

सिंचाइ विकास गुरुयोजना, २०१८

प्रदेश स्तरीय प्रस्तुती एवं छलफल कार्यक्रम

प्रदेश नं. ५
मिती २०७५।१०।२२

पृष्ठभूमि

- सिंचाइ विभागले सन् १९९० मा पहिलो गुरुयोजना तयार गरेको २५ वर्ष भन्दा बढी भएको
- यो अवधीमा सिंचाइका धेरै कार्यक्रम संचालन भएकोले सिंचाइ विकासको अवस्था अध्यावधिक गर्न आवश्यक भएको
- राज्यको समेत राजनितिक एवं संरचनागत परिवर्तन भएको
- विज्ञान प्रविधीको विकास संगै सिंचाइ एवं कृषि विकासको नयाँ सम्भावनाहरु देखिएको ।
- सिंचाइ सम्बन्धी सूचनाहरु आधुनिक कम्प्युटर प्रणालीमा रुपान्तरण अपरिहार्य भएको
- जनसंख्या वृद्धी संगै परिवर्तन भएको भूउपयोग एवं कृषि उत्पादनका आवश्यकताहरु थग्न सक्ने गरि आगामी वर्षहरुमा अवलम्बन गर्नु पर्ने मार्ग निर्दिष्ट गर्न आवश्यक भएको

पृष्ठभूमि

- एशियाली विकास बैंक तथा नेपाल सरकार बीच Water Resources Project Preparatory Facility सम्बन्धी सम्झौता भएको
 - सम्झौता मिति: २ नवम्बर २०१२
 - एडिबी को अनुदान रकम: ११ मिलियन डलर
 - नेपाल सरकार: २.८ मिलियन डलर
- उद्देश्य
 - उच्च प्राथमिकताका जलस्रोत योजनाहरुको सम्भाव्यता अध्ययन, योजना तयारी
 - सिंचाइ विभाग तथा जल उत्पन्न प्रकोप नियन्त्रण विभाग सुदृढीकरण
 - सिंचाइ गुरुयोजना १९९० लाइ पुनरावलोकन गरि अध्यावधिक गुरुयोजना तयारी
 - योजना व्यवस्थापन

पृष्ठभूमि

- सिंचाइ गुरुयोजना तयारीको लागि सिंचाइ विभाग तथा परामर्शदातृ Lahmeyer International in Association GmbH (Germany) with Total Management Services Pvt.Ltd. And NIRAS A/S (Denmark) बीच ३० नभेम्बर २०१५ मा सम्झौता सम्पन्न ।
- कार्यारम्भ मिति: १० जनवरी २०१६
- करार अवधि: ३६ महिना (२ महिना म्याद थप)

अपनाइएका प्रकृया

NIRAS LAHMEYER INTERNATIONAL

TAAS

- उपलब्ध भूमिश्रोत आँकलन
- उपलब्ध जलश्रोत आँकलन
- सिंचाइ योजना /कार्यक्रमहरूको कार्यान्वयन स्थितीको पुनरावलोकन एवं सूचना प्रणालीलाइ अध्यावधिक
- सिंचाइ क्षेत्र सम्बन्धित निति, ऐन, नियमहरूको पुनरावलोकन एवं परिमार्जनका सुझाव
- सिंचाइ क्षेत्रको संस्थागत व्यवस्थाको पुनरावलोकन एवं परिमार्जनका सुझाव
- सम्भावित योजनाहरूको पहिचान, प्रारम्भिक लागत अनुमान एवं प्राथमिकिकरण
- आगामी योजनाहरू कार्यान्वयनको कार्यतालिका
- तयार भएका प्रतिवेदनहरूमा छलफल, सुझाव संकलन एवं क्रमिक परिमार्जन

© Lahmeyer International GmbH 2018



5

जलाधार क्षेत्रको वर्गीकरण

NIRAS LAHMEYER INTERNATIONAL

TAAS

- गुरुयोजना तयारीकोलागि देशलाइ ३ वटा जलाधारको रूपमा लिइयो
 - कर्णाली बेसीन (महाकाली, बबइ र पश्चिम राप्ती, चुरे समेत)
 - नारायणी बेसीन (चुरे समेत)
 - कोशी बेसीन (बागमती, कमला, कन्काइ, मेची, चुरे समेत)

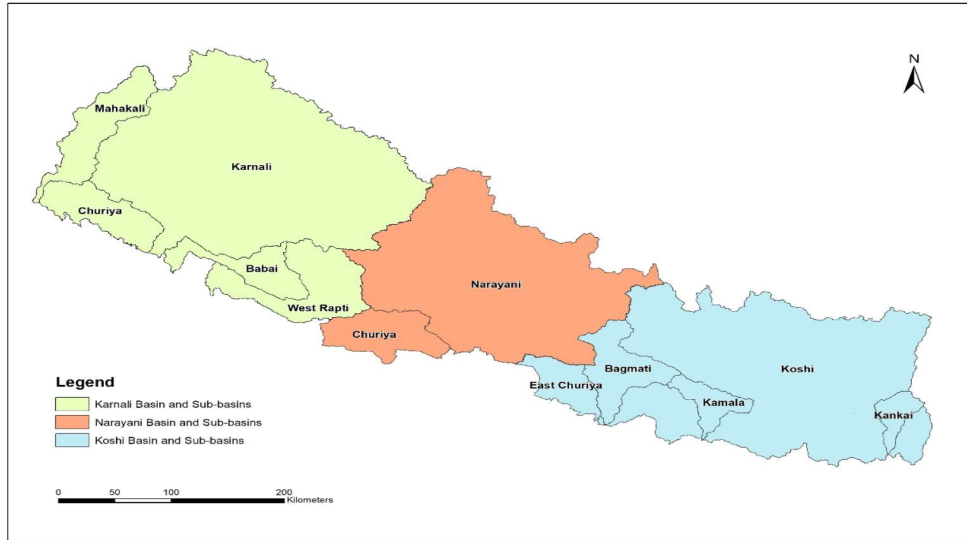
Basin	Area (km ²)	Pop (M)	District (#)	Sub-basin (#)
Karnali	50,529	6.10	24	4
Narayani	40,469	6.58	21	2
Koshi	57,023	13.81	30	5
Total		26.49	75	11

© Lahmeyer International GmbH 2018



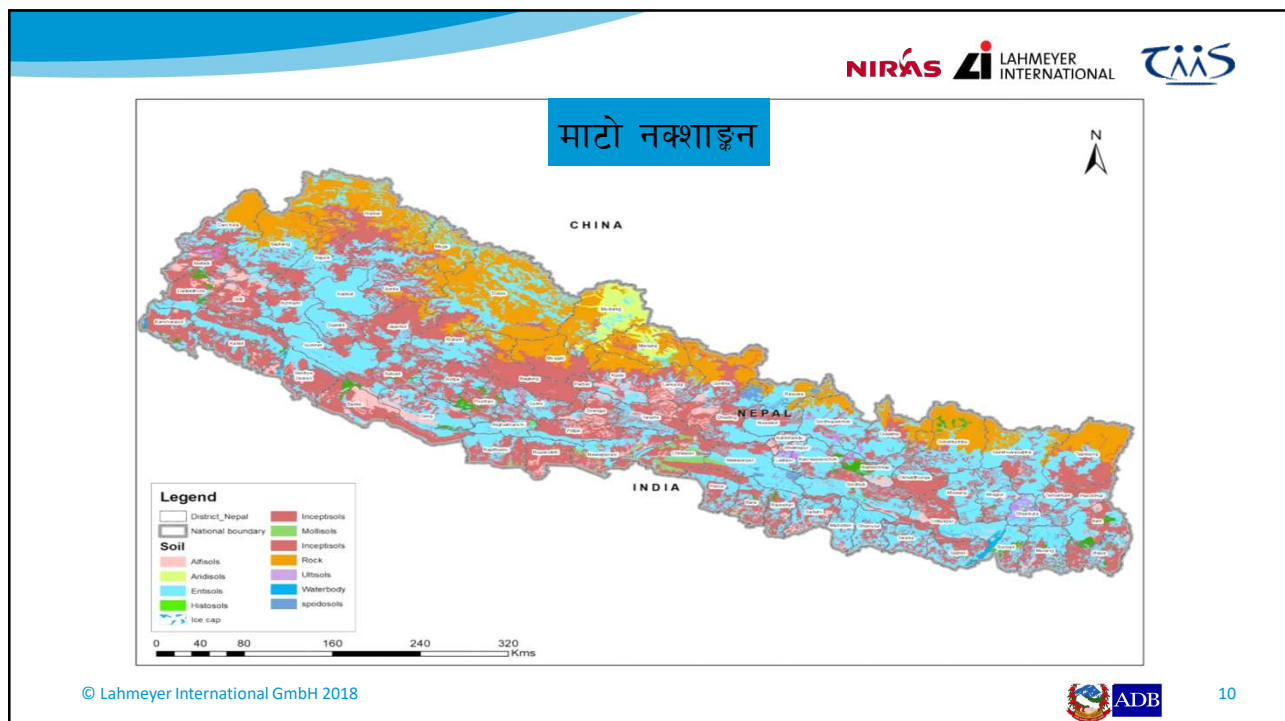
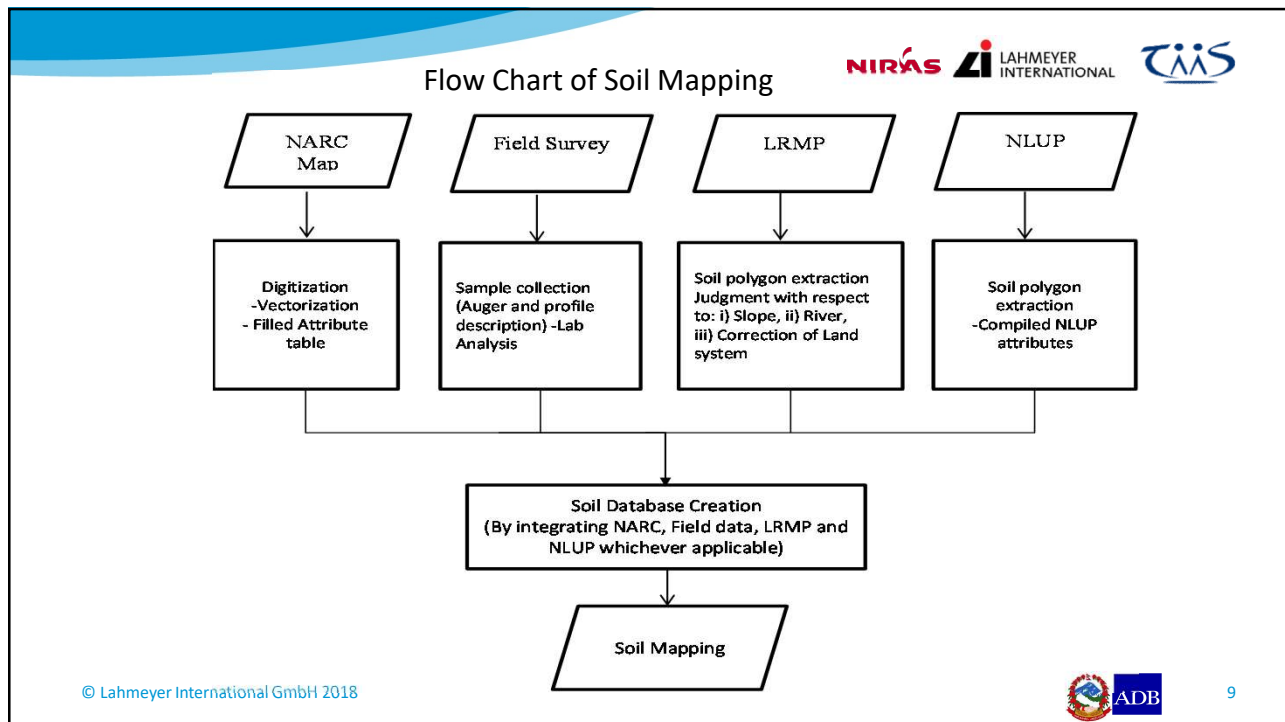
6

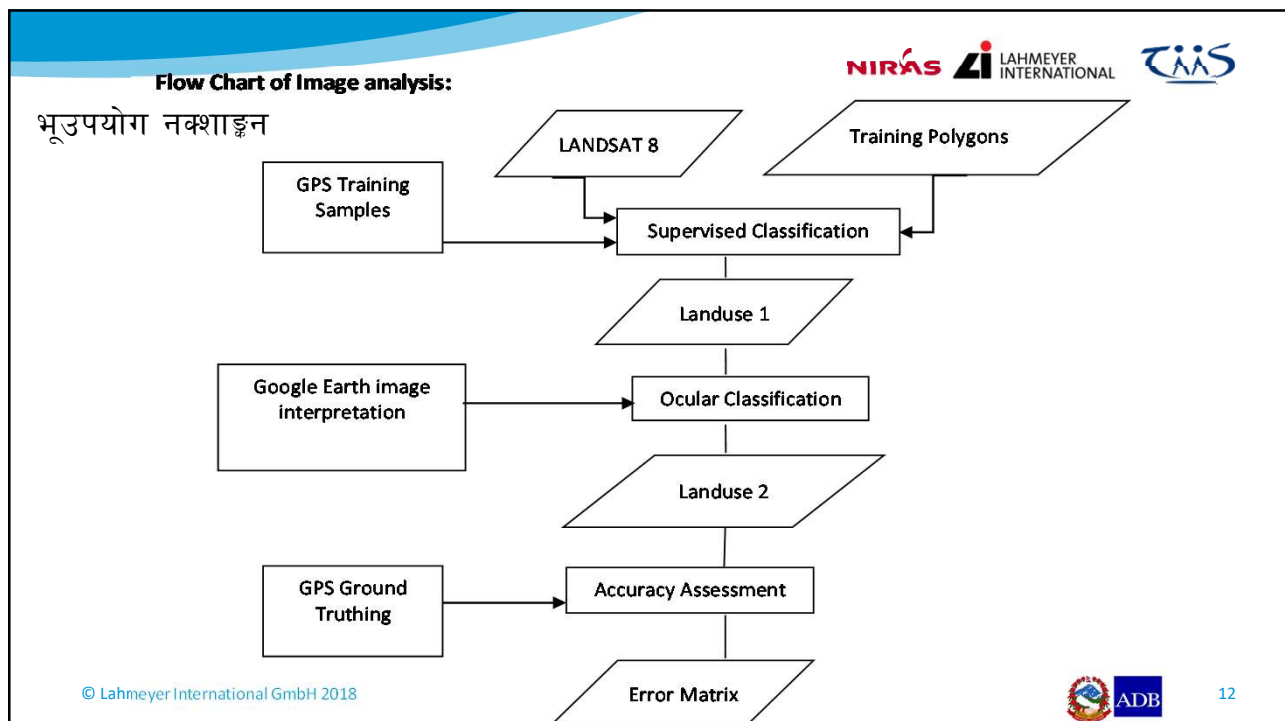
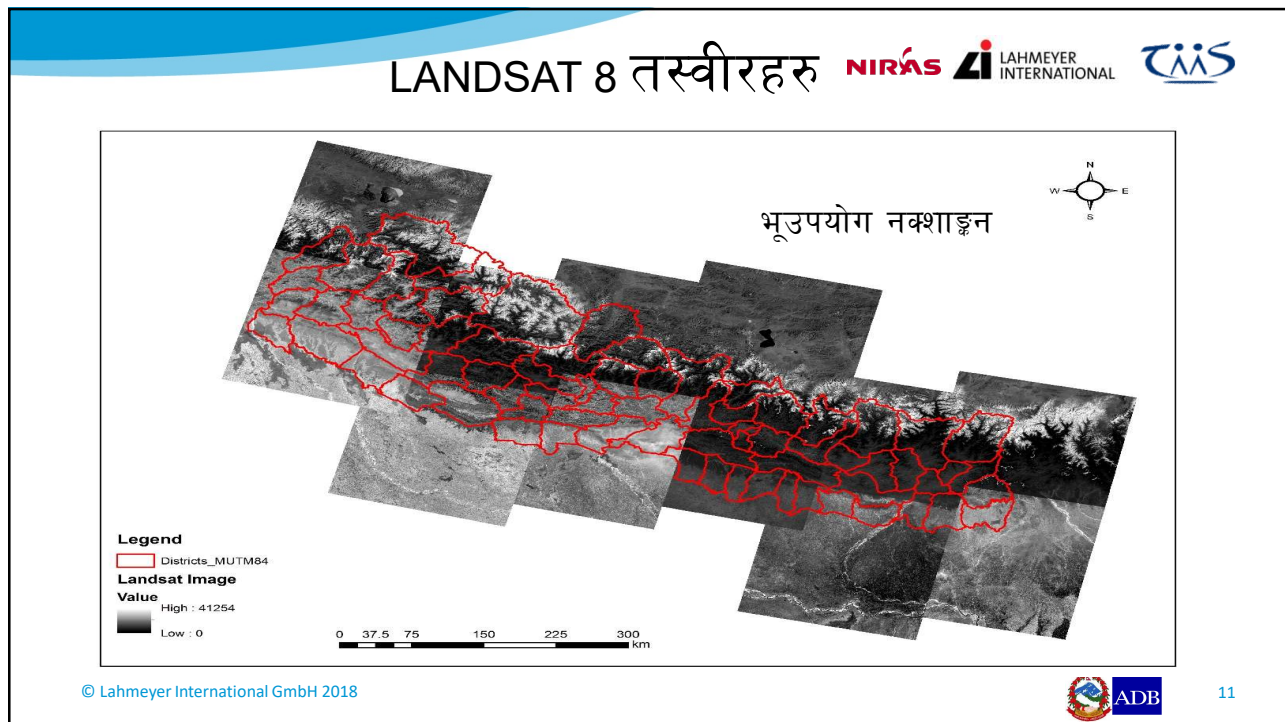
जलाधार क्षेत्रको वर्गीकरण



भूमिश्रोत आँकलन

- माटो नक्शाङ्कन
- भूउपयोग नक्शा तयारी
- कृषि क्षेत्रको नक्शाङ्कन (वन, आवादी, जल क्षेत्र, बगर एवं चट्टान आदि समेत)
- सम्भावित सिंचाइ योग्य क्षेत्रको पहिचान एवं नक्शाङ्कन
- DEM नक्शा तयारी





भूउपयोग वर्गीकरण



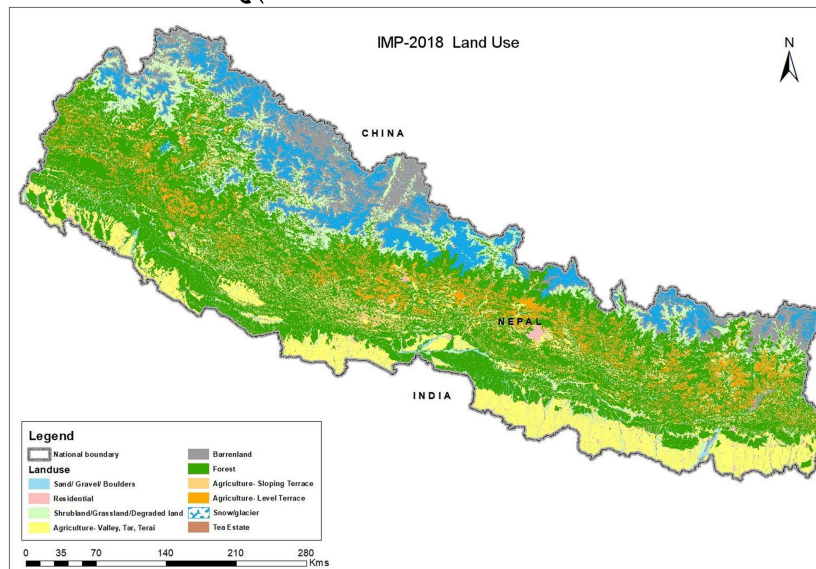
IMP-2018	LRMP-1986
Agriculture- Level Terrace	Level Terraces
Agriculture- Sloping Terrace	Sloping Terraces
Agriculture- Valley, Tar, Terai	Drylands
	Mixed Lands
	Tars, Alluvial fans, Foothslopes
	Valley Floors
Barrenland	Wetlands
	Rock
Forest	Coniferous
	Hardwoods
	Mixed Forest
	Protection Forest, Coniferous, Mixed, Shrub, Hardwoods
Residential	Urban Area
River/Water body	Lake
	Sand/Gravel/Boulders
Shrubland/Grassland	Grazing Lands
	Shrub
Snow/Glacier	Perpetual Snow & Ice

© Lahmeyer International GmbH 2018



13

भूउपयोग नक्शा



© Lahmeyer Inte



14

भूउपयोग क्षेत्रफल

Basin Area (ha)	Agriculture - Level Terrace	Agriculture - Sloping Terrace	Agriculture - Valley, Tar, Terai	Total Agricultural	Barrenland	Forest	Residential	River/water body	Shrubland/Grassland	Snow/Glacier
Total IMP-2018	1,035,758	679,559	1,846,005	3,561,322	1,456,608	6,419,242	130,776	353,406	1,512,000	1,345,703
Total LRMP-1986	1,213,860	914,940	1,863,477	3,992,277	1,950,381	5,646,411	12,059	228,295	2,412,844	536,796
Change	-0.15	-0.26	-0.01	-0.11	-0.25	0.14	9.84	0.55	-0.37	1.51

- केन्द्रीय तथ्याङ्क व्युत्पत्ति अनुसार व्यक्तिगत जग्गा : 2,525,639 ha, कित्ता 12096417
- LRMP नक्शा १९८६ मा तयार भएको
- राष्ट्रिय बन इन्भेन्ट्री योजनाले १९९४ मा भूउपयोग आँकलन गरेको ।

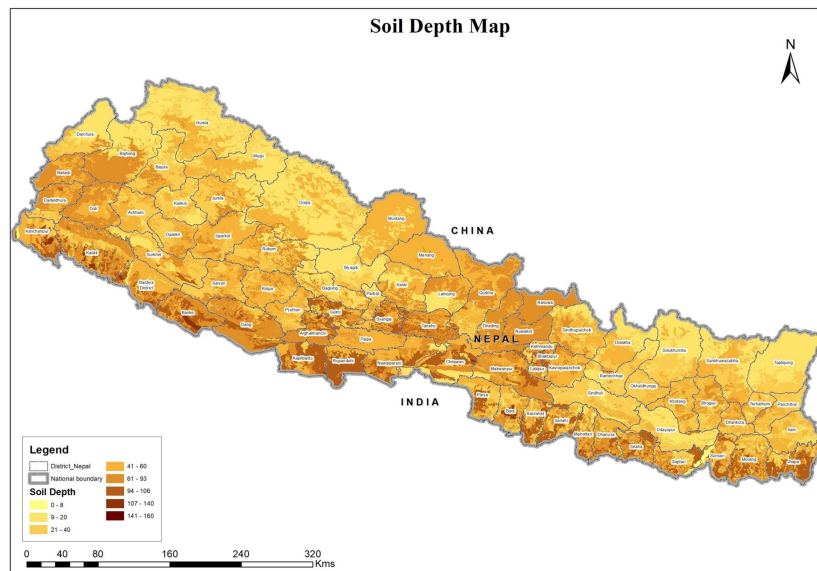
Table 2: Changes in Nepal's Land Use/Land Cover in between 1979 and 1994

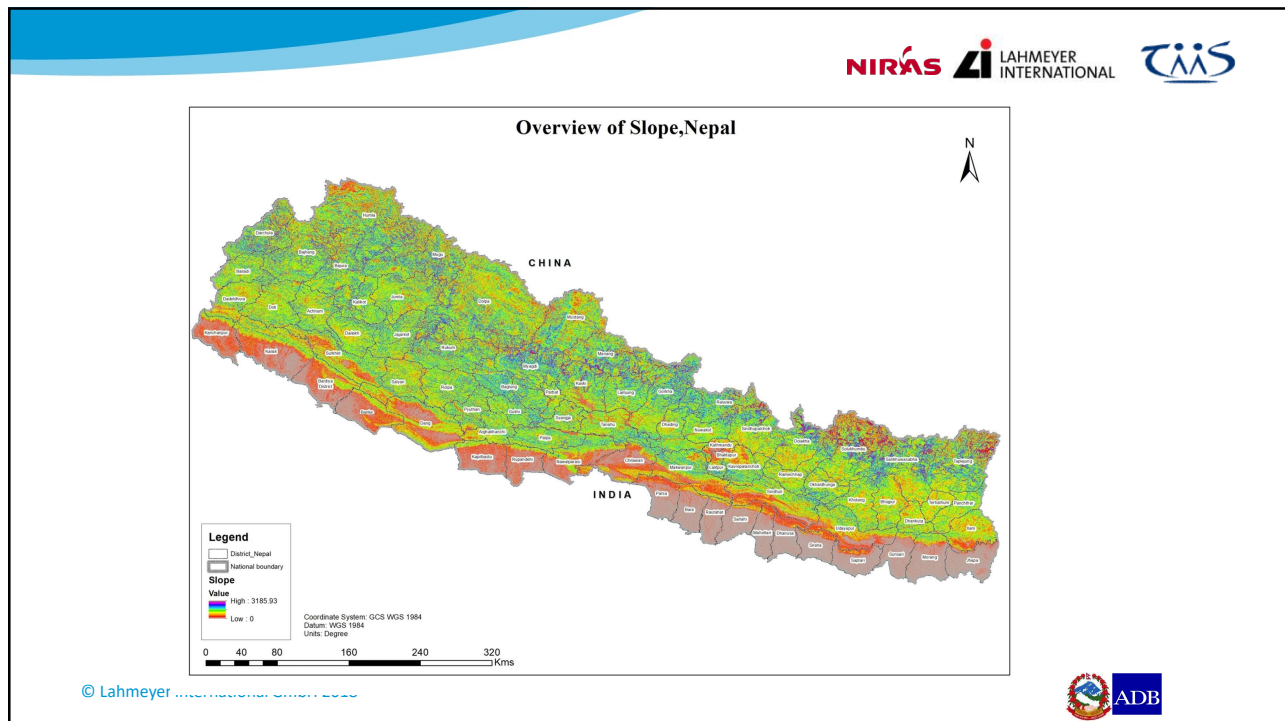
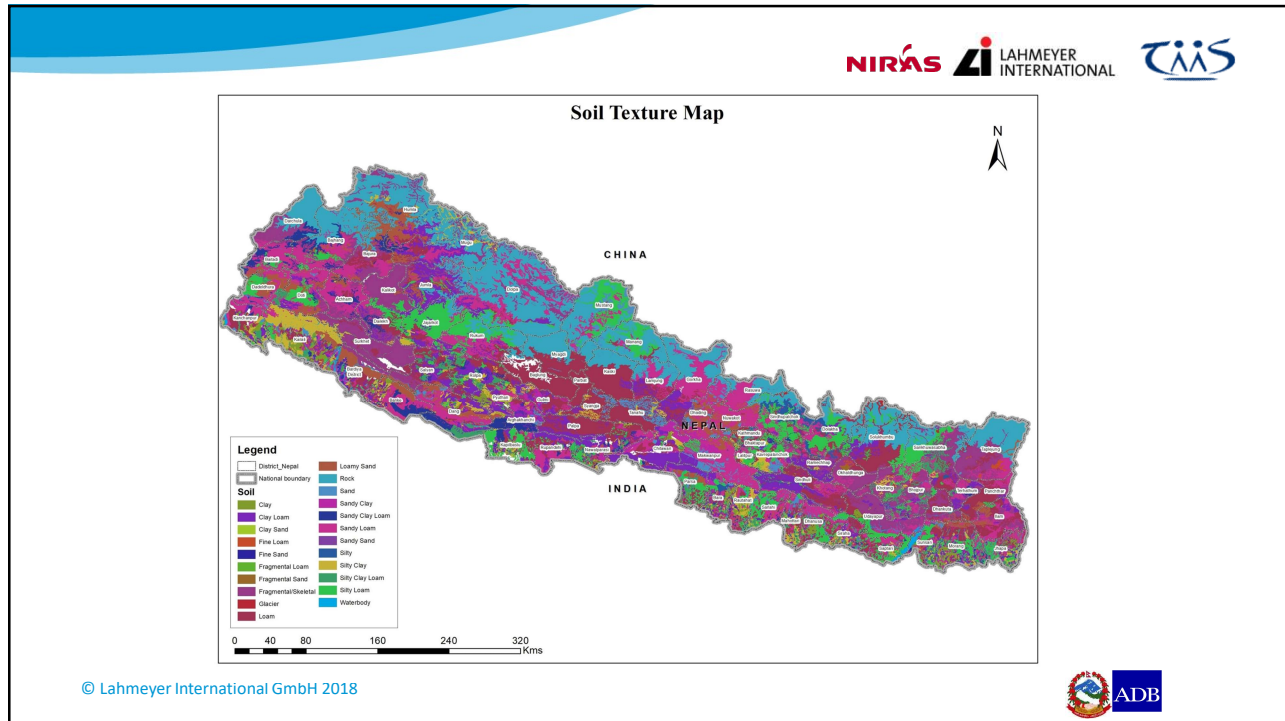
Category	1978/79 (LRMP)		1994 (NFI)		% Change, 1979-1994	
	Area (000 ha)	%	Area (000 ha)	%	Total	Annual
Cultivated	2,969.4	20.1	3,090.8	21.0	4.1	0.3
Non-cultivated	986.9	6.7	1,030.4	7.0	4.4	0.3
Forest	5,612.4	38.1	4,268.2	29.0	-24.0	-1.6
Shrubland	694.0	4.7	1,560.1	10.6	124.8	8.4
Grassland	1,755.9	11.9	1,766.2	12.0	0.6	0.0
Water	N/A	N/A	382.7	2.6	N/A	N/A
Other	2,729.8	18.5	2,619.8	17.8	-4.0	-0.3
Total	14,748.4	100.0	14,718.1	100.0		

Table 4: Estimated coverage by different types of wetlands




Wetland Type	Estimated Coverage	
	Area (ha.)	%
Rivers	395,000	48.2
Lakes	5,000	0.6
Reservoirs	1,500	0.2
Ponds	7,277	0.9
Marginal swamps	12,500	1.5
Irrigated paddy fields	398,000	48.6
Total	819,277	100.0

Source: Directorate of Fisheries Development (DOFD; 2012)




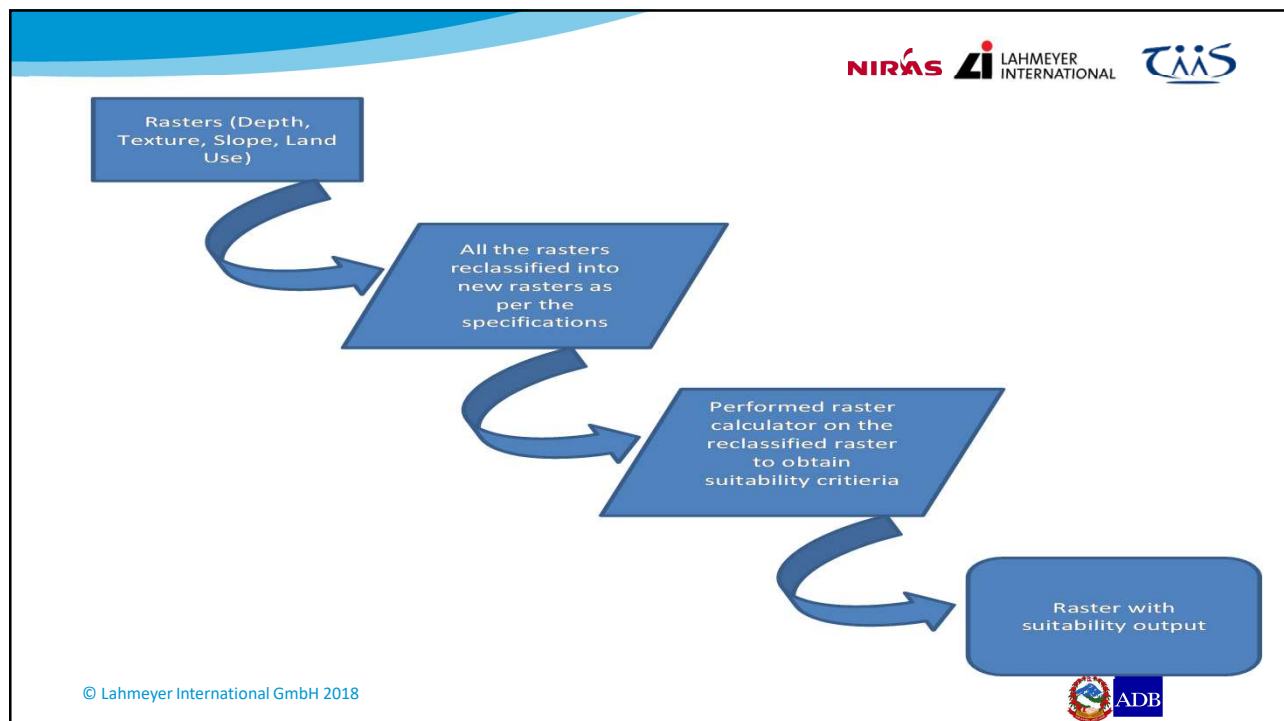


सिंचाई योग्य भूमि वर्गिकरणको आधार

SN.	Soil criteria	Unit	S1	S2	S3	S4	Not Suitable
1	Effective depth	cm	>90	60 – 90	30 – 60	>30	<30
2	Texture	Textural group	SL, SiCl, Sil, CL, L, SCL	SC, Si	S, SiC, LS	S1-S3	Cv, Cm, SiCm, gravel, G
3	Slope	%	<3	3 – 10 Progressive Terrace	10 – 25 Radical Terrace	25-60	>25
4	Land Use		Arable, (Degraded Forest Separate category)				Urban, river channels, permanently flooded land, National Forest conservation or protected areas, sloping terrace
5	Surface Irrigation		Suitable for surface irrigation system			Not suitable for surface irrigation	
5	Piped Irrigation		A Special category meeting the above criteria, upto 200 m above river bed and /or within 5 km radius of water source.				

 21



सिंचाइ योग्य क्षेत्रफल (हेक्टर)

NIRAS LAHMEYER INTERNATIONAL

TAIS

Suitability	SN	Narayani	Koshi	Karnali	Total
NS	1	400,521	468,672	418,495	1,287,688
S1	2	6,816	490,628	73,034	570,477
S2	3	249,018	114,982	116,133	480,133
S3	4	86,476	300,033	199,739	586,248
Total S1-S3	5	342,310	905,642	388,906	1,636,859
S4	6	208,775	237,062	182,783	628,620
Total S1-S4	7	551,085	1,142,705	571,689	2,265,479
Agricultural	8	951,606	1,611,377	990,184	3,553,167

Note:

1 Not suitable, mainly Sloping Terrace

2 S1 Highly Suitable,

3 S2 Moderately Suitable

4 S3 Marginally Suitable

5 Sum of 1 to 3

6 S4 Steep Level Terrace Suitable

7 S1-S4 Sum of all suitable land

8 Sum of 1+2+3+4+6 = Total Agricultural

© Lahmeyer International GmbH 2018



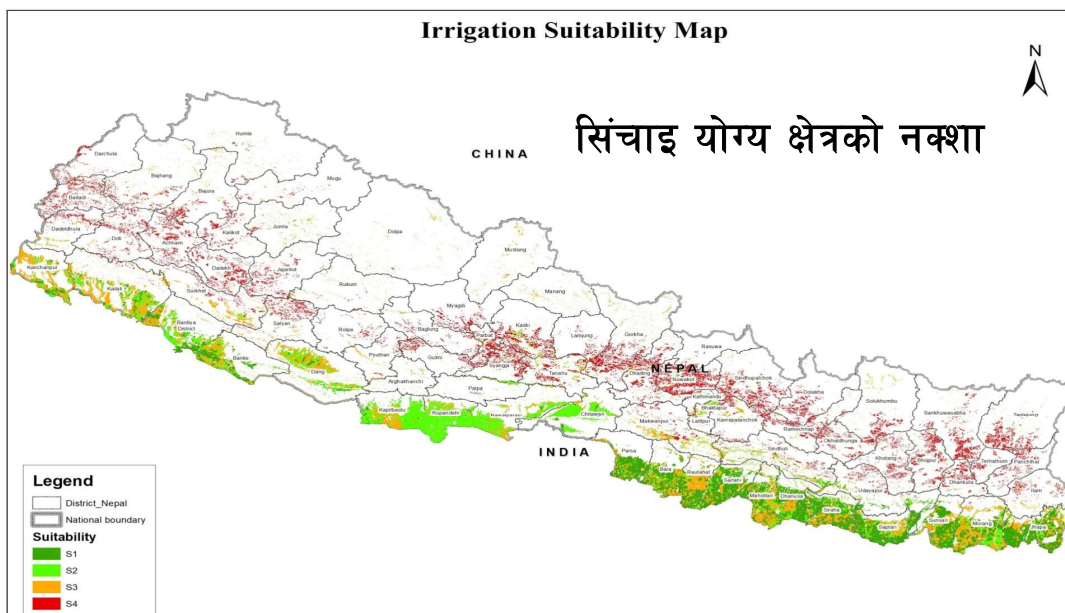
D5 – LRM

Determination of Irrigable Land

NIRAS LAHMEYER INTERNATIONAL

TAIS

Irrigation Suitability Map



गुरुयोजना १९९० र २०१८ को सिंचाइयोग्य क्षेत्रफलको तुलना

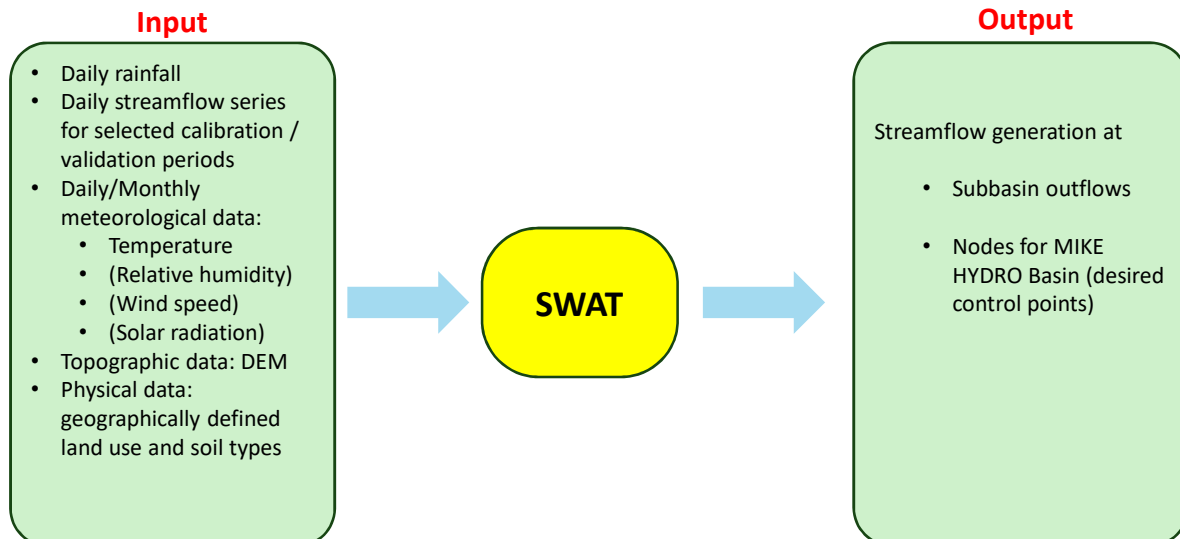
Potential Irrigable Land (ha)	IMP-2018			IMP-1990		
	Agric.	Non Agric.	Total	Agric.	Non Agric.	Total
TERAI DISTRICTS	1,479,768		1,479,768	1,520,555	465,320	1,985,875
HILL DISTRICTS	626,513		626,513	537,763	6,404	544,167
MOUNTAIN DISTRICTS	159,198		159,198	95,398	1,637	97,035
TOTAL FOR ALL DISTRICTS	2,265,479		2,265,479	2,153,716		2,153,716
Non-Agricultural Total		666,943			473,361	
TOTAL FOR ALL DISTRICTS			2,932,422			2,627,077

Note: Non-Agriculture land for IMP-2018 Estimated using IMP-1990 maps and interpretation

© Lahmeyer International GmbH 2018

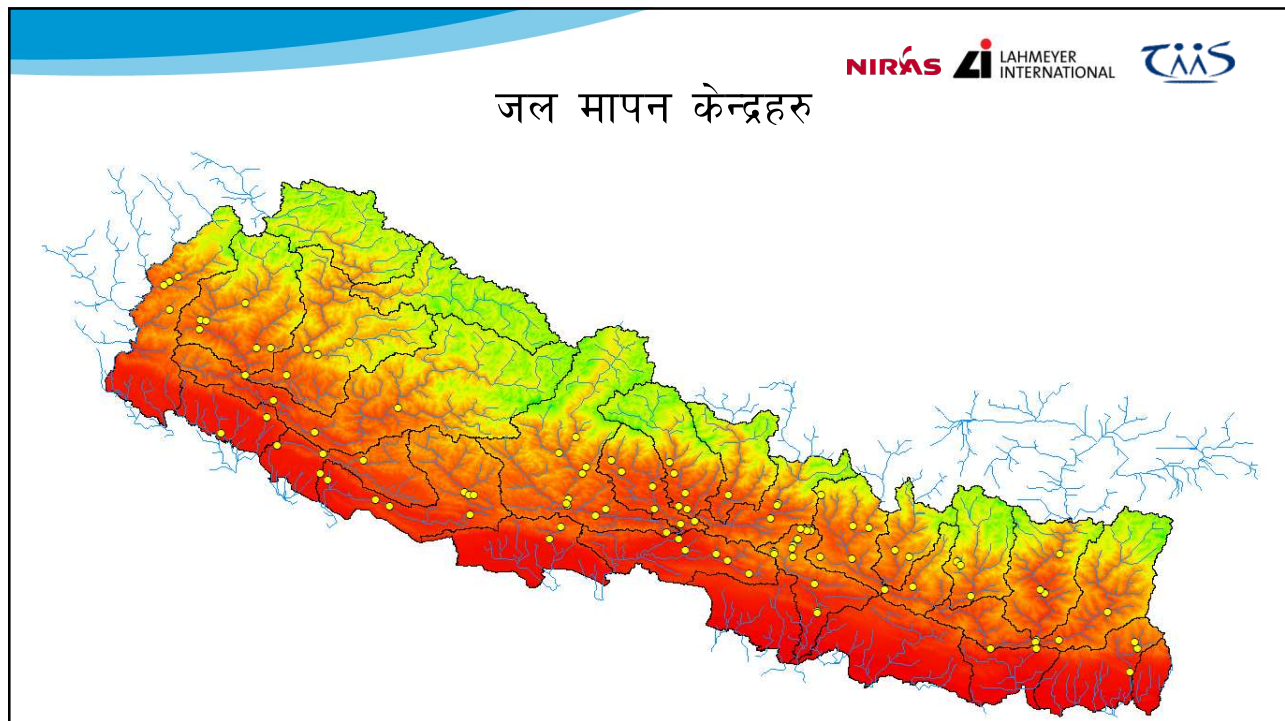
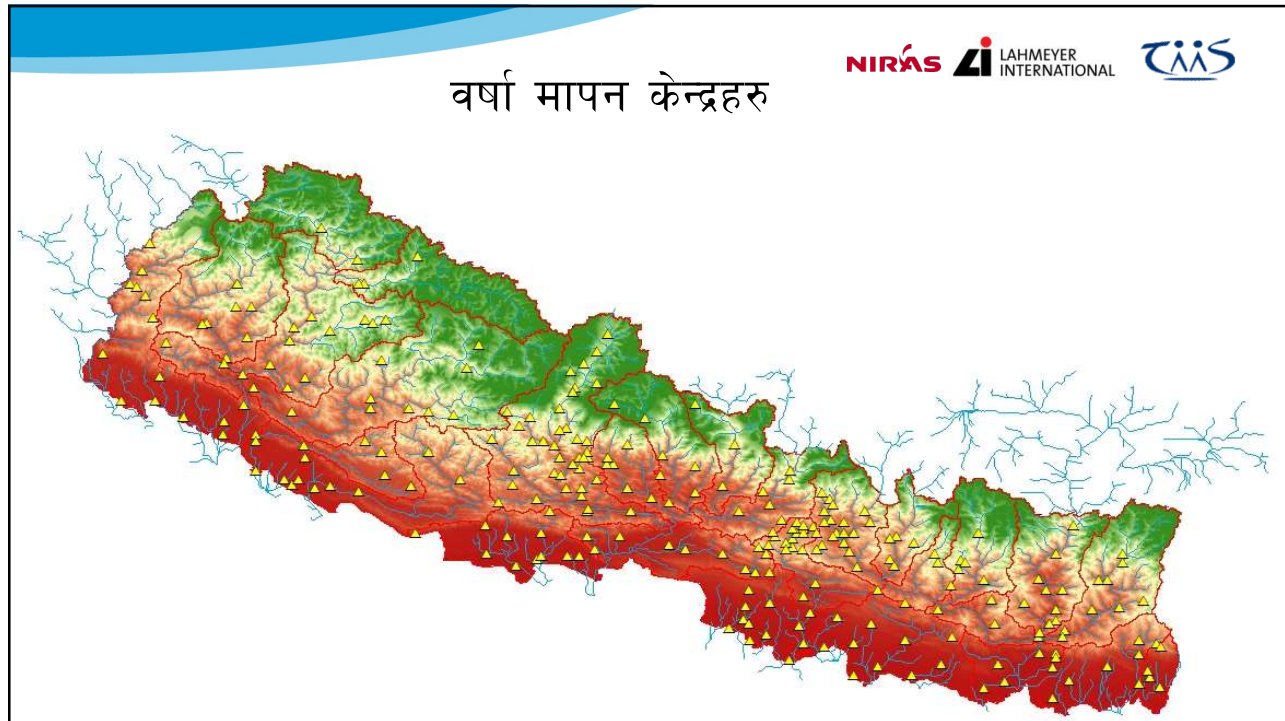


सतहगत जलश्रोत आँकलन

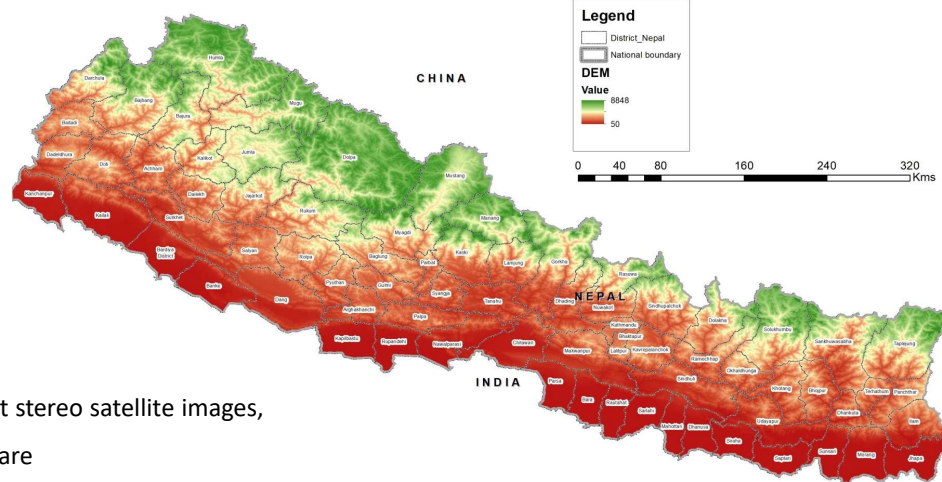


© Lahmeyer International GmbH 2018





Digital Elevation Model (DEM)



- From 2.5 m Cartosat stereo satellite images,
- Using ERDAS software

SWAT MODELS

9 SWAT Models:

- Mahakali (IWMI)
- Karnali-Mohana (IWMI)
- Koshi (ICIMOD)
- Babai
- West Rapti
- West Churia
- Narayani
- East Churia
- Koshi
- Kankai



SUMMARY OF SWAT MODEL SET-UP

Basin	DEM	Soil	Landuse	Rainfall data	Model Period	Warmup Period
Kankai	SRTM 30m	IMP 2018	IMP 2018	DHM, CFSR	1979-2010	3
Koshi (ICIMOD)	SRTM 90m	SOTER	ICIMOD	DHM, CFSR, TRMM, IMD	1979-2010	3
East Churiya	SRTM 90m	IMP 2018	IMP 2018	DHM, CFSR	1979-2010	3
Narayani	IMP 2018	IMP 2018	IMP 2018	DHM, CFSR, TRMM	1979-2010	3
West Rapti	IMP 2018	IMP 2018	IMP 2018	DHM, CFSR	1979-2010	3
Babai	IMP 2018	IMP 2018	IMP 2018	DHM, CFSR	1979-2010	3
Karnali (IWMI)	ASTER 30m	SOTER	IWMI	DHM	1980-2013	5
Mahakali (IWMI)	ASTER 30m	SOTER	IWMI	DHM	1980-2013	5
West Churiya	SRTM 90m	IMP 2018	IMP 2018	DHM	1979-2010	3

© Lahmeyer International GmbH 2018

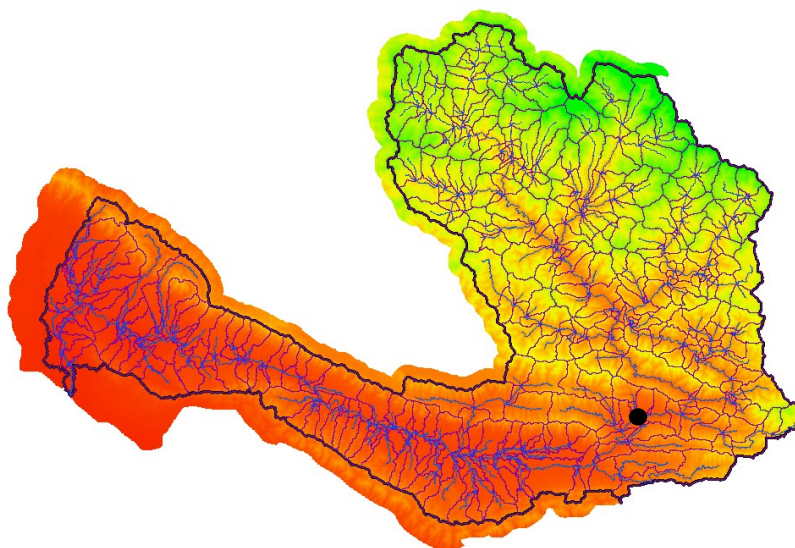


SOME RESULTS – WEST RAPTI

Calibration Bagasotigaun (350)

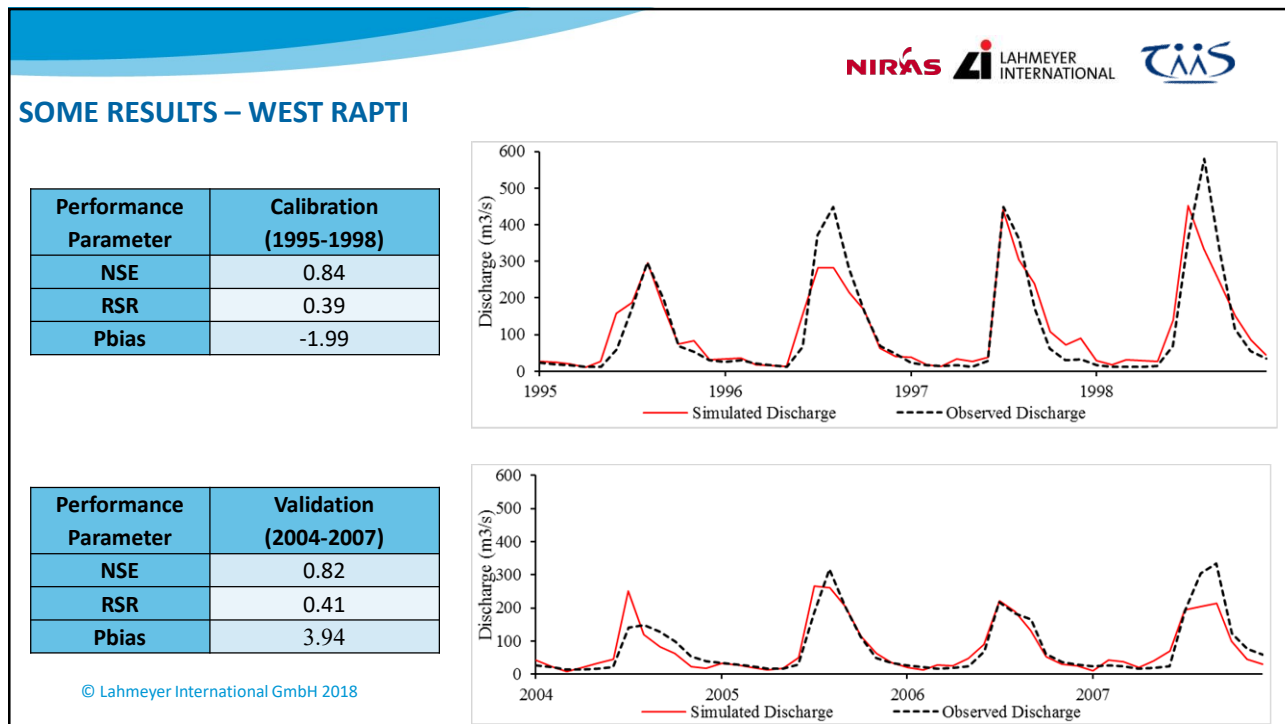
Elevation 381 m asl


- Basin area 3380 km²
- Measuring Period
1976 to 2007
- DHM Data Quality: Good



© Lahmeyer International GmbH 2018








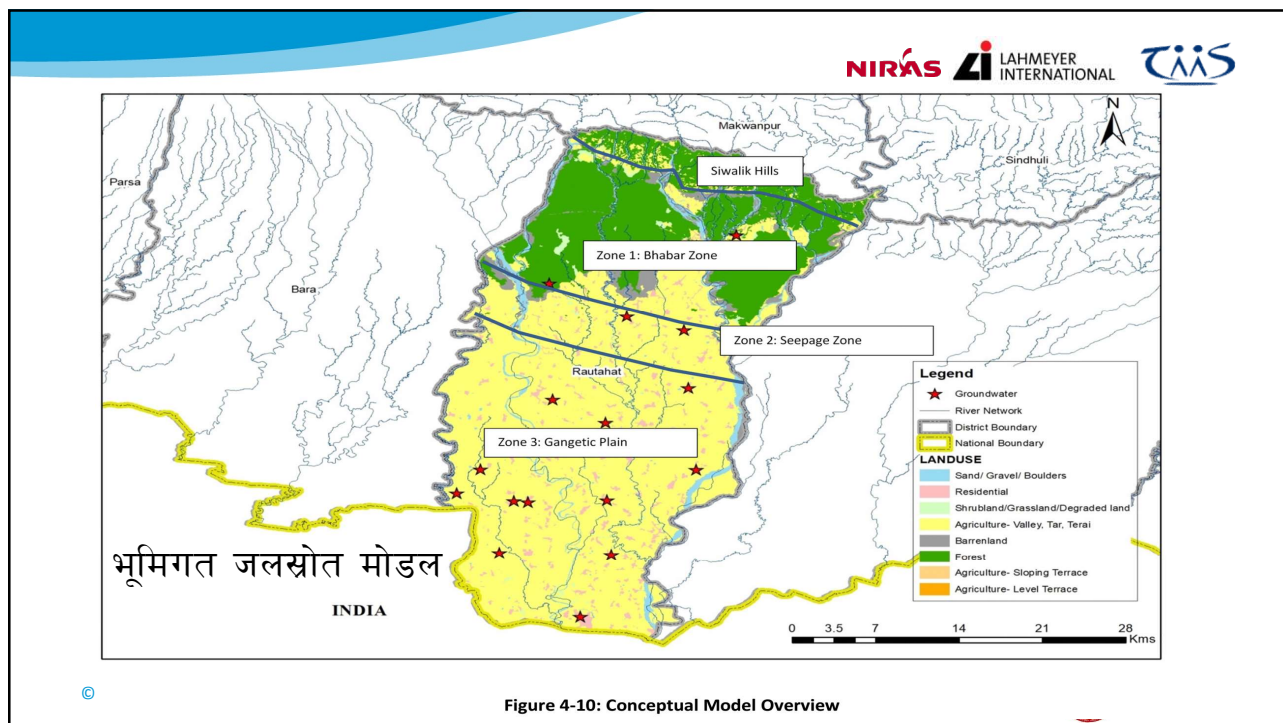
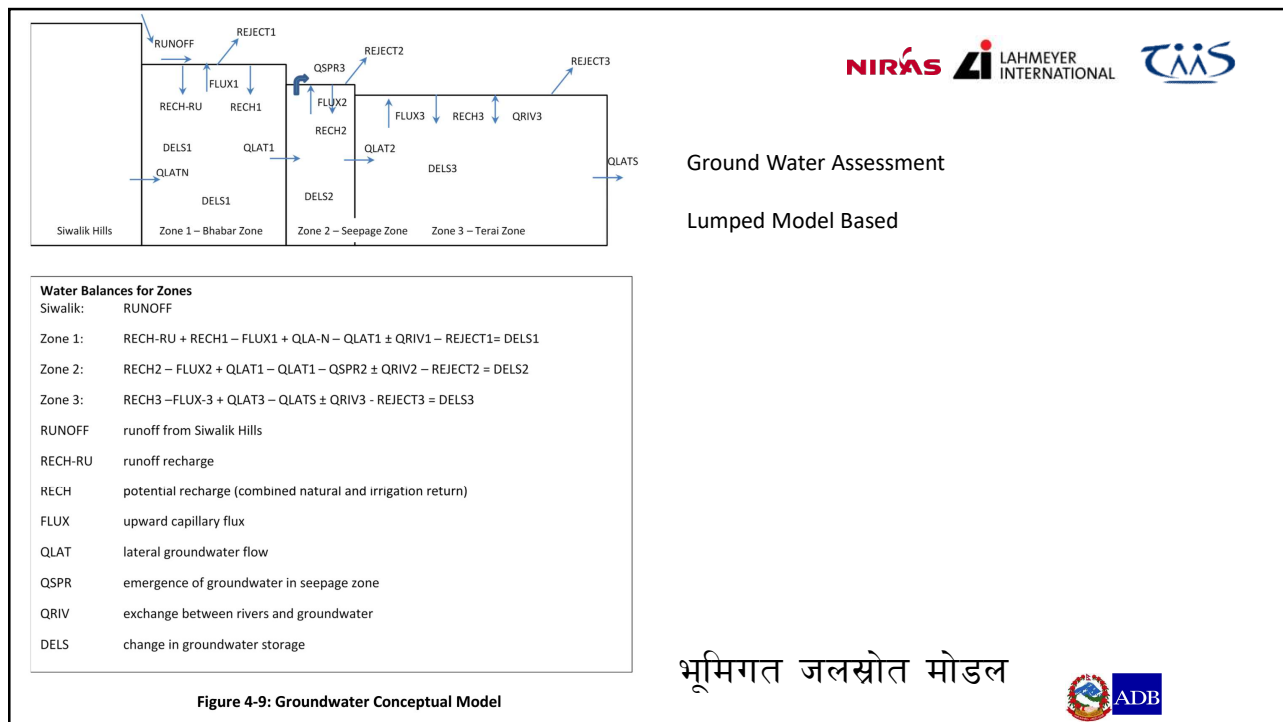
मौसम परिवर्तनको प्रभाव मूल्याङ्कन

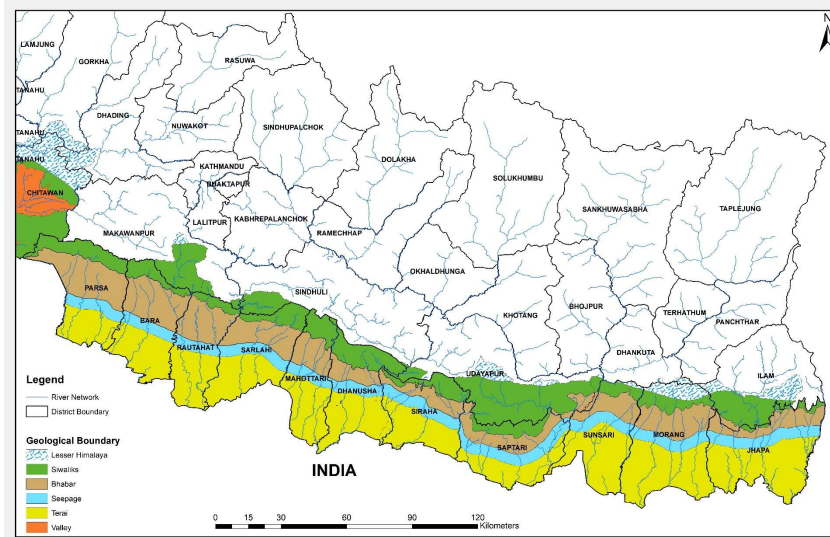
प्र श

Basin	Gauge Station	Dry Season									Monsoon Season				Average Gauge		Average Basin	
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Dry	Monsoon	Dry	Monsoon	
Koshi	600.1	12.20	14.07	10.85	11.49	15.53	19.70	29.63	32.96	5.02	-1.46	2.45	7.63	18.30	3.41	8.64	4.10	
	590	8.47	13.06	12.92	16.68	17.10	16.23	4.01	13.97	13.42	8.06	7.74	17.35	12.81	11.64			
	680	-2.35	-2.81	-3.70	-3.06	-5.34	-9.49	-14.27	-10.01	-0.58	2.21	4.28	-2.41	-6.38	0.87			
	695	5.91	6.96	5.97	6.26	8.07	11.31	17.00	17.29	2.71	-2.15	-2.23	3.54	9.85	0.47			
Narayani	450	11.40	11.74	11.11	10.28	10.29	8.91	6.13	3.69	0.48	3.78	5.34	11.28	9.19	5.22	9.20	4.72	
	449.91	11.64	13.26	13.81	12.95	14.41	15.27	13.33	2.92	-1.71	3.12	4.91	10.57	12.20	4.22			
	410	12.06	11.11	11.34	12.12	11.54	9.26	-2.53	4.62	-0.86	1.47	4.27	11.08	8.69	3.99			
	420	11.81	12.08	10.00	8.80	6.19	5.56	-4.17	3.44	1.52	3.24	5.00	11.98	6.71	5.43			
Karnali	259.2	7.45	5.78	7.06	8.68	0.90	-0.01	3.93	4.72	8.01	11.55	10.46	15.40	4.81	11.36	5.35	7.01	
	240	9.89	8.52	8.68	8.05	4.97	10.50	16.54	27.81	1.67	4.51	5.20	9.56	11.87	5.23			
	269.5	8.60	4.57	3.64	2.57	-2.03	-2.27	0.76	-8.33	1.51	5.57	4.95	9.57	0.94	5.40			
	283.3	7.70	5.30	4.71	4.04	-2.66	0.35	4.18	6.67	3.53	5.28	5.26	10.20	3.79	6.07			

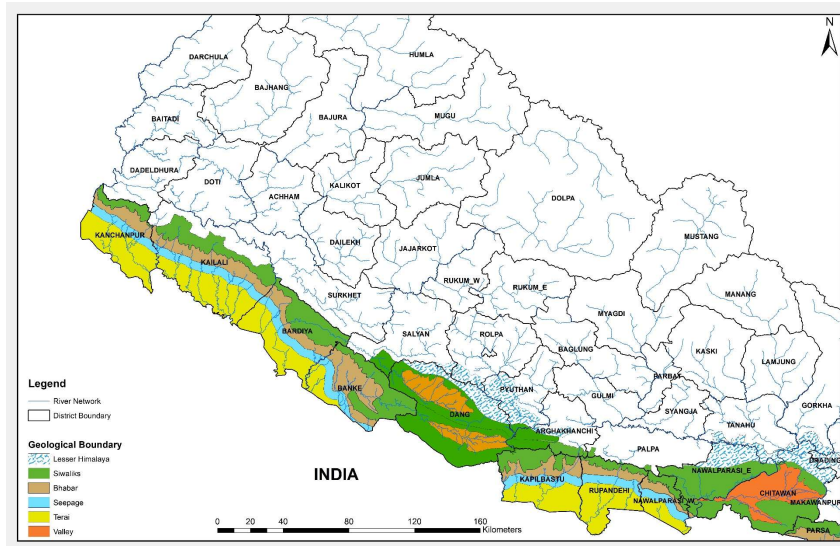
© Lahmeyer International GmbH 2018







© Lahmeyer International GmbH 2018



© Lahmeyer International GmbH 2018



Basin (Mm ³ /yr)	Net total groundwater recharge [Mm ³ /yr]			
	Half of cultivable area irrigated with groundwater water			
	Bhabar Zone	Seepage Zone	Terai Zone	Total
Jhapa	422	181	333	936
Morang	418	100	345	863
Sunsari	264	100	357	721
Saptari	342	197	250	789
Siraha	247	112	213	572
Dhanusha	168	59	202	429
Mahotari	237	49	200	486
Sarlahi	249	108	143	501
Rautahat	205	79	106	390
Bara	361	41	195	597
Parsa	470	37	154	661
Koshi Basin	3,383	1,063	2,498	6,945
Chitwan	222	63	262	547
Nawalparasi East	205	196	231	632
Nawalparasi West	130	121	146	397
Rupandehi	143	131	326	600
Kapilbastu	240	155	197	592
Narayani Basin	940	666	1,162	2,768
Dang	130		185	315
Bardiya	211	185	363	759
Banke	320	167	145	632
Kailali	522	73	269	864
Kanchanpur	320	135	334	789
Karnali Basin	1,503	560	1,296	3,359
Total	5,826	2,289	4,956	13,072

NIRÁS LAHMEYER INTERNATIONAL T&S

Results of GW Assessment

13.07 Bil m³/yr

भूमिगत जल परिमाण

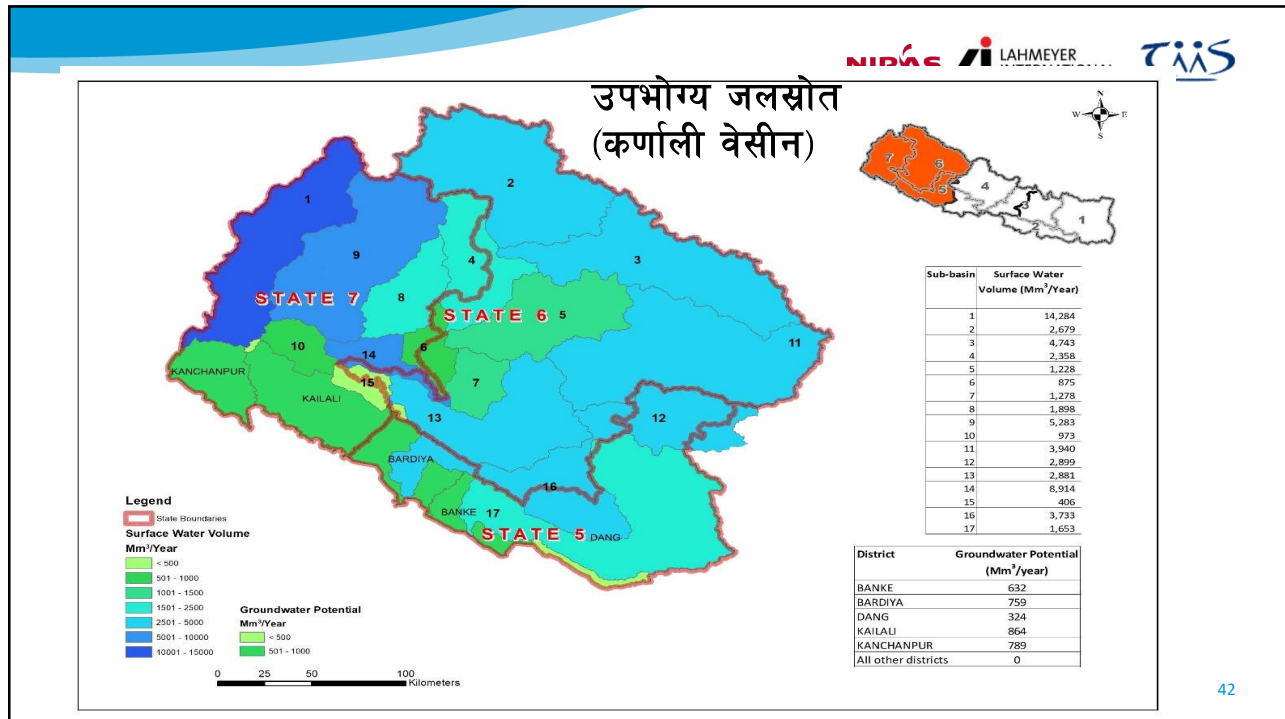
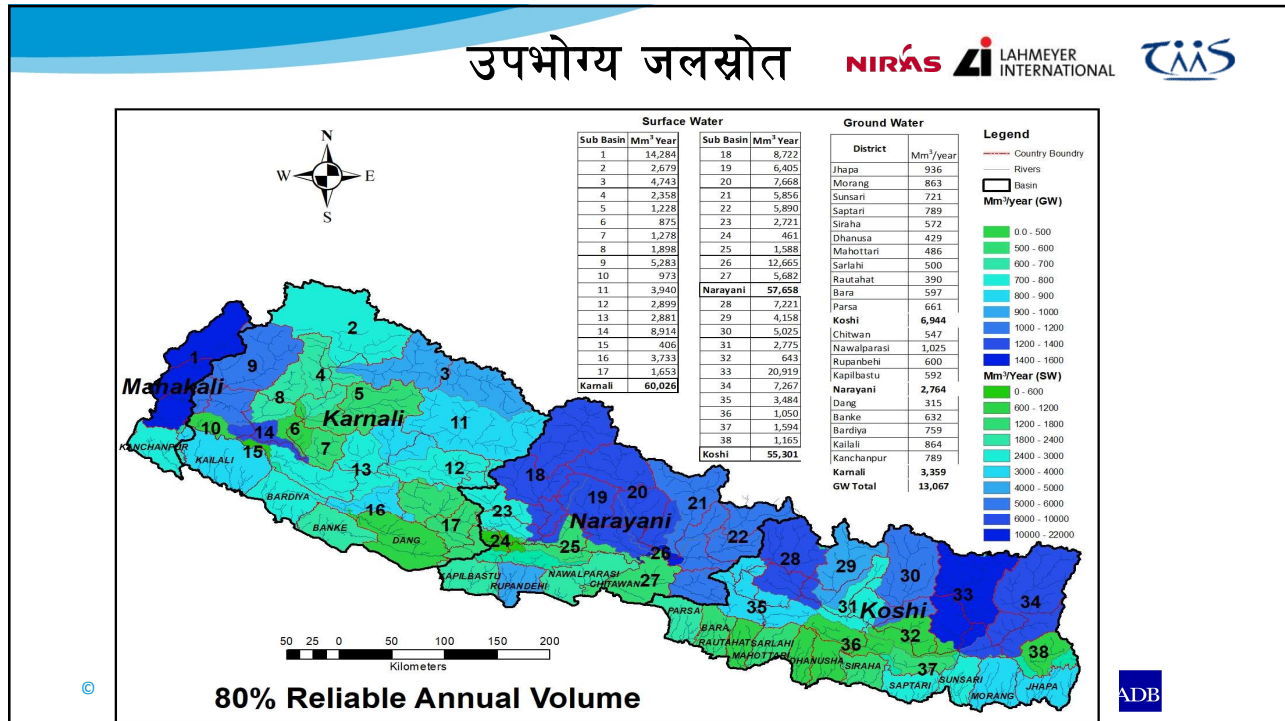


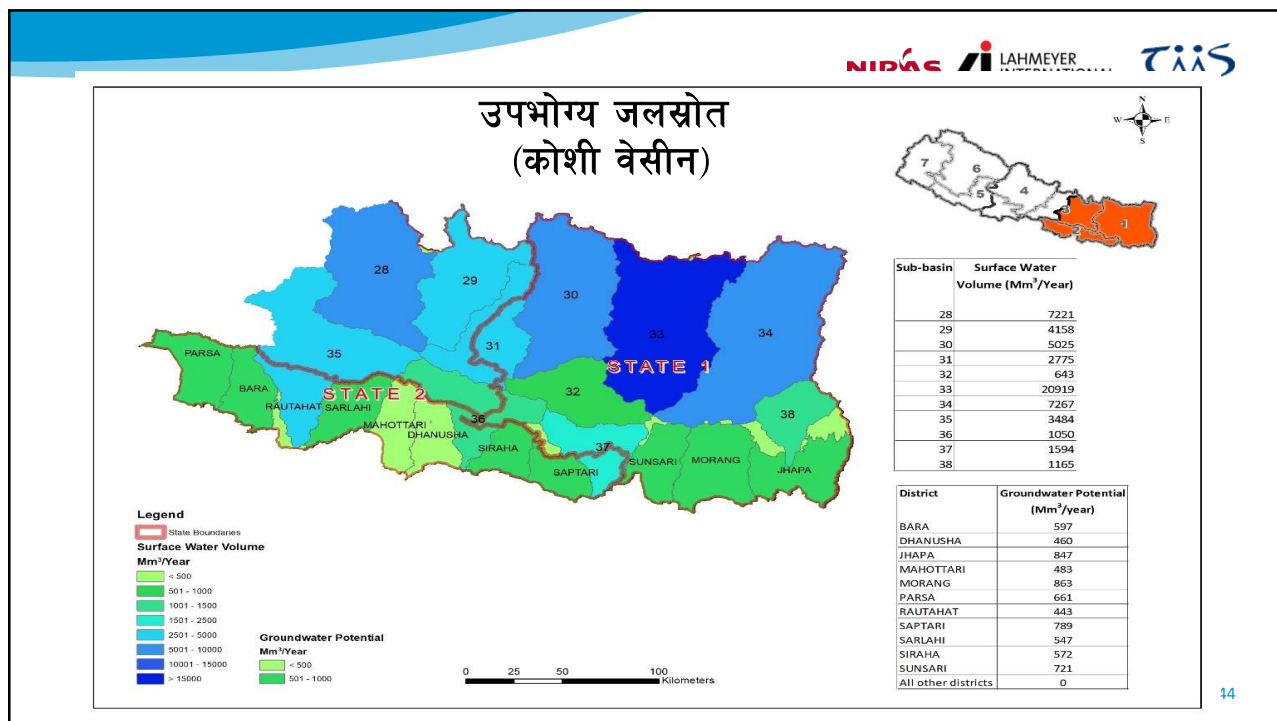
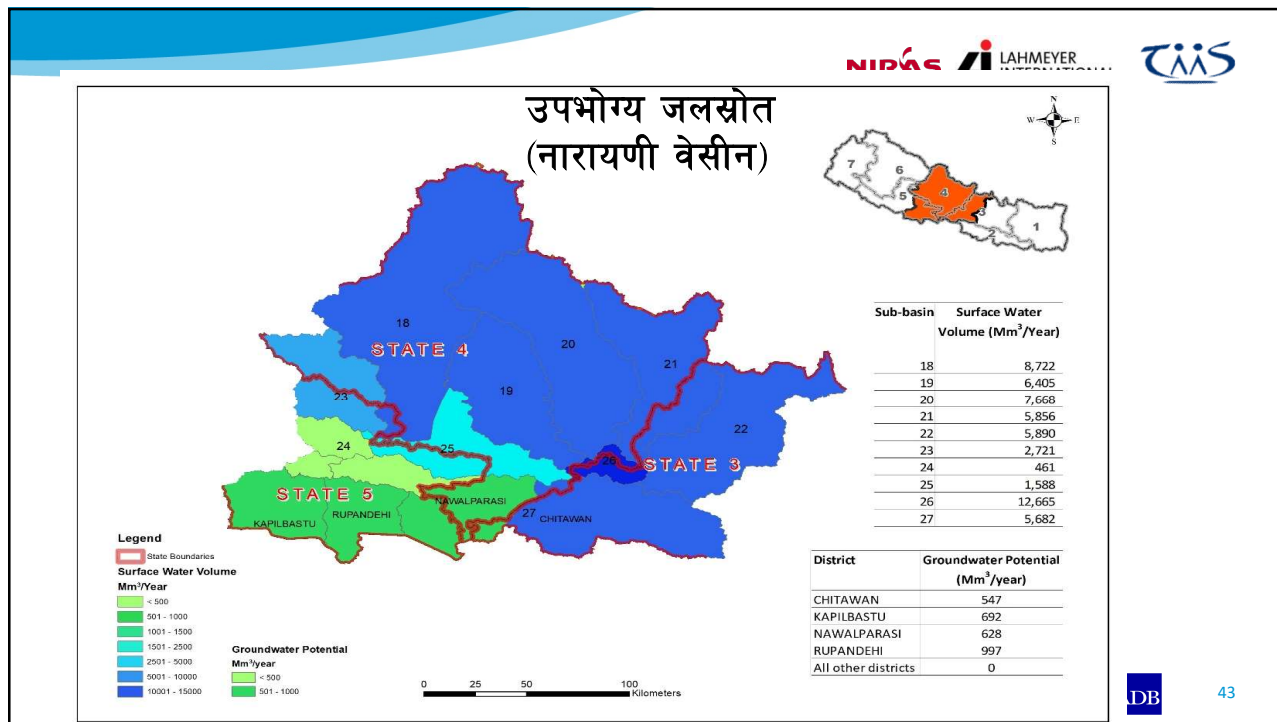
उपभोग्य जलस्रोत			
Basin (Bm ³)	Surface Water	Ground Water	Total
Karnali	60.0	3.36	63.36
Narayani	57.6	2.76	60.36
Koshi	55.3	6.94	62.24
Total	172.9	13.06	185.96

Reliability: 80 %
Resources from Churia Catchments not included in SW.

NIRÁS LAHMEYER INTERNATIONAL T&S







सिंचाइ योजनाहरुको अभिलेख तयारी

NIRAS LAHMEYER INTERNATIONAL

T&S

- पहाडको १० हेक्टर र तराइको २५ हेक्टर भन्दा बढी सिंचित क्षेत्र भएको योजनाहरुको अभिलेख तयार गर्ने ।
- अभिलेखमा सिंचाइ विभाग, कृषक निर्मित, डोलिडार लगायत सबै निकायबाट निर्मित योजनाहरु समावेश ।
- सतह, भूमिगत एवं गैर परम्परागत सबै प्रकारका योजनाहरु हुने ।
- नदी बेसीन योजना तर्जुमाको लागि उपयुक्त हुने गरि घरायसी, शहरी, पशु, उद्योग, माछापालन, पर्यटन एवं जलविद्युत लगायत जल उपयोगको सूचनाहरु संकलन गर्ने ।
- सबै सूचनाहरुलाई **spatial maps and tabular form** मा जिल्ला एवं बेसीनगत रूपमा तयार गर्ने ।

© Lahmeyer International GmbH 2018

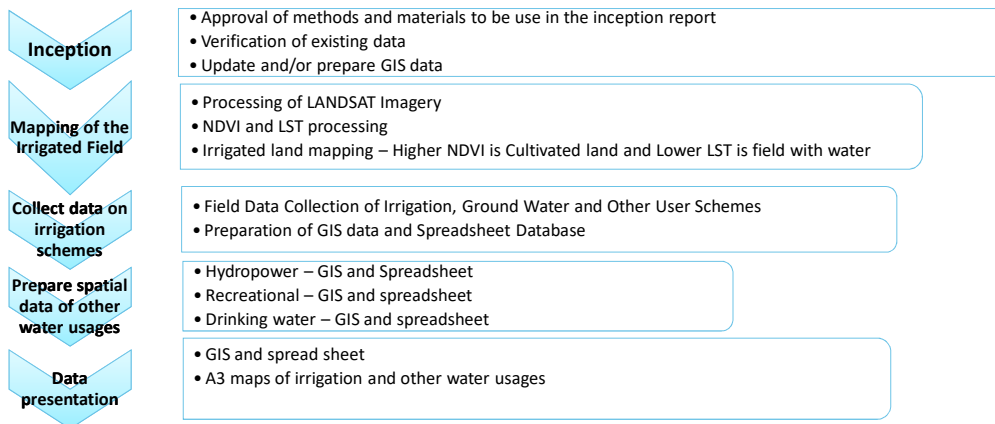


45

अभिलेख तयारीको प्रकृया

NIRAS LAHMEYER INTERNATIONAL

T&S



© Lahmeyer International GmbH 2018



विद्यमान अभिलेखमा देखिएका विसंगतिहरू

- कतिपय योजनाहरू दोहारिएको ।
- कतिपय योजनाहरू पहिचान हुन सकेन ।
- साना तथा मझौला योजनाहरू ठुला योजनाहरूको कमाण्ड क्षेत्र भित्र पर्ने भइ सिंचित क्षेत्रफल अभिलेख दोहोरिएको ।
- सतहगत सिंचाइ क्षेत्र भित्र भूमिगत सिंचाइका संरचनाहरू समेत भएकाले सिंचित क्षेत्रफलको अभिलेख दोहोरिएको ।
- निर्मित सिंचाइ प्रणाली (भूमिगत एवं सतहगत) हरुबाट वास्तविक रूपमा कति क्षेत्रमा सिंचाइ भइ रहेको छ भन्ने अभिलेख नरहेको ।
- पुराना प्रयोगमा नरहेका भूमिगत सिंचाइ प्रणालीहरूको क्षेत्रफल अभिलेखमा नरहेको ।

सिंचित क्षेत्र (हे.)

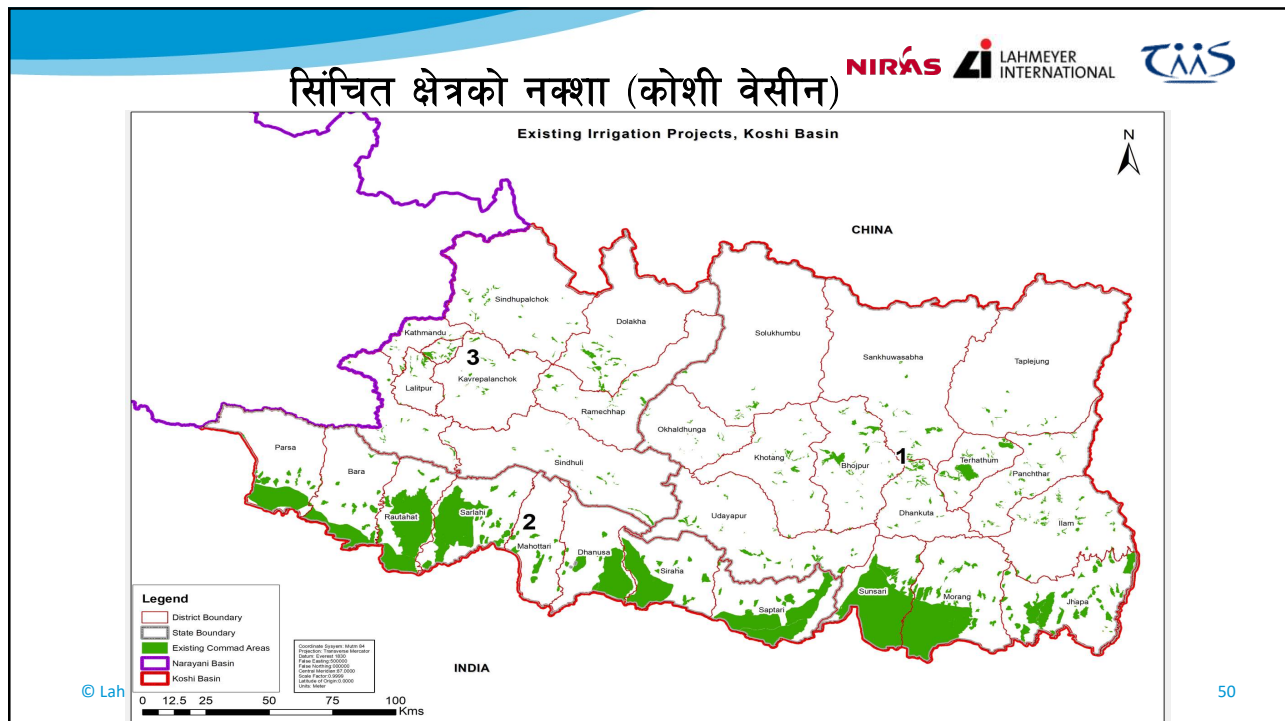
Province	Surface Water								Ground Water	Grand Total
	National/ DOI	Agency Assisted FMIS	Non Assisted FMIS	DoLIDAR	Non Conv	Un-identified	Hill <5 Terai <10 ha	Total		
1	82,877	72,933	7,183	3,361	1,707	17,278	13,838	199,177	99,726	298,903
2	187,009	65,032	10,984	0	968	11,446	7,506	282,945	183,056	466,001
3	9,516	33,803	8,750	2,580	3,467	12,574	2,582	73,272	15,262	88,534
4	14,274	26,034	5,044	0	1,451	11,168	6,076	64,047	21,144	85,191
5	107,218	85,680	11,521	3,173	2,083	6,430	979	217,084	118,503	335,587
6	0	17,359	712	5,589	1,217	3,385	5,323	33,585	470	34,055
7	38,644	31,223	2,642	4,234	1,921	7,619	4,383	90,666	55,680	146,346
Total	439,538	332,064	46,836	18,937	12,814	69,900	40,687	960,776	493,841	1,454,617

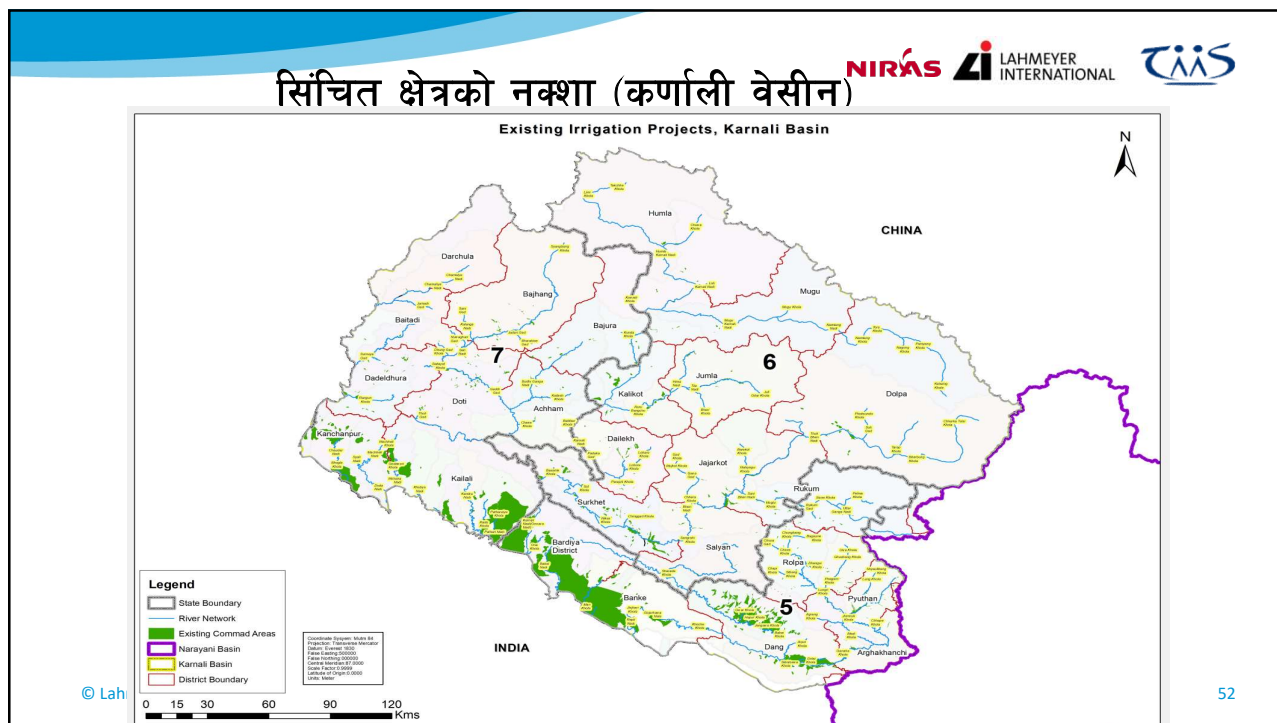
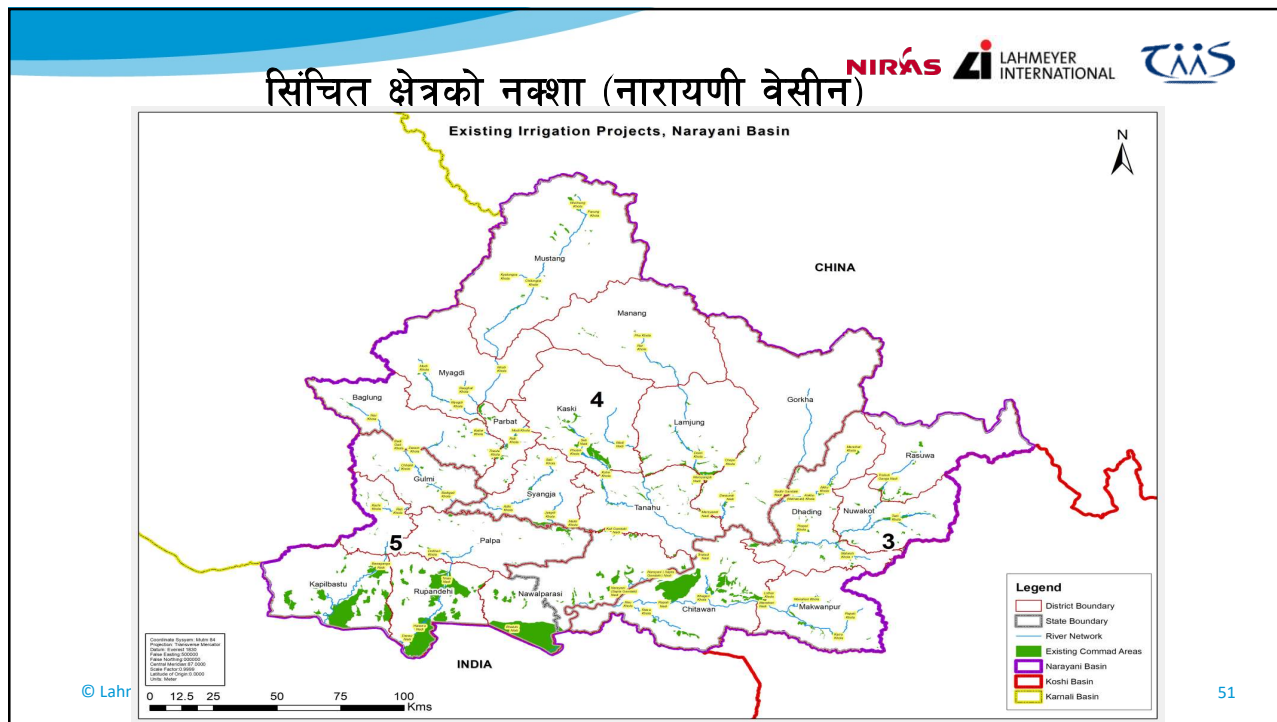
पहिचान हुन नसकेका योजनाहरु (उदाहरण)

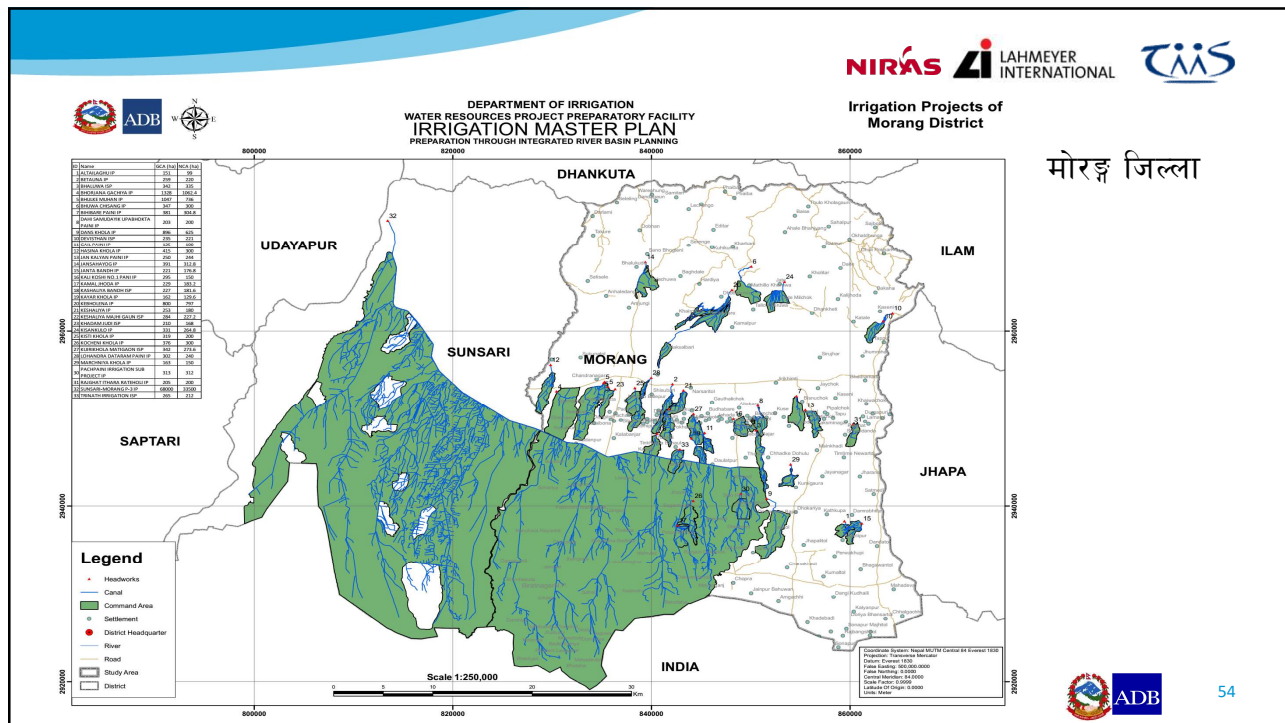
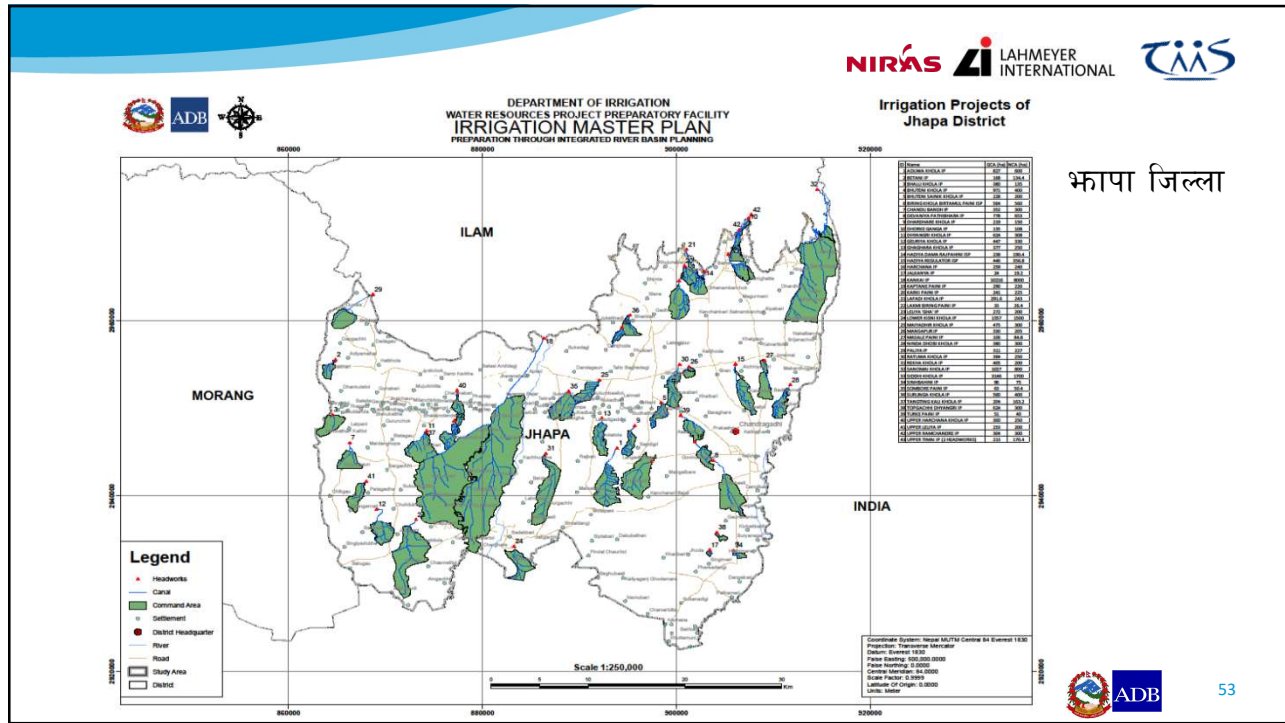
Taplejung	AGRI	75
Taplejung	CHYAMGGMENGMAVA	485
Taplejung	DANDA GAUN	82
Taplejung	HEREWA	75
Taplejung	HIUNDE KHOLA	88
Taplejung	JAWA KHOLA	250
Taplejung	KANUWA	125
Taplejung	KHEJUNIM 2,3	94
Taplejung	KHOKLING	178
Taplejung	KHOKSE NANGKHOLY	76
Taplejung	LINSHEP	88
Taplejung	MAWA	75
Taplejung	MEDIBUNG	106
Taplejung	NAREWA	125
Taplejung	NAURANG KHOLA	59
Taplejung	NEBU KHOLA	94
Taplejung	NIGURADIN	31
Taplejung	NIGURADIN PHUL BARI	212
Taplejung	PHURUMBU	50
Taplejung	PHURUMBU(7)	100
Taplejung	SIWADIN 3,6,8	125
Taplejung	THECHUMBU-7	50
Taplejung	THUKIMBA	241
Total ha		2884
Total Number		23

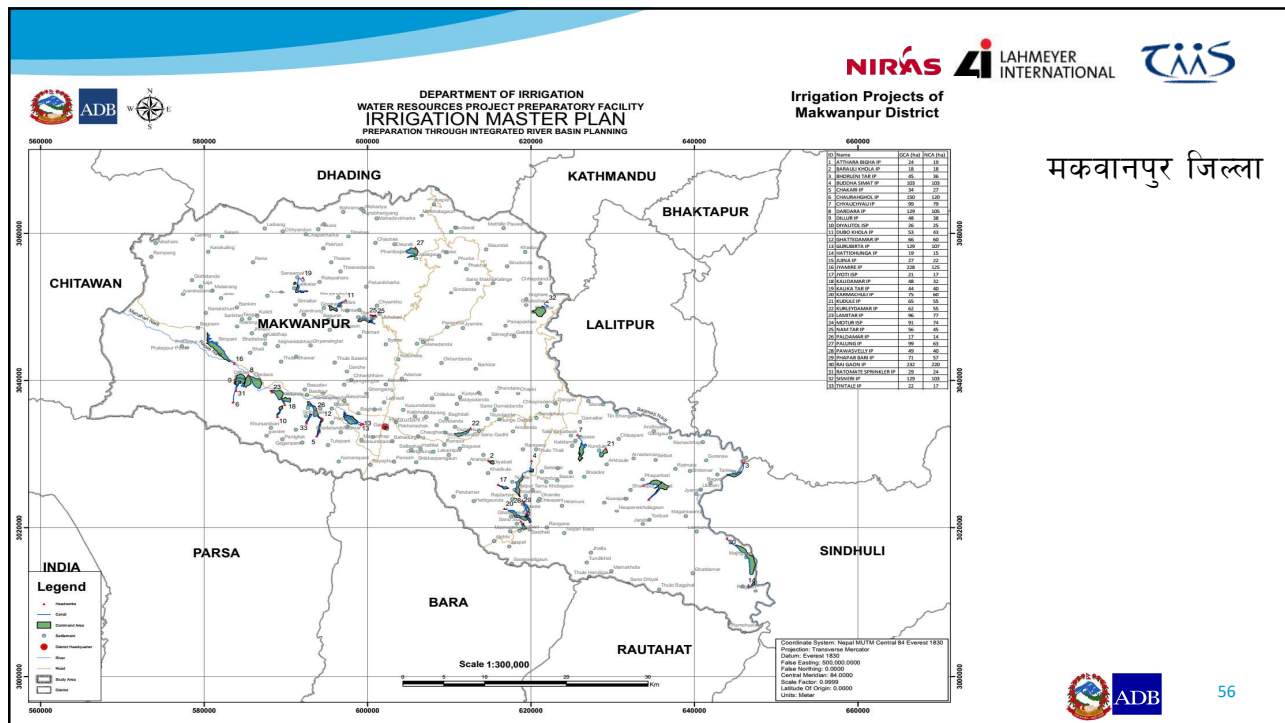
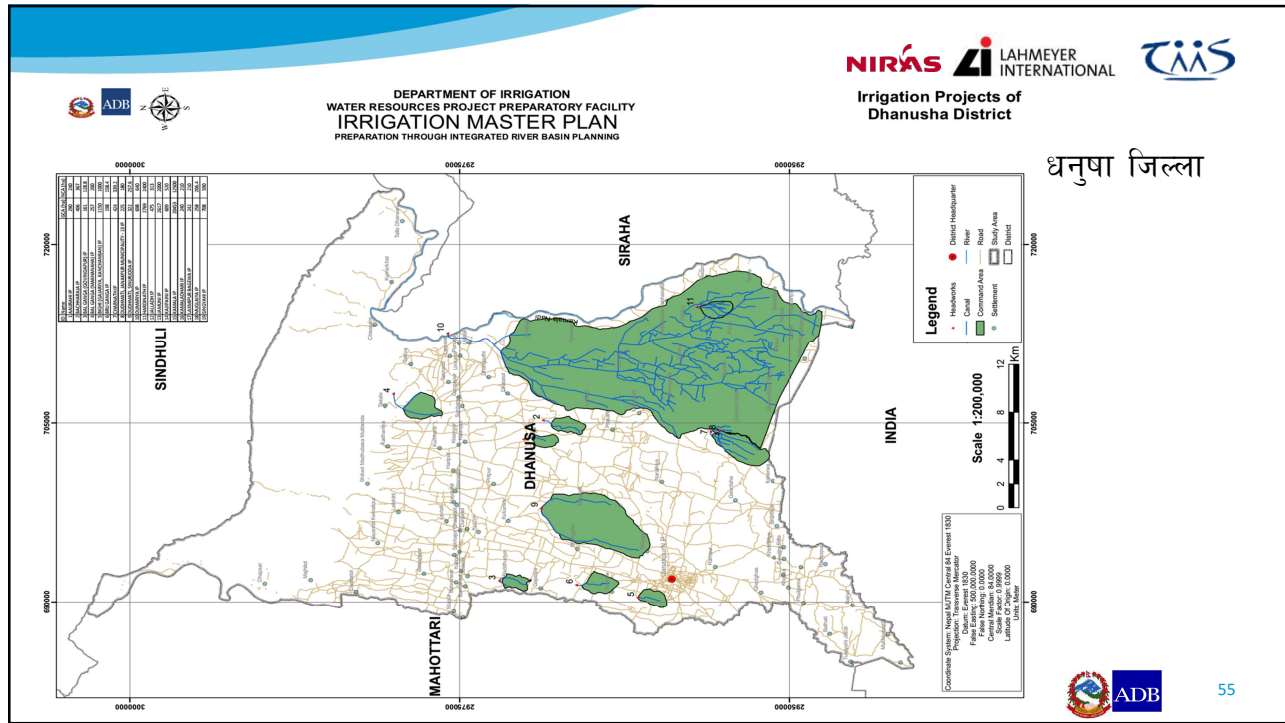
© Lahmeyer International GmbH 2018

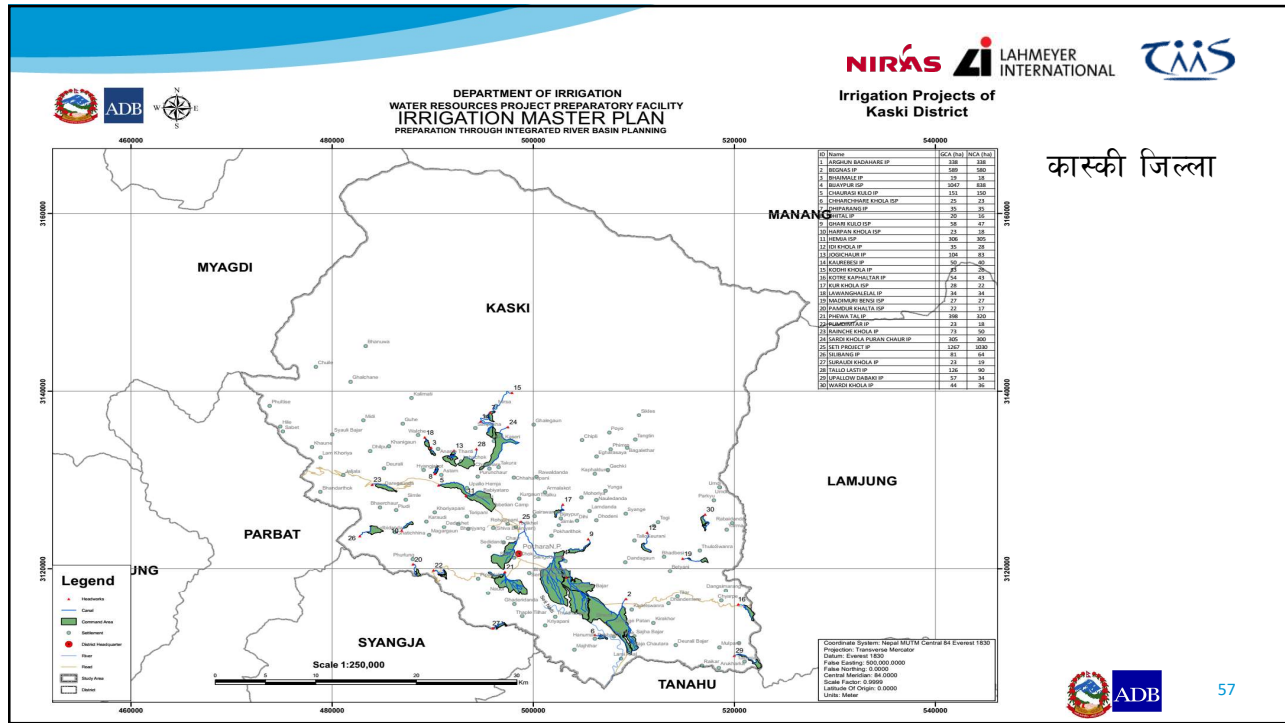
49



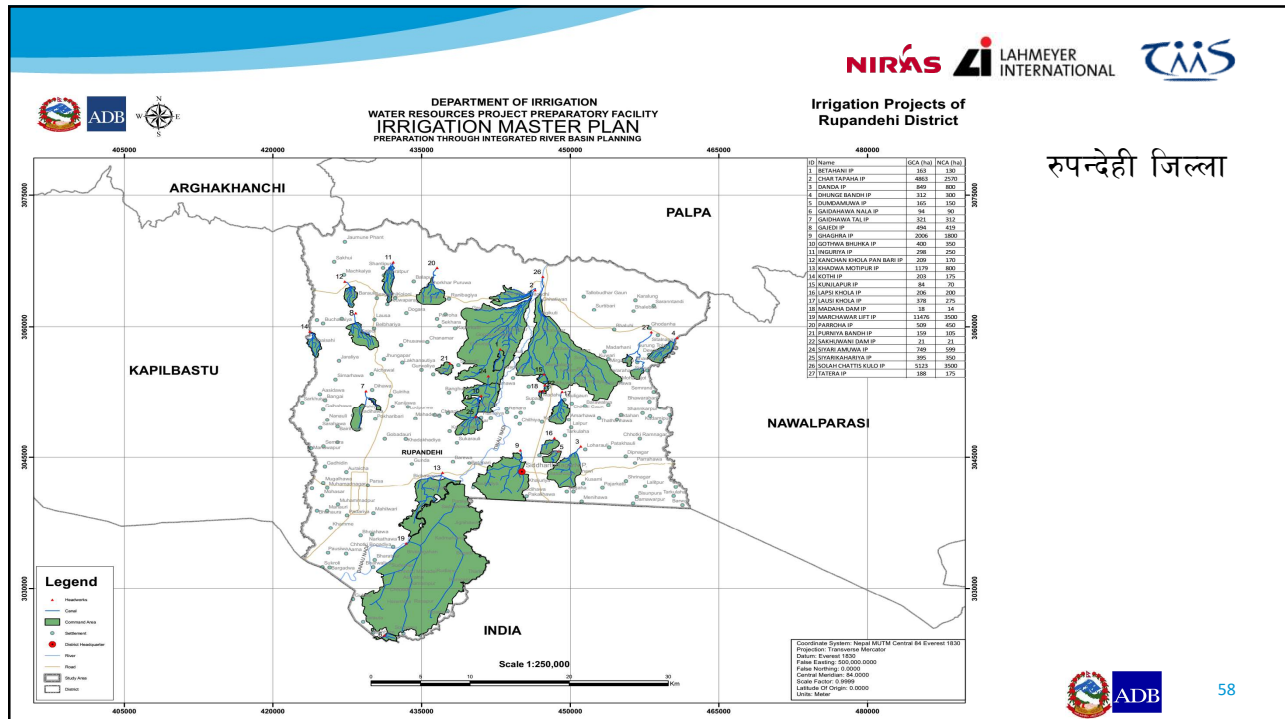






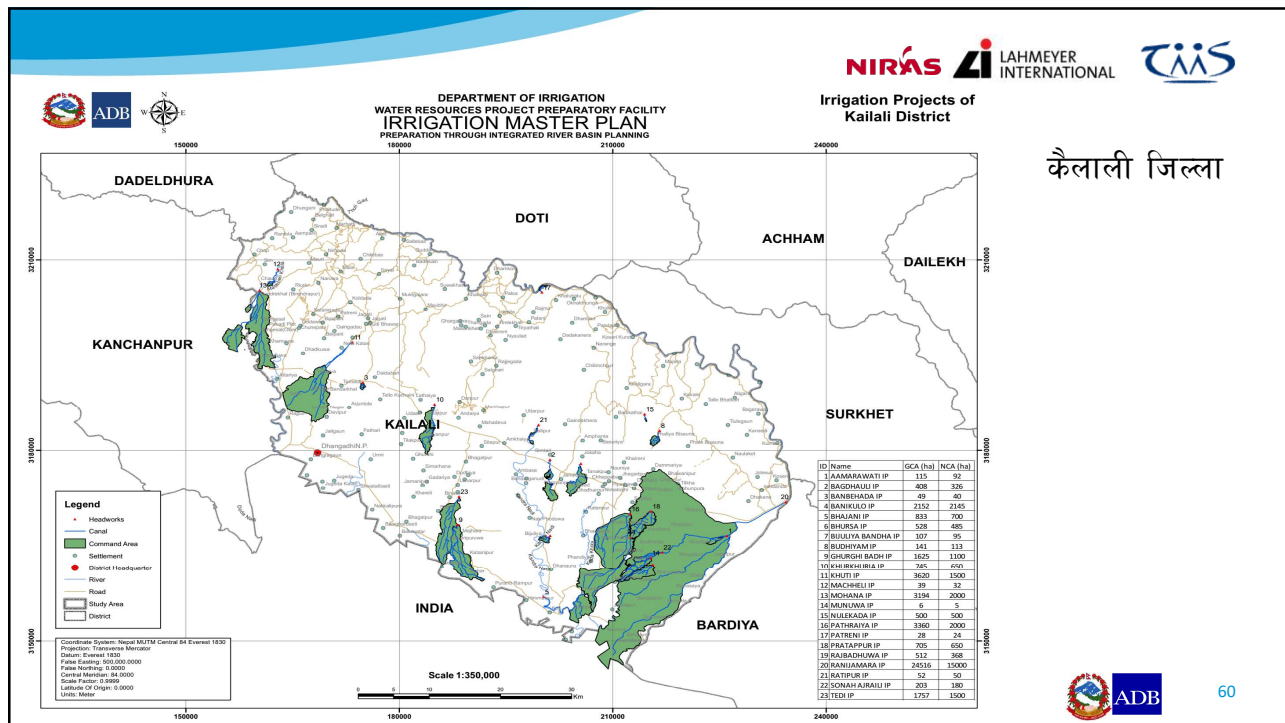
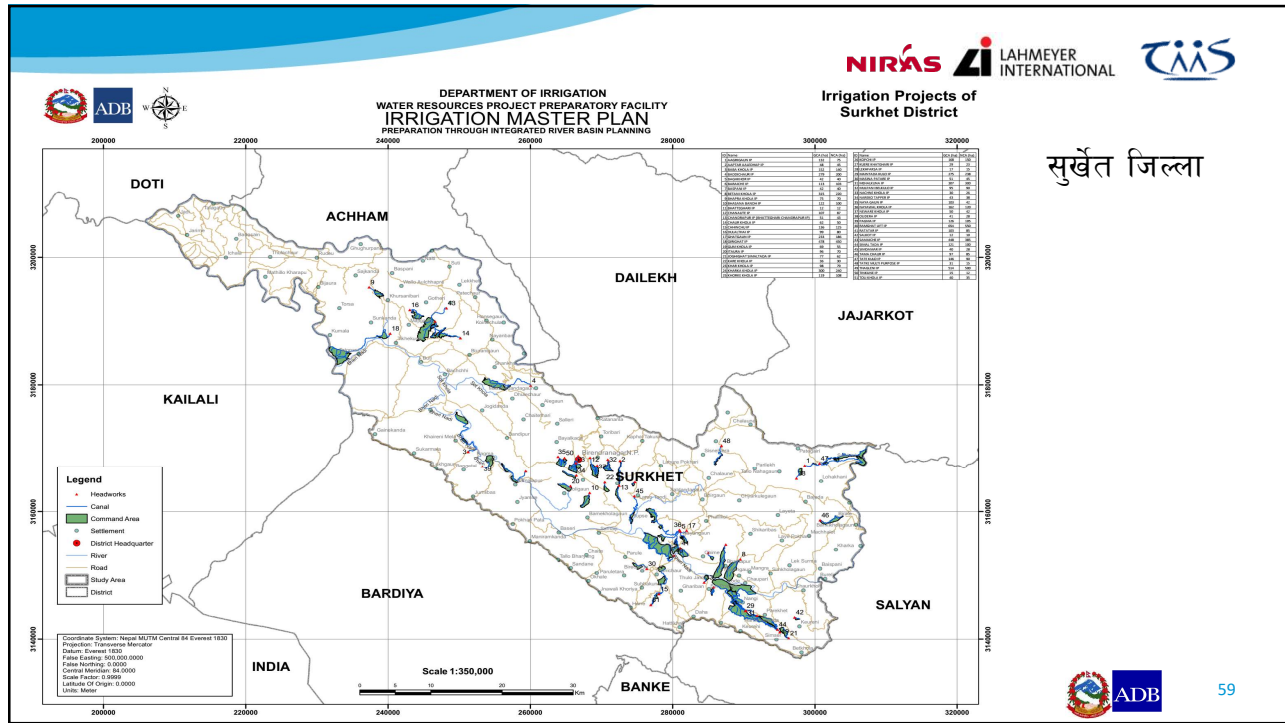


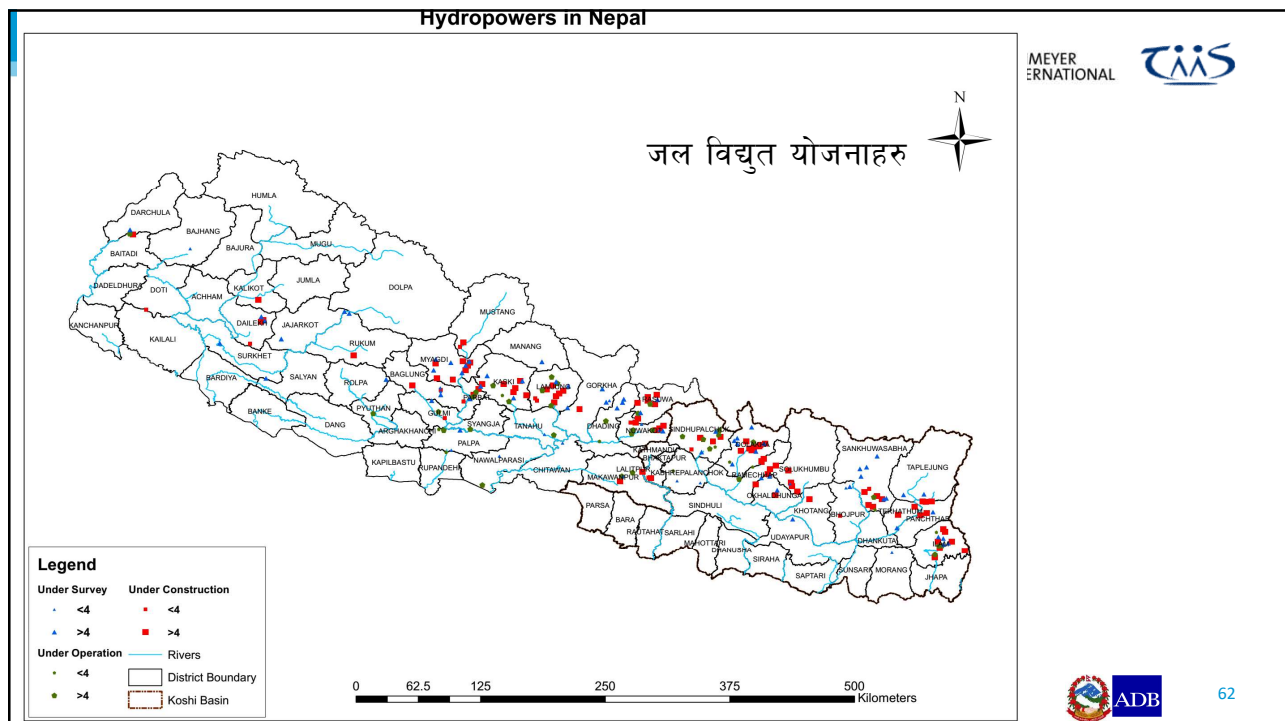
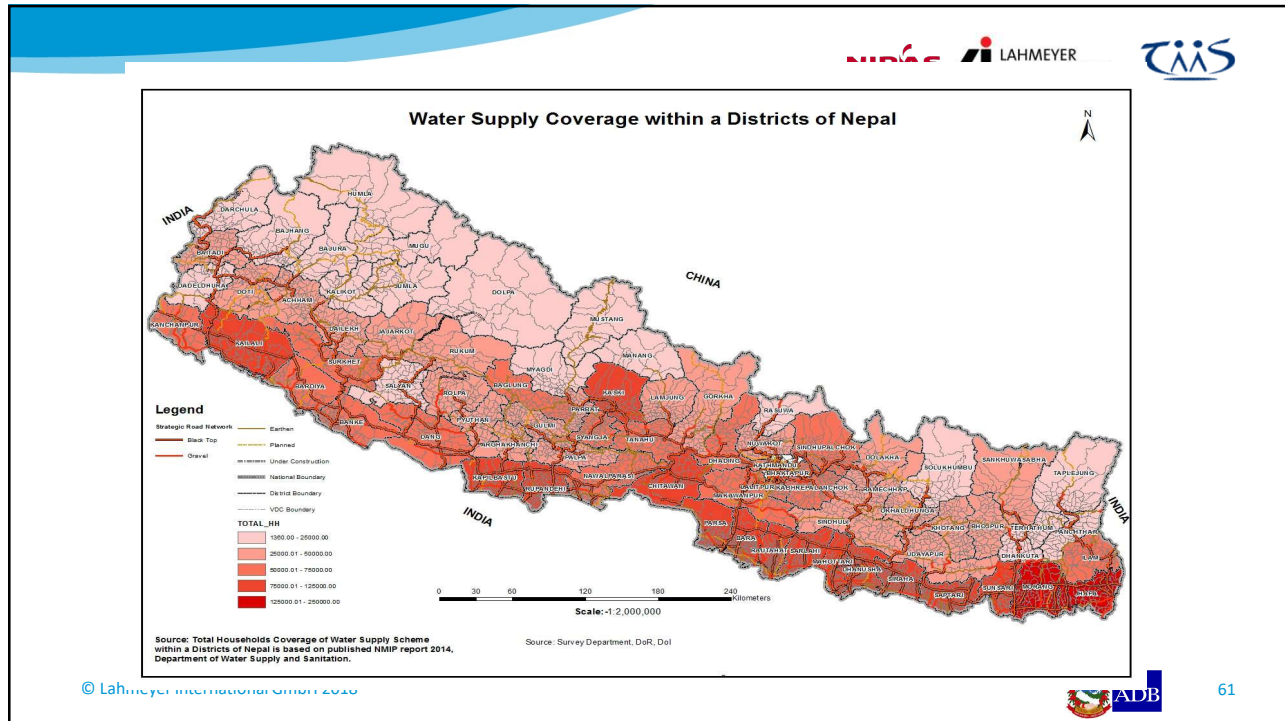
कास्की जिल्ला



रुपन्देही जिल्ला









सिंचाइ विकासको अवधारणा

NIRÁS LAHMEYER INTERNATIONAL T&S

- विद्यमान सिंचाइ प्रणालीहरुको सबलीकरण
 - वर्षभर सिंचाइ उपलब्ध हुने गरि थप जलस्रोत उपलब्ध गराउने (जलपथान्तरण एवं भूमिगत जलस्रोतको विकास)
 - प्रणाली आधुनिकीकरण एवं व्यवस्थापन सुधार (जल उत्पादकत्व वृद्धि)
- सिंचित क्षेत्रको विस्तार
 - तराइमा जलपथान्तरणको माध्यमबाट ठुला आयोजनाहरुको विकास ।
 - ठुला आयोजना कार्यान्वयन गर्न समय लाग्ने भएकाले यी आयोजनाहरुको निर्धारित सिंचित क्षेत्र एवं सतहगत जल सिंचाइ हुन नसक्ने क्षेत्रमा भूमिगत जलस्रोतको विकास ।
 - पहाडमा टार एवं पाखाहरुमा सम्भव भएसम्म सतह सिंचाइ एवं नभएमा पाइप प्रणालीको विकास ।
 - उपलब्ध प्रविधीको अधिकतम प्रयोग ।

© Lahmeyer International GmbH 2018

ADB 64

सिंचाइ विकासको समष्टीगत सम्भावना

#	Land Use (ha)	Option	Terai	Hill	Mountain	Total
A	Existing Irrigated Land					
A.1	Surface Water Systems					
A.1.1	Improved Surface Water Supply ¹		400,000			400,000
A.1.2	Modernisation ²		323,522	191,126	46,128	560,776
	Subtotal		723,522	191,126	46,128	960,776
A.2	Groundwater Systems					
A.2.1	Modernisation		485,884	7,957		493,841
	Total Existing Systems		1,209,406	199,083	46,128	1,454,617
B	New Irrigation Systems/Lands					
B1	Terai					
B.1.1	Surface Water Supply		200,000			200,000
B.1.2	Groundwater Supply		70,362			70,362
B.2	Hill/Mountain					
B.2.1	Gravity			94,000	67,842	161,842
B.2.2	Pumped/Tank/Solar			333,430	45,228	378,658
	Total of New Systems		270,362	427,430	113,070	810,862
	Total		1,479,768	626,513	159,198	2,265,479

© Lahmeyer International GmbH 2018



65

वृहत् योजना पहिचान

#	Ref	Project / Option (ha)	Irrigable Area	Irrigated	Un-irrigated	Option	Installed MW
1	W	Bheri-Babai Diversion Multipurpose					
	W.1	Transfer only	45,111	42,467	2,645	45,111	46
	W.2	Transfer + Nalsyaugad dam	45,111	42,467	2,645	45,111	73
	W.3	Transfer + Uttar Ganga dam	45,111	42,467	2,645	45,111	73
2	W.4	Karnali Diversion	40,628	7,632	32,996	40,628	80
3	W.5	Madi Dang Diversion	35,639	17,107	0	17,107	61
4	W.6	Naumure Dam, Rapti Kapilbastu Diversion	57,142	40,849	10,407	51,256	343
		Subtotal (West)	178,520	108,055	46,048	154,102	557

© Lahmeyer International GmbH 2018



66

वृहत् योजना पहिचान

NIRAS LAHMEYER INTERNATIONAL

TAAS

#	Ref	Project / Option (ha)	Irrigable Area	Irrigated	Un-irrigated	Option	Installed MW	
5	C	Kaligandaki Tinau Diversion	149,830				244	
	C.1	No reservoir		31,464	0	31,464		424
	C.2	Andhikhola dam		41,953	0	41,953		
6	C.3	Kaligandaki Nawalparasi Diversion	11,539	2,080	9,459	11,539	4	
7	C	Trishuli-Shaktikhor Diversion	34,892				254	
	C.4	No reservoir		12,785	22,107	34,892		
	C.5	Bhudhi-Gandaki dam		12,785	22,107	34,892		
Subtotal (Central)			196,261	56,818	31,566	88,384	682	

© Lahmeyer International GmbH 2018



67

वृहत् योजना पहिचान

NIRAS LAHMEYER INTERNATIONAL

TAAS

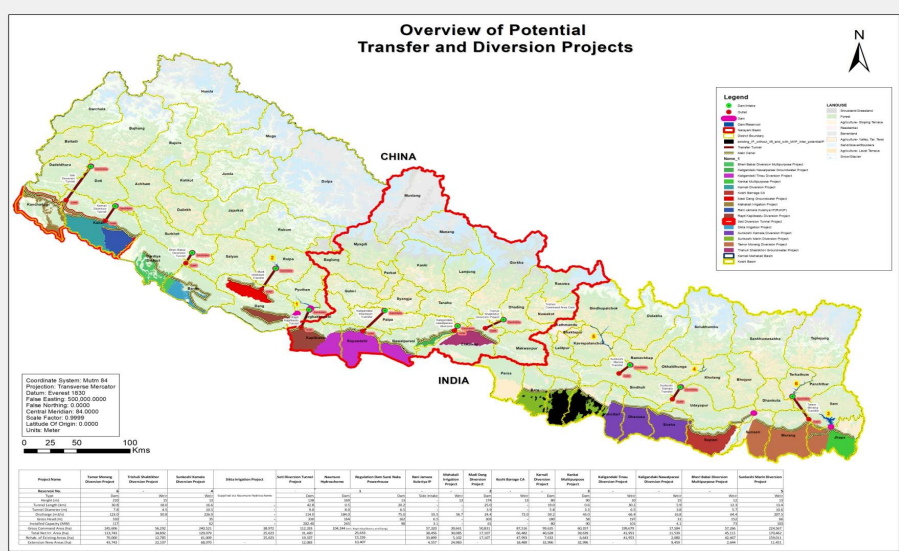
#	Ref	Project / Option (ha)	Irrigable Area	Irrigated	Un-irrigated	Option	Installed MW	
8	E.1	Sunkoshi Marin Diversion	170,462	54,548	0	54,548	33	
	E.2	Sunkoshi Kamala Diversion		181,802	61,009	68,070	68,070	44
	E	Sunkoshi Marin + Kamala		352,264				300
	E.3	Dudhkoshi HPP			115,557	120,792	236,350	536
	E.4	Sunkoshi HPP			220,020	132,244	352,264	
9	E	Tamor Morang Diversion	113,743				42	
	E.5	No reservoir		45,497	0	45,497		849
	E.6	Tamor 3 HPP		70,000	43,743	113,743		
10	E.7	Kankai Multipurpose	39,639	6,643	32,996	39,639	90	
11	E.8	Koshi Barrage	66,482	47,993	18,490	66,482		
Subtotal (East)			572,128	344,656	227,473	572,128	1,775	
Total			946,909	509,529	305,087	814,614	3,014	

© Lahmeyer International GmbH 2018



68

वृहत् योजना पहिचान



Coordinate System: Mutm 84
 Projection: Transverse Mercator
 Datum: Everest 1830
 False Easting: 500,000.0000
 False Northing: 0.0000
 Central Meridian: 84.0000
 Scale Factor: 0.9999
 Latitude of Origin: 0.0000
 Units: Meter

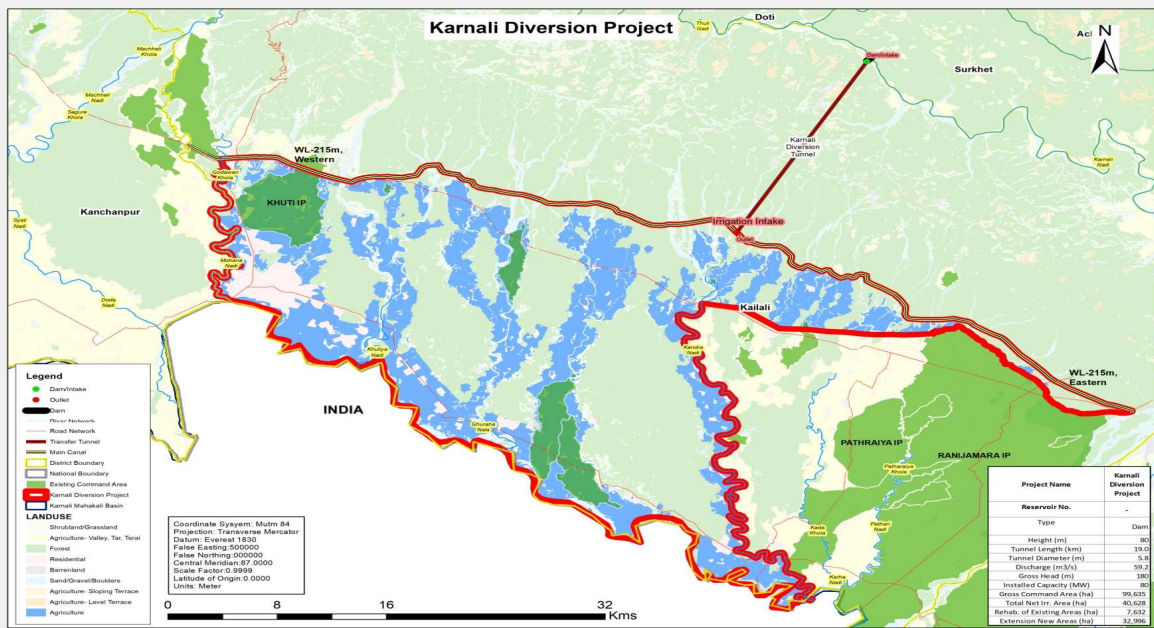
Project Name	Reservoir No.	Reservoir Name	Reservoir Capacity (MCM)	Reservoir Type	Project Type	Project Status	Project Cost (M USD)	Project Start Year	Project End Year	Project Duration (Years)	Project Beneficiaries (No.)	Project Area (Ha)	Project Description
...

© Lahmeyer International GmbH 2018



69

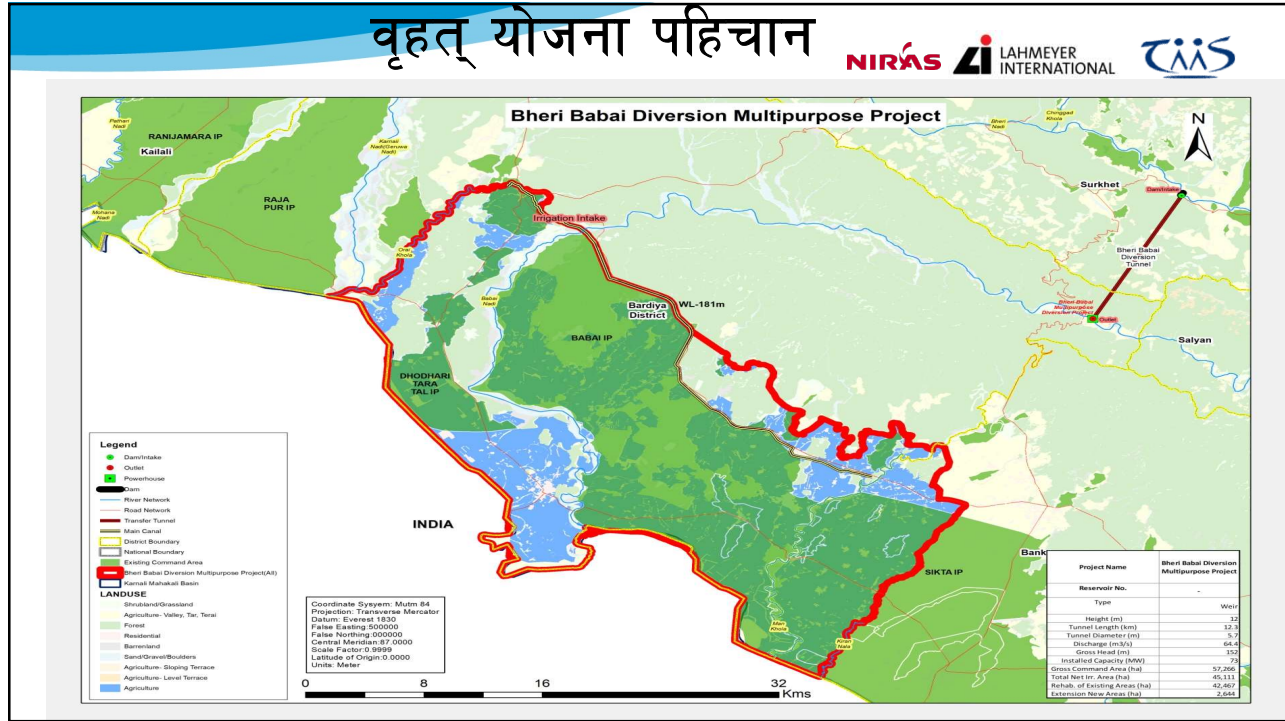
वृहत् योजना पहिचान



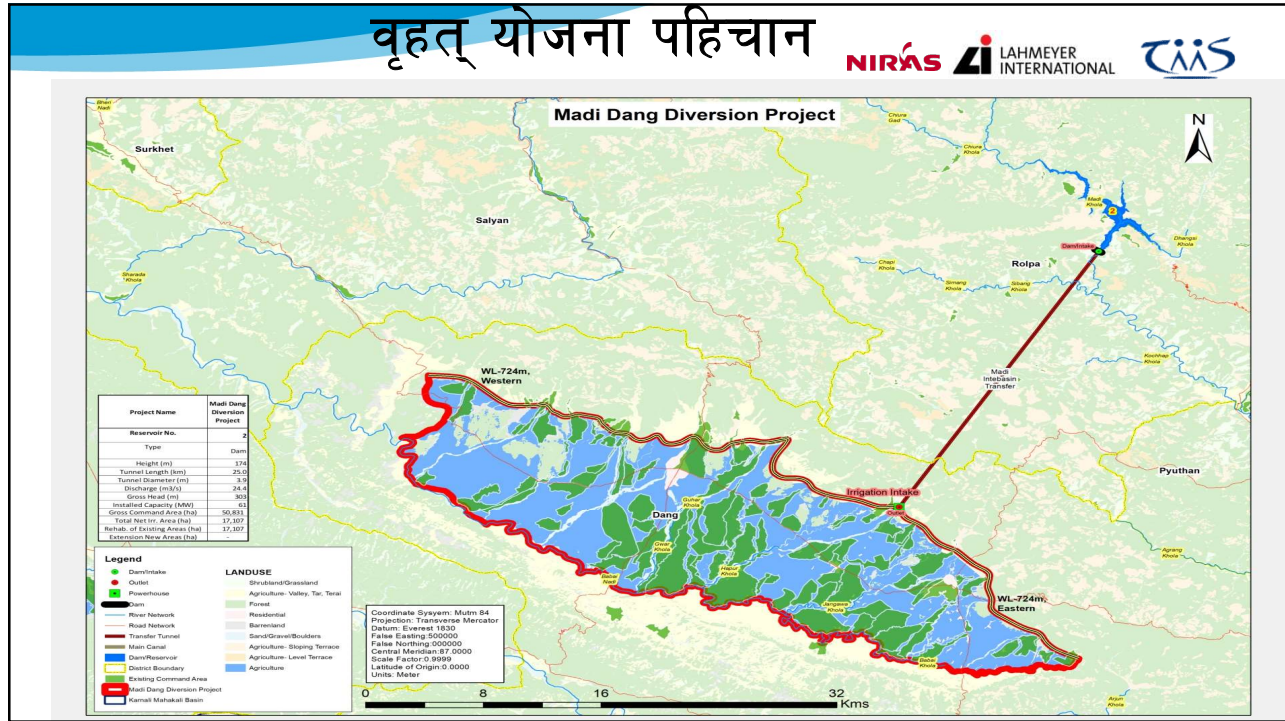
Coordinate System: Mutm 84
 Projection: Transverse Mercator
 Datum: Everest 1830
 False Easting: 500,000.0000
 False Northing: 0.0000
 Central Meridian: 87.0000
 Scale Factor: 0.9999
 Latitude of Origin: 0.0000
 Units: Meter

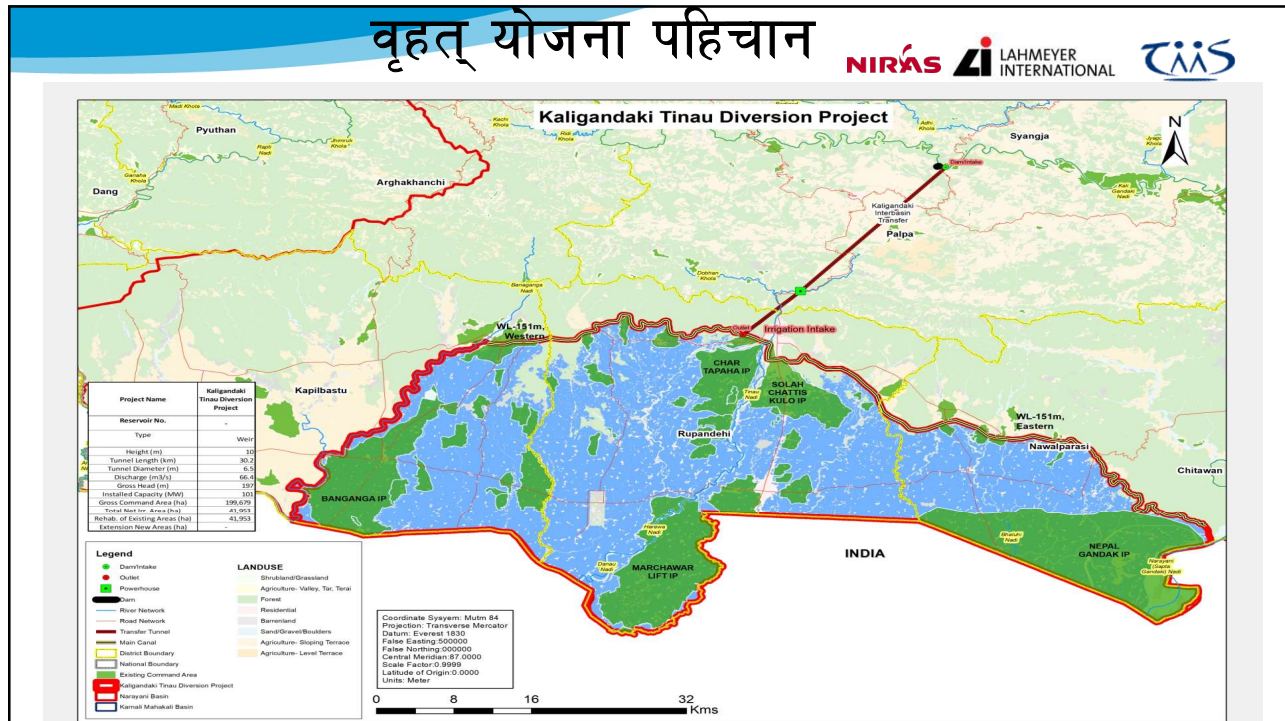
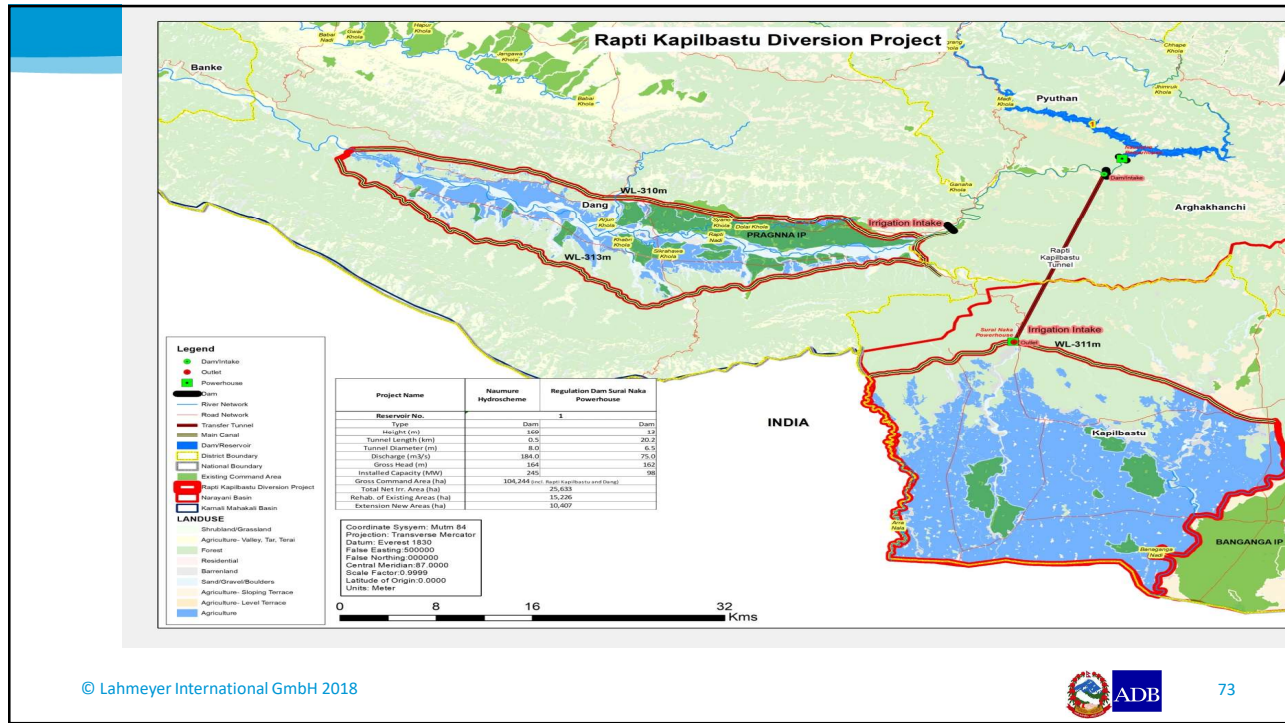
Project Name	Karnali Diversion Project
Reservoir No.	-
Type	Dam
Height (m)	80
Tunnel Length (km)	13.02
Tunnel Diameter (m)	5.8
Discharge (m ³ /s)	59.3
Gross Head (m)	180
Installed Capacity (MW)	80
Gross Command Area (ha)	95,635
Total Net Irr. Area (ha)	40,628
Rehab. of Existing Areas (ha)	7,632
Extension New Areas (ha)	32,996

वृहत् योजना पहिचान

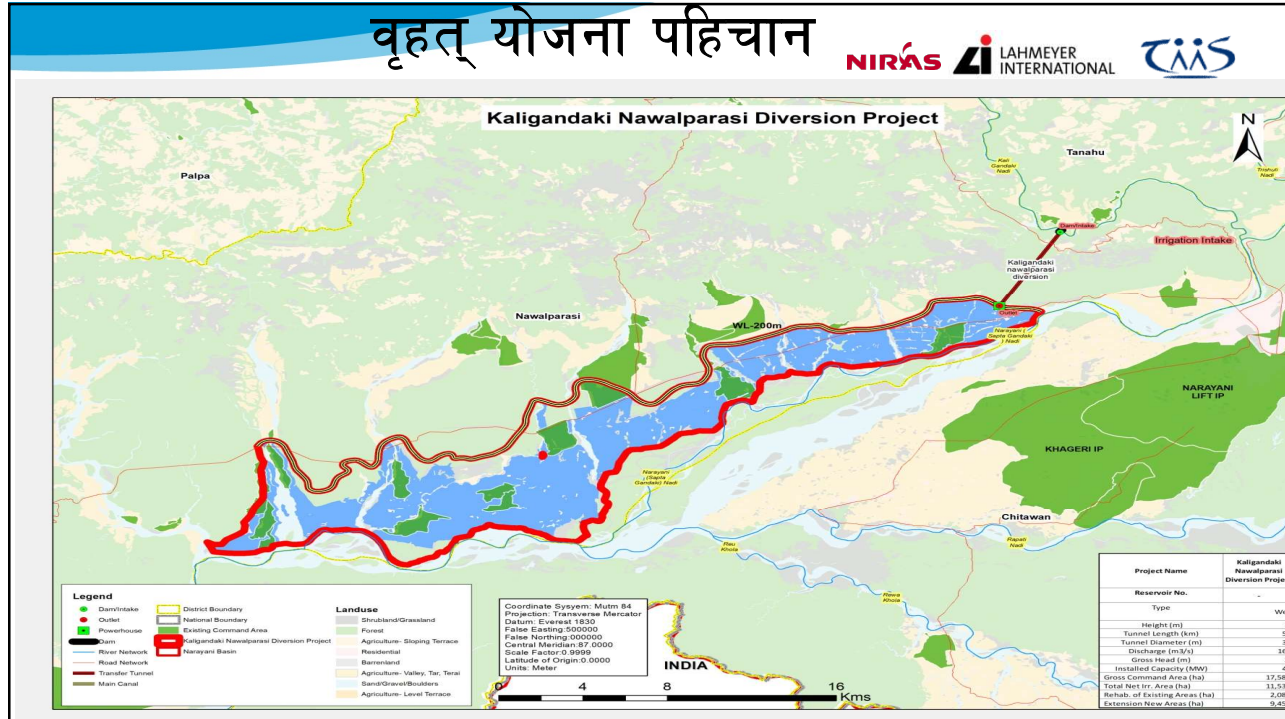


वृहत् योजना पहिचान

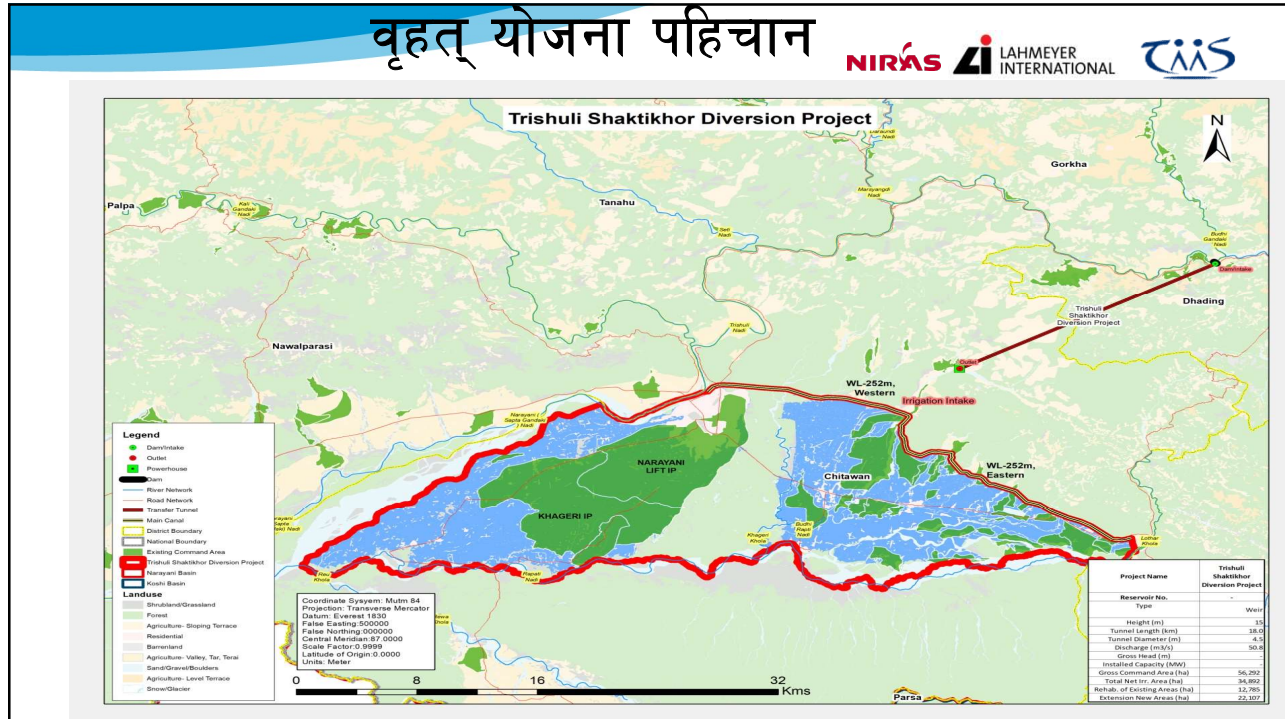




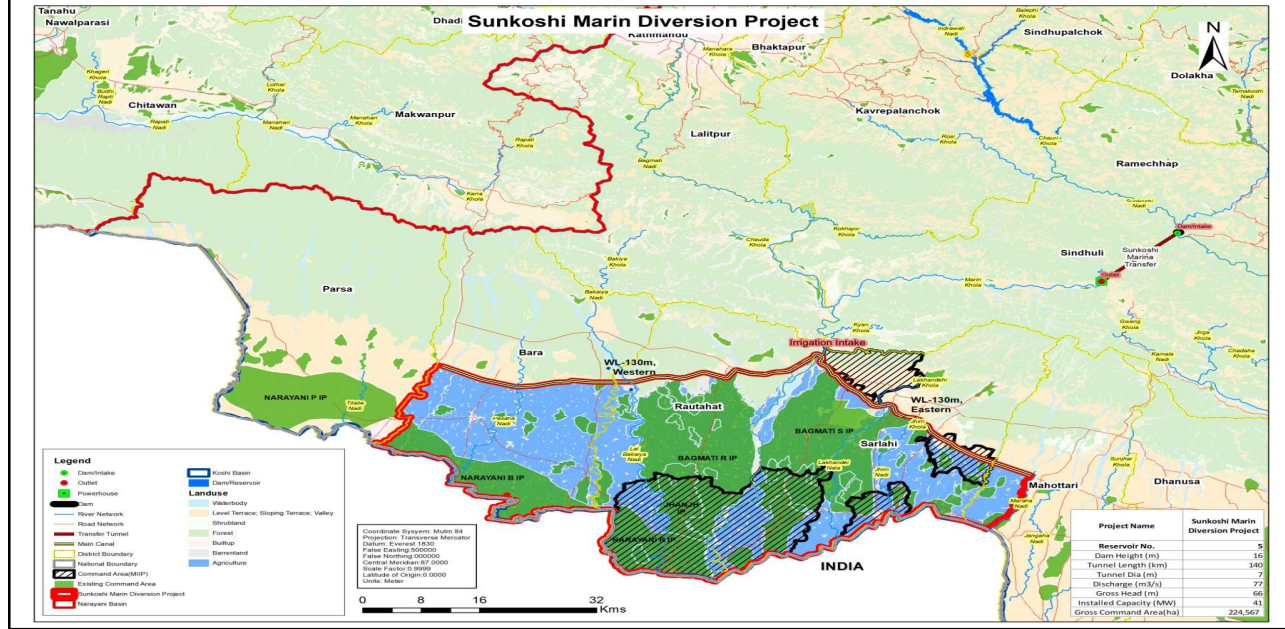
वृहत् योजना पहिचान



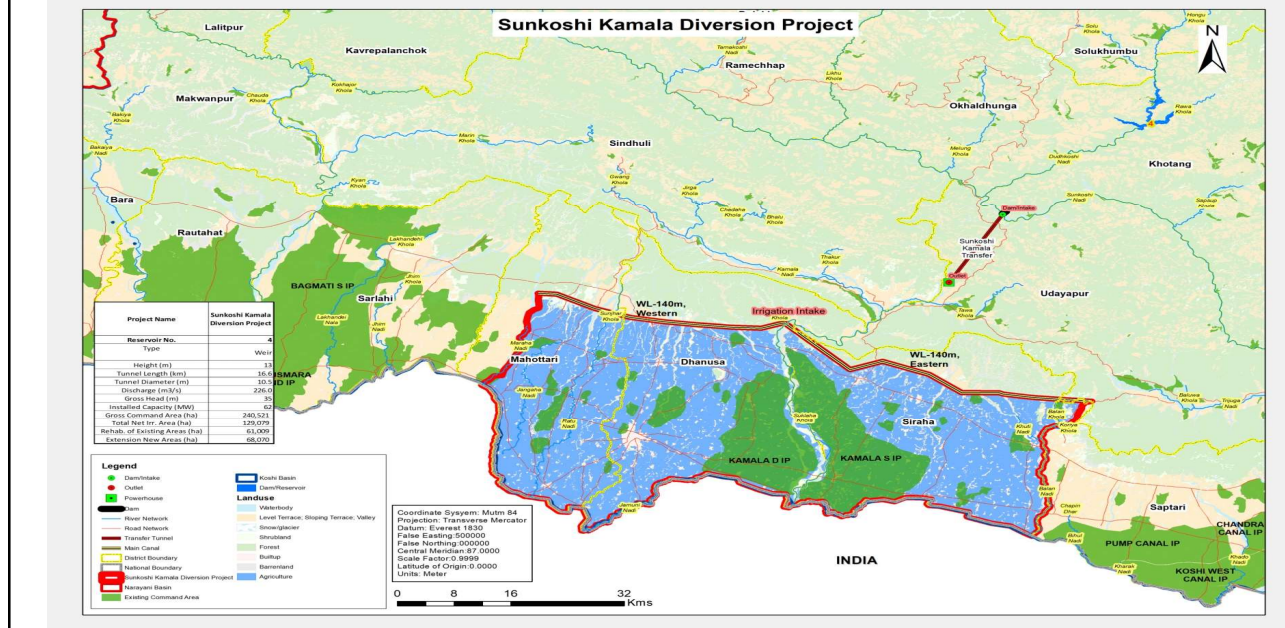
वृहत् योजना पहिचान



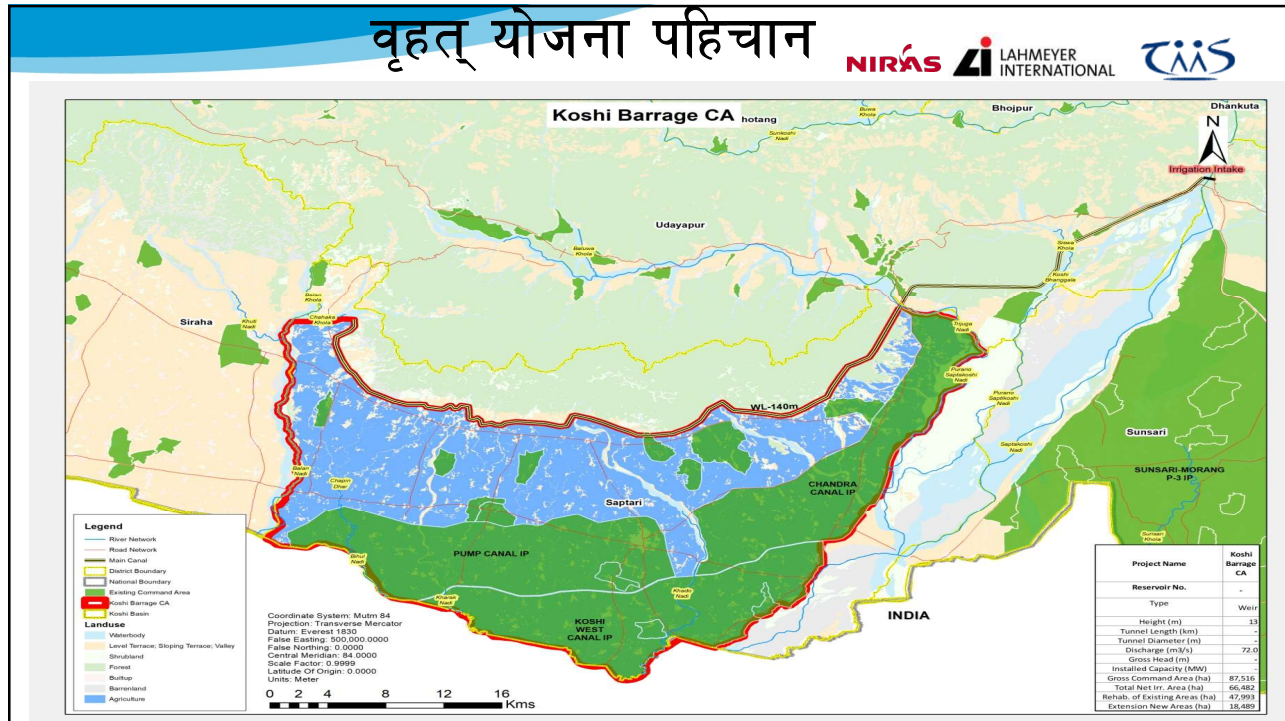
वृहत् योजना पहिचान



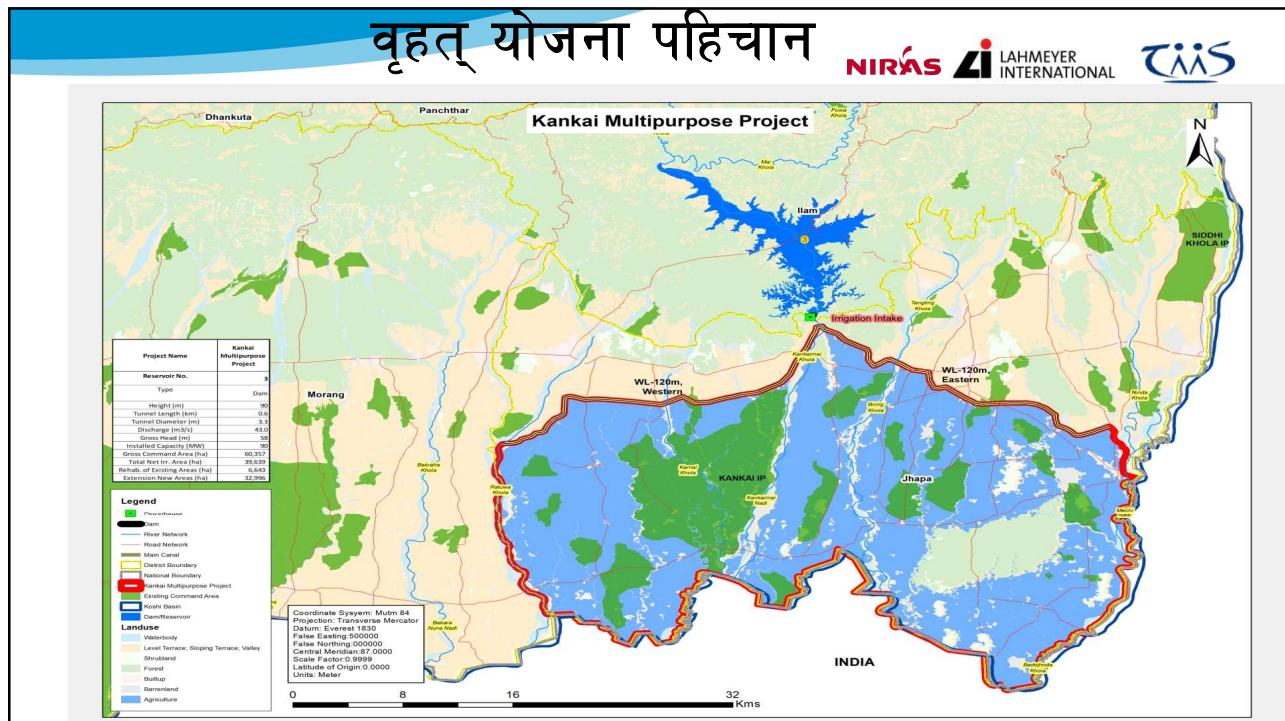
वृहत् योजना पहिचान



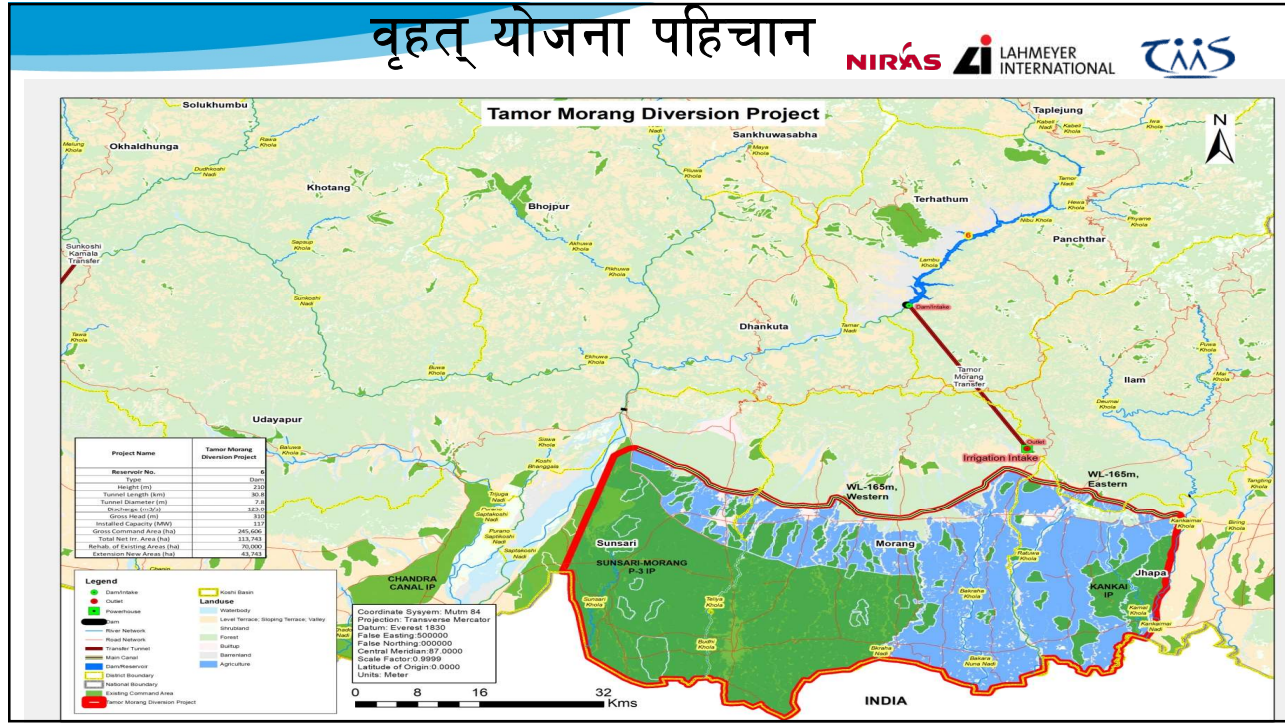
वृहत् योजना पहिचान

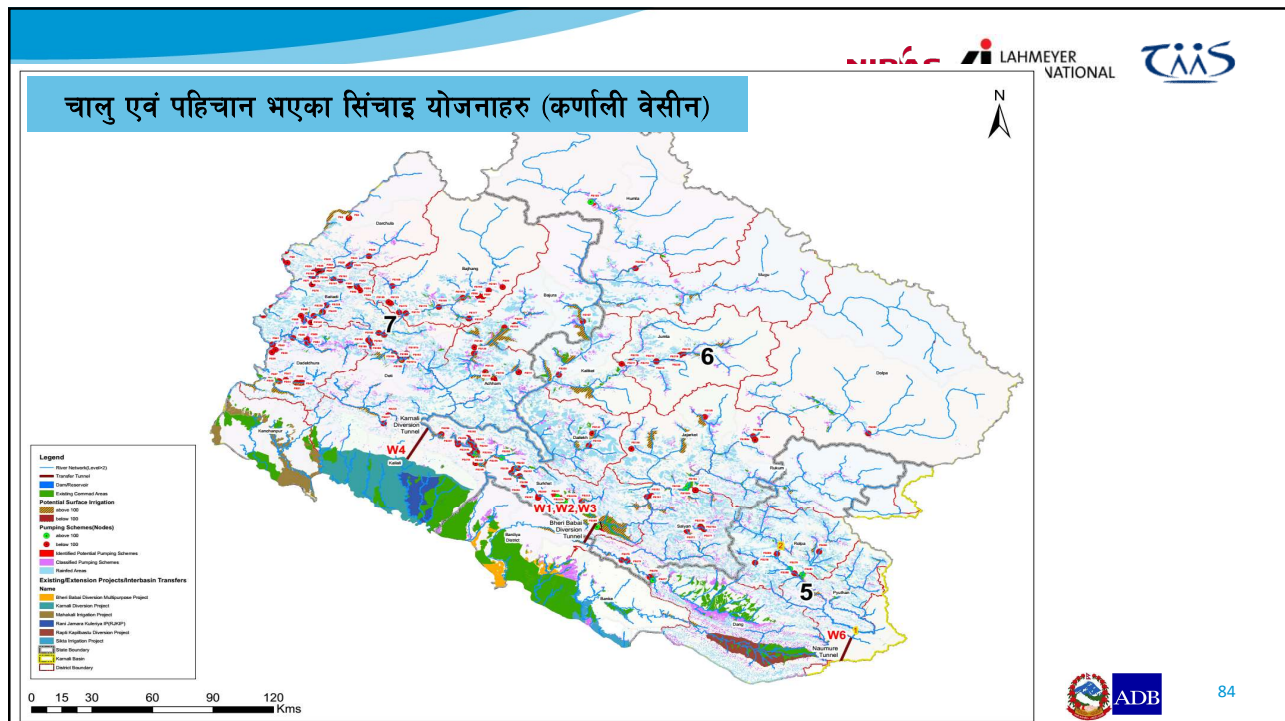
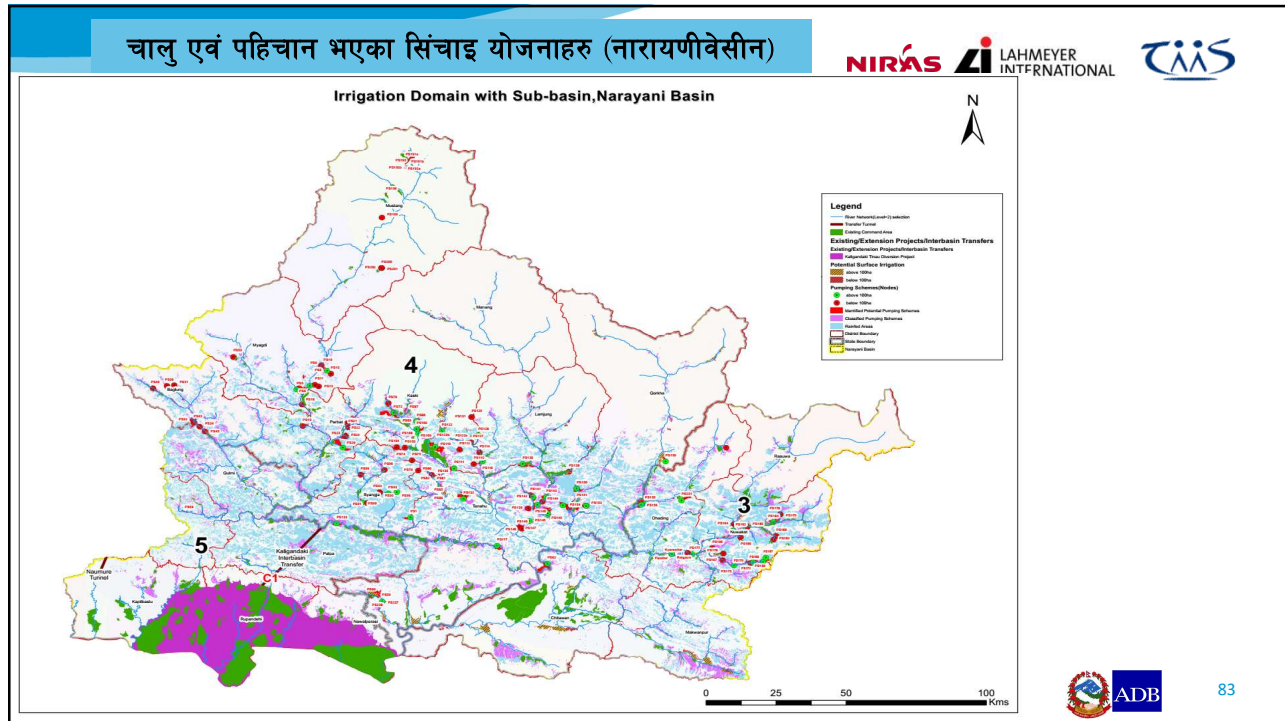


वृहत् योजना पहिचान



वृहत् योजना पहिचान





योजना प्राथमिकीकरणका आधार



- Technical
- Environmental
- Social and GESI
- Market and Regional Development
- Water availability and Use of Resources (incl. Climate Change vulnerability)
- Economics
- Policy



योजना प्राथमिकीकरणका आधार



#	Criteria	Score
1	TECHNICAL	
1.1	Availability of Design Studies(1) Source: available reports	
a	Complete Design/Tender Document	100
b	Feasibility Design (incl. Geotechnical investigations and Slope Survey)	60
c	Pre-Feasibility Design	10
d	No design available	0
1.2	Type of project (10) Source: available reports	
a	Project contains innovative features	(max)100 (100/10)
b	Project is a new construction or rehabilitation (Percentage New ha x 200 + percentage Rehabilitation ha x 20) x weight	(max)90
2	Physical Characteristics (100)	
2.1	Net irrigated area, New construction Source: GIS data	
a	more than 200,000 ha	100
b	between 140,000 ha and 200,000 ha	75
c	between 90,000 ha and 140,000 ha	50
d	between 40,000 ha and 90,000 ha	25
e	less than 40,000 ha	0
2.2	Net irrigated area, Rehabilitation Source: GIS data	
a	more than 200,000 ha	100
b	between 140,000 ha and 200,000 ha	75
c	between 90,000 ha and 140,000 ha	50
d	between 40,000 ha and 90,000 ha	25
e	less than 40,000 ha	0
2.3	Sustainable (Source: GIS data)	
a	more than 90% (2+12)	100
b	between 80% and 90% (12+12)	75
c	between 70% and 80% (12+12)	50
d	less than 70% (12+12)	25
e	less than 60% (12+12)	0
2.4	Projected generation capacity MW (20) Source: available reports	
a	More than 200 MW	100
b	between 100 MW and 200 MW	75
c	between 50 MW and 100 MW	50
d	between 20 MW and 50 MW	25
e	No production of energy	0
3	Technical merit Supply (20) Source: available reports	
a	The project includes DWS component	(max)100 (100/20)
b	Geotechnical (GIS) source: available reports	
a	Suitable geology and geotechnical conditions	(max)100 (100/10)
3.2	Other Engineering Criteria (10)	
3.2.1	Accessibility/availability of roads, airports etc(5) (Source: GIS data)	
a	Easily accessible	100
b	Not easily accessible	0
3.2.2	Complexity of diversion tunnel Source: available reports	
a	Simple	100
b	tunnel between 1 and 20 km	75
c	tunnel between 2.1 and 20 km	50
d	tunnel more than 2.1 km	25
e	no tunnel	0
3.2.3	Pumping (15) (Source: GIS data)	
a	Existing head more than 100m	0



प्राथमिकता प्राप्त योजनाहरू

NIRAS LAHMEYER INTERNATIONAL

T&S

Selected Project	Scenario	Project	Score	NPV (M NPV)	IRR (%)	New Irrig Area (ha)	Rehab Irrig Areas (ha)	Irrg & HP Cost (MNpr/ha)
1	E.6	Tamor Morang with Tamor HPP	113	180,563	17.1%	43,743	70,000	889.3
2	E.4	Sunkoshi Marin and Sunkoshi Kamala with Sunkoshi 3 HPP	108	187,714	15.6%	132,244	220,020	2875.7
3	C.2	Kaligandaki Tinau transfer. Rupandehi Irrigation and Andikhola Dam	88	151,066	16.5%		41,953	981.2
4	W.6	Naumure Dam, Regulation Dam, Rapti Kapilbastu Tunnel, Powerhouse and Irrigation Area	59	- 55,017	5.1%	10,407	40,849	625.3
5	W.4	Karnali Diversion Tunnel Project	50	30,952	13.8%	32,996	7,632	644.1
6	W.2	Bheri-Babai transfer and Nalsyuga Dam	48	41,991	16.7%	2,644	42,467	505.9
	E.7	Kankai Multipurpose Project	45	- 16,304	5.0%	32,996	6,643	484.7
7	E.8	Sunkoshi Barrage	45	- 6,370	6.8%	18,489	47,993	279.9

© Lahmeyer International GmbH 2018



87

भूमिगत सिंचाइ कार्यक्रम

NIRAS LAHMEYER INTERNATIONAL

T&S

District	Proposed Area ha	Economic NPV, NPR m at 9%	Economic IRR	Suggested Rank (priority)	Investment Cost Npr M	Investment Cost \$ M
Kailali	3,600	887.06	18%		933.1	8.6
Banke	17,700	4,590.10	18.50%	4	4,587.8	42.5
Dang	32,500	371.91	9.50%	3	8,424.0	78.0
Kapilbastu	11,700	-190.97	8.30%	6	3,032.6	28.1
Rupandehi	5,000	1,082.55	12.00%	7	1,296.0	12.0
Nawalparasi	31,400	-1,033.66	7.40%	8	8,138.9	75.4
Chitawan	20,500	4,776.58	17.80%	2	5,313.6	49.2
Parsa	21,400	2,613.12	13.90%	1	5,546.9	51.4
Rautahat	25,000	9,363.01	22.20%	In pipeline	6,480.0	60.0
Sarlahi	15,000	2,203.06	14.90%	In pipeline	3,888.0	36.0
Sunsari	5,500	1,706.65	20.20%		1,425.6	13.2
Jhapa	86,400	8,215.93	12.90%	5	22,394.9	207.4
All areas	285,700	34,585.33	13.90%		74,053.4	685.7

पम्प सिंचाइ योजना

NIRAS

LAHMEYER
INTERNATIONAL

TAAS

DISTRICT	EXISTING COMMAND AREA	POTENTIAL SURFACE IRRIGATION	IDENTIFIED POTENTIAL PUMPING SCHEME	CLASSIFIED POTENTIAL PUMPING SCHEME
Bara	20051	5979		4,110
Bhaktapur	1109	630		1,862
Bhojpur	4174	1529		1,824
Dhankuta	2465	1528	46	1,003
Dhanusha	23110	1447		1,330
Dolakha	2568	785		1,389
Ilam	2599	851	435	7,637
Jhapa	25855	12931		165
Kathmandu	823	198		567
Kavre	1243	2305	129	6,337
Khotang	1516			2,489
Lalitpur	976	464		2,111
Mahottari	5436	4395		2,024
Morang	106862	2630		2,242
Okhaldhunga	713	502	25	1,451
Panchthar	1717	578		1,467
Parsa	23582	14436		14,217
Ramechhap	1419	1680	68	1,822
Rautahat	48868	514		993
Sankhuwasabha	2008	4327		4,833
Saptari	43151	545		2,115
Sarlahi	39569	5806		4,664
Sindhuli	1210	9005	641	12,302
Sindhupalchowk	1393	376	40	2,335
Siraha	26767	496		446
Solukhumbu	1076	293	26	2,147
Sunsari	11539	327		2,745
Taplejung	763	3622		2,316
Terathum	4648			336
Udayapur	3954	3128	2705	10,787
Total	411,161	81,310	4,115	100,067

© Lahmeyer International GmbH 2018



89

कोशी बेसीन
पम्प (१००,०६७ हे)

पम्प सिंचाइ योजना

NIRAS

LAHMEYER
INTERNATIONAL

TAAS

DISTRICT	EXISTING COMMAND AREA	POTENTIAL SURFACE IRRIGATION	IDENTIFIED POTENTIAL PUMPING SCHEME	CLASSIFIED POTENTIAL PUMPING AREA
Arghakhanchi	714	38		2,774
Baglung	1014	355	239	6,708
Chitawan	16992	3036		7,659
Dhading	2481	276	406	12,990
Gorkha	1531	1301	620	9,866
Sulmi	1220	36		7,921
Kapilbastu	22216			3,365
Kaski	2580	1945	1488	8,560
Lamjung	2951	540	4	5,005
Makwanpur	1460	4107		11,520
Manang	296	333		745
Mustang	1239	203	369	1,293
Myagdi	508	240	744	4,346
Nawalparasi	22823	1893	538	11,624
Nuwakot	1766	1394	711	7,731
Palpa	2646		112	9,395
Parbat	997	270	266	2,414
Rasuwa	1325	315		2,598
Rupandehi	26253			2,034
Syangja	1728	308	175	5,202
Tanahu	1836	860	1773	11,961
Total	114,576	17,451	7,445	135,711

© Lahmeyer International GmbH 2018



90

नारायणी बेसीन
पम्प (१३५,७११ हे)

पम्प सिंचाई योजना

NIRAS LAHMEYER INTERNATIONAL T&S

DISTRICT	EXISTING COMMAND AREA	POTENTIAL SURFACE IRRIGATION	IDENTIFIED POTENTIAL PUMPING SCHEME	CLASSIFIED POTENTIAL PUMPING SCHEME
ACHHAM	442	1718	95	7,959
BAITADI	206	655	329	6,102
BAJHANG	1061	568	418	7,616
BAJURA	733	3115	72	7,566
BANKE	35063	353	-	7,931
BARDIYA	47575	170	-	4,107
DADELHURA	1589	2389	466	9,897
DAILEKH	989	875	-	4,946
DANG	27731	444	113	19,756
DARCHULA	386	1150	198	5,370
DOLPA	1050	45	31	2,747
DOTI	1516	822	269	8,732
HUMLA	759	63	193	4,747
JAJARKOT	431	1973	188	6,956
JUMLA	843	606	278	7,527
KAILALI	37892	1039	470	2,221
KALIKOT	2536	1677	12	4,786
KANCHANPUR	18070	0	-	29
MUGU	342	435	-	4,950
PHYUTHAN	1814	1054	-	5,791
ROLPA	932	262	460	8,403
RUKUM	1570	121	85	6,866
SALYAN	544	1811	484	11,893
SURKHET	5714	7539	2,518	10,389
Total	189787	28,888	6,682	167,287

**कर्णाली बेसीन
पम्प (१६७,२८७ हे)**

ADB 91

निर्माणाधीन वृहत् योजनाहरू

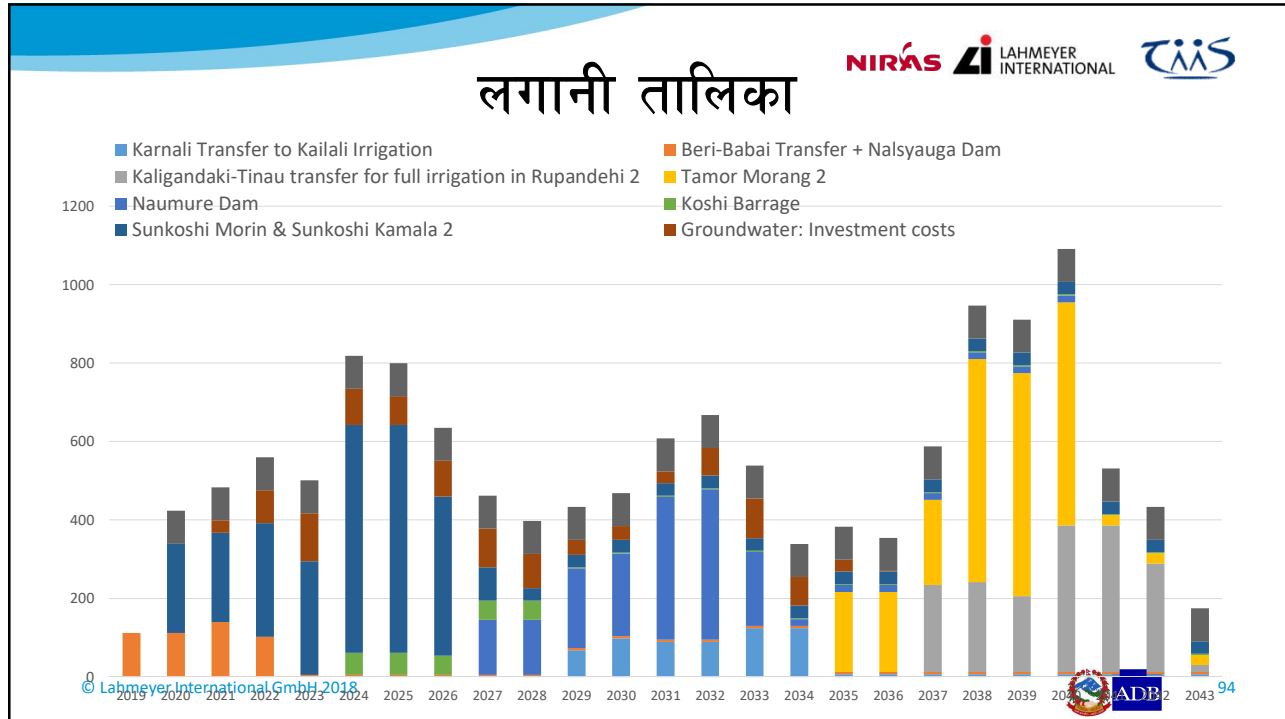
NIRAS LAHMEYER INTERNATIONAL T&S




- महाकाली सिंचाई योजना तेश्रो चरण
- रानी जमरा कुलरिया सिंचाई योजना
- बबइ सिंचाई योजना
- सिक्टा सिंचाई योजना
- बडकापथ सिंचाई योजना

ADB 92

कार्यान्वयन तालिका NIRÁS LAHMEYER INTERNATIONAL T&S

Selected Project	Scenario	Project	Score	Economic IRR (re-scheduled)	NPV, 9%, NPR, m	New Irig Area (ha)	Rehab Irig Areas (ha)	Total Development Construction Period	Start	End	2019-2043																									
											2019-2024					2024-2029				2029-2034				2034-2039				2039-2044								
											2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	
1	E.6	Tamor Morang with Tamor HPP	100	10.0%	85,542	45,766	70,000	150,766	6	2005	2008																									
2	E.4	Sunkoshi Marin and Sunkoshi Kamala with Sunkoshi 3 HPP	100	10.0%	182,832	122,244	200,000	322,244	10	2009	2019																									
3	C.2	Kaligandaki Tinau transfer, Rupandehi Irrigation and Andikholra Dam	86.2	14.0%	85,477		81,953	81,953	4	2007	2014																									
4	W.6	Naumure Dam, Regulation Dam, Rapiti Kapilbastu Tunnel, Powerhouse and Irrigation Area	10.1	11.4%	36,778	10,407	40,849	51,256	4	2009	2014																									
5	W.4	Karnali Diversion Tunnel Project	10.7	14.0%	12,579	12,006	7,102	49,628	7	2009	2016																									
6	W.2	Bheri-Babai transfer and Nalsyuga Dam	49.3	14.7%	41,974	2,644	42,617	45,111	5	2009	2014																									
7	E.8	Koshi Barrage	44.4	10.0%	4,749	18,489	47,993	66,442	5	2004	2009																									
8		GroundWater: Rautahat, Sialahi	10.4%		10,744			44,000	3	2010	2013																									
9		GroundWater: Mahottari, Dhanusha, Siraha, Phase 1	9.2%		295			40,000	3	2012	2015																									
10		GroundWater: Mahottari, Dhanusha, Siraha, Phase 2	7.1%		2,000			40,000	3	2010	2013																									
11		GroundWater: Parsa, Chitwan	11.3%		6,548			40,000	3	2020	2022																									
12		GroundWater: Jhapa, Morang, Phase 1	10.4%		2,201			40,000	3	2021	2024																									
13		GroundWater: Kapilbastu, Nawalparasi, Rupandehi, Phase 1	10.8%		4,447			10,000	4	2017	2021																									
14		GroundWater: Jhapa, Morang, Phase 1	8.9%		4,500			40,000	3	2019	2021																									
15		GroundWater: Kapilbastu, Nawalparasi, Rupandehi, Phase 2	6.7%		3,003			50,000	4	2011	2015																									
16		GroundWater: Dang	11.3%		2,140			33,500	3	2012	2015																									
17		Hills Gravity and Pumping - Identified	11.3%		2,140			160,000	7	2010	2016																									
18		Hills Gravity and Pumping -Classified	11.3%		2,140			160,000	18	2017	2035																									








लगानी तालिका

MPP and Koshi Barrage: Investment and Operating Costs, USD m current 2018 prices

Total Cost	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044																																																							
Karnali Transfer to Kailali Irrigation	2029	0	0	0	0	0	0	0	0	0	42.88	98.84	89.73	88.79	136.8	124.4	6.895	6.895	6.895	6.895	6.895	6.895	6.895	6.895	6.895	6.895																																																							
Beri-Babai Transfer + Nalsyuga Dam	2019	112.3	112.3	189.9	182.7	5.42	5.42	5.42	5.42	5.42	5.42	5.42	5.42	5.42	5.42	5.42	5.42	5.42	5.42	5.42	5.42	5.42	5.42	5.42	5.42	5.42																																																							
Kaligandaki-Tinaw transfer for full irrigation in Rupandehi 2	2037	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	233.1	206.5	193.7	374	374	274.8																																																							
Tamor Morang 2	2035	0	0	0	0	0	0	0	0	0	0	0	0	0	0	264.3	264.3	216.7	168.5	168.5	25.8	25.8	25.8	25.8	25.8	25.8																																																							
Naumure Dam	2030	0	0	0	0	0	0	0	0	140.2	140.2	203.2	203.2	364	383.1	189	17.49	17.49	17.49	17.49	17.49	17.49	17.49	17.49	17.49	17.49																																																							
Koshi Barrage	2024	0	0	0	0	0	15.97	15.97	48.83	48.83	48.83	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6																																																							
Sunkoshi Morin & Sunkoshi Kamala 2	2020	0	227.8	227.8	289.2	289.2	581.1	581.1	851.8	851.8	32.18	32.18	32.18	32.18	32.18	32.18	32.18	32.18	32.18	32.18	32.18	32.18	32.18	32.18	32.18	32.18																																																							
NB Construction periods as recommended by Andreas																																																																																	
<table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <tr> <td>0</td><td>0.177</td><td>31.84</td><td>84.42</td><td>122.5</td><td>82.22</td><td>79.11</td><td>95.89</td><td>85.19</td><td>87.15</td><td>37.43</td><td>35.74</td><td>85.25</td><td>70.13</td><td>151.2</td><td>73.82</td><td>29.95</td><td>1.138</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td> </tr> <tr> <td>2020</td><td>2020</td><td>2020</td><td>2022</td><td>2023</td><td>2024</td><td>2025</td><td>2026</td><td>2027</td><td>2028</td><td>2029</td><td>2030</td><td>2031</td><td>2032</td><td>2033</td><td>2034</td><td>2035</td><td>2036</td><td>2036</td><td>2036</td><td>2036</td><td>2036</td><td>2036</td><td>2036</td><td>2036</td><td>2036</td><td>2036</td> </tr> </table>																												0	0.177	31.84	84.42	122.5	82.22	79.11	95.89	85.19	87.15	37.43	35.74	85.25	70.13	151.2	73.82	29.95	1.138	0	0	0	0	0	0	0	0	0	2020	2020	2020	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2036	2036	2036	2036	2036	2036	2036	2036	2036
0	0.177	31.84	84.42	122.5	82.22	79.11	95.89	85.19	87.15	37.43	35.74	85.25	70.13	151.2	73.82	29.95	1.138	0	0	0	0	0	0	0	0	0																																																							
2020	2020	2020	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2036	2036	2036	2036	2036	2036	2036	2036	2036																																																							
Groundwater: Investment costs																																																																																	
Package 8	2020	2024	0.177	31.58	17.96	38.18	1.54	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0																																																							
Package 12	2021	2025	0.258	45.3	15.64	15.87	2.258	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0																																																							
Package 9	2022	2026	0.161	28.71	34.51	34.71	1.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0																																																							
Package 13	2024	2028	0.261	35.89	43.14	43.14	1.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0																																																							
Package 14	2025	2029	0.259	41.3	15.64	15.97	2.258	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0																																																							
Package 11	2027	2031	0.145	29.43	35.17	35.58	1.455	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0																																																							
Package 10	2030	2034	0.141	28.71	34.51	34.71	1.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0																																																							
Package 15	2030	2035	0.201	35.89	43.14	43.14	1.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0																																																							
Package 16	2032	2036	0.151	21.23	28.04	28.2	1.138	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0																																																							

© Lahmeyer International GmbH 2018


95

