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SCENARIO OF SMALL SCALE HYDRO POWER PLANTS IN INDIA

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ABSTRACT: Development of any nation one or other way depends on power generation. It is the tool to forge the economic growth of a country. The main objective of research is to find out the status of small hydro power in India. Importance of the small hydro power has also been focused. There are many renewable sources of energy like wind, solar, geothermal and hydro power. Development of trend to focus on small scale power projects are indicated on the bases of national and international literatures reviewed related to small scale hydro power projects. Large hydro power projects are help full in generating power but at the same time they are associated with many problems like local community opposition, multiple social and environmental effects lose of land etc. State vice power generation from small hydro power projects has been given, and that is compared with large hydro power projects. Finally it has been concluded that in India more power has been generated by constructing large hydro power projects and very less amount of hydro power has been generated by constructing small hydro power projects, that means in India more focus is required to develop small scale hydro power projects.

Key words: Hydro Power, Firm Power, Run off River Power House, Renewable Energy, Turbine

1. INTRODUCTION

In this paper focus is made to understand the importance of small hydro power and the scenario of small hydro power plants in India. Knowing the scenario development in the field of small hydro power can be initiated. Power is a very important infrastructure of the overall development of a nation. It is the tool to forge the economic growth of a country. There has been, therefore, an ever-increasing need for more and more power generation recently in all the countries of the world. In a true global perspective of the power demand, It can be said with certainty that all the countries of the world are now actually experiencing 'energy crisis' and are busy formulating methods and devices to explore the various possibilities of energy generation for the growing demand.

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1.1 Sources of Energy

The sources of energy are (i) Hydro-power, (ii) Thermal power Hydro-power, and (iii) Nuclear power. The other sources of power generation are (i) Solar energy, (ii) Tidal power, (iii) Geo-thermal energy and (iv) Wind power. Figure 1 shows the various sources of energy.

Fig. 1. Sources of Energy
(Ref: www.Stcentech.com)

1.2 Hydro-Power

Hydro power means the power is generated using flow of water. Many countries like Norway Producing power using hydro power.

1.3 Definitions

1.3.1 Load Factor The Ratio of the average load to the maximum load is known is 'load factor'. Thus,

$$\text{Load Factor} = \frac{\text{Average load}}{\text{Maximum load}}$$

1.3.2 Capacity Factor

The 'capacity factor' also known as 'plant use factor' or 'plant factor' is the ratio of the average output of the plant for a given period of time to the plant capacity.

1.3.3 Diversity Factor

The ratio of the sum of Sum of individual maximum demands to Simultaneous maximum demand is known as 'diversity factor. Thus:

$$\text{Diversity Factor} = \frac{\text{Sum of individual maximum demands}}{\text{Simultaneous maximum demand}}$$

1.5 Components of Hydro Power Plants

As shown in Figure 2. Components of dam are Superstructure, Substructure, Penstock, Fore Bay, Headrace, Hydraulic Turbines, Tailrace, Surge Tanks, Transformer and Transmission Lines, Intake, Generators, Power Lines and Turbines.

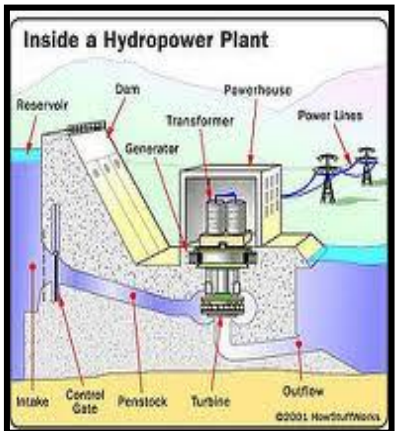

Fig. 2 Components of Hydro Power Plant
(Ref: www.wikieducator.org.com)

II. LITERATURE REVIEW

To get the information about the latest developments going on worldwide and within India, papers of well know international journals, government organizations have been reviewed.

J. K. Kaldellis (**2007**)[4] has focused on contribution of small hydro power stations to the electricity generation in Greece. Hydro Power is considered to be the most widely used renewable energy source in the world, and contributing almost with 18.5% to fulfillment of the planet electricity generation. In future locations for installation of large hydro power stations will be utilized and also there is a local community problem for large power stations. Hence small hydro power stations will remain one of the best options to generate power. In Greece there is less exploitation of hydro –power potential.

Ardizzon et. al (2014)[1] emphasized on repair and maintenance of old small hydro power plants instead of investing huge amount of money in development of new power plants. Importance of hydro power as a renewable and sustainable energy has been discussed.

Adhau et. al (2012)[6] highlighted the importance of micro-hydropower plants as a major renewable energy resource. Micro–hydro power creates less pollution and environmental problems. Where as large hydro power plants are associated with environmental problems.

Singal S. et. al (2010)[7] in this paper two criteria one financial viability considered to the most important as far as the development of the small hydro power project are concerned. An attempt for cost of run-of river small hydro power project, considering head and capacity as cost influencing parameters. Cost of project had been found by finding quantity of work and with market price of each item for all components of the projects

Yulianus et. Al (2014)[8] Micro-hydro power project is environment friendly, easy to operate and low operation cost. In this paper the hydro power potential in Hink River (Indonesia) has been searched, And Small hydro power had been suggested and economical analysis has dared.

Ya.I. Blyashko (2010)[9] In this paper information about small hydro power is given, And features related to construction of modern hydraulic power equipments for small hydro power stations are mentioned, Detail about small hydraulic

power facilities in Russia and abroad has been described. Rivers are having potential to generate energy. Energy crisis were noted in mid.1970s, because of which small hydro power development around the world started.
Paish (2002)[5]emphasized that small hydropower (SHP) is an emerging renewable, inexpensive, harmless to environment energy source. The importance of small hydro power has giving rise to latest trend to generate renewable energy generation.

Schwartz et. al (2005)[3] discussed differences between large-scale hydro and small hydro. Addressed the issue of small hydro as green power and investigated small hydro implementation from the stand point of its development operational, philosophy, construction features, principles, the small hydro resource, and scheduling, equipment maintenance.

Baidya (2006)[7] Discussed the important of renewable energy like small hydro power plants worldwide. He compared install capacity electricity with small hydro electricity. Small hydro power is the oldest source of energy. Working of SHP is with water wheels moving by force of water and generates energy. Definition of small hydro-power-plants followed in different countries including India

III. STUDY AREA

For the analysis of small hydro power projects in India about 13 states having small hydro power plants of India have been considered. They are Andhra Pradesh, Gujarat, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Meghalaya, Orissa. Table 1 shows the details of state wise small hydro power projects considered for analysis.

Table I State wise SHPP numbers

Sr. No.	State	No. of Small Hydro Power Project considered
1	Andhra Pradesh	5
2	Gujarat	2
3	Himachal Pradesh	2
4	Jammu & Kashmir	2
5	Karnataka	19
6	Kerala	20
7	Madhya Pradesh	8
8	Meghalaya	7
9	Orissa	7
10	Punjab	4
11	Rajasthan	1
12	Tamil Nadu	4
13	Uttar Pradesh	25

IV. Methodology

Analysis and discussion has been done followed by data collection and Literature review.

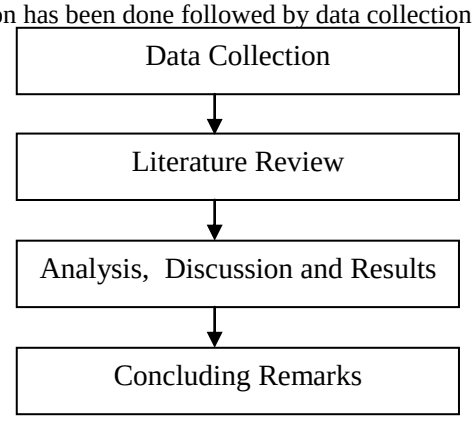

Fig. 3 Methodology Flow Chart

V. ANALYSIS , DISCUSSION AND RESULTS

According to the data available in Major, Medium & Minor River Valley Projects of Gujarat, Water Resources Department Govt. of Gujarat 1989 book. Analysis has been carried out.

Table II Small Hydro Power Projects of India[9]

Sr.	State and Scheme	Power	State Wise Power MW
1	**Andhra Pradesh**		7.26
	Karimanagar Mini Hydropower station II	660KW	
	Karimanagar Mini Hydropower station I	690 KW	
	Karimnagar Mini Hydro Power Stat(on-li'	660 KW	
	Mini Hydel Power Project on Guntur Branch Canal-I (GBC)	3.75MW	
	Yeleru Reservoir Left Main Canal Scheme	1.5 MW	
2	**Gujarat**		
	Vanakbori weir	1MW	8.0
	Left Bank Canal Ukai Mini Hydro Scheme	5 MW	
	Panam Mini Hydro Scheme	2 MW	
3	**Himachal Pradesh**		10.5
	Uttrala Small Hydro Power Station	6 MW	
	Rampur Small Hydro Scheme	4.5 MW	
4	**Jammu & Kashmir**		24
	Gander bal Small Hydro Power Station	15 MW	
	Mohora Small Hydro Power Station	9 MW	
5	**Karnataka**		170.95
	Kalmala Mini Hydro Power Station	400 KW	
	Sir war Mini Hydro Power Station Project	1000 KW	
	Dhupdal Hydel Project	2.8 MW	
	Aanveri Mini Hydel Scheme	1.5 MW	
	Shahpur Mini Hydel Scheme-i	10.8 MW	
	Shahpur Mini Hydel Scheme-2	10.8 MW	
	Shahpur Mini Hydel Scheme-3	10.8 MW	
	Shahpur Mini Hydel Scheme-4	10.8 MW	
	Shahpur Mini Hydel Scheme-5	10.8 MW	
	Shiva Mini Hydel Project	3 MW	
	Malaprabha Mini Hydel Project	2.4 MW	
	Kabini Dam Power House Hydel Project	20 MW	
		9 MW	

5	**Karnataka**		
	Narayanpur Hydel Scheme	9 MW	
	Devaraya Micro Hydel Scheme	0.5 MW	
	Keerthihole Mini Hydel Scheme	27 MW	
	Hemavathy Left Bank Canal Hydel Scheme	16 MW	
	Varahi Tail Race Hydro Electric Project	15 MW	
	Ganek.a Mini Hydra Power Station	350 KW	
	Shivapur Hydro Power Scheme	18 MW	
6	**Kerala**		186.8
	Kallada	15 MW	
	Maniyar Mini Hydel Scheme	12 MW	
	Maniyar Small Hydro Electric Scheme	12 MW	
	Peppara	3 MW	
	Kuttivadi Tail Race	3 MW	
	Lower Meenmutty Small Hydro Electric Scheme	3.75 MW	
	Mad patty	3.5 MW	
	Malampuzha	2 MW	
	Malankara Small Hydro Electric Scheme	2.5 MW	
	Ullunkal Small Hydro Electric Project	10.5 MW	
	Ranni Small Hydro Power Project	7 MW	
	Ranni Small Hydro Power Project	7 MW	
	Boothathankettu Small Hydro Electric Scheme	15 MW	
	Chimoni Small Hydro Electric Scheme	16 MW	
	Kuthungal Hydro Electric Project	2.5 MW	
	Kuthungal Small Hydra Electric Scheme	21 MW	
	Maniyar Tailrace Small Hydra Electric Scheme	21 MW	
	Karikkayam Small Hydra Electric Scheme	5 MW	
	Perumthenaruvi Small Hydra Electric	15 MW	
7	**Madhya Pradesh**		8.305
	Morand Mini Hydra Power Station	1005 KW	
	Rudri Mini Hydro Power Station	200 KW	
	Bhimgarh Small Hydro Power Station	2400 KW	
	Chargaon Jatlapur Mini Hydro Power Station	800 KW	
	Satpura Return Canal Mini Hydro Power Station	1000 KW	
	Tilwara Mini Hydro Power Station	250 KW	
	Chambal Mini Hydra Power Station	1800 KW	
	Korba Mini Hydro Pow6r Station	850 KW	

8	**Meghalaya**		.275
	15 KW Kynthang Portable Micro Hydel Project	15 KW	
	15 KW Latynger Portable Micro Hydel Project	15 KW	
	15 KW Tau Portable Micro Hydel Project	15 KW	
	15 KW Ronga Portable Micro Hydel Project	15 KW	
	15 KW Umlangla Portable Micro Hydel Project	15 KW	
	Galwang Micro Hydel Project	100 KW	
	Rongap	100 KW	
9	**Orissa**		20.02
	Barboria Mini Hydro Power Station	2.5 MW	
	Biribati Mini Hydro Power Station	2.784 MW	
	Kendupatna Mini Hydro Power Station	2.886 MW	
	Andharibhangi Mini Hydro Power Station	1.848 MW	
	Badanala Mini Hydro Power Station	1.976 MW	
	Banpur Mini Hydro Power Station	1.238 MW	
	Harabhangi Mini Hydro Power Station	6.784 MW	
10	**Punjab**		16.7
	Nidampur Mini Hydro Power Station	1000 KW	
	Rohti Mini Hydro Power Station	800 KW	
	Thuhi Mini Hydro Power Station	800 KW	
	Daudhar Mini Hydro Power Station	1500 KW	
11	**Tamil Nadu**		16.7
	Mukkurthy Dam Mini Hydro Electric Project	0.7 MW	
	Pykara Micro Hydel	2 MW	
	Lower Bhawani Micro Hydel	8 MW	
	Vaigai Micro Hydel	6 MW	
12	**Uttar Pradesh**		6.072
	Kempty Fall Small Hydro Power Project	12 KW	
	Khet Small Hydro Power Project	100 KW	
	Ramgad Small Hydro Power Project	100 KW	
	Sahashdhara Small Hydro Power Project	10 KW	

12	**Uttar Pradesh**		6.072
	Bilkot Small Hydro Power Project	50 KW	
	Dior Small Hydro Power Project	50 KW	
	Khokta Small Hydro Power Project	50 KW	
	Naini Small Hydro Power Project	50 KW	
	Shasaria Small Hydro Power Project	50 KW	
	Gogina Small Hydro Power Project	100 KW	
	Jankichatti Small Hydro Power Project	100 KW	
	Badiakot Sma Hydro Power Project	100 KW	
	Bach ham Small Hydro Power Project	100 KW	
	Kedarnath Small Hydro Power Project	100 KW	
	Surag SmaU Hydro Power Project	50 KW	
	lstergad Small Hydro Power Project	100 KW	
	Kagrmi Small Hydro Power Project	50 KW	
	Lathi Small Hydro Power Project	200 KW	
	Bagar Small Hydro Power Project	50 KW	
	Bur sol Small Hydro Power Project	100 KW	
	Lathi Small Hydro Power Project	50 KW	
	Melkhet Small Hydro Power Project	200 KW	
	Toli Small Hydro Power Project	50 KW	
	Jumagad Mini Hydel Project	100 KW	
	Urgam Mini Hydel Project.	100 KW	
		1.2 MW	
		3 MW	
13	**Rajasthan**		.0045
	Anoopgarh Shakha Small Hydro Power Station	4.5 KW	

Total Power in MW= 444.616MW + 18316.5KW = 444.616MW + 18316.5KW
An analysis for state vice small scale hydro power generation has been done

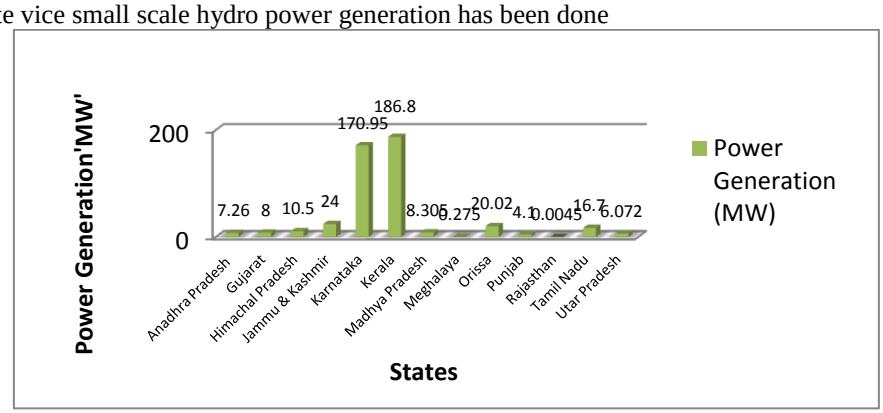

Fig. 4 State wise Small Scale Hydropower Generation

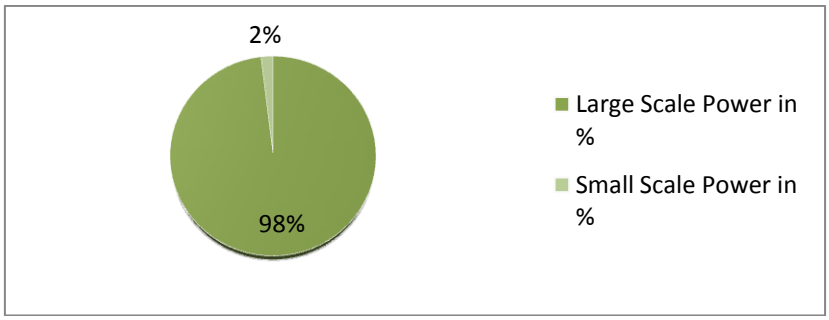

Fig. 5 Comparisons Between Large Scale and Small Scale Hydropower In India

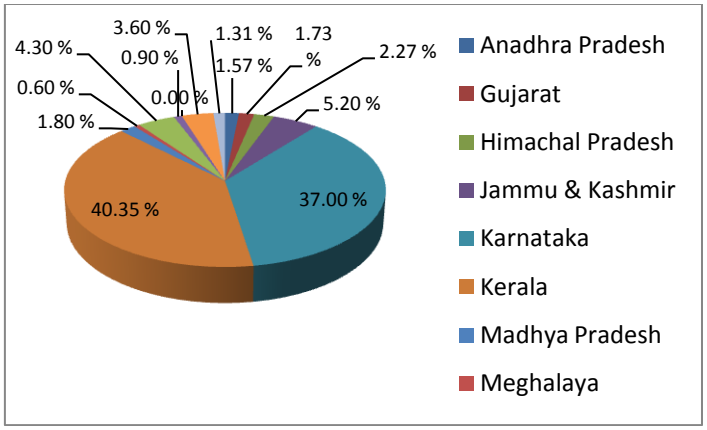

Fig. 6 State wise Small Scale Hydro Power Generation in Percentage

Figure 4 shows that Kerala is the only state in India generating Electricity of about 186.8 MW utilizing small scale hydro power projects, hence it can be said that development of small scale hydro power is more in Kerala. Rajasthan is the state of India where there is very less small scale hydro power development. Figure 4 shows that Rajasthan is generating only 0.0045MW of electricity utilizing small scale hydro power projects. Comparative study between percentage hydro power generation from large scale and small scale hydro power projects have also been done. From the Figure 5 it clear that utilizing small scale projects only about 2% of total hydro power generation of India have been generated and that means there is very less development in India in the field of small scale hydro power project. Figure 6 shows that Kerala is generating 40.35 %, And Rajasthan is generating .001% of total small scale hydro power of India.

VI. CONCLUSIONS

Out of all the states of India, Kerala is the one where small scale hydro power development is more and generating 186.8 MW. That is about 40.35 % of total power generated by small power projects of India. And Rajasthan is the state where there is very less or negligible development in the field of small scale hydro power projects. Rajasthan is generating only 0.0045MW of electricity, which is .001% of total power generated by small scale hydro power projects. As only 2% of total hydro power hydro power generation is from small scale hydro power project, it is clear that more focus is required to develop large numbers of small scale hydro power projects. Only 1.73 % of total power generated by small power projects of India has been generated in Gujarat, it means there is a need to focus on development of small scale hydro power projects in Gujarat also.

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