Welcome

Further Optimization of Upper Karnali Project : A Key to Energy Crisis and Prosperity

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Why this Presentation

- Cheap , Reliable Energy is the Key input for industrial Development and Prosperity of any Nation
- Do we have Resources?
  - No Oil, No Gas, No Coal
  - 83,000 MW, 44000 Economically Feasible Hydropower
  - With the balance of Storage and RoR Projects ~ 100,000 MW (with PF~ 0.5) can be generated
  - Considering all kinds of benefit (Power, Irrigation, Navigation, Fisheries, Water Supply, Recreation….) about 12 times the Annual Budget (6,000 bln/Year)
  - And Energy can be generated at a much cheaper price if we develop in a planned way

Content of Presentation

Why this Presentation

- Do we have Financial Resources?

  Remittance Alone
  - About 4,000,000 Nepalese work outside
  - About 2,500,0000 alone in Gulf and Malaysia
  - Minimum wage is NRs 25,000/month (saving)
  - In average NRs 40,000/month (saving) can be estimated
  - In Annual term 12 00 bln is received through official and non official (Hundi) channel
  - However most of this resource is not utilized in productive sector

Why this Presentation

- Existing Scenario

Power Energy Scenario

- ~ 700 MW Installation with < 50% capacity in Winter
- Peak load ~ 1100 MW
- Load shedding ~ 18 hrs plus
- 1200 MW addition in 4 years all except KL-3 (14 MW) are RoR
- Only ~ 250-300 MW will be available in Winter
- In 4 years time again a shortfall of ~ 600 MW
- Large Storage Project with capacity ~ 1500-2000 MW should be sougt in 10 yrs time horizon

Why this Presentation

- Existing Scenario/Plan
  - Import from India ?????
  - Upper Karnali 900 MW
    - 12% free Energy, 27% Equity, Royalty etc. Looks wonderful
    - 900 MW in Summer, ~150 MW in Winter out of that 12% (18 MW will be supplied to domestic grid)
  - Similar situation with Arun 3
  - Imbalanced generation makes energy very expensive and state authority Bankrupt
  - Ministry of Water Resources eliminated, institutions weakened or destroyed
  - Who to be blamed???

Why this Presentation

- Existing Scenario/Plan
  - Upper Seti – Tanahun 140 MW
    - Small reservoir, very expensive
  - Budigandaki Storage (600 MW in next 8-10 yrs)
    - Very expensive, social issues severe, severe impact for eg. Flood , Financing ~ 250 bln not easy
  - Nalsaugad (400 MW) in Planning
  - In Ten years horizon again we will have shortage of ~600 MW
  - Remember for a similar dam height the cost of the dam is almost same be it Kulekhani or Karnali

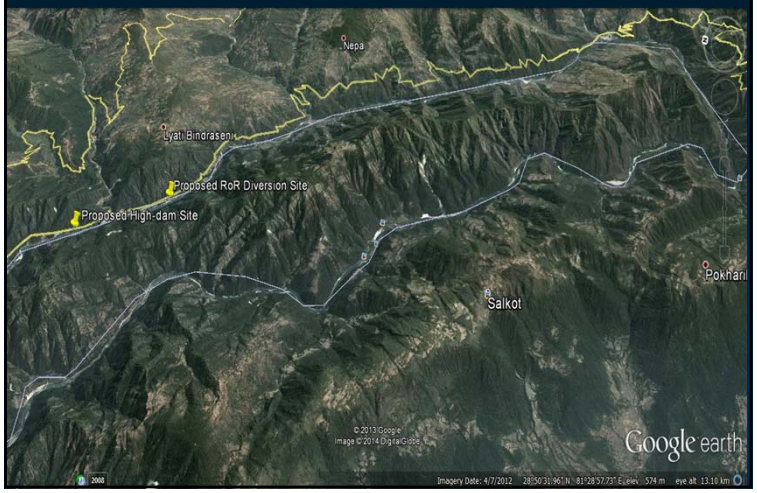
Problem in Understanding??

- Whether we need Power/ Energy?
- Whether we need Water ?
- Whether we need both water and Energy?
- In Major river basins we have surplus water for irrigation and Water Supply
- Only in some Basins such as Babai, Kamala, Bagmati are deficit basins
- Therefore, not a dam with big storage but a small dam/ reservoir with multiple benefit in cascade is the viable and cheaper option for Nepal

Problem in Policy/Regulations

- Licensing Haphazard
- No policy for the pricing of Regulated flow
- Licensing of RoR Projects is a continuous process
- No River Basin Study
- No Master Plan
- Made aware Chief Secretary and DoED – no Response from either institutions

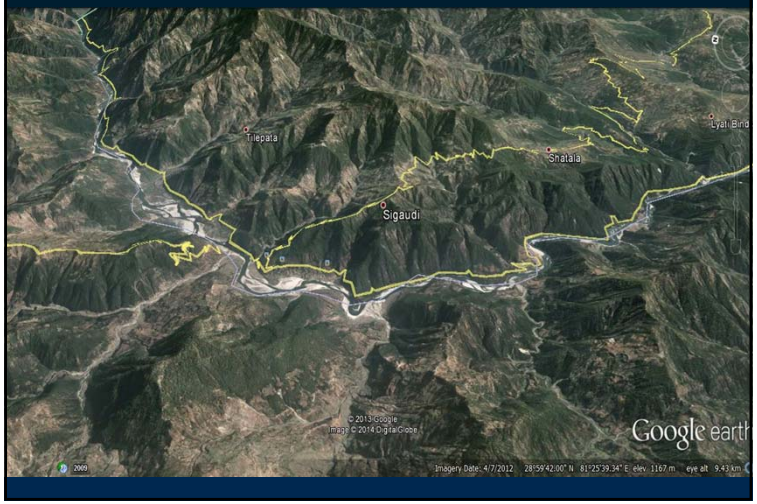
Upper Karnali Project: Dam Site



Why Upper Karnali Project (UKP)

- Because of Magic bend with a head difference as 140 m this project is the cheapest in Nepal and probably in the World
- Often called "Jewel of the Crown " by Engineers and Economist
- Instead of Developing a single PRoR Project as planned (UK 900 MW) dam and reservoir followed by RoR project with several options can be planned.

Upper Karnali Project: Reservoir Area



Methodology

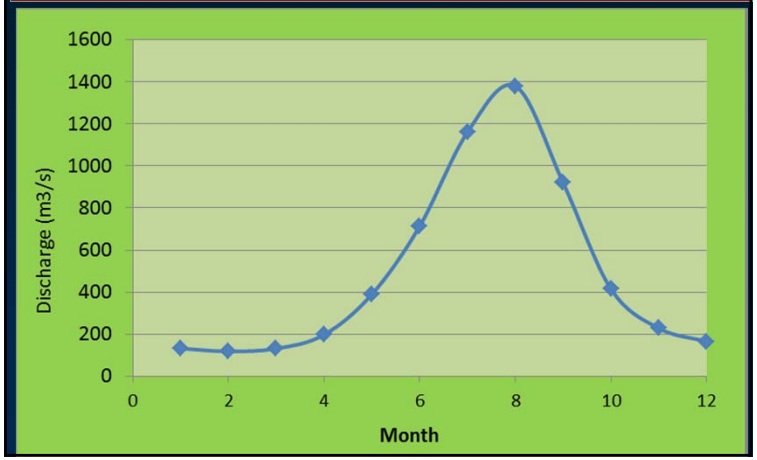
- Hydrology and Energy : Hydrology of Asraghat(DHM:1962-2006)
- Topography and Head : Topographical Map, 1:25,000 (FinMap)
- Geology: FSR by NEA/ CIWEC, 198? and Site Visit and Study
- Quantity Estimation : Sections Drawn from Topo Sheets, Quantity Estimates from "Base Cost for large Hydropower Plants, NVE, Norway, 2010
- Cost : NVE, 2010 and Contractor's rates from ongoing Projects, Nepal
- Benefit : Avg. Price of Energy U$c 6.0/kWh
- Reliability/Accuracy: Revenue ±5% ,Cost (±20%)

Hydrology and Energy Potential

Qd= 680 (m3/s) QEnv = 12.4 (m3/s)

Month	Days	Q (m3/s)	Asraghat (1962-2006)	Env Runoff (mcm)	Effective Runoff (mcm)	Runoff Wet	Runoff Dry	Qexcess	Excess Runoff
Jan	31	137.1	132	32.5	334.7		334.69	0.0	-
Feb	28	121.4	118	29.4	264.3		264.32	0.0	-
Mar	31	133.1	131	32.5	324.0		323.98	0.0	-
Apr	30	206.9	197	31.5	504.8		504.82	0.0	-
May	31	392.2	389	32.5	1018.0		1017.95	0.0	-
Jun	30	733.1	713		1900.2	1900.2		33.0	86
Jul	31	1166.7	1160		3124.9	3124.9		480.0	1,286
Aug	31	1376.8	1380		3687.6	3687.6		700.0	1,875
Sep	30	916.4	920		2375.3	2375.3		240.0	622
Oct	31	418.9	415	32.5	1089.5		1089.47	0.0	-
Nov	30	231.3	228	31.5	568.1		568.06	0.0	-
Dec	31	162.2	165	32.5	401.9		401.92	0.0	0
Annual	365	499.675	495.667		15593.2	11,088	4,505		3,868

Hydrology and Energy Potential



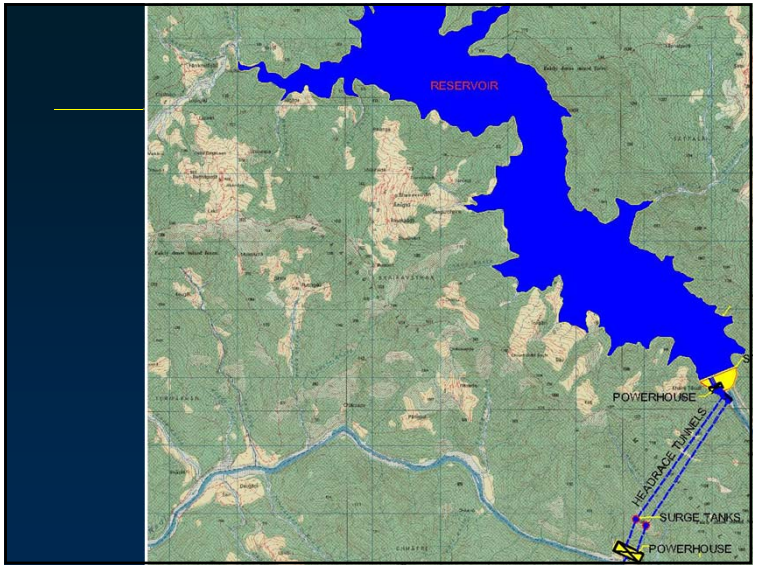
Hydrology and Energy Potential

FSL	820	m
MDDL	730	m
TWL	480	m
QD	619.6	m
Gross Head	340.0	m
Net Head at FSL	333.2	m
Reservoir Variation	90.0	m
Rated Head	304.0	m
Overall efficiency	0.9	m
Installed Capacity	1,822,704	kW
Total Generation at rated head	11,626	GWh

Development Alternatives

Alternative 1 : Projects in Cascade

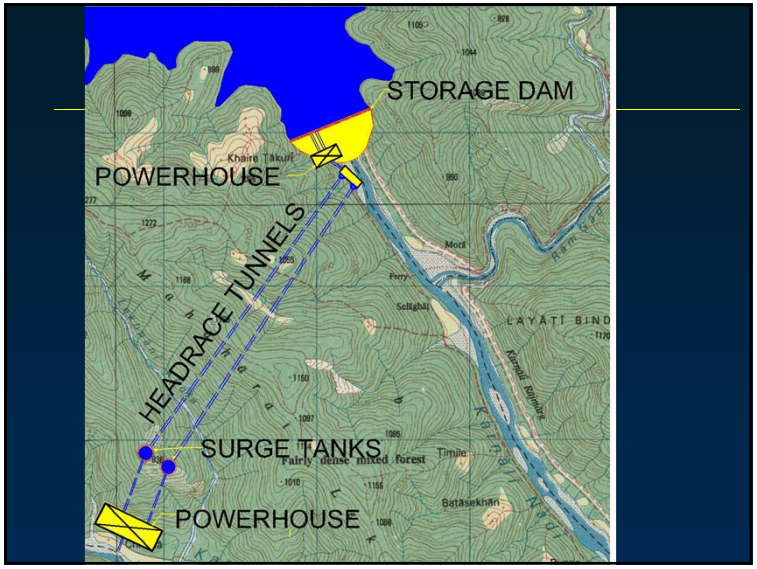
- Project 1 : Reservoir Project
  - 230 m Dam at Tuinkuna (U/S of Ramagad) with FSL at 820 masl
  - Gross Head = 200 m
  - Powerhouse at Dam toe
  - Discharge = 680 m^3/s
  - Power = 1177 MW
  - Energy= 6272 GWh



Development Alternatives

Alternative 1 : Projects in Cascade

- Project 2 : RoR Project in Cascade
  - Tailrace Tapping with FSL at 620 masl
  - TWL = 480 masl
  - Gross Head = 140 m
  - Underground Powerhouse
  - Discharge = 680 m^3/s
  - Power = 825 MW
  - Energy
    - RoR 3931 GWh
    - Reservoir storage 1303 GWh
  - Total 5233 GWh



Development Alternatives

Alternative 2 : Projects not in Cascade

Assumption:Project 2 starts earlier (Now)

- Project 1 : Reservoir Project
  - Same as in Alternative 1
- Project 2 : PRoR Project downstream of Ramagad
  - FSL at 620 masl
  - Diversion Headworks with all components
  - TWL = 480 masl
  - Other Parameters same as Alternative 1
- As the project starts earlier, about NRs 15-18 Bln more compared to Alternative 1

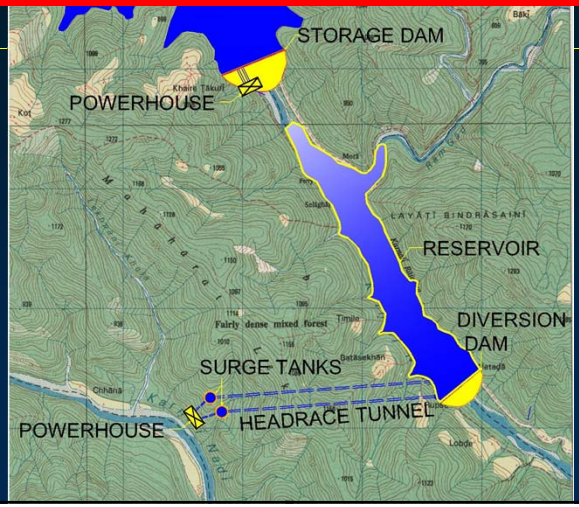
Development Alternatives

Alternative 3 : Single Dam/ reservoir

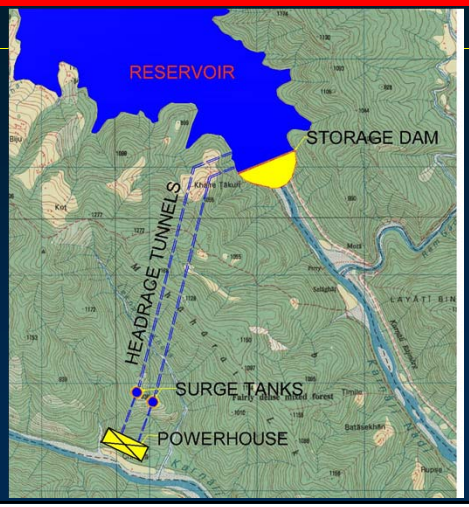
Dam/Reservoir at Dailekh/Achham

- FSL =820 masl
- TWL = 480 masl
- Gross Head = 340 m
- Underground Powerhouse across Valley
- Discharge = 680 m^3/s
- Power = 1823 MW
- Energy
  - Wet 7716 GWh
  - Dry+ storage 3910 GWh
- Total 11626 GWh

Alternative 2



Alternative 3



Site Information- Reservoir Area

Dam Site- Left Bank

Site Information- Dam Site

Site Information- Test Adits

Comparison of Alternatives

Parameters	Alternative 1		Alternative 2		Alternative 3
	Storage	RoR	Storage	PRoR	Single Project
Total Power (MW)	1177	824	1177	824	1823
Total Energy (GWh)	6272	5233	6272	5233	11626
Total Cost (U$, Mln)	1719	373	1719	537	2064
Total Revenue (U$, Mln)	690		691		697.5
Cost/kw (U$)	1045		1128		1132
Cost/kwh (U$c)	2.0		2.2		1.95
Cost/kwh (NRs)	2.0		2.2		1.95

Note : Interest Rate: 10%
Prel calculation Without IDC

Benefit to downstream Project

- Benefit in Capital investment
  - No dam, no settling basins, which is major cost item of Civil works. NRs 15 -18 Bln saving
- Benefit related to Operation and Maintenance (Annual Flood and Sediment benefit)
  - No or negligible outage of plant
  - no or negligible damage in hydro-mechanical equipment such as turbines and accessories, 3-4 % of revenue in most of the RoR projects
  - significant reduction in operation maintenance cost, especially, due to reduced number of manpower

Which Alternative Preferred

- Phase 2 Development
  - With the development of RoR projects, Peak demand will be increased
  - About 2000 Mw can be installed keeping 8hrs/day peaking (West Seti, BG 640 etc)
  - **Therefore, Alternative 1 with Dam and Reservoir upstream followed by RoR plant with tailrace tappingis recommended.**

Benefit to downstream Project

- Benefit due to Catastrophic Flood events and Glacier Lake Outburst Floods (GLOF)
  - With the reservoir upstream, flood is dampened and smaller flood peak is generated. In case of GLOF, flood peak may not be the issue but a debris flow, with a huge quantity of bed load is anticipated, which is trapped in the upstream reservoir.
- Benefit in revenue due to augmented flow during dry season
- If sold in a same market the Energy Price will be much higher because of increased Firm Energy

Downstream benefit

In Nepal

reduction of dam height at least by 20-40 meters in Karnali Chisapani Dam.

No irrigation benefit is perceived in Nepal as there is already sufficient flow for such purpose.

India and Bangladesh

Irrigation: 500,000 ha additional (which receives no water during dry season) can be irrigated.

The resulting net benefit according to a research carried out in farm land of Bihar is about NRs 15 billion/ year.

Flood Benefit

UKP VS other Reservoir Projects

Name of Project	Power (MW)	Energy (GWh)		Dam H (m)/ Rated head	Reservoir (mcm)		Total Cost (Bln,NRs)	Cost/kW (Mln NRs)	Approx.Cost /kWh (NRs)	Revenue, Nepal (NRs Bln/yr)*
		Dry	Total		Gross	Live				
Pancheswor Multipurpose Project (PMP)	6,480		10,671	315	6,560		298	45,988	3.07	53.41
Upper Seti	140		586	140		323	45	321,429	8.45	3,516
Budigandaki	640	1,800	2,900	245	3,320	2,755	250	390,625	9.48	17,400
Upper Karnali	1,823	3,910	11,623	230		3,900	206	113,001	1.95	69,738

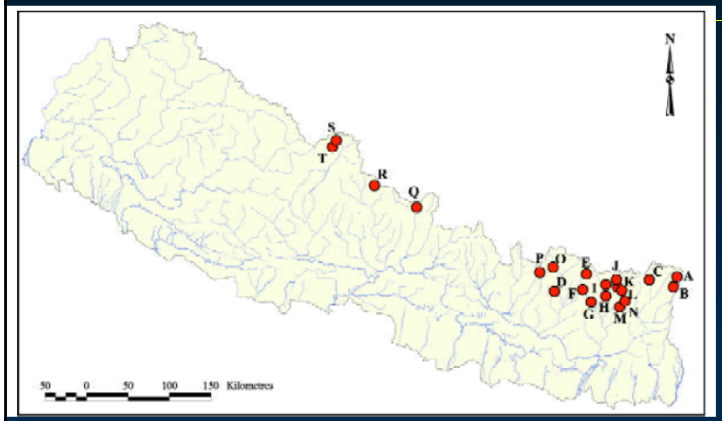
Cost Benefit Sharing

- Downstream project – right to Energy due to Natural Flow only ~ 4000 GWh
- Upstream project – right to regulated Energy from downstream Project- Total 7600 GWh
- Saving in Capital cost in d/s project can be settled by mutual understanding
- Cost/Benefit sharing with India/ Bangladesh can be settled with dialogues

UKP VS other Reservoir Projects

- Study of ICIMOD - So Far no threat to GLOF
- Sediment concentration 3 times less than other rivers such as Budigandaki
- Much less Environmental and Social impact, sparsely populated area (~ 800 HH within Reservoir area counted from Topo sheet)
- Generation cost too low

GLOF Threats (Recent ICIMOD Study)



WORK SCHEDULE

S.N	Activities	Mo	Year 1		Year 2		Year 3		Year 4		Year 5		Year 6		Year 7		Year 8	
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Decision Making for UKP																	
2	Pre-Construction Activities	24																
	Review/update of FSR																	
	Physical Hydraulic Modelling																	
	Detailed Engineering Design																	
	Preparation of Tender Documents																	
	Financial Commitment																	
3	Bid Invitation/Evaluation/ Award																	
4	Construction of Civil Works	72																
5	Electriomechnical & AIS Works	48																
6	Hydromechanical Works	42																
7	Testing & Commercial Operation of the plant	6																

How to Consume Huge Energy

- Energy 11626 GWh
  - Wet 7716 GWh
  - Dry+ storage 3910 GWh
- Fertilizer Industry ~ 800 – 1000 MW
- Replacing Cooking Gas by Electricity~ 500-1000 MW
- Other Industries- Cement, Metal, Agri, …..
- Transportation
  - Electric Car
  - Trolley bus/tram
  - Electric Railway

Financing Model

- Public Private Partnership
  - 50 % (~100 bln) from Public 15 bln/yr
  - 20 % (~40 bln from Govt)
  - 15-20% (~ 40 bln from Banks)
  - 15-20% (~40 bln from Power Developers/Investers)
    - UTK
    - Chilime
    - NEA
    - Other Developers
    - NTC, Citizen Trusts
  - 10% International Investor (Unconditional, who provides technical Assistance in Grant)
  - More than 100%

Model of Federal state

- Water Resources is the major Income Generating Resources so the states should be planned according to Watershed with sub-states as discussed now
  - Less conflict in resources sharing
  - Optimum Benefit can be achieved
  - Infrastructure will be developed faster

THANK YOU