

# Opportunities and Challenges in Micro/Mini Hydropower Project Implementation in Federal Context.

**Sanjeev Pokhrel**  
**Chief Executive Officer(CEO)**  
**Smart Consult Pvt Ltd.**  
[www.smartconsult.com.np](http://www.smartconsult.com.np)  
Email: [sanjeev@smartconsult.com.np](mailto:sanjeev@smartconsult.com.np)

# Content

---

Present context of  
Hydropower Development

---

The Federal System

---

Licensing arrangement of  
Hydropower

---

Financial Analysis of Mini-  
Micro Hydro Power (present)

---

Financing prospects in the  
federal Structure

---

Challenges and Opportunities

# Energy Consumption Status

- Per Capita Electricity Consumption: 150 kWh.
- Access to Electricity: 75% (60% grid(NEA), 15% renewables(AEPC)).
- Electricity as % of total energy consumed: 4%, mainly from Hydropower.

# Classification of Hydropower

- Pico Hydro: <10 kW
- Micro Hydro: 10-100 kW
- Mini Hydro: 100kW- 1000 kW.
- Small Hydro: 1000- 10000 kW.
- Medium Hydro: 10000-50000 kW.
- Large Hydro > 50000 kW.

# Key Agencies Involved

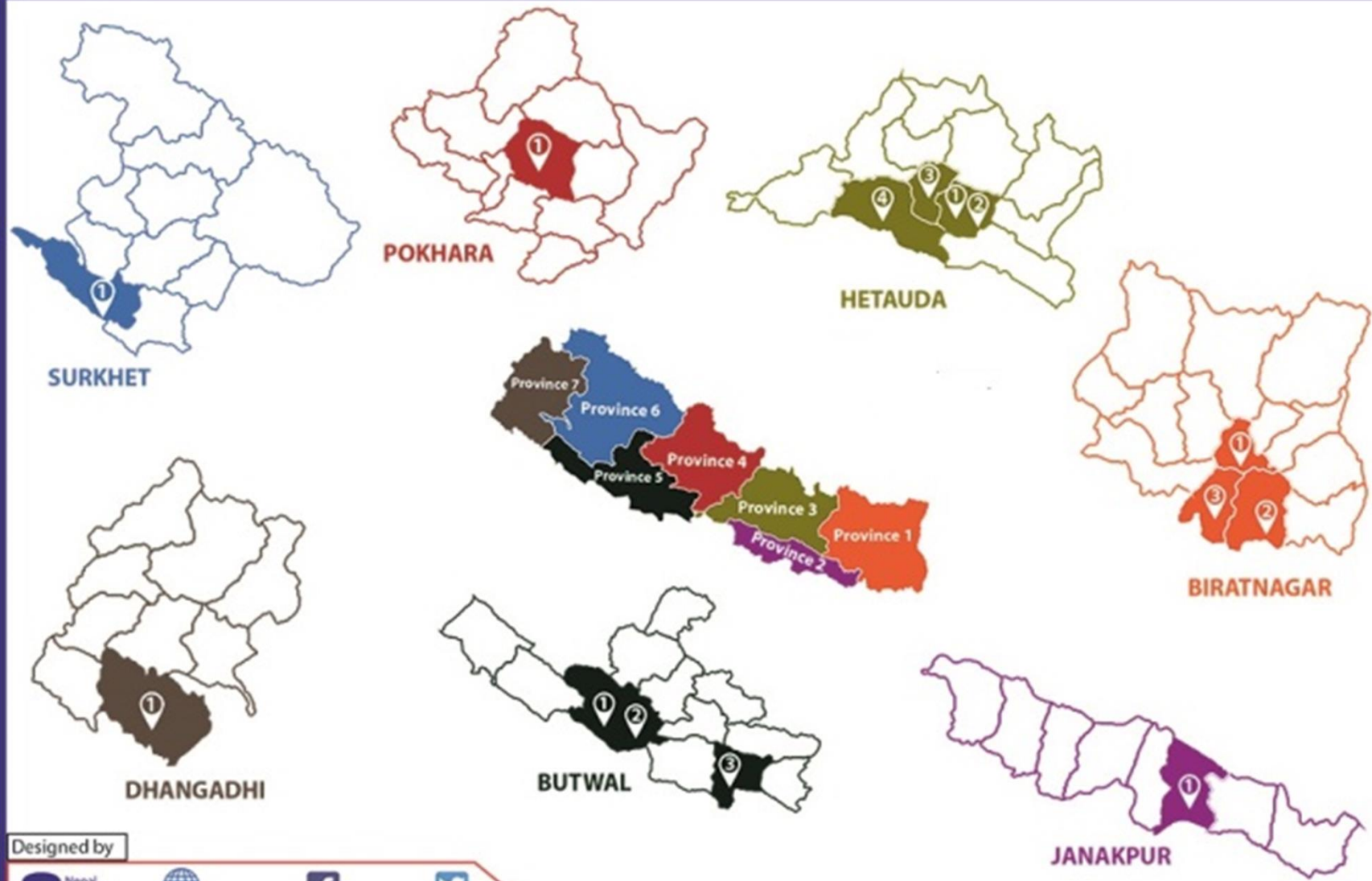
<b>Ministry of Energy, Water Resource and Irrigation.</b>	<b>Policy/Planning and Approvals.</b>
Department of Electricity Development	Government Interface with Private Sector.
Water and Energy Commission	Policy, Monitoring and Coordination.
Nepal Electricity Authority	Utility, Sole Power Purchaser, Grid Owner/Operator.
Tariff Fixation Commission	Fixes the tariff
Ministry of Environment	Environmental approval/clearances.
Investment Board	Promote HP Projects > 500 MW
Alternative Energy Promotion Center (AEPC)	Responsible for Off Grid RE based electrification.
Private-Sector Financers	Banks, Financial Institutions (FIs)
Private Developers	Mainly Generations

# Three tier of Government in Nepal.

- Central or Federal Government based in Kathmandu, the Capital.
- 7 Provincial Government.
- 753 Local Governments which include 6 Metropolitan Cities(Mahanagarपालिका), 11 Sub Metropolitan Cities (Upa-Mahanagarपालिका), 276 Municipalities (Nagarपालिका) and 460 Rural Municipalities (Gaunपालिका).



# Provincial Capital of Nepal



Designed by



# Province wise summary of identified hydropower sites.

S.N	Province	No of local bodies	No of sites identified.	Power (MW)
1	Province 1	56	84	66.11
2	Province 2	-	-	-
3	Province 3	53	81	64.44
4	Province 4	29	54	45.14
5	Province 5	23	38	26.99
6	Province 6	60	102	94.75
7	Province 7	56	97	86.12
		<b>277</b>	<b>456</b>	<b>383.56</b>

Source: SUDIGGAA 2018

# Licensing arrangement of Mini Hydropower

- Survey License
  - Desk Study report showing the project boundary and major project components in topographic map of 1:25000 or 1:50000.
  - Hydrology: Probability of exceedence Q45% (Grid Connected) and Q80% (Off Grid).
  - License Fee Rs 5 Lakhs.
  - Issuing agency Local Body after technical clearance from DoED.
  - Duration of License 2 Years, but in case of extension requirement in the study/investigation, additional one year can be added.

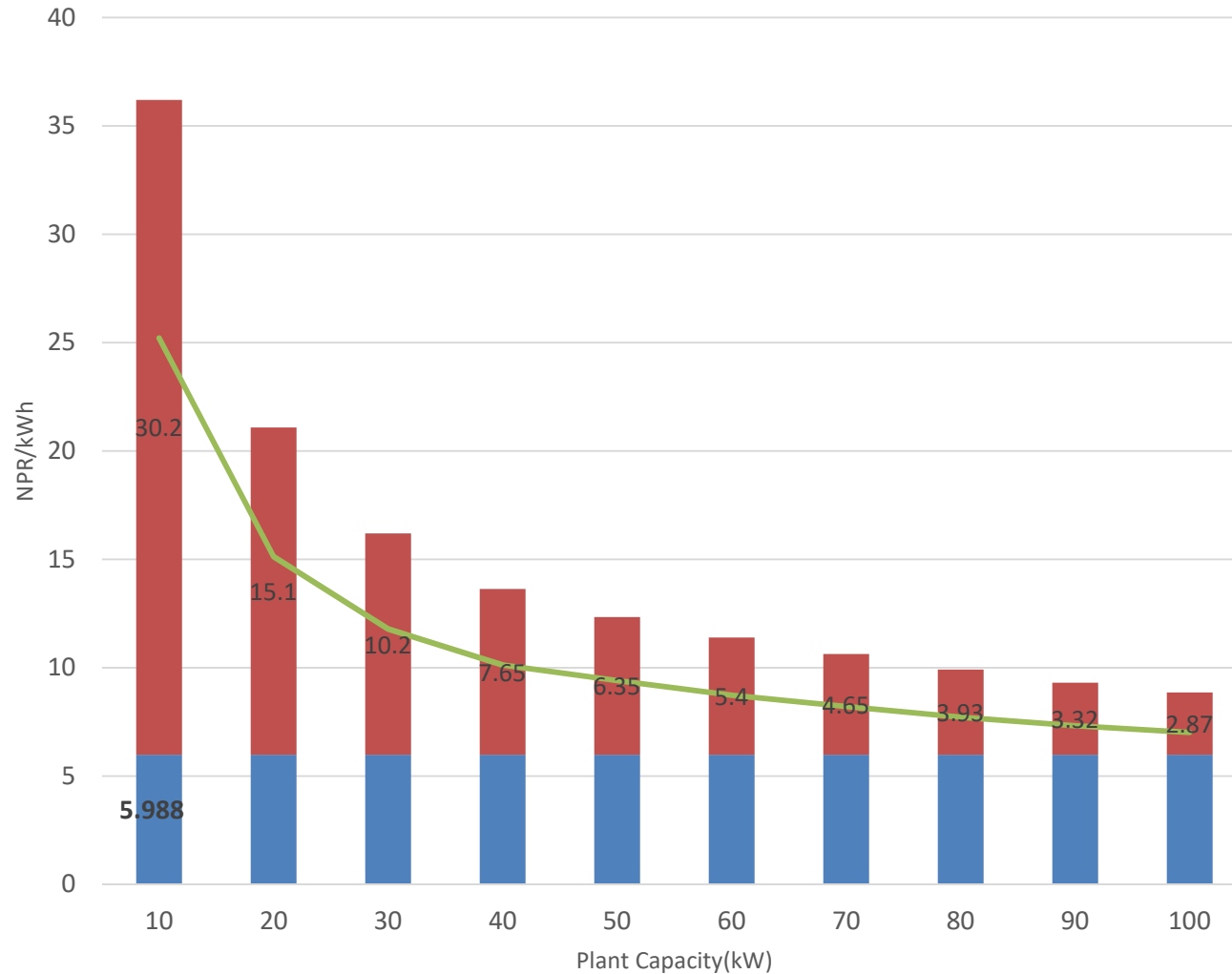
- Generation/Transmission/Distribution License.
  - IEE/EIA as per condition and location of the site.
  - Power Purchase Agreement(PPA) or Connection Agreement.
  - In case of off grid projects-Details of area to be electrified.
  - Topo Sheet showing the major project components and co-ordinates.
  - Financial Closure Arrangement Documents (Equity and Loan proportion)
  - The construction has to be started within 3 years after issuing of Generation License.
  - Duration of license period is 35 years after that it has to be hand over to Government under running condition.
  - Royalty(Capacity and Energy) is decided by the local government.

# Financing of Micro Hydropower.

- Assumptions
  - Financial analysis is performed for Micro hydropower plant( $\leq 100$  kW) to get better understanding of financial indicators and the Viability Gap Funding(VGF).
  - The selling electricity rate NRs 5.988/kWh (NEA PPA Rate with 8 simple escalation of 3% each.)
  - The project being grid connected, ideal case PLF of 80% is taken into account.

Source:

# Micro Hydro Power Sites (<100 kW)



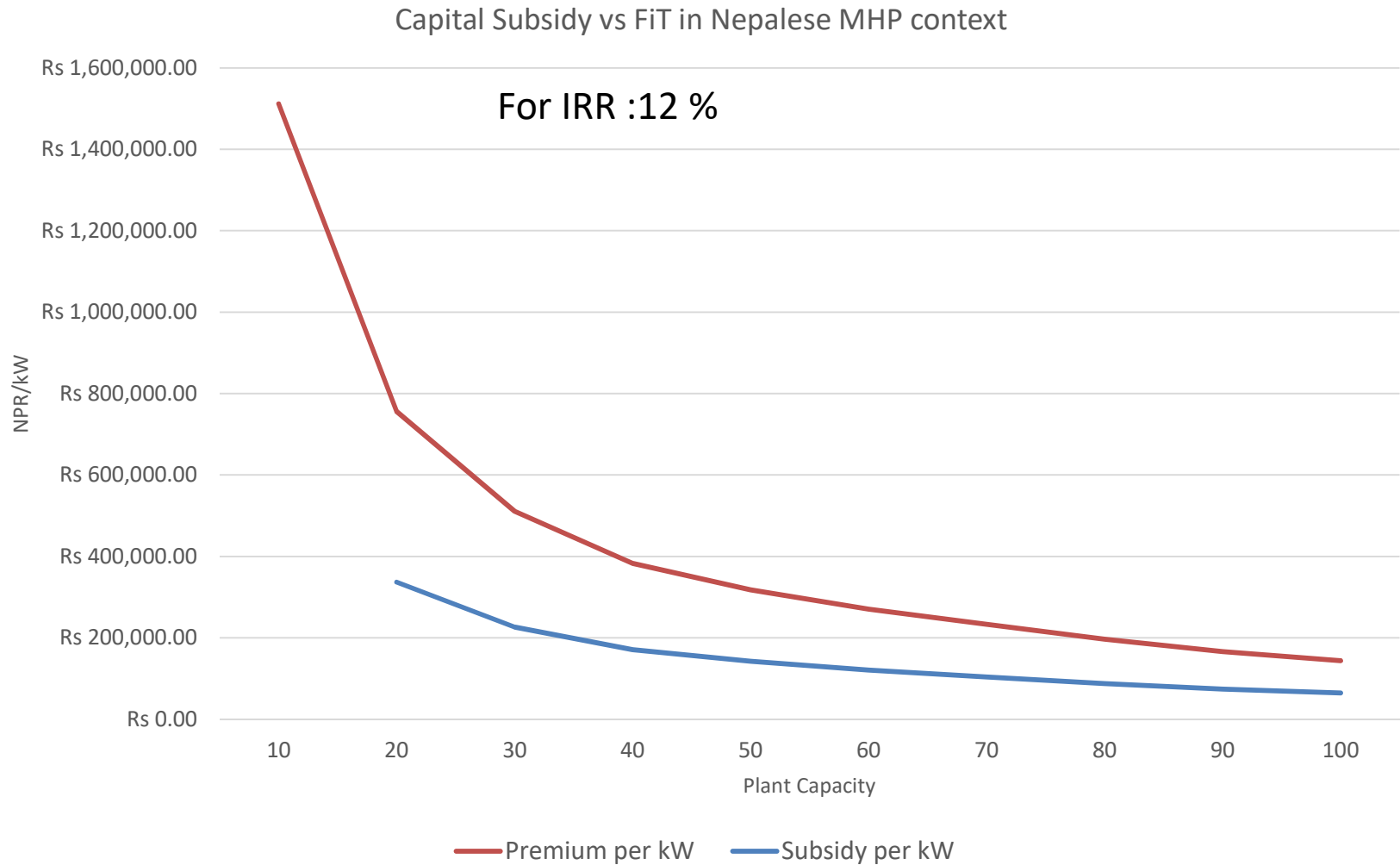
■ NEA Tariff ■ premium required — LCOE

- Grid Connected
- Considering Optimum PLF of 80 %
- Off-grid operation: Not Allowed
- PPA Duration 30 years

# Feed In Tariff

- Policy mechanism designed to accelerate investment in renewable energy technologies.
- Long-term contracts to renewable energy producers, typically based on the cost of generation (LCOE) of each technology

# FiT Vs Capital Subsidy (Nepalese Context)



# Financing of Mini Hydropower.

- Assumptions
  - Financial analysis is performed for 1MW hydropower plant to get better understanding of financial indicators and the Viability Gap Funding(VGF) by federal government.
  - The selling electricity rate NRs 6/kWh (NEA PPA Rate with 8 simple escalation of 3% each.)
  - The project being grid connected, 65% PLF is taken into account.

Source: SUDIGGAA 2018.



**Table : Financial Analysis of Hydropower (1000 kW) at different Costs**

OUTPUT	COST#	Cost I	Cost II	Cost III	Cost IV	Cost V	Cost VI	Cost VII
		Capital Cost* [NPR/ kW] = 162,528	Capital Cost [NPR/ kW] = 200,000	Capital Cost [NPR/ kW] = 235,000	Capital Cost [NPR/ kW] = 300,000	Capital Cost [NPR/ kW] = 400,000	Capital Cost [NPR/ kW] = 500,000	Capital Cost [NPR/ kW] = 579,475
LCOE [NPR/kWh]		3.95	4.86	5.71	7.29	9.72	12.15	14.09
LBOE [NPR/kWh]		7	7	7	7	7	7	7
ROE [%]		30.85%	20.93%	15.07%	8.33%	2.30%	-1.65%	-4.11%
NPV [NPR-Million]		136.78	93.29	52.66	-22.77	-138.84	-254.91	-347.15
Cost Benefit Ratio		3.81	2.55	1.75	0.75	-0.16	-0.70	-1.00
Pay Back Period [Years]		3.75	6.15	9.56	14.70	21.02	>25	>25
VGF required** per kW [NPR/ kW]		None	None	0	79,000	201,000	323,000	420,000
First Year PPA Rate*** required [NPR/ kWh]		4.16	5.12	6.00	7.67	10.22	12.77	14.81

\* O&M Costs changes as well because Yearly O&M Costs is calculated as 3% of Capital Cost

\*\* To achieve at least 15% ROE (criteria for financial viability)

\*\*\* With 8 simple escalations of 3% each to achieve 15% ROE in case of No VGF provided

# The Cost I to Cost VII models are based on increased costs in constructing hydropower plant due to site characteristics and distance from road head.  
The Discount rate used is 10%.

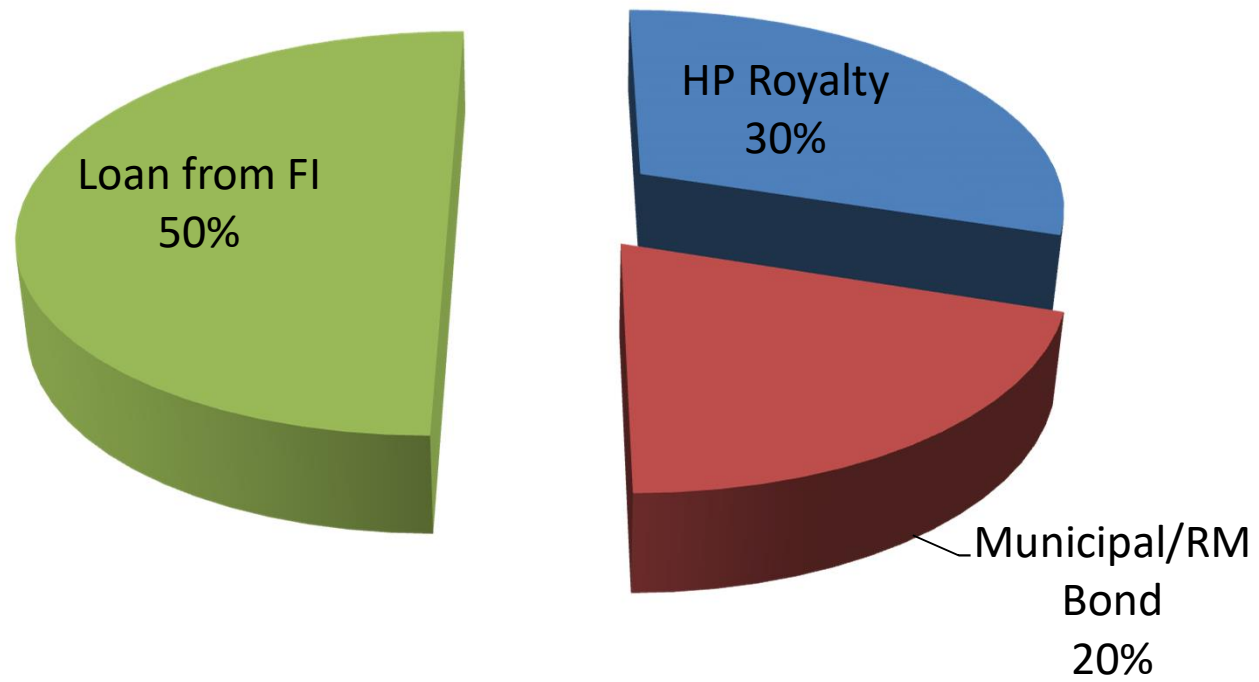
Source: SUDIGGAA 2018

# Royalty Allocation from different Hydropower Plants.

S.N1	Fiscal Year	Amount	Remarks
1	066/67	768,844,215.40	
2	067/68	527,507,500.50	
3	068/69	2,539,490,616.17	
4	069/70	1,254,029,198.81	
5	070/71	1,056,683,826.56	
6	071/72	1,137,961,160.99	The Generation was around 600MW.
	Total	7,284,516,518.43	
7	074/75		The generation is around 1000 MW.

List of Issued Generation License : 4641.57 MW (172 Projects), (Source: Doed, April 2018)

## Proposed Financing Mini Hydropower under Federal Structure Local Bodies



# Background on Bonds.

- Bonds: Long-term debt securities issued by government agencies or corporations.
- Par Value: for a bond, its face value, or the amount returned to the investor at the maturity date when a bond is due.
- Most bonds have maturities between 10-30 years.
- Issuers required to make interest payment and repay par value.

# Type of Bonds

- Municipal Bonds: Long-term debt securities issued by state and local government agencies.
  - Low risk, Interest exempt from federal income tax.
- Federal agency bonds: long-term debt securities issued by federal agencies.
  - Low default risk, Interest is taxable.
- Corporate bonds: long-term debt securities issued by large firms.
  - Subject to default risk .

# Opportunities of Mini Hydropower

- Optimum use of Natural resources at local level.
- Huge amount of opportunity can be created in term of consulting and construction business.
- Mini Hydropower can be a utilized as a sustainable revenue generator at the local level.

# Challenges in Micro/Mini Hydropower Implementations.

- Natural Resource and Revenue Sharing in the Federal System of Nepal must be thoroughly studied to avoid these kinds of situations.
- Lack of Specialized EPC contractor in the sector of Mini Hydropower.
- Poor infrastructure of Local bodies in term of licensing.
- Reluctance of FI to invest on mini hydropower at local level.

Thank You.