

Department of Water Resources and Irrigation

70th Irrigation Day- 2079

Investment in Irrigation in Federal System: Issues and Challenges

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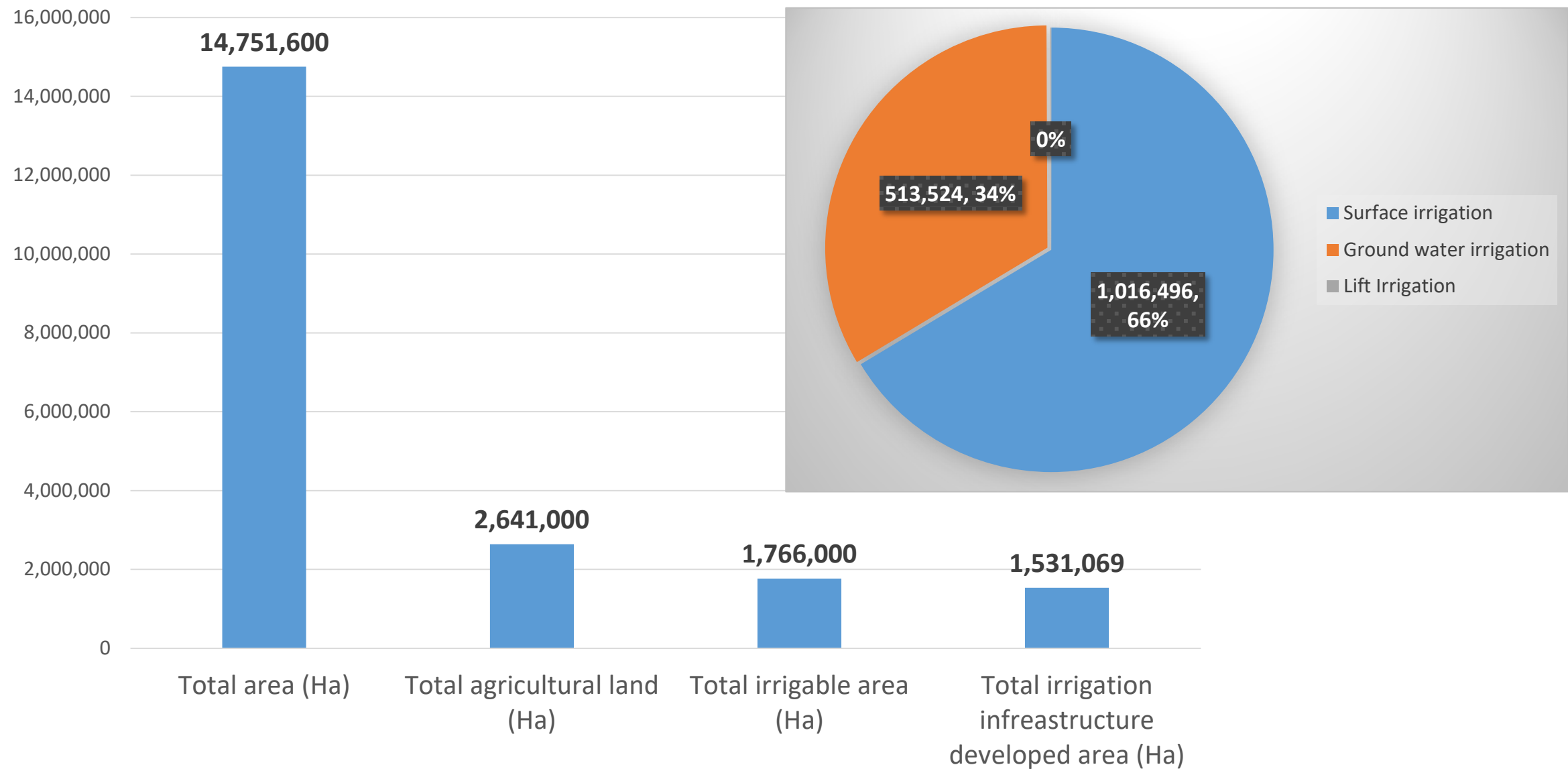
Presentation Outline

- Context
- Irrigation development status
- Irrigation development opportunities
- Budget allocation in irrigation sector (GP and DP) in last ten years
- Annual Investment need in irrigation sector
- Different financing modality
- Multipurpose project and investment modality
- Climate change impact and irrigation investment
- Way forward

Context: Irrigation Sector

- Agriculture provided employment for 874 million people in 2020, totaling 27 percent of the global workforce (FAO,2021).
- Total production of primary crops increased by 53 percent between 2000 and 2019, hitting a record high of 9.4 billion tonnes in 2019.
- Half of global primary crop production is made up of just four crops: sugar cane, maize, wheat and rice (FAO,2021).
- Over 66% of the population of Nepal is involved in agriculture. Share of Agriculture to GDP about 23.95 % in 2021.
- Investment from government of Nepal as well as the support from donor partner in Irrigation sector is decreasing compared to other sector.
- Department of Water resources and Irrigation has started several basin diversion multipurpose project. Some of which are in advanced stage and some are at the preparation stage. Huge investment is needed to start these projects.
- Because of lack of appropriate operation, maintenance and modernization of irrigation system, desired level of irrigation services has not been achieved.
- More investment is needed to develop climate resilient infrastructure to cope with the impact of climate change in irrigation systems.

Irrigation Development: Current Status (Upto FY 2078/079)

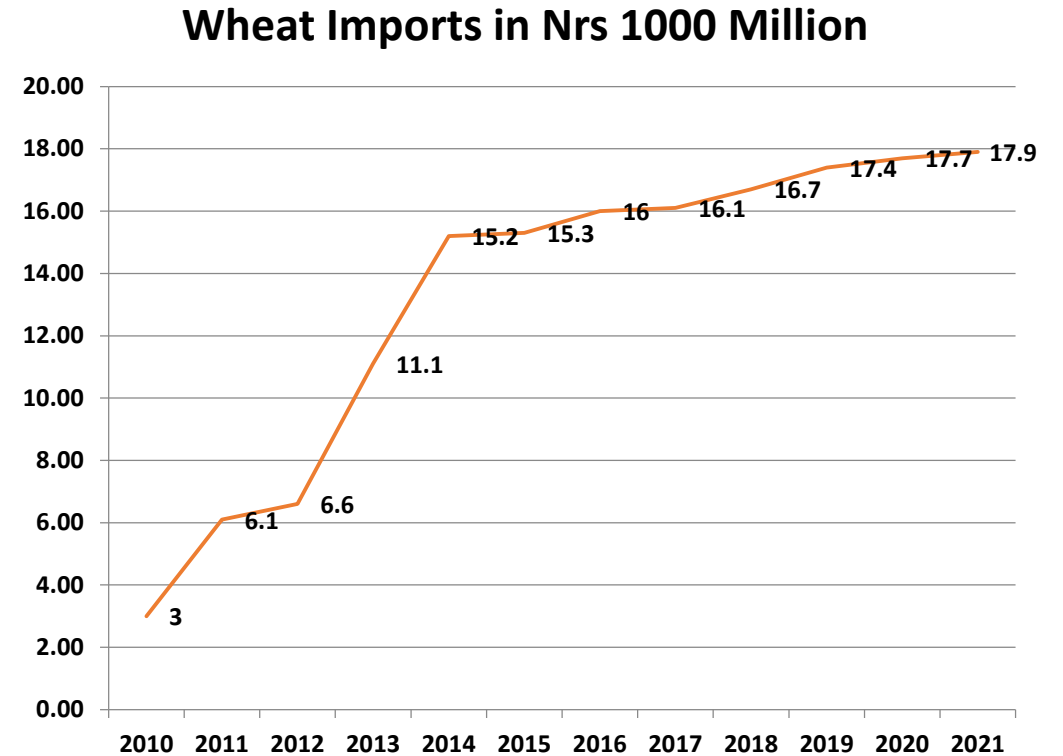
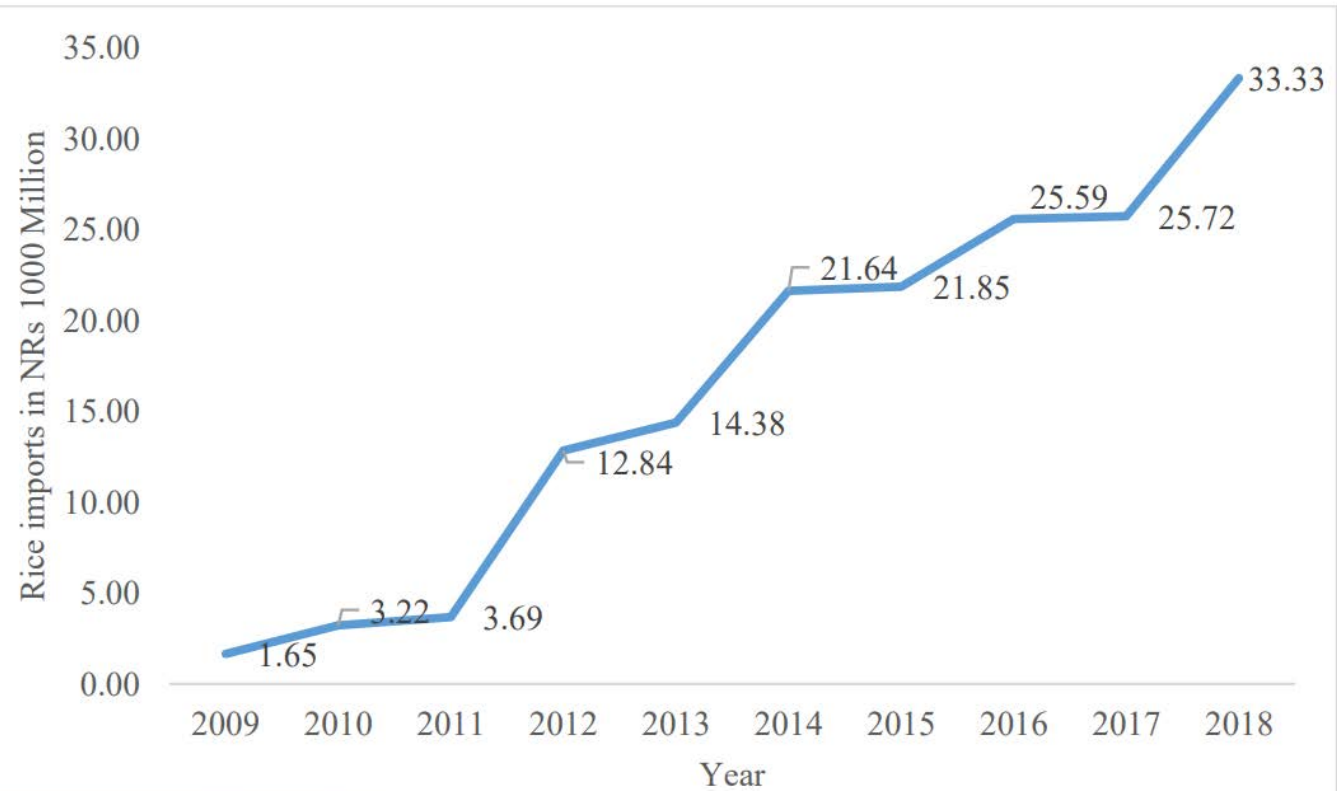


Annual Expenditure and Achievements

S.No	Fiscal Year	Budget (Lakhs)	Expenditure (Lakhs)	% Expenditure	Irrigated Land (Ha)	Total Irrigated Land(Ha)
1	2070/71	94,907	80,204	84.51	19,310	1,350,831
2	2071/72	129,972	112,174	86.31	18,083	1,368,914
3	2072/73	154,873	129,830	83.83	23,263	1,392,177
4	2073/74	202,320	177,853	87.91	41,180	1,433,357
5	2074/75	247,550	229,209	92.59	39,639	1,473,026
6	2075/76	237,190	195,820	82.56	3,705	1,476,731
7	2076/77	247,875	140,540	56.7	5,567	1,482,298
8	2077/78	271,290	196,478	72.42	27,129	15,09,427
9	2078/79	308,236	249,502	80.95	21,642	1,531,069
10	2079/80 till falgun	252,921	120,530	47.66	2,260	1,533,329

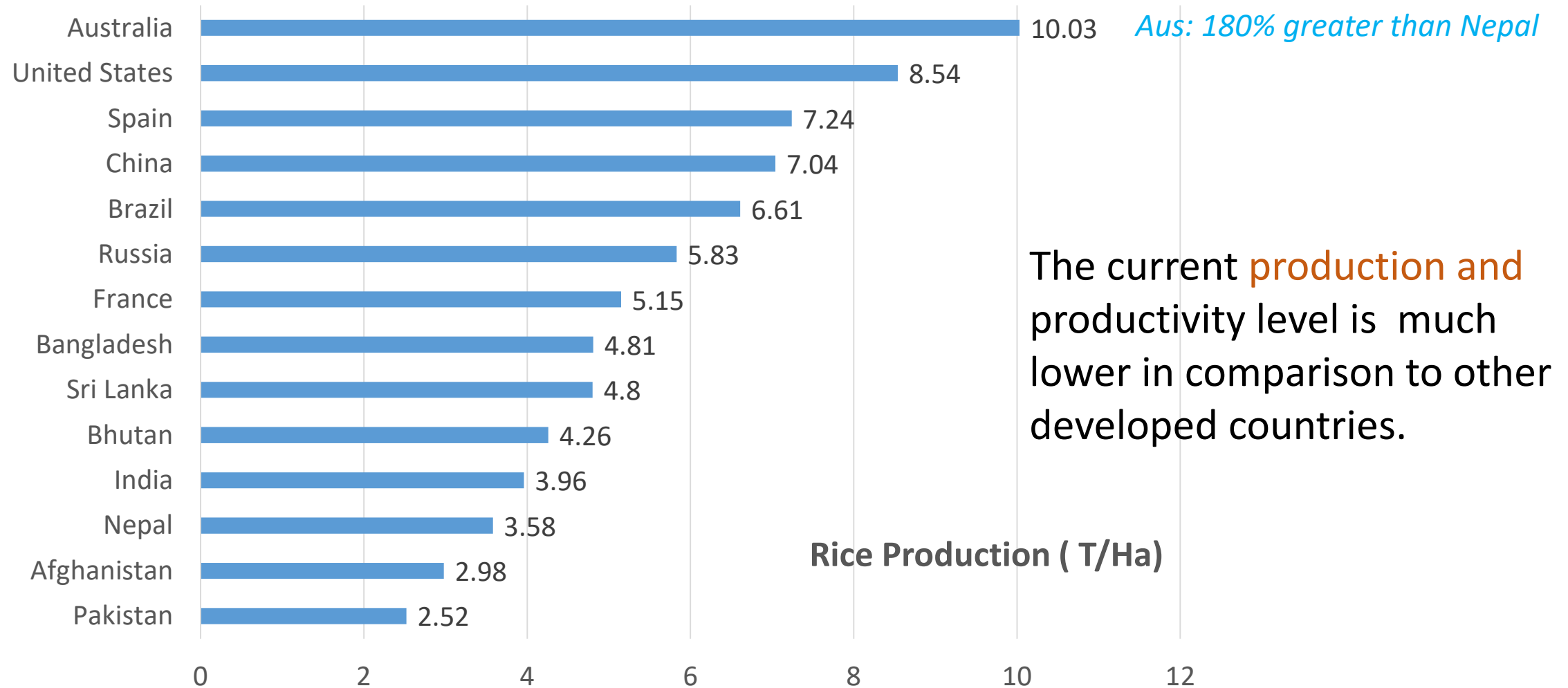
Budget, expenditure and achievements of last ten years in irrigation sector

Why Irrigation Needs Priority?



Import of agricultural product is increasing annually resulting huge trade imbalance.

Rice Production (Yield)



Rice production rate (T/Ha) worldwide and comparison with Nepal (FAO,2021)

Increasing Production and Productivity: An Opportunity

Targeted Production/ Productivity level?

Bagmati Irrigation Project
Paddy : 3.5/ 7.68 MT/Ha
Maize : 5.7/ 13.75 MT/Ha

Additional rice of 1500000 Ton can be produced in the potential irrigable land if the existing production rate of 3.5 Ton is improved to 6 Ton with cropping intensity of 40 %.



Rice – 6 Ton/ Ha
Wheat – 4 Ton/Ha

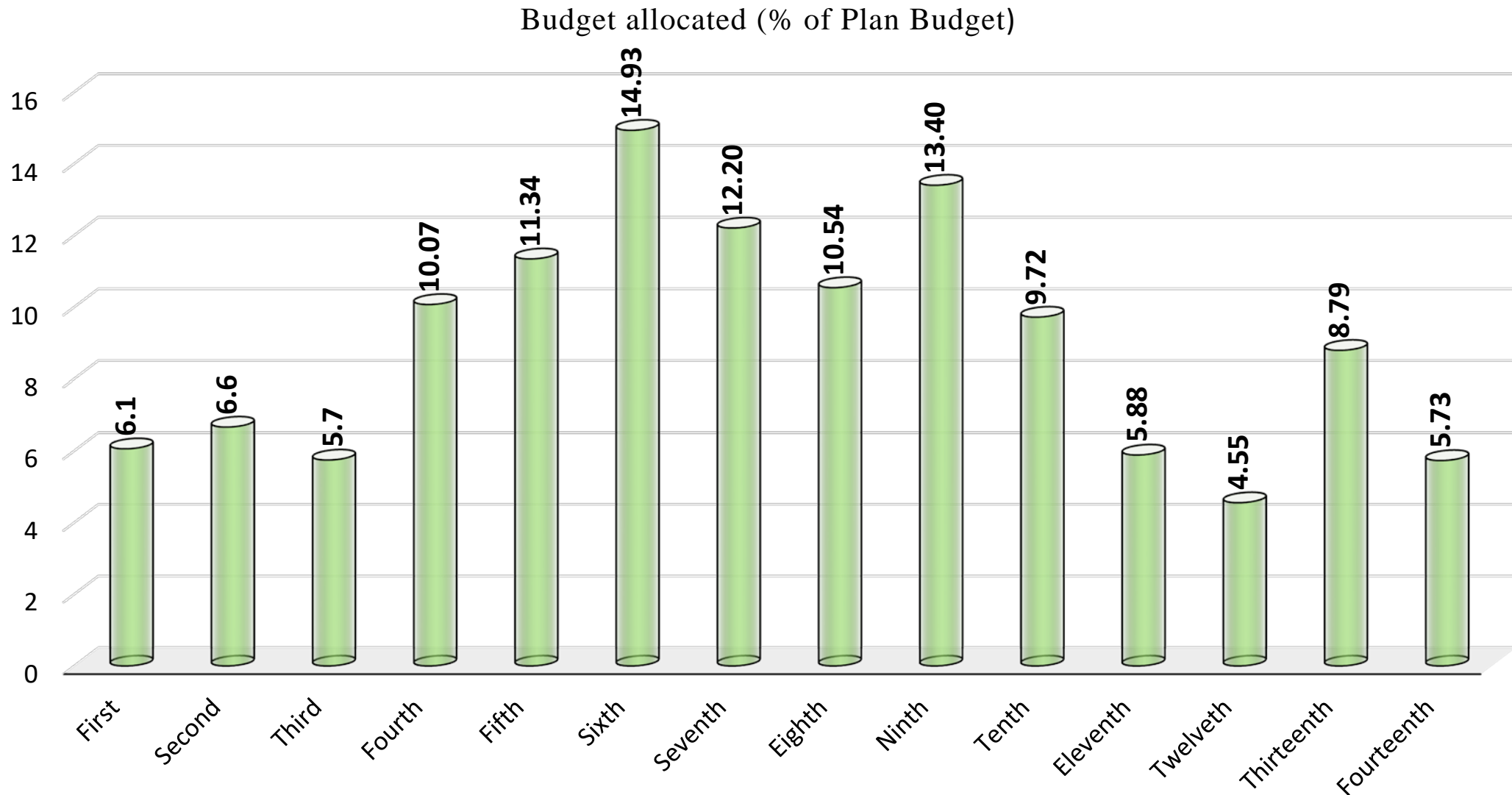


Rice – 3.5 to 4 Ton/ Ha (3.58)
Wheat – 2.5 to 3 Ton/Ha (2.35)

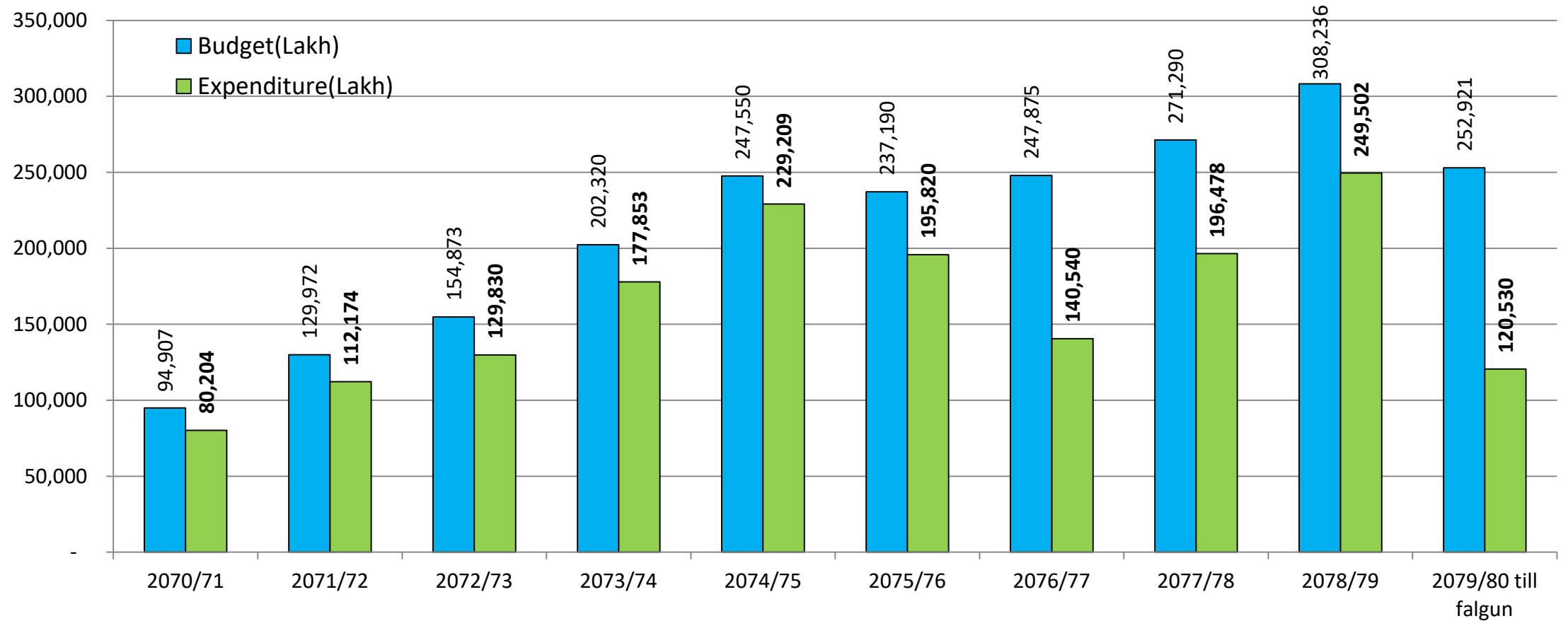
Existing Production Level

The agriculture production is primarily rain fed with subsistence based farming .

Budget Priority for Irrigation Sector

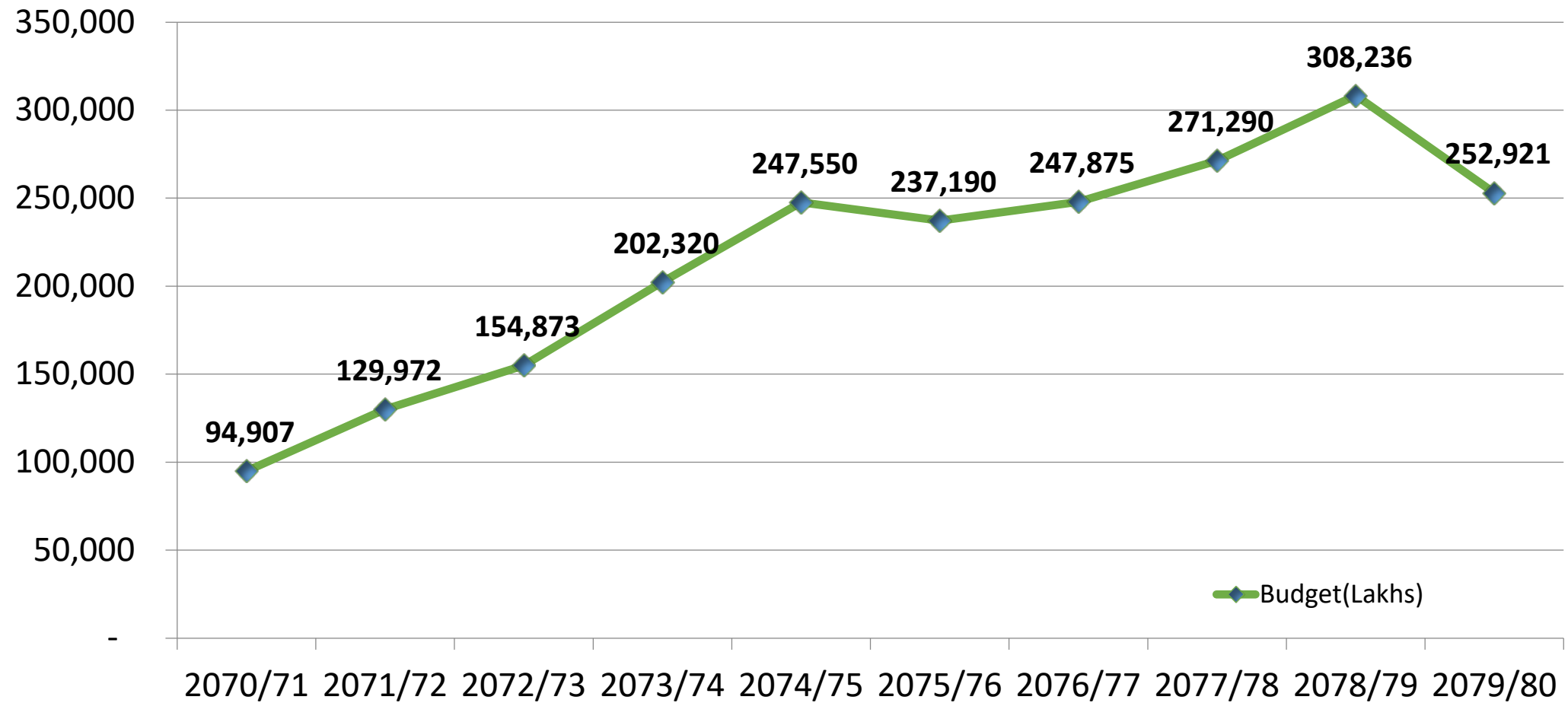


Allocation and Expenditure



Budget, expenditure of last ten years in irrigation sector

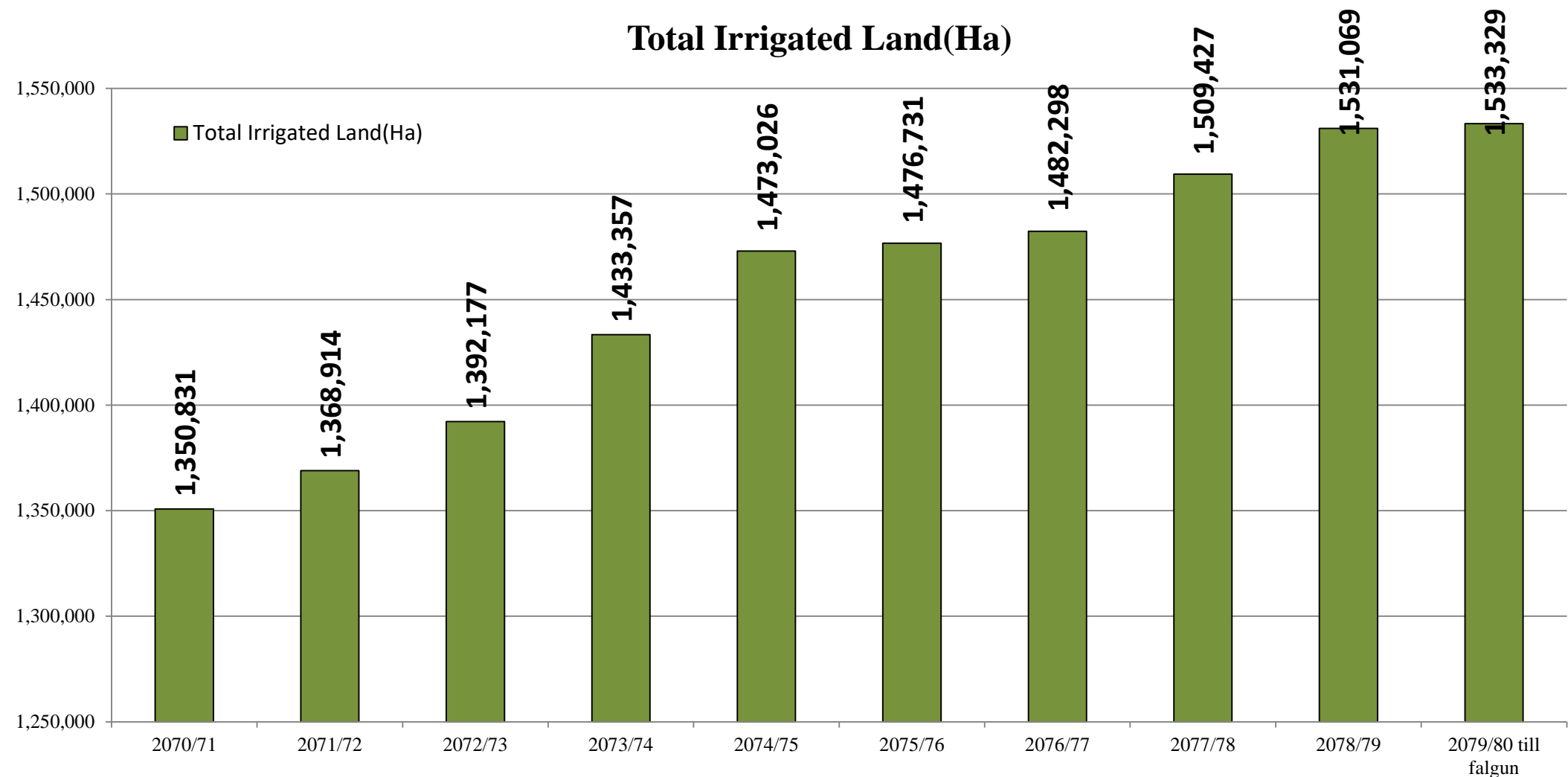
Budget Allocation in Irrigation Sector



Budget allocation of last ten years in irrigation sector

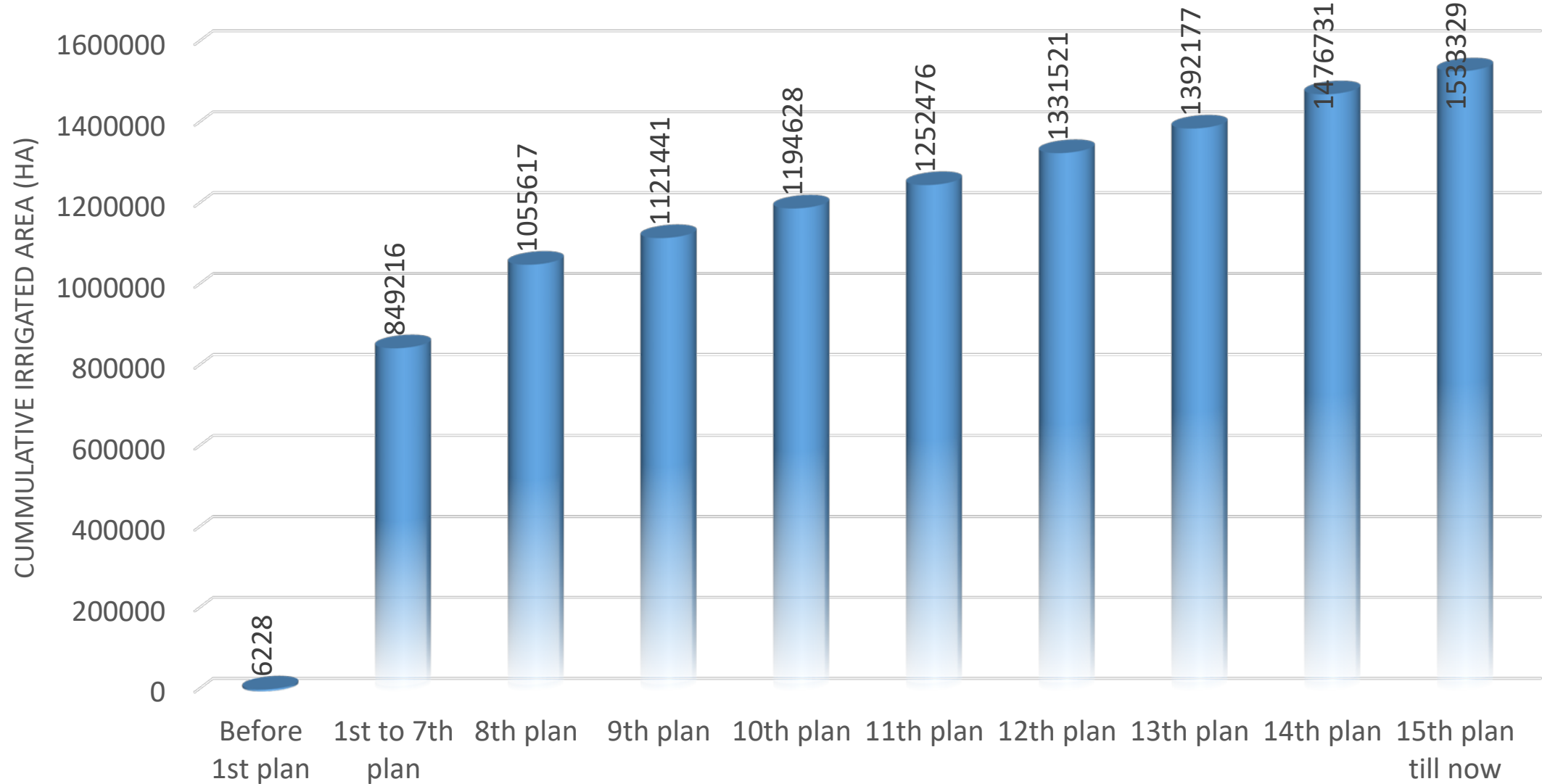


Achievements of Irrigation Sector







Achievements (total irrigated area- Ha) of last ten years in irrigation sector

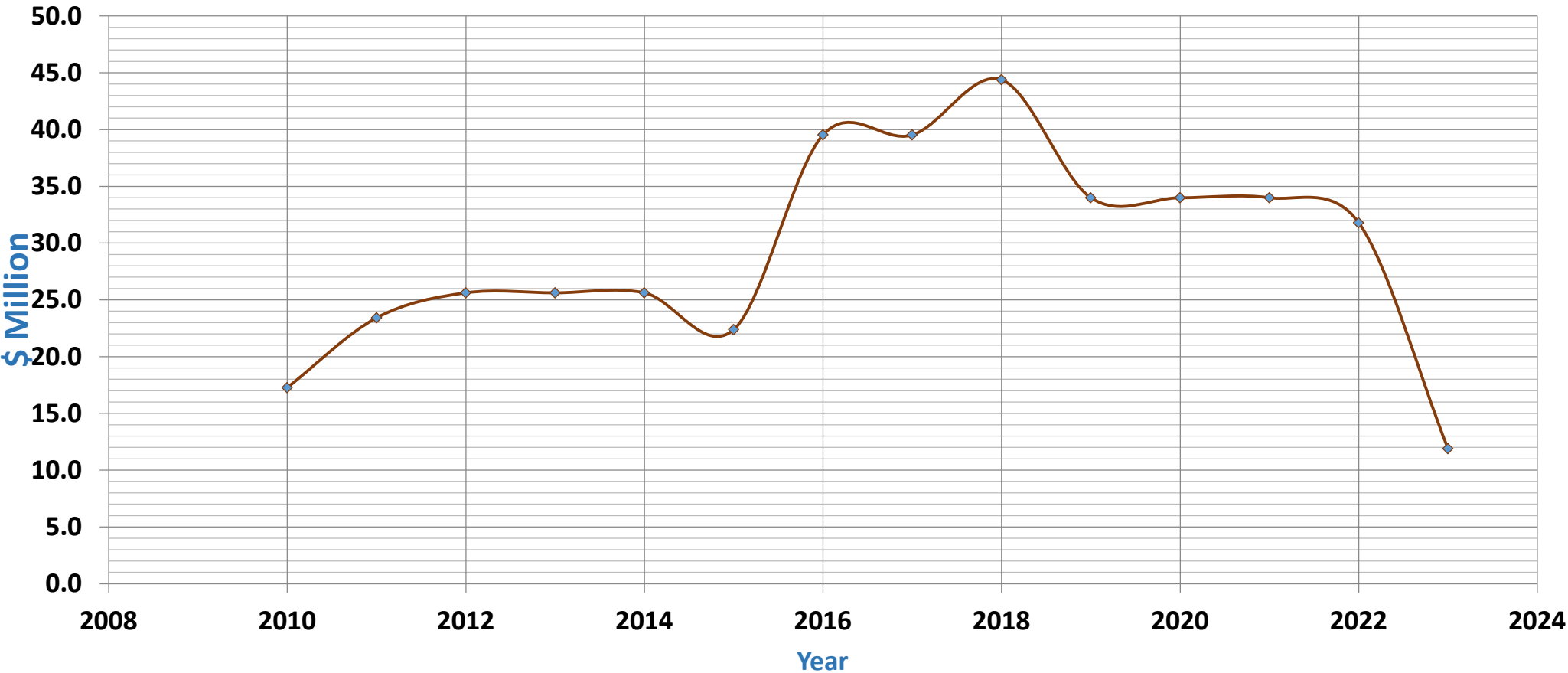
Irrigated Area in Different Plan Period



Investment from Development Partners In Irrigation Sector (Last 10 Yrs.)

Major Development Partners		Project Name	Implementation Duration	Amount (\$ million)	Status
	Asian Development Bank (ADB)	Community-Managed Irrigated Agriculture Sector Project (CMIASP)	2006–2014	27	Completed
		Community-Managed Irrigated Agriculture Sector Project (CMIASP-AF)	2016-2022	60	
		Water Resources Project Preparatory Facility (WRPPF)	2012–2021	11	
	The World Bank	Modernization of RJKIP (2nd Phase)	2018-2023	66	Ongoing
		Modernization of RJKIP (1nd Phase)	2011-2017	43	Completed
		Irrigation and Water Resources Management Project (IWRMP)	2008-2018	114.3	
	Kuwait Fund For Arab Economic Development (KFAED)	Irrigation System Improvement Project	2015-2023	19.35	Ongoing
	The Saudi Fund for Development (SFD)	Sikta Irrigation Project (Dunduwa Irrigation Project)	2015-2022	3.47	Completed
		Bagmati Irrigation Project	2007-2024	15	Ongoing

Investment trend by Development Partners



Future Projects

- After completion of IWRMP, a follow-up project **Climate Resilient Irrigated Agriculture Project (CRIAP)** has been proposed under WB support – yet to be materialized
- Study of Storage (Small and Medium) has been initiated (WB support)
- After completion of CMIASP-AF on Dec 2022 , preparation of a follow up project **Climate Resilience Community Managed Irrigation Sector Project (CRCMISP)** has been initiated (100 FMIS rehabilitation, Rajapur Modernization, Lift system development) (ADB Support) (115 MUSD)
- **Mechanized Irrigation Innovation Project (MIIP)** (in Sarlahi and Rautahat) – Initiated (ADB Support) – 136 MUSD
- **Nagmati Dam** (After Completion of Dhap Dam)
- **Digitalization of Water Management for Improved Resilience** (KSTA: Knowledge and Support Technical Assistance) Digitalization of Water Management for Improved Resilience
- **Mahakali IP**- Under request for ADB Support
- Extension of **Bagmati Irrigation Project** – Under request for AIIB Support

Not so encouraging commitments from Development Partners in Irrigation sector for coming years

Annual Investment need for Large Projects																
(A) Large Scale Projects	Total cost M\$	Annual Investment Breakdown														
		2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037
Bheri Babai Diversion	278.8	39.9	39.6	39.6	39.6											
Sunkoshi Marin Diversion	387.0	57.1	57.1	57.1	57.1	57.1	57.1									
Naumure Dam (Rapti Kapilvastu Diversion)	954.0		77.9	116.7	151.8	187.0	239.7	173.4	7.8							
Kaligandaki Tinahu Diversion	1684.6							224.0	231.5	195.4		377.2				
Tamor Chisang Diversion	2350.8									203.8	203.8	391.7	391.7	386.6	386.6	386.6
Chatara Barrage	260.6		56.4	56.4	49.2	49.2	49.4									
Karnali tranfer to Kailali	599.6							68.6	99.2	90.5	90.5	125.4	125.4			
Total (M \$)	6515.5	96.9	230.9	269.8	297.7	293.2	346.2	466.0	338.5	489.7	671.5	894.3	796.4	386.6	386.6	386.6
Total (M NRS)	860043.4	12796	30482.6	35611.7	39289.9	38708.3	45694.5	61511.7	44676.3	64640.4	88638.0	118047	105127	51031.2	51031.2	51024.6

Total Annual Investment Need

Projects	Total cost M\$	Annual Investment Breakdown														
		2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037
(A) Large Scale Projects	6515.5	96.9	230.9	269.8	297.7	293.2	346.2	466.0	338.5	489.7	671.5	894.3	796.4	386.6	386.6	386.6
(B) Groundwater Development	724.0	63.5	60.8	66.6	72.2	63.2	29.3	54.2	55.7	59.5	43.6	28.3	29.3	12.6	0.5	0.0
(C) Gravity and pumped hill schemes	1583.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0
(D) Irrigation management modernization and rehabilitation	1138.0	47.4	47.4	47.4	47.4	47.4	47.4	47.4	47.4	47.4	47.4	47.4	47.4	47.4	47.4	47.4
Total (M \$)	9960.5	273.8	405.1	449.8	483.3	469.8	488.9	633.6	507.6	662.6	828.5	1036.0	939.1	512.6	500.5	500.0
Total (M NRS)	1314,783.4	36146.9	53477.0	59371.7	63789.1	62019.5	64530.9	83634.9	66997.5	87463.2	109362.0	136752.0	123963.8	67663.2	66066.0	65993.4

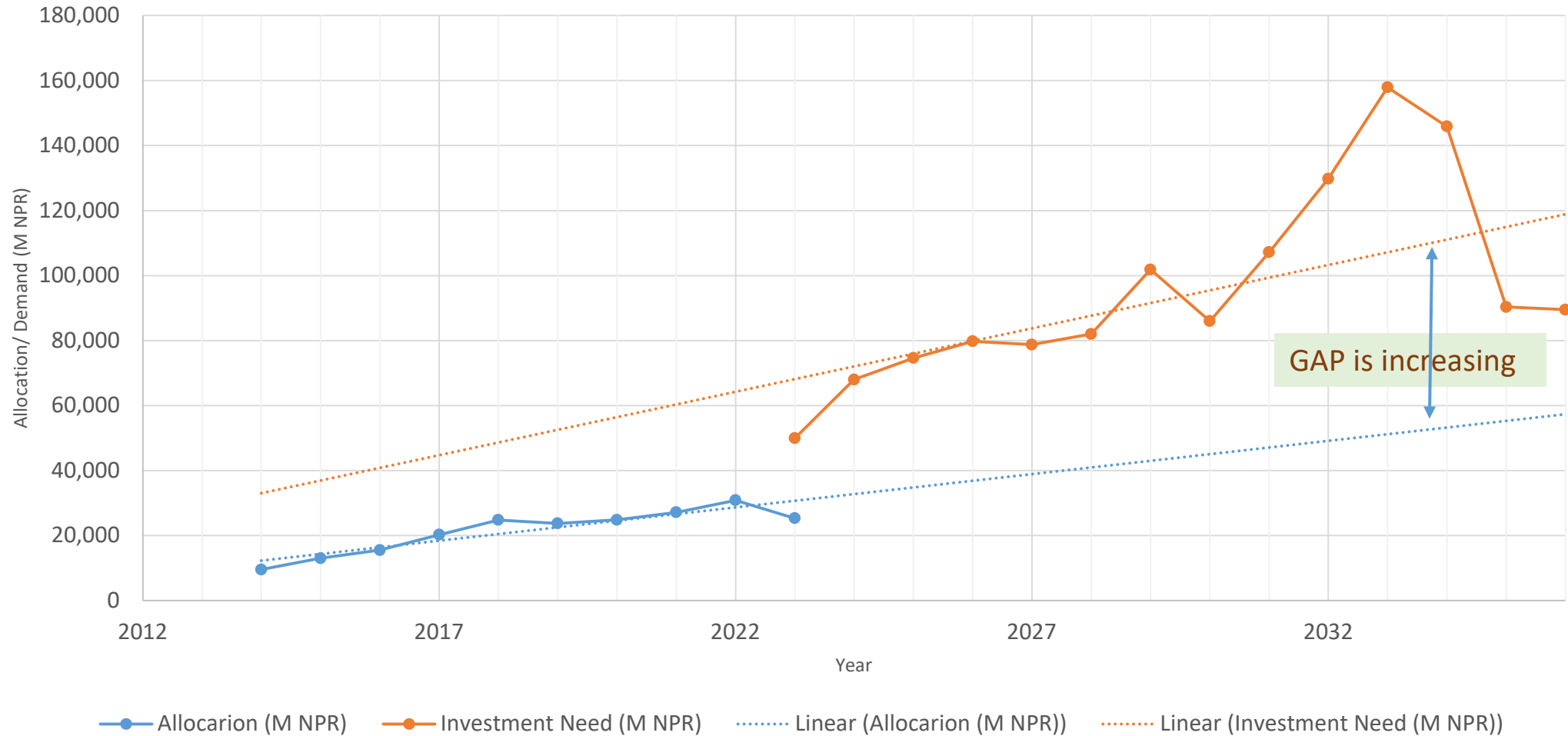
Total Annual Cost with MOM

Total Cost	Total cost (M NRS)	Annual Investment Breakdown (M NRS)														
		2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037
Grand Total Cost	1314783.4	36146.9	53477	59371.7	63789.1	62019.5	64530.9	83634.9	66997.5	87463.2	109362	136752	123963.8	67663.2	66066	65993.4
MOM cost	492565	13747	14492	15236	15980	16725	17469	18214	18958	19703	20447	21191	21936	22680	23425	24169
Grand Total cost with MoM	1,807,348.24	49,893.99	67,968.52	74,607.63	79,769.55	78,744.32	82,000.23	101,848.63	85,955.69	107,165.80	129,809.03	157,943.47	145,899.74	90,343.54	89,490.78	90,162.61

MOM Cost: NRS 4,550/ha for surface irrigation , NRS 20,500 /ha for ground water and lift scheme (Irrigation Master Plan -2019)

Allocation, Demand and GAP

Increasing GAP between Allocation and Demand



Different Financing Modalities

- Traditional Government of Nepal's investment
- Development Partner's Support
- Company Model (Case study of MIIP)
- Company model for BBDMP and SMDP – separating hydropower and irrigation (Operation and Management Company – already invested by GoN)
- Viability Gap Funding
- Public Private Partnership
- Management contracts

PPP Type, Function and Participation

Origine of revenues for private operator	Functions under responsability of private operator	Participation of private operator in investment functions ?	
		Yes	No
Services paid to the private operator by the final users (farmers) - Public Service Delegation (PSD)	Design		
	Construction		
	Operation & Maintenance		
	Ownership of O&M assets		
	Transfer of infrastructures after completion of construction		
	Ownership of infrastructures		
	Transfer of infrastructures after completion of PPP contract		
Services paid to the private operator by the Public Authority	Design		
	Construction		
	Management (staff of private operator in Public Entity)		
	Operation & Maintenance		
	Ownership of O&M assets		
	Transfer of infrastructures after completion of construction		
	Ownership of infrastructures		

Legend:

Differences between lease and affermage is in the rent paid to the Contracting Authority (lease fees: fixed rent / Affermage fees : varying on revenues collected from users)

BOT : Build Operate Transfer

BOO: Build Operate Own

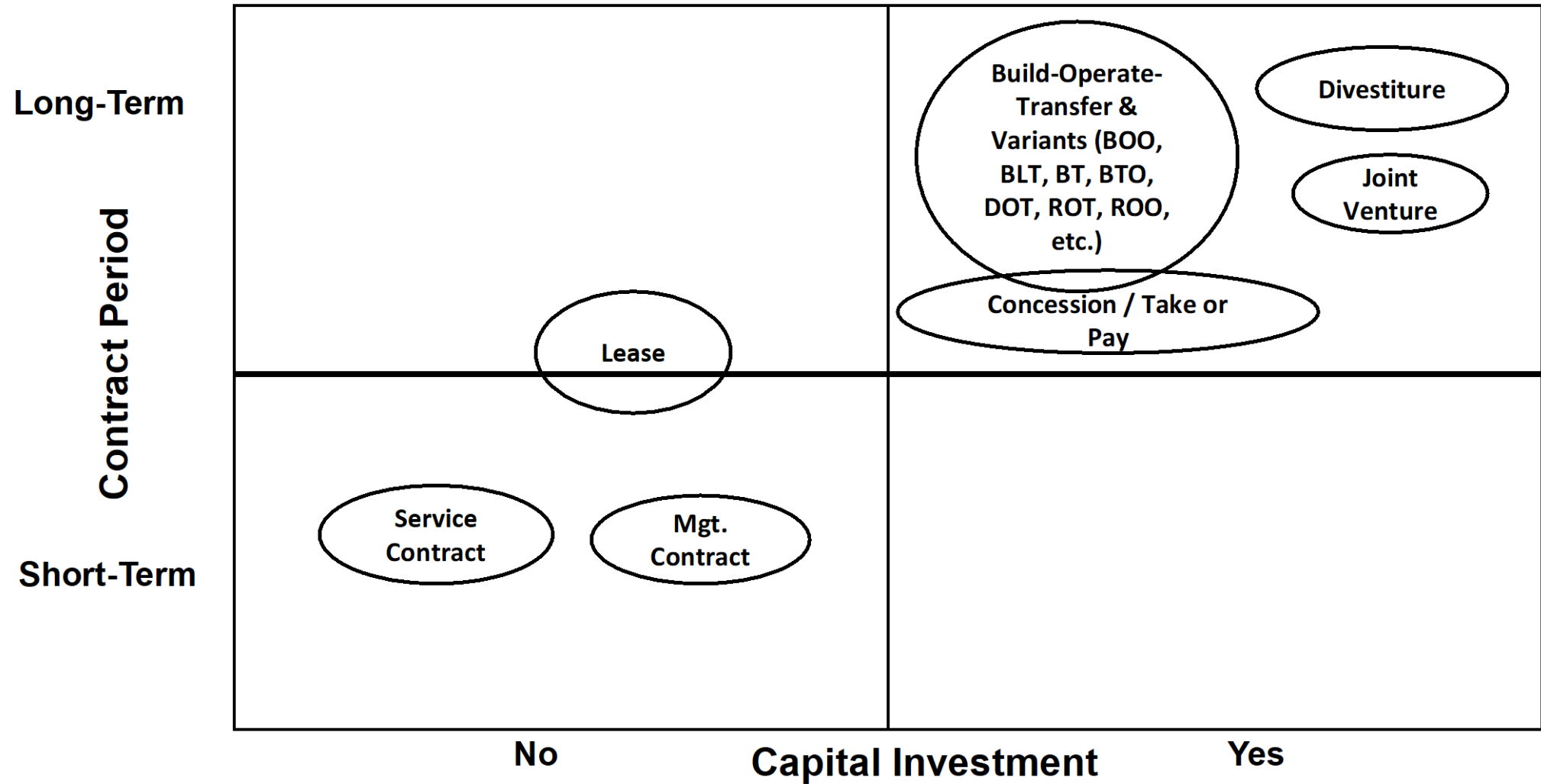
Manag. Contract : Management contract

O&M Contract : Operation & Maintenance contract

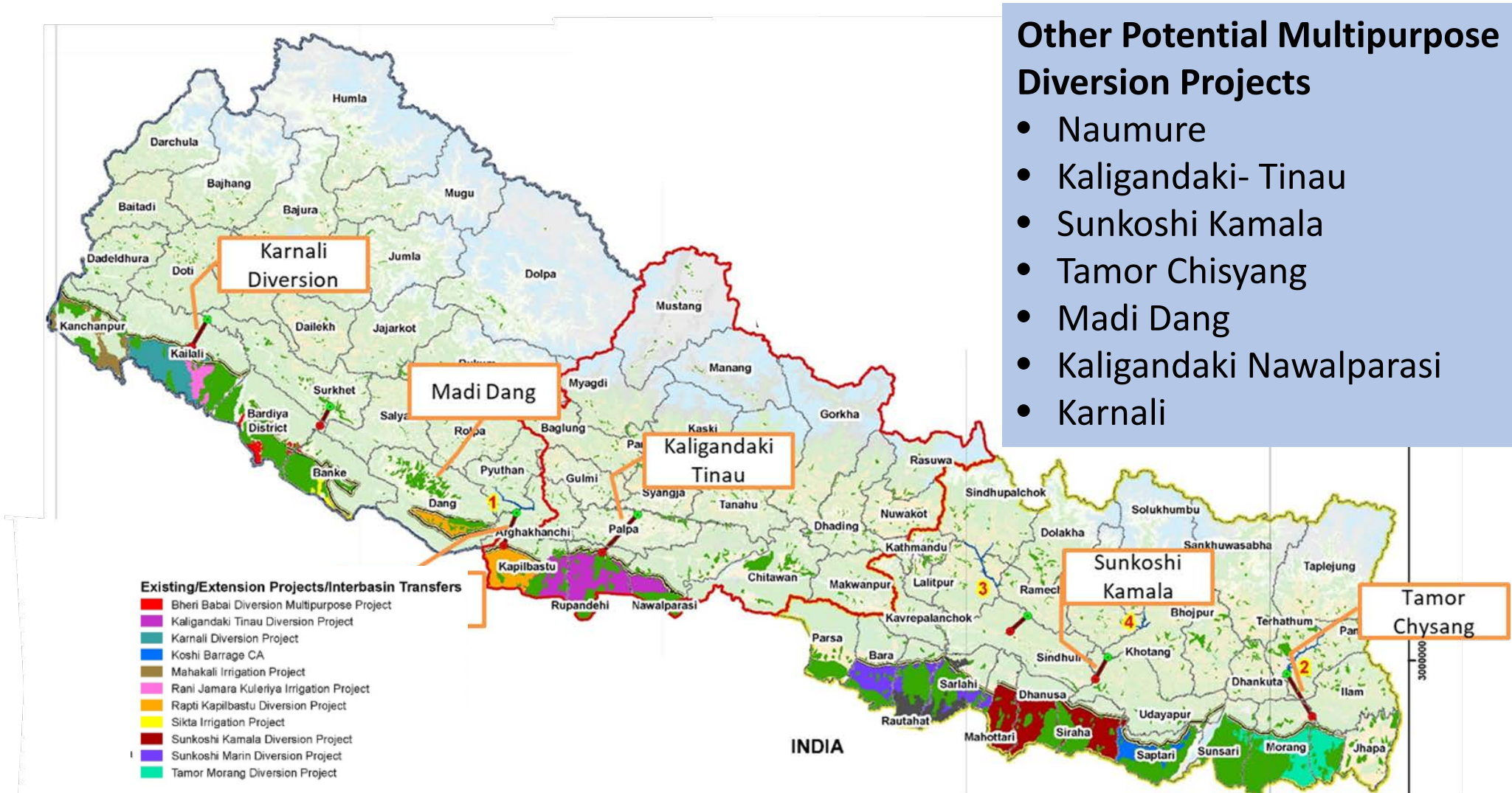
EPC / DB : Engineering Procurement Construction (also called Design Build)

DBO : Design Build Operate (contract with EPC + O&M together)

PPP Option/Model



Investment on Multipurpose Projects



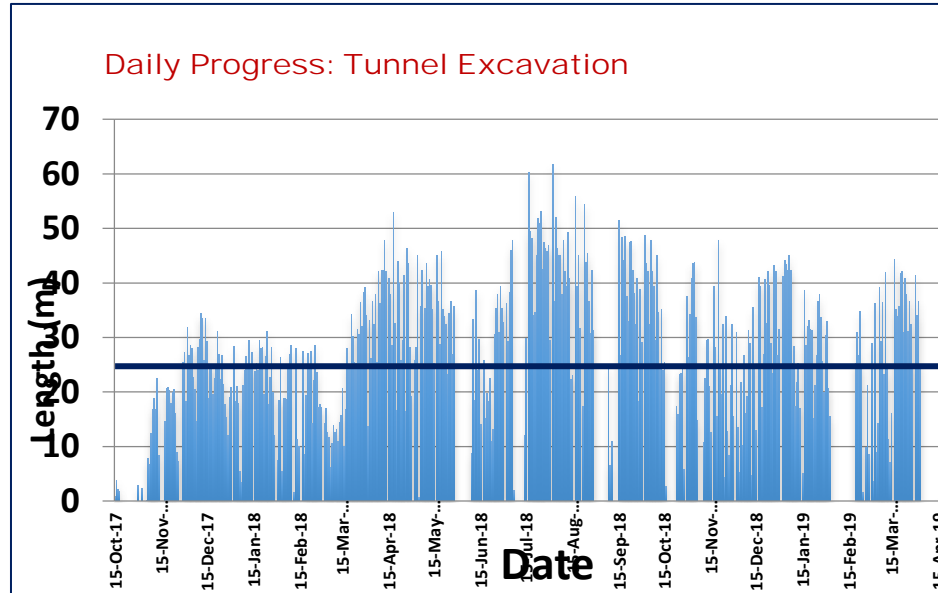
1. Bheri Babai Diversion Multipurpose Project – Advanced stage
2. Sunkoshi Marin Diversion Multipurpose Project – On going

Multipurpose Benefits

SN	Diversion Projects	Design Discharge (m ³ /s)	Installed Capacity (MW)	Irrigation (Ha)
1	Bheri Babai Diversion Multipurpose Project	40	46	51,000.00
2	Sunkoshi Marine Diversion Multipurpose Project	67	31	123,000.00
Sub Total A			77	174,000.00
1	Naumure (Surai HP only)	41.6	281 (54.7)	29,736
2	Kaligandaki Tinau	66.4	101	199,679
3	Sunkoshi Kamala	226	62	240,521
4	Tamor Chisang	109.7	45.7	107,851
5	Madi Dang	24.4	61	50,831
Sub Total B			550.7 (324.4)	628,618
Total			627.7 (401.4)	802,618.00

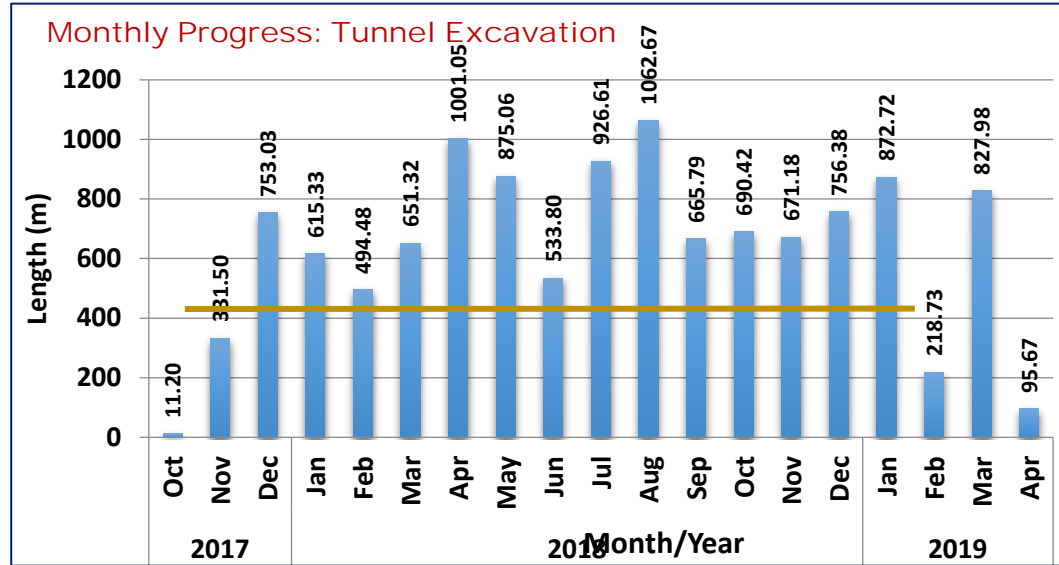
Additional Environmental benefits and other benefits

Bheri Babai Multipurpose Project



**TBM Tunneling from 15 Oct 2017 to 16 April 2019
Breakthrough on April 16, 2019**

Best day : 61.77m (2 Aug 2018)
Average/working day : 28.65m
Best Week : 324.53m (2018 Aug2-Aug8)
Best Month : 1062.67m (Aug, 2018)

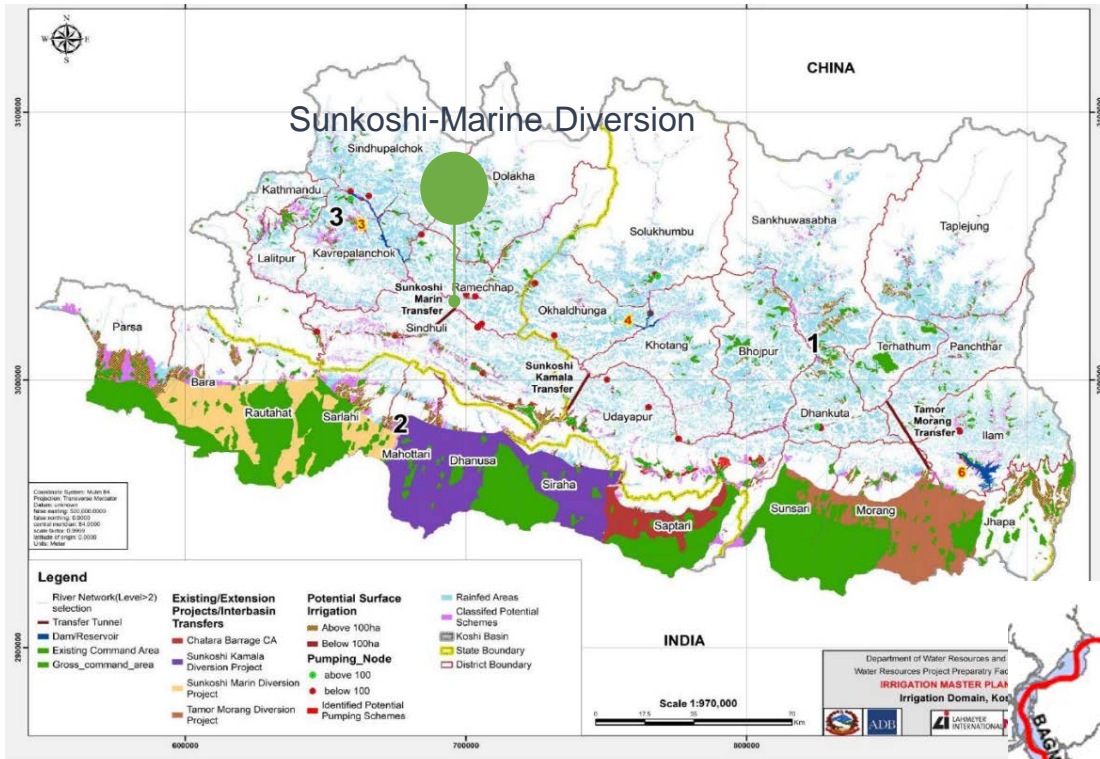


Best Month: 1062.69m (Aug, 2018) Average Monthly : 709m



Success on TBM tunnel, Need to complete the remaining works to rationalize the benefits

Sunkoshi Marin Diversion Multipurpose Project



Design Discharge = $67\text{m}^3/\text{sec}$

Finished Diameter = 5.5m

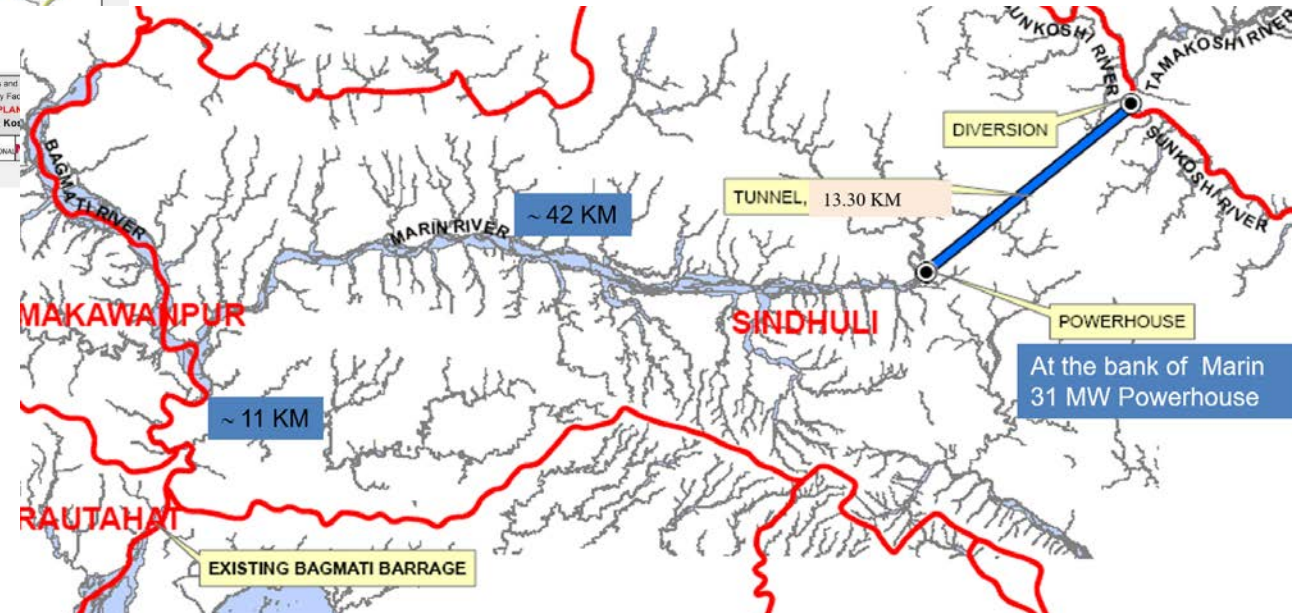
Length of Tunnel = 13km

Head = 64m

Hydropower generation = 31MW

6.4m diameter double shield TBM

More than 4.5km tunnel construction has been completed



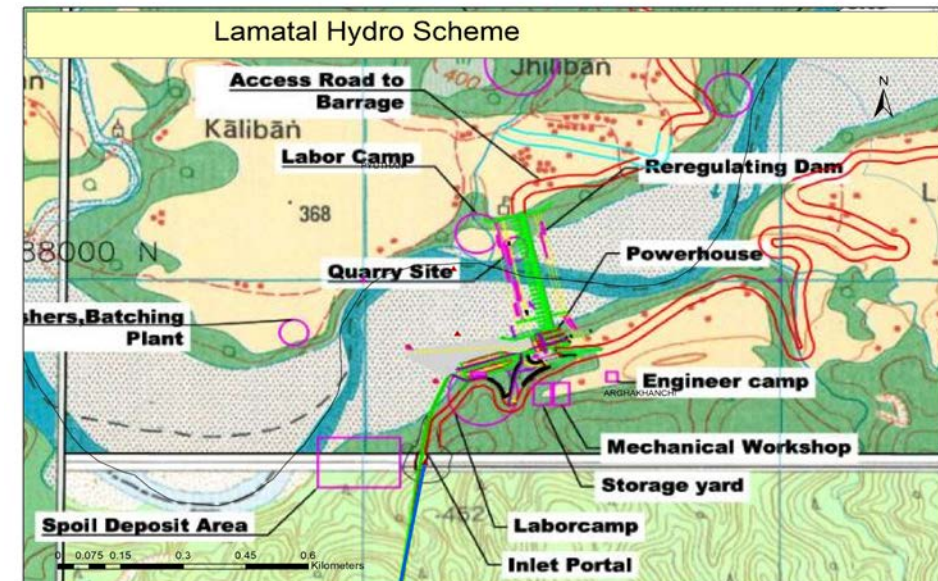
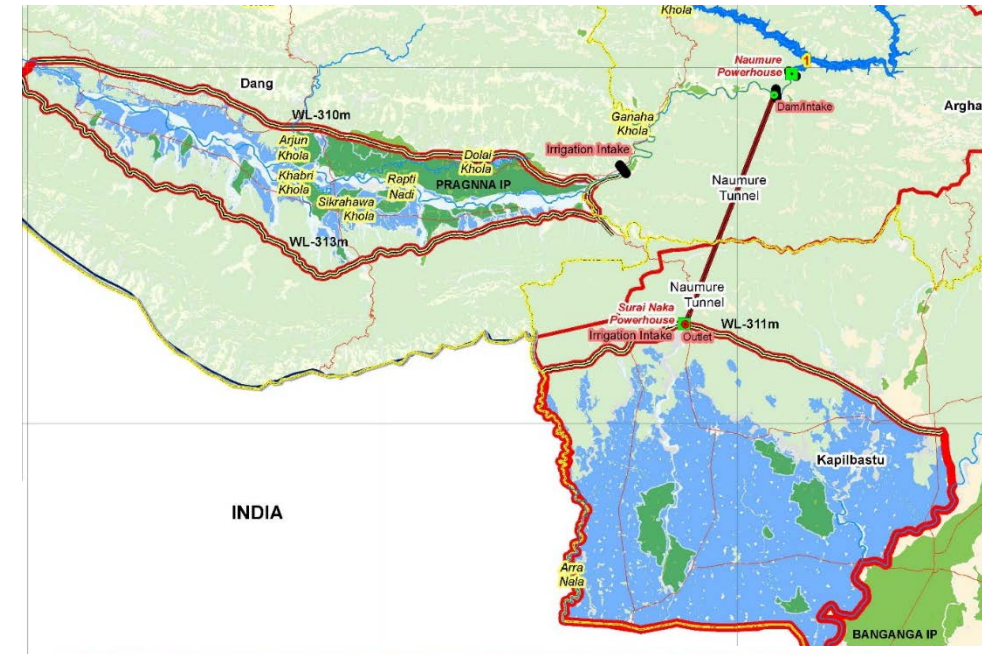
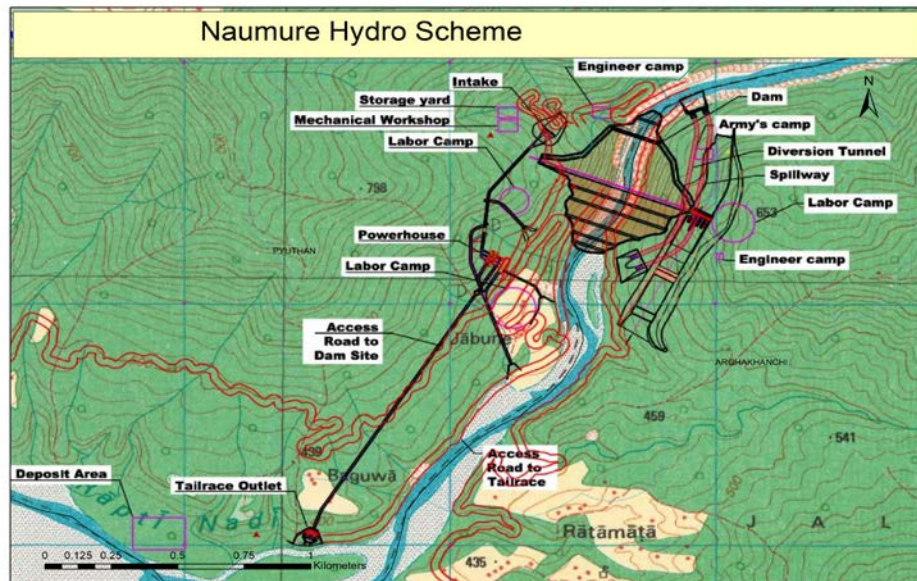
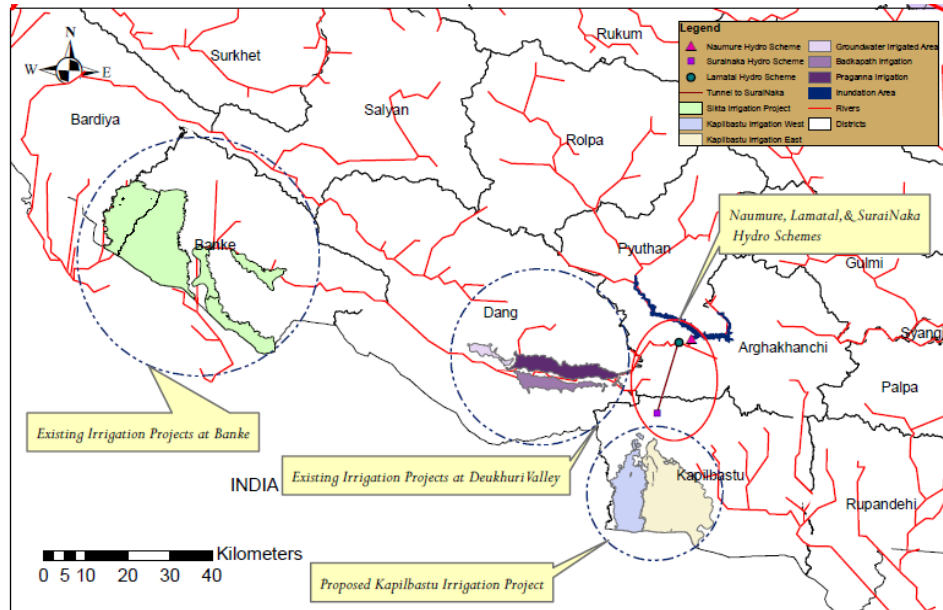
Hydropower Operation and Maintenance Company



For construction already started projects like BBDMP and SMDMP, company can be established and Public private partnership can be done.

- Hydropower Operation and Maintenance Company shall be established for Bheri Babai Diversion Multipurpose Project and Sunkoshi Marine Diversion Multipurpose Project.
- For Example: Based on current cost and contract status total Cost = 30,000 Million.
- Considering Cost proportion for Hydropower 40% and irrigation 60%.
- Hydropower Cost = 12,000Million (12 Arb), based on which the public private partnership can be done.
- *Benefits: 12 Billion can be collected from the market which can be invested in another Multipurpose Diversion Project and The operation and maintenance sustainability can be achieved.*
- Irrigation Projects in standalone may not be economically feasible but when integrated with Hydropower schemes, the basin diversion multipurpose project can be developed, operated and maintained in a sustainable way and financial arrangements can be done.

Naumure Multipurpose Project



Naumure Multipurpose Project

Naumure Hydropower Scheme

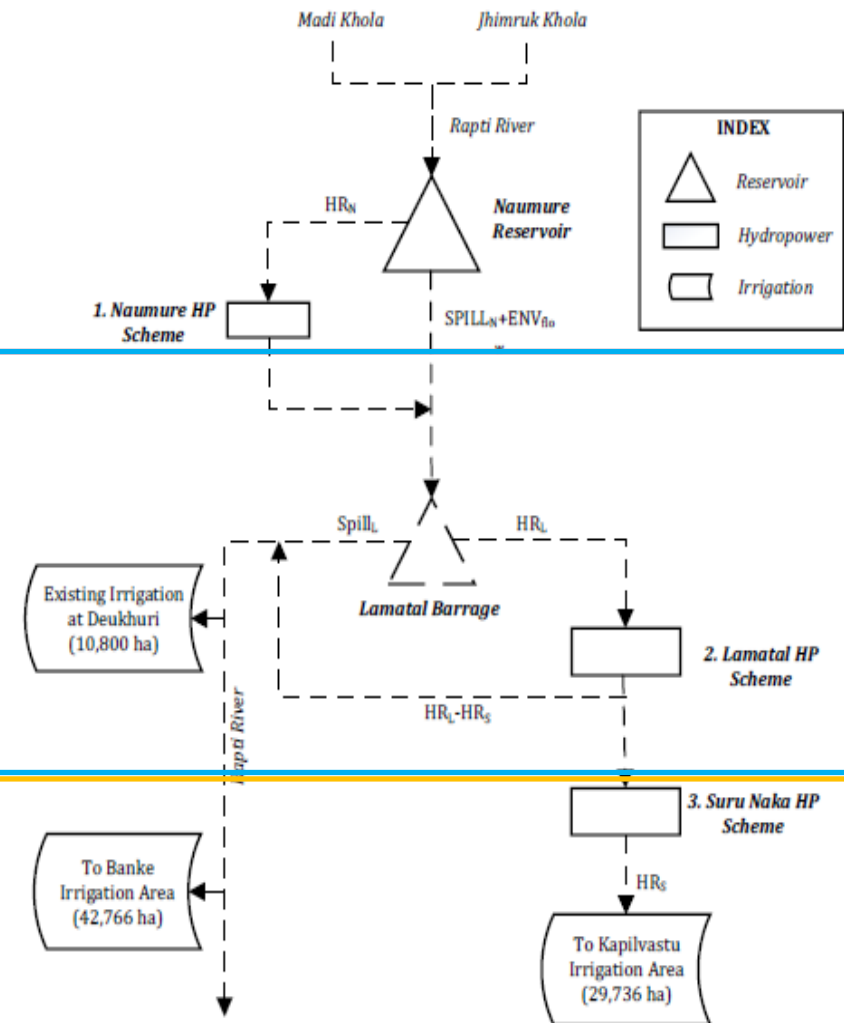
- About 3 km d/s of Madi and Jhimruk Khola
- 169 m high Concrete Faced Rockfill Dam (CFRD)
- Design discharge (**Q**) = **154 m³/s**
- Generate **218.34 MW** hydropower

Lamatal Hydropower Scheme

- About 6 km d/s of Naumure dam → Lamatal reregulating barrage (15.5m High)
- Design discharge (**Q**) = **136.3 m³/s** , head 7m,
- Generates **8 MW** of electricit
- Divert 41.6 m³/s to Surainaka HPS for irrigating 29,736 Ha Land
- Irrigate **53,566 (10,800+42766) Ha** of Land Deukhuri and Banke

Surai Naka Hydropower Scheme

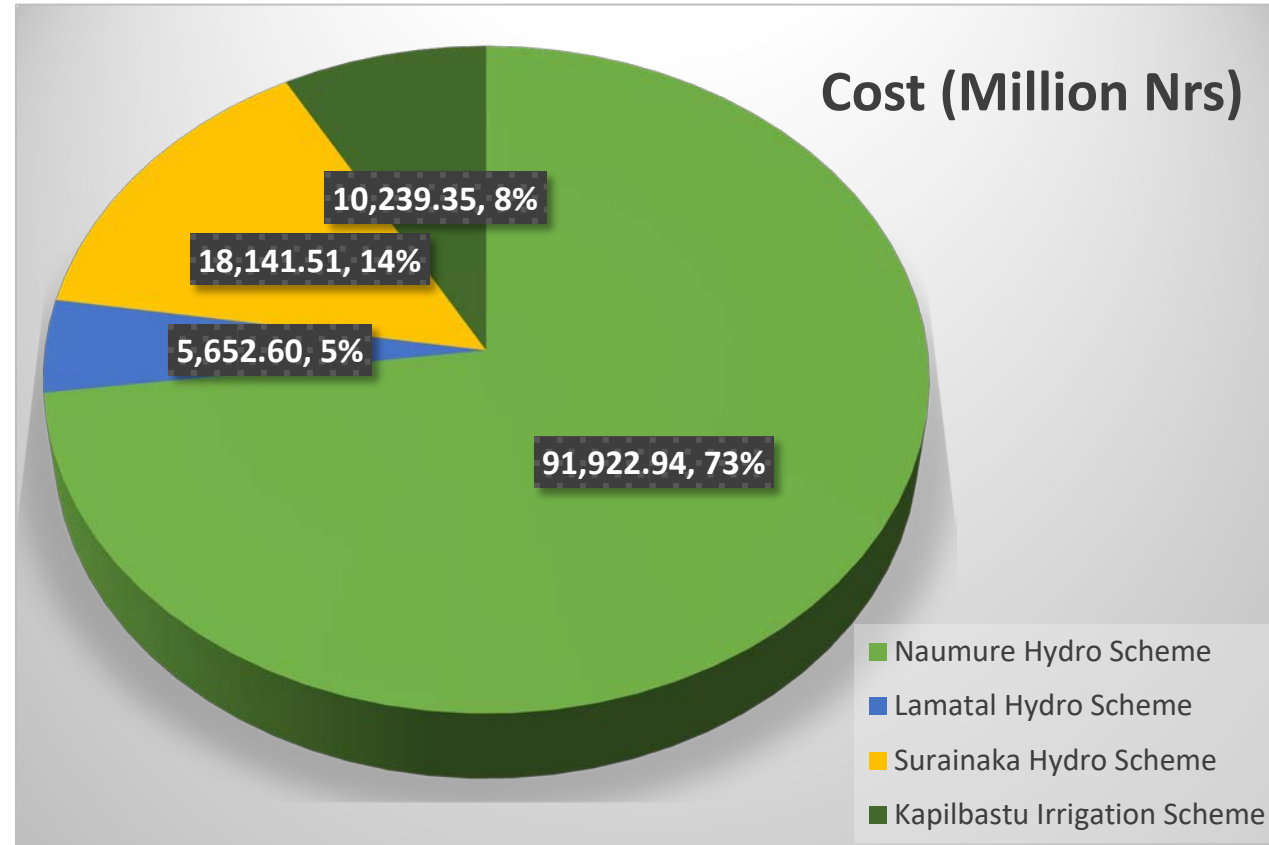
- Divert water from Lamatal HS → 18.2 km long tunnel
- Generates **54.7 MW** electricity
- Design discharge (**Q**) = **41.6 m³/s** , Head = 160m and Tunnel: 18km long, 5.5m finished diameter, Irrigating 29,736 Ha Land



Total Hydropower: 281 MW and total Irrigation (YRI): 83,302 Ha

Financing Modality for Naumure MPP

- Major Cost is for Naumure Dam (73% of Project Cost) – Viability Gap Funding (VGF) can be done to attract private sector for hydropower construction.
- The Lamatal re-regulation barrage, Surainaka diversion tunnel, hydropower and irrigation component can be done by Department of Irrigation.
- **Benefits:** Resources management as a whole can be possible and year round irrigation can be achieved in low government's budget allocation.

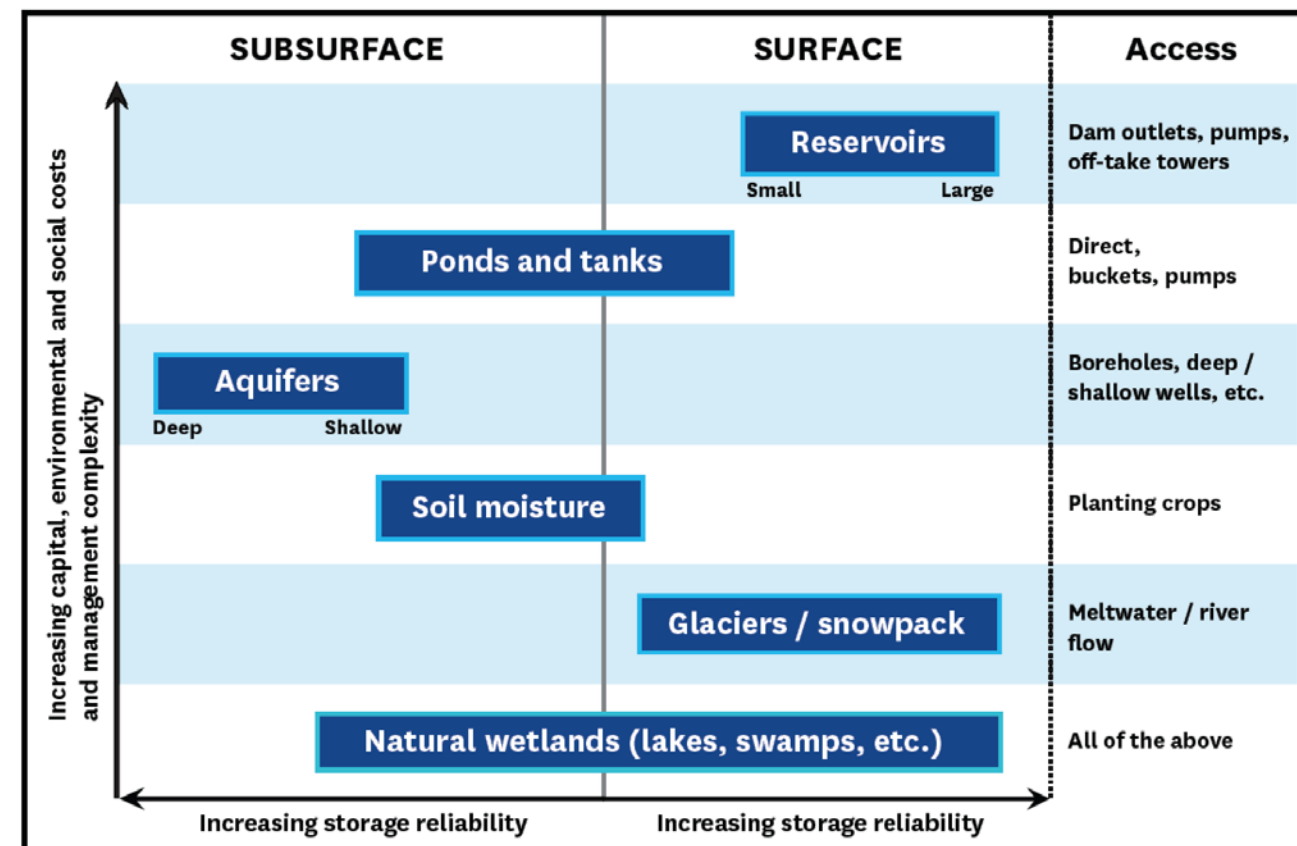
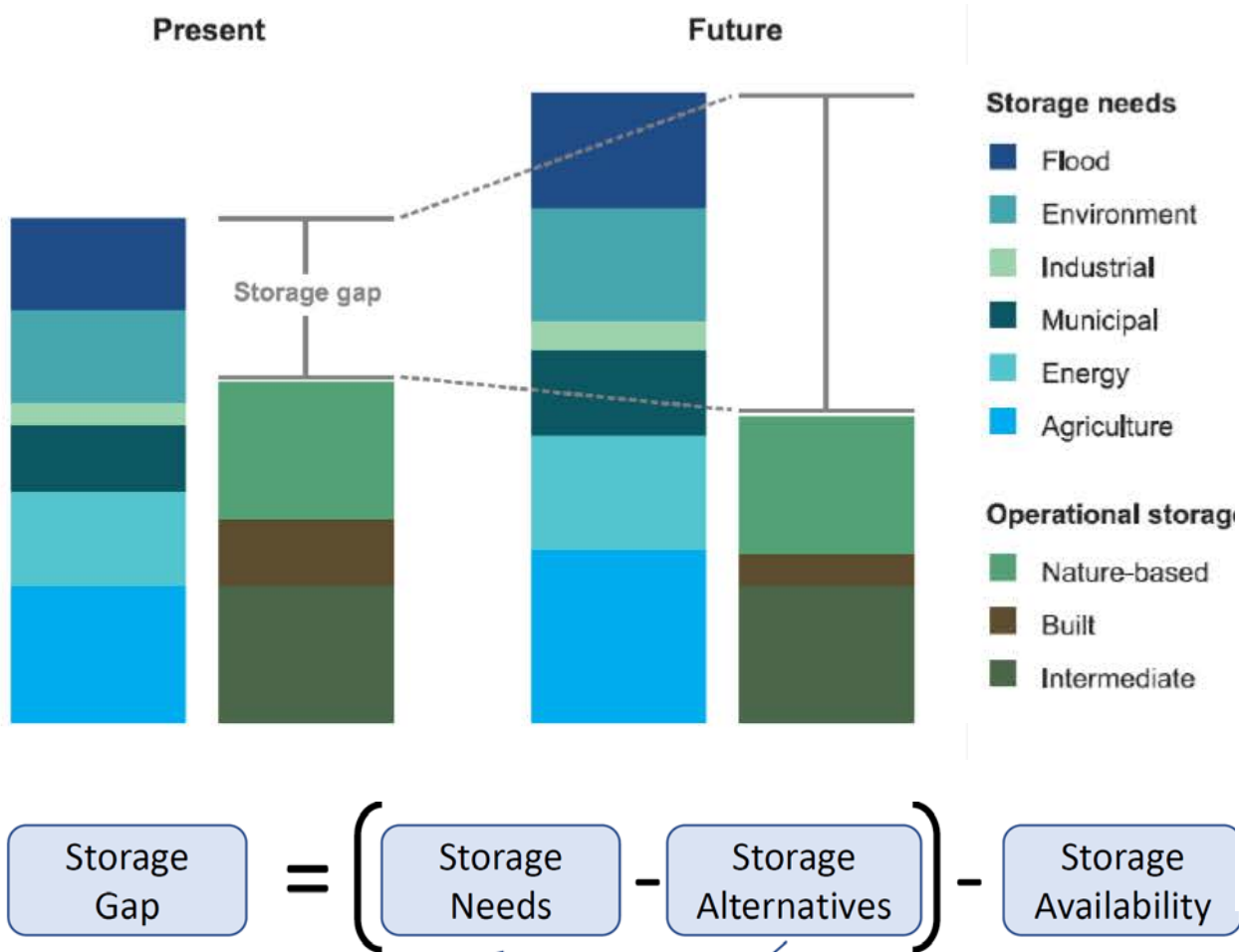


Total Cost of Project = 125,956.39 Nrs Million

Cost of Naumure Hydro scheme = 91,922.9 Nrs Million (73%)

Cost of other d/s components = 34,033.4 Nrs Million (27%)

Different Types of Storage to Meet the Gap



The difference between the amount of water storage needed and the amount of water storage exist for a given time and place (STORAGR GAP) is increasing!

Investment on Storage Projects

- Growing demand for storage system over time to address climate change, population growth, urbanization, and standard of living
- Existing natural storages of freshwater are deteriorating because of siltation, environmental changes and pressure on water and land resources
- Huge potential for different forms of storage; however, Nepal has the lowest dam per capita storage capacity in Asia
- To address climate change impact: more than 80% of cc impact relate to water
- Appropriate solution considering the context of Nepal (temporal and spatial variation in water resource availability (to address too much or too less)
- For Resilience building - most effective : water storage, it addresses both extremes; flood control & dry flow

Investment for sustainability: developing all forms/ types of storage Projects. Investment from Government of Nepal as well as from Multilateral agencies need to be intensified.



Investment on Lift Irrigation Projects

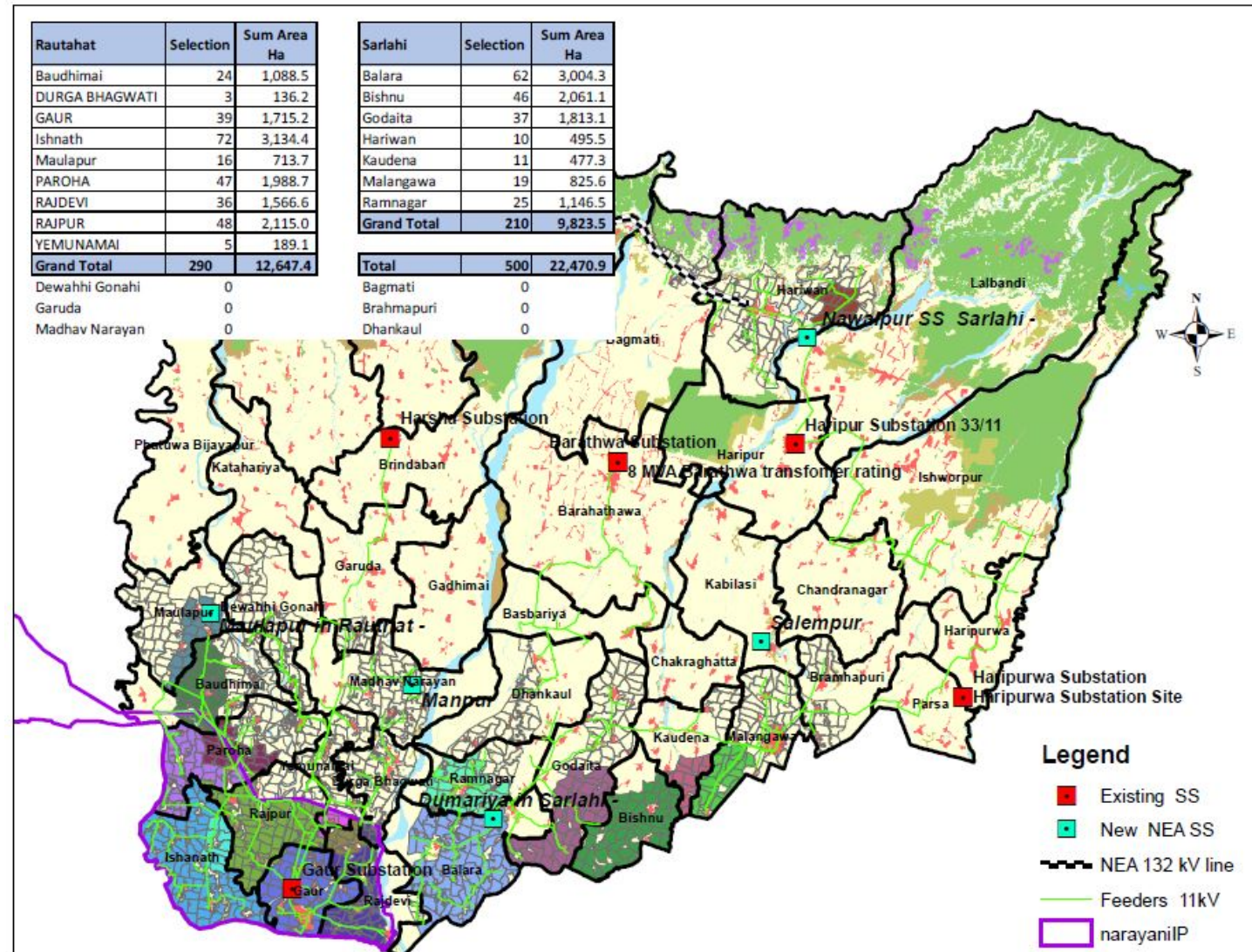
Category	Sloping	Valley/Tar (S1+S2)	Valley/Tars (S3)	Level Terrace (S4)	Total
	Terrance				
Total Hills	206,409	33,653	54,033	127,451	421,546
Total Mountain	80,036	532	4,618	59,306	144,492
Total Hills and Mountains	286,445	34,185	58,651	186,757	566,038

- To develop reliable irrigation in sloping terrace and rivers
- Irrigation Master Plan 2019 identified potential for lift irrigation scheme considering economic Pumping head: 140 m, the minimum flow value chosen was 60 l/s, with is roughly equivalent to a level 3 river
- Lift Irrigation projects shall be implemented by Government of Nepal resources and also taking resources from the support of Multilateral Agencies.



Mechanized Irrigation Innovation Project (MIIP)

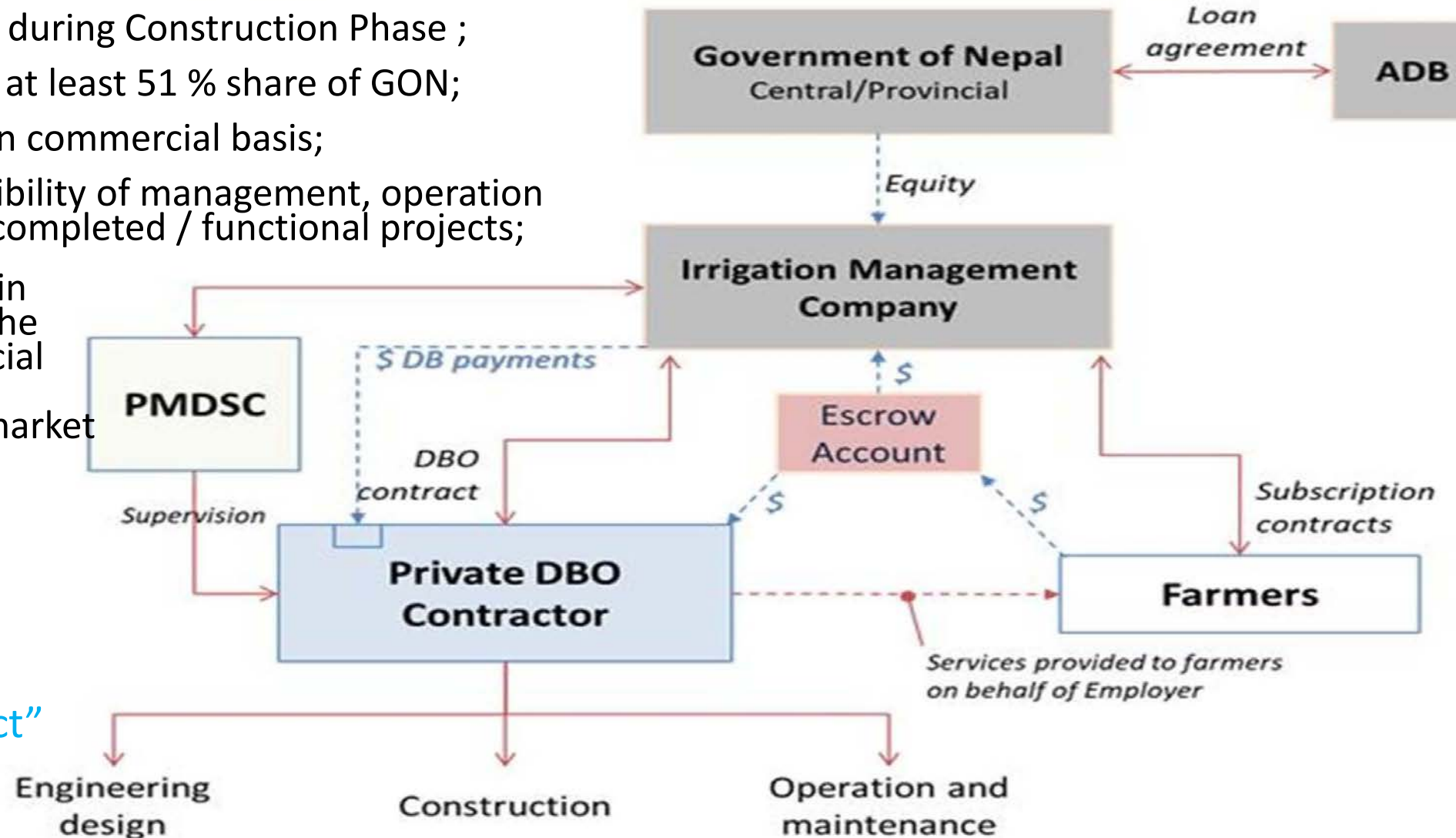
- Provide round the year irrigation facilities to 22,400 ha of irrigable land of Sarlahi and Rautahat
- 500 Deep Tubewells, VFD/VSD pumps
- 900 Km of Distribution System
- 125 Km of Transmission Line (High voltage and Low voltage)
- Smart card
- Prepaid system



Company Model for GW operation MMIP

- Registered under Company Act 2074
- Work as an Employer during Construction Phase ;
- Public Company with at least 51 % share of GON;
- Can run its business in commercial basis;
- Can take the responsibility of management, operation and maintenance of completed / functional projects;
- Engage with farmers in agriculture, provide the facilities for commercial agriculture and assure/manage the market for the produce to promote industrial agriculture

Private sector can be involved through “management contract” for operation of such irrigation system



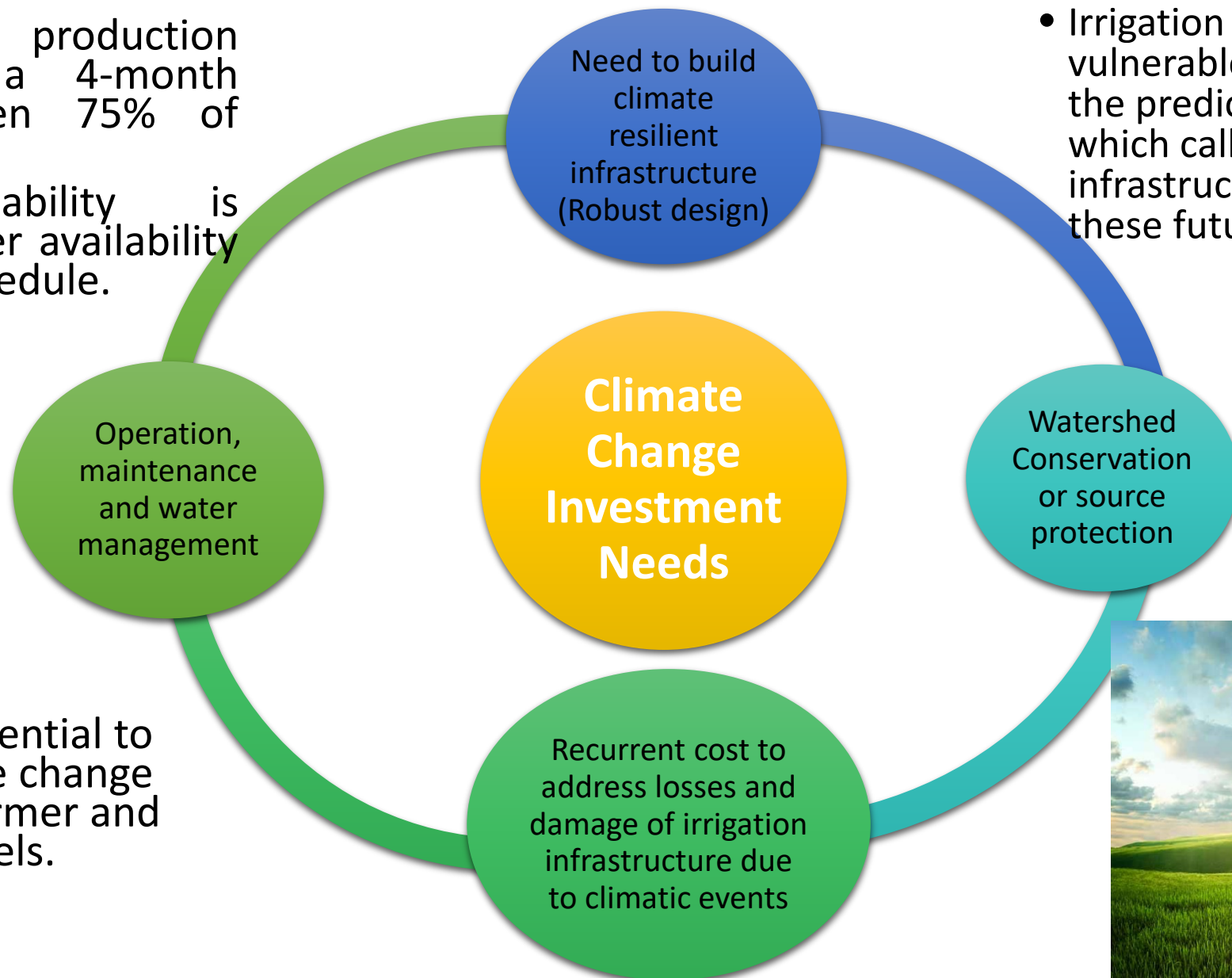
Irrigation Development and Management Board

- Irrigation Development and Management Board shall be establish – for management of large irrigation system
- Irrigation development fund shall be provisioned under the board
- Board shall be involved for the resource generation (PPA with NEA for hydropower generated from multipurpose project and other income)
- Irrigation service shall also be fixed and collected by the board
- The resources shall be mobilized for the operation and maintenance of the irrigation system
- Irrigation development and Management Board shall be instrumental for sustainable resources generation, operation and maintenance of the irrigation systems.

Climate change impact and irrigation investment

- Agriculture production depends on a 4-month monsoon, when 75% of annual rain falls.
- Climate variability is decreasing water availability and farming schedule.

- Irrigation systems will be more vulnerable in the future under the predicted climate scenarios, which calls for more resilient infrastructure that can absorb these future shocks.



**Climate Resilient
Irrigation and
agricultural Practices**

- It is equally essential to address climate change resilience at farmer and community levels.



Climate Resilient Irrigation Practices

FMIS

Suffer from inadequate infrastructure and inefficient seasonal intakes,
Seepage in conveyance system,
Recurrent damage due to landslides and flood, and
Lack of knowledge among farmers in construction and optimized

AMIS

Recurrent damage due to landslides and flood
Suffers from shifting river morphology,
High flood entering the system, and
High sedimentation.

Climate Resilient Irrigation Practices

Climate Smart Irrigation Infrastructures

Maximizing water diversion through improved intakes.
Securing water through pumping.
Piped supply minimizing evaporation loss will ensure water security.
Storage of water for irrigation purpose.
Increase in water use efficiency.

Agricultural Practices

Agriculture technologies and management initiatives to boost productivity and climate resilience .
Development of more efficient on farm irrigation systems including micro-irrigation .
Research on climate resilient and adoptable crop varieties.
Crop Diversification.

Way Forward

- Completion of the under-construction to rationalize the benefit at the earliest and project to raise confidence optimizing the allocated resources;
- Increasing investment for sustainable irrigation system in all three tier of governments;
- Public private partnership for development of Multipurpose project (PPA can be done for hydropower) : For two under-construction project – operation and maintenance company and for others development and operation company (with Viability Gap Funding if required);
- Company model for cluster mode GW development and involving private sector in “Management Contract” model for operation of the system;
- Irrigation development and management board for resources management, sustainable operation and maintenance of the irrigation system;
- Different Investment option to be made for different projects to meet the investment need for sustainable irrigation development and management in Nepal.

Thank You!