fuel energy prices to obviate misallocation of resources for optimal gains from capital investment. (11) Intensive and extensive use of electronic media to impart public awareness of economic and judicious use of electricity in homes. Standardisation of electric cables and wires and switches used in domestic sector. Presently there is a mushroom growth of household/cottage industry manufacturing these products—people buy cheap products being ignorant that there will be recurrent replacement, and huge financial loss to the utilities (from damage to equipment all of which is imported at exorbitant foreign exchange cost). (12) Initiate study to finance rural electrification through Agricultural Development Bank (as it is an integral economic development programme related to the agro sector). (13) Use of zakat funds, if permitted by *Shariah*, for rural electrification. (14) Employment of professional ethics in making demand projections and policy advice. (15) Employment of trained economists in all public uplift development organisations, and their thick and thin involvement in team work action-oriented works of project planning, preparation, appraisal and evaluation, and policy formulation.

REFERENCE

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