National survey on Helminthiasis and health behavior associated with Geographic Information in Thailand, 2009

Department of Disease Control
Ministry of Public Health
THAILAND

กลุ่มโรคหนอนพยาธิ สำนักโรคติดต่อทั่วไป

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National Helminthiasis survey

Research Question????

1. How about the prevalence of Helminthiasis and the level of intensity of Opisthorchiasisis and Hookworm infection among Thai people in Thailand?

2. What is the correlation between behavioral factors and helminthic infections ?

National Helminthiasis survey

Research Objective

- **To determine the prevalence and the intensity of helminthiasis (OV,HW, Al, Tt, SS, T. spp EV etc) among Thai people in 75 provinces of Thailand**
- **To study the correlation between behavioral factors and helminthic infections including the logistic regression with analyze the determinant factors**
- **To analyze the correlation between prevalence of OV and HW with geographic information by using spatial analysis in topic of rainfall , land use , and soil types**

National Helminthiasis survey

Research Methodology

Descriptive Research or Cross-sectional Studies research

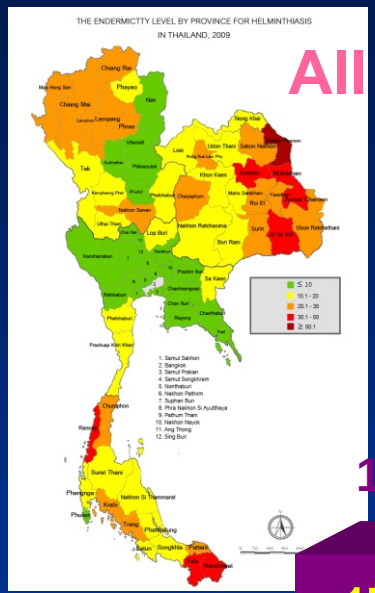
Sample size which represented for the whole population

At least 8,712 Samples under statistic information

$$n = \frac{Z^2_{(\alpha/2)} NP_{(1-p)}}{Z^2_{(\alpha/2)} P_{(1-p)} + (N-1)d^2} \times \text{Design effect}$$

Using 30 Clusters Sampling techniques under the criteria of WHO guideline

Helminthiasis situation in Thailand, year , 2009 classify by region using Formalin Ether Concentration



All Helminthiasis

Prevalence (%)

50
40
30
20
10
0

18.1 | 17.7 | 26.0 | 19.8 | 18.1

5.8 | 17.7

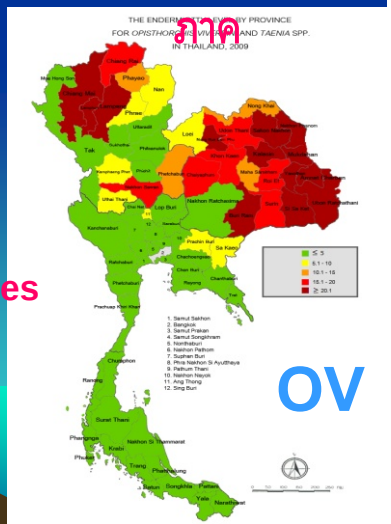
Cental | North | Northeast | South | Total

REGION

18.1 | 8.7 | 6.5 | 1.2 | 0.5 | 0.7 | 1.6 | 0.5 | 1.7

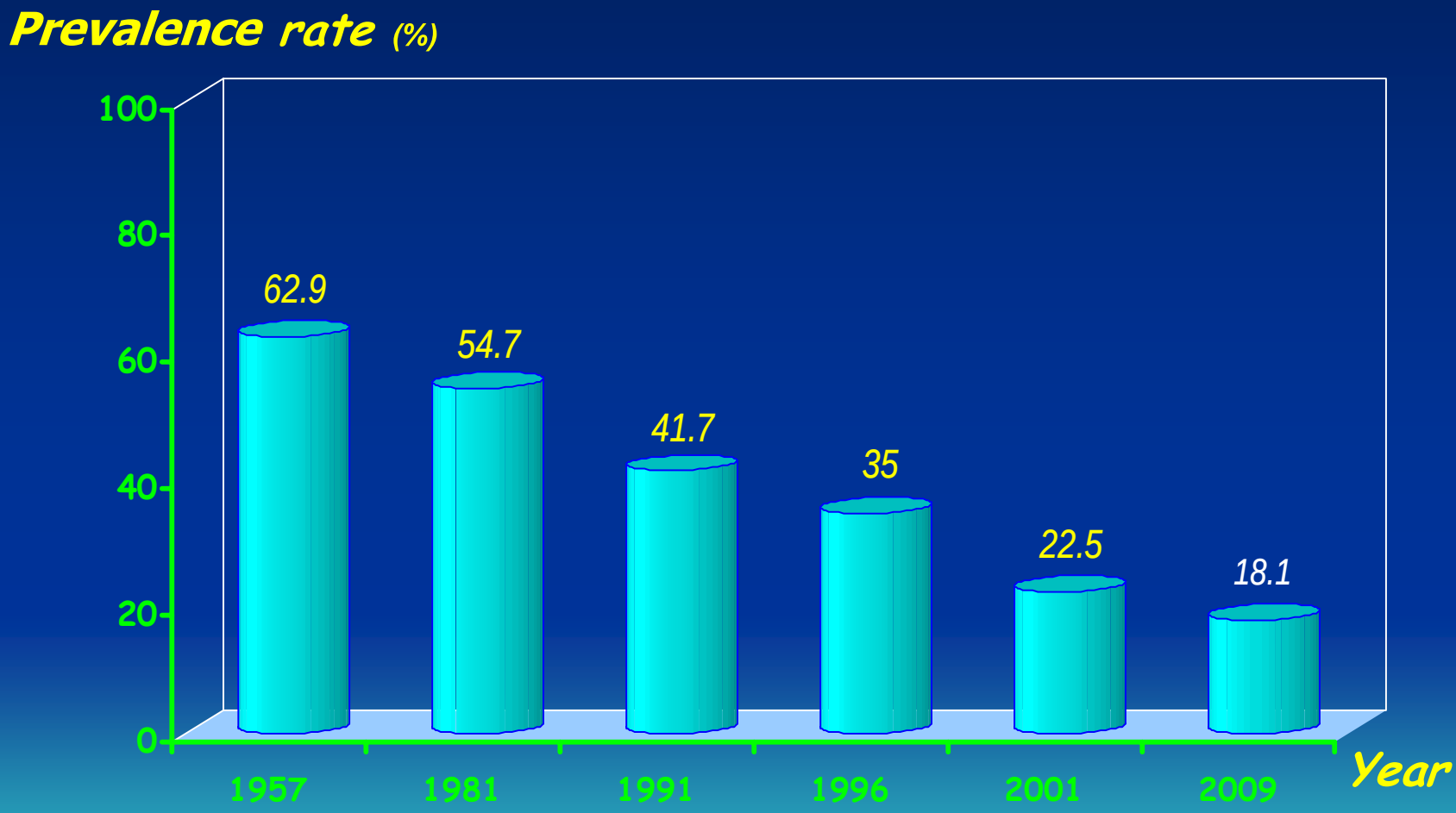
Total | HW | OV | TT | Intestinal Fluke | Taenia | MIF | AL | SS

Helminthes

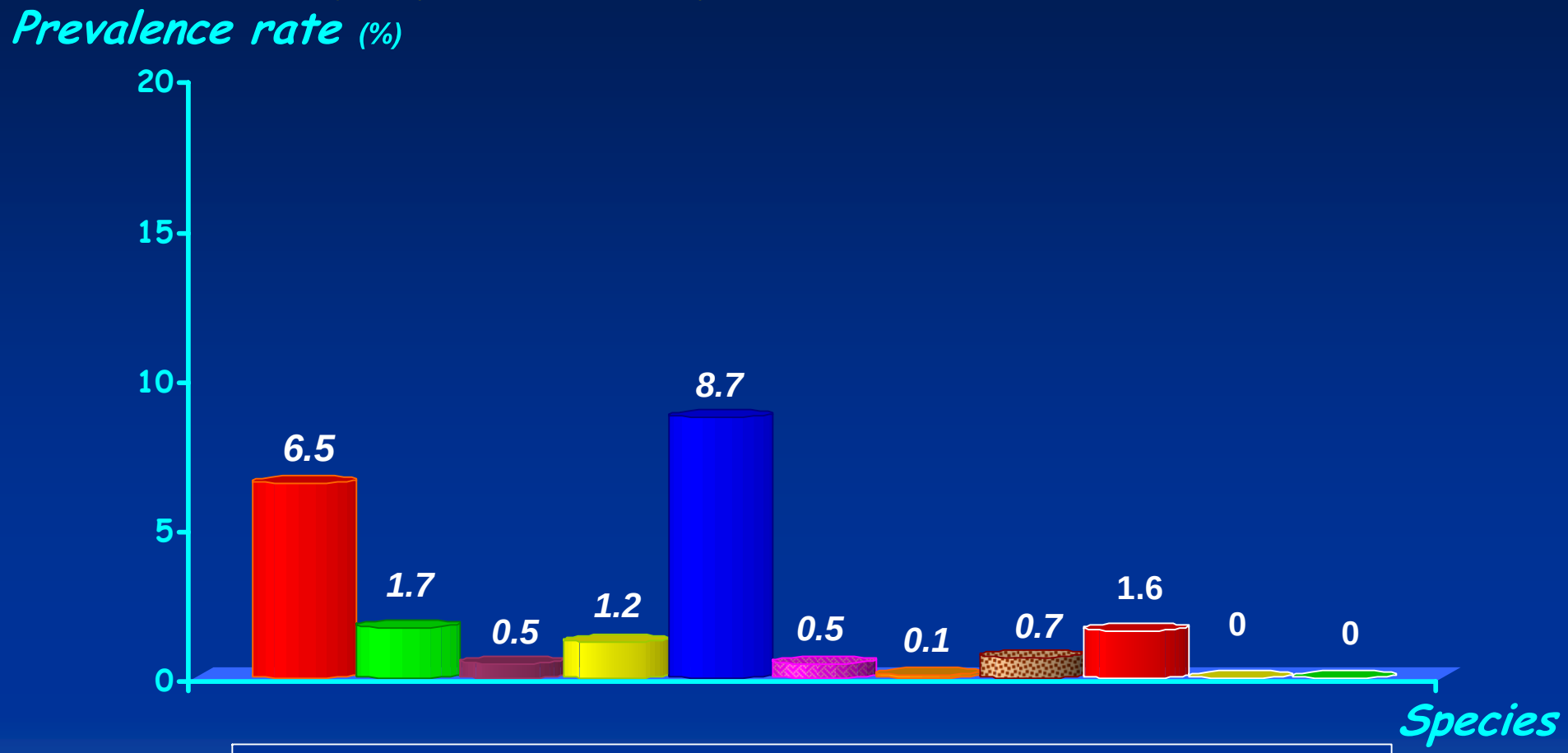


กลุ่มโรคหนอนพยาธิ สำนักโรคติดต่อทั่วไป

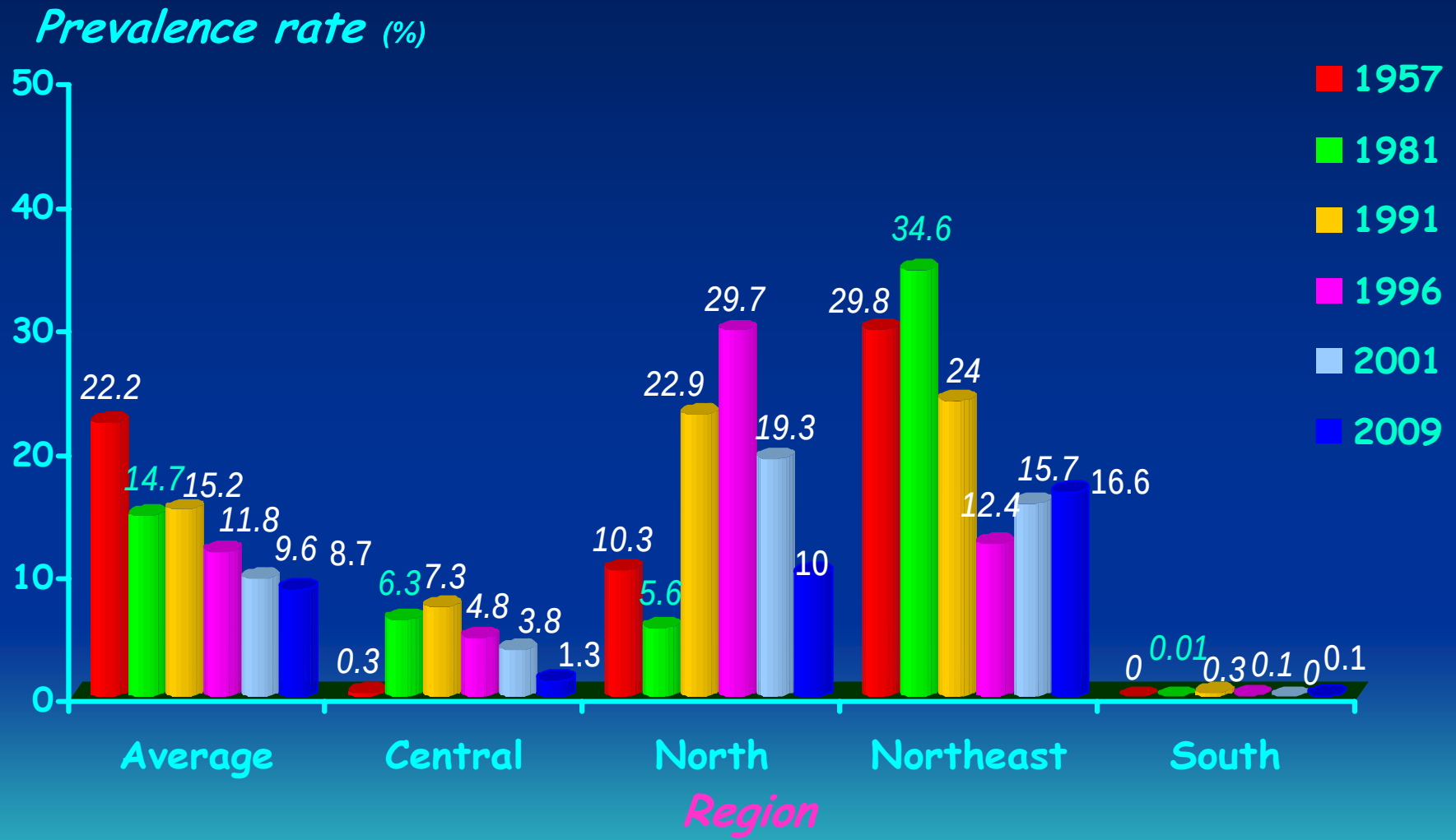
Prevalence rate of Intestinal Helminthiasis in Thailand in 1957, 1981, 1991, 1996 2001 and 2009



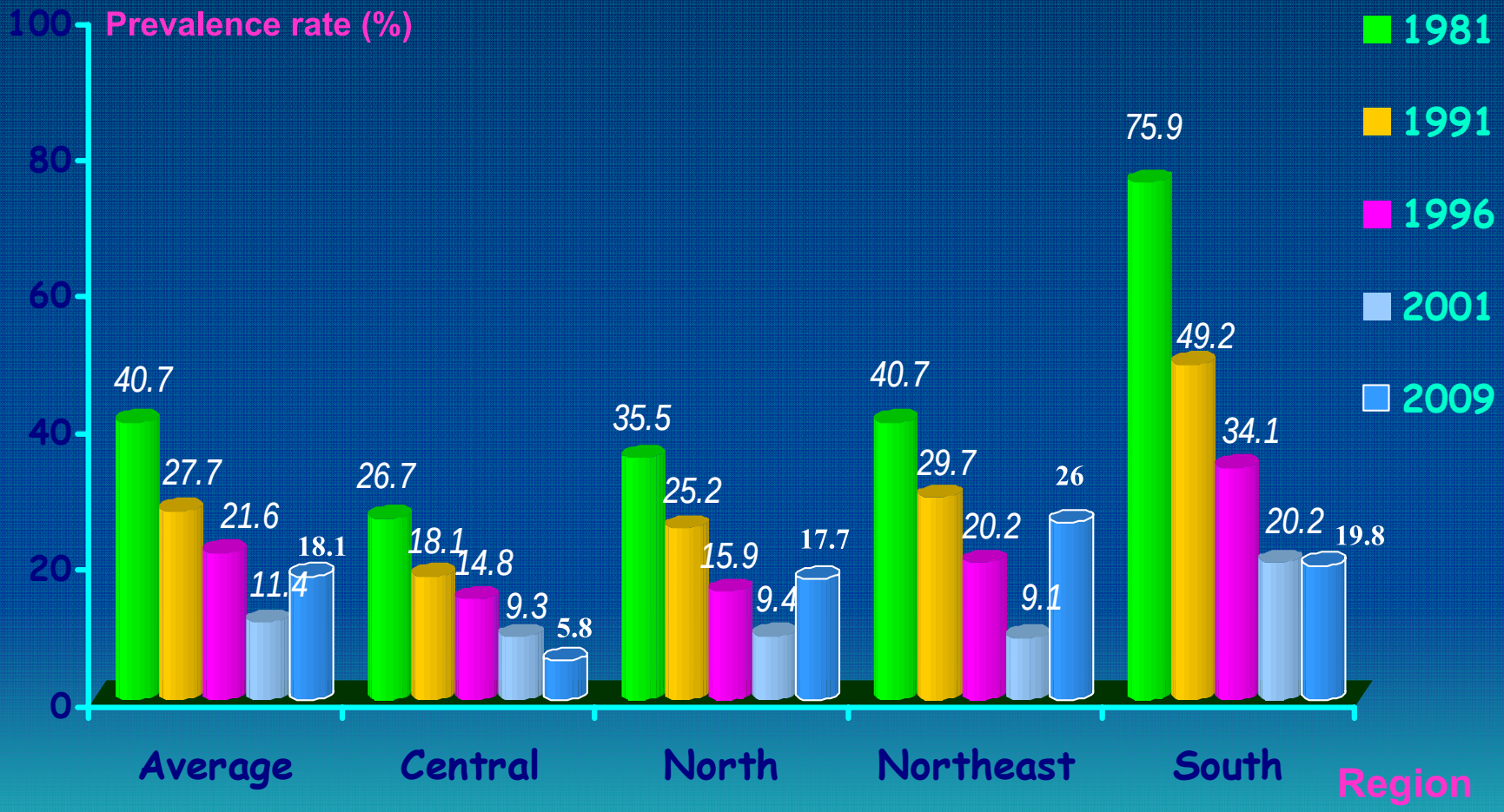
Prevalence rate of Intestinal Helminthiasis by species of parasite, Thailand, 2009



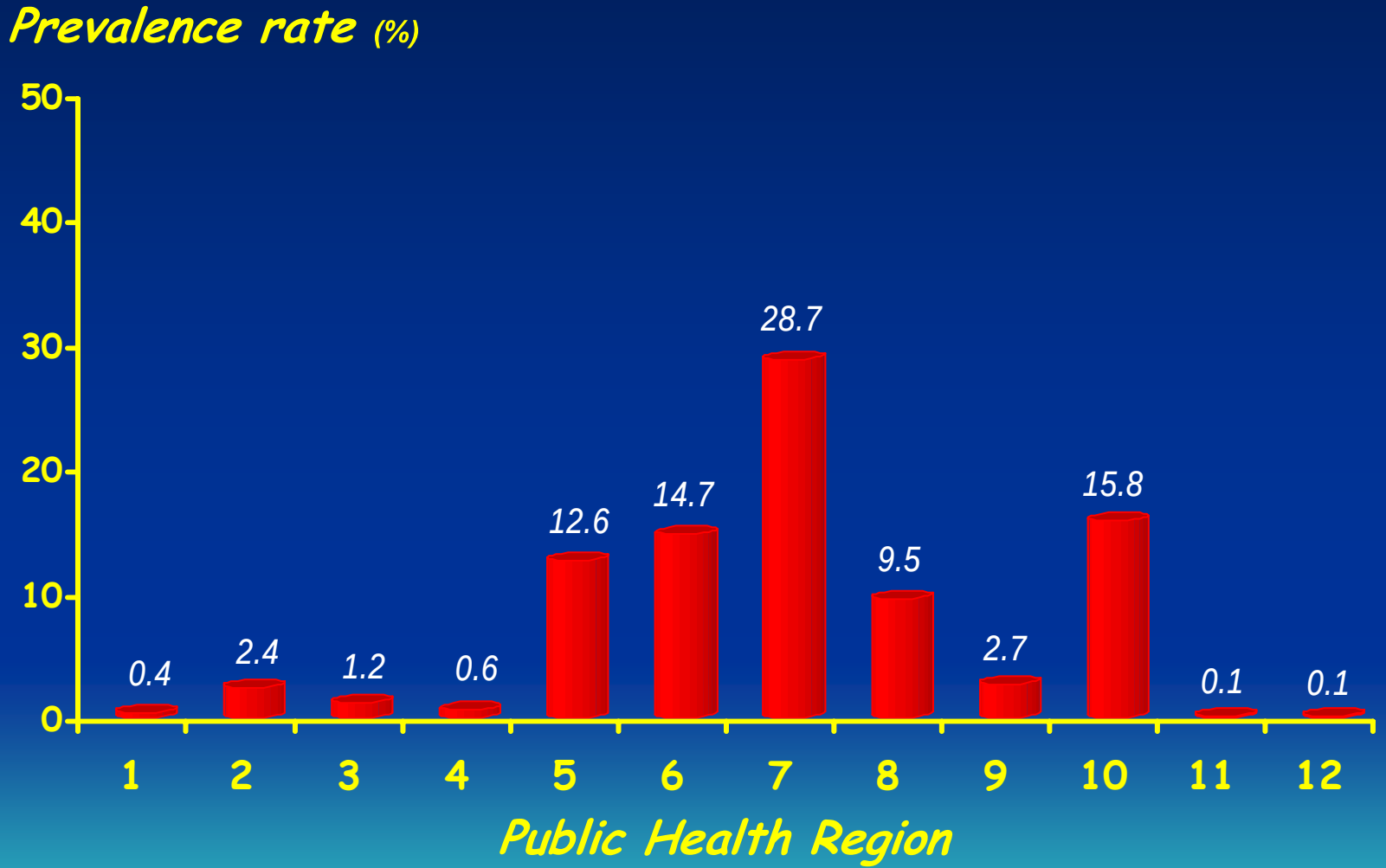
Prevalence rate of Opisthorchiasis in Thailand by region and year



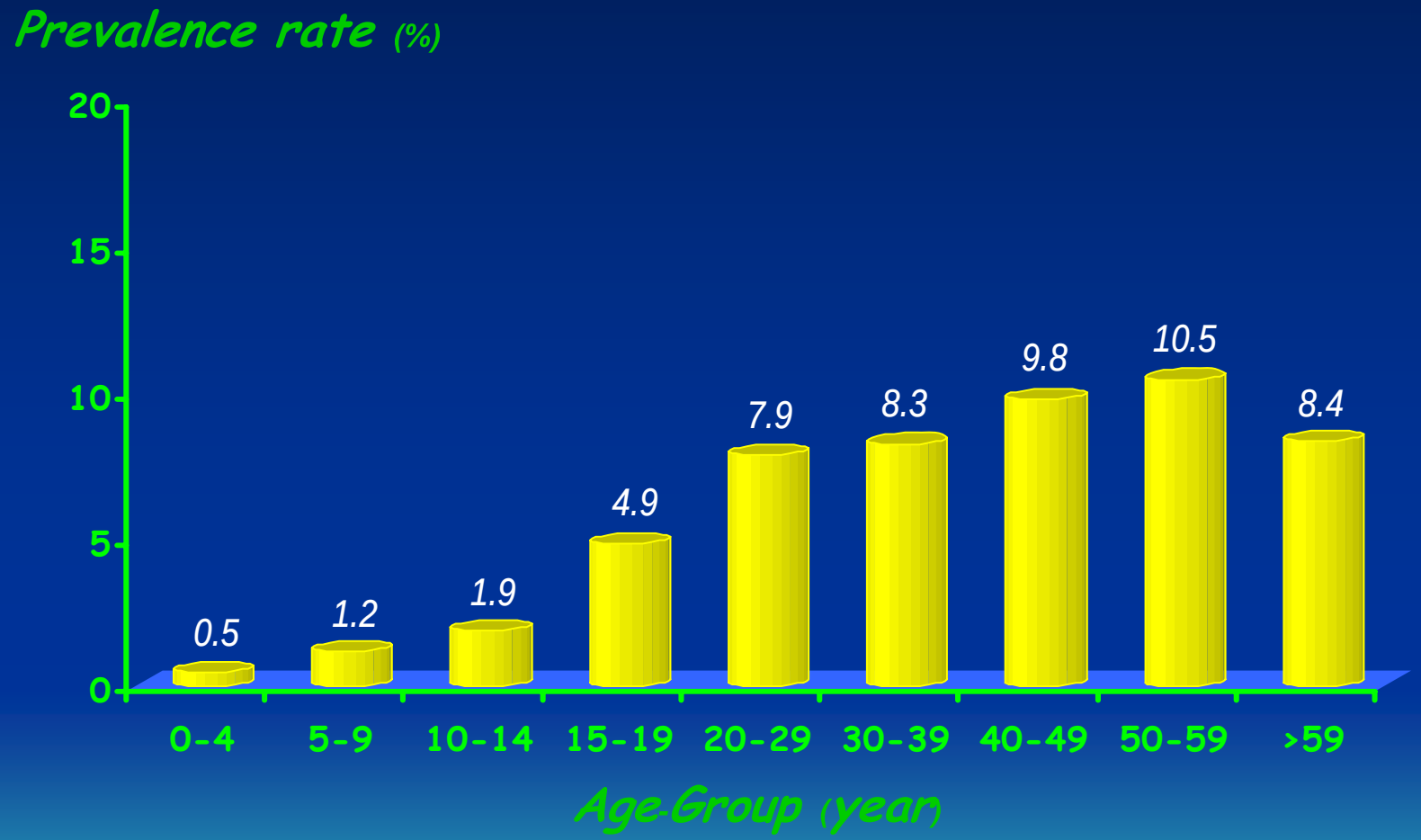
Prevalence rate of Hookworm Infection in Thailand by region and year



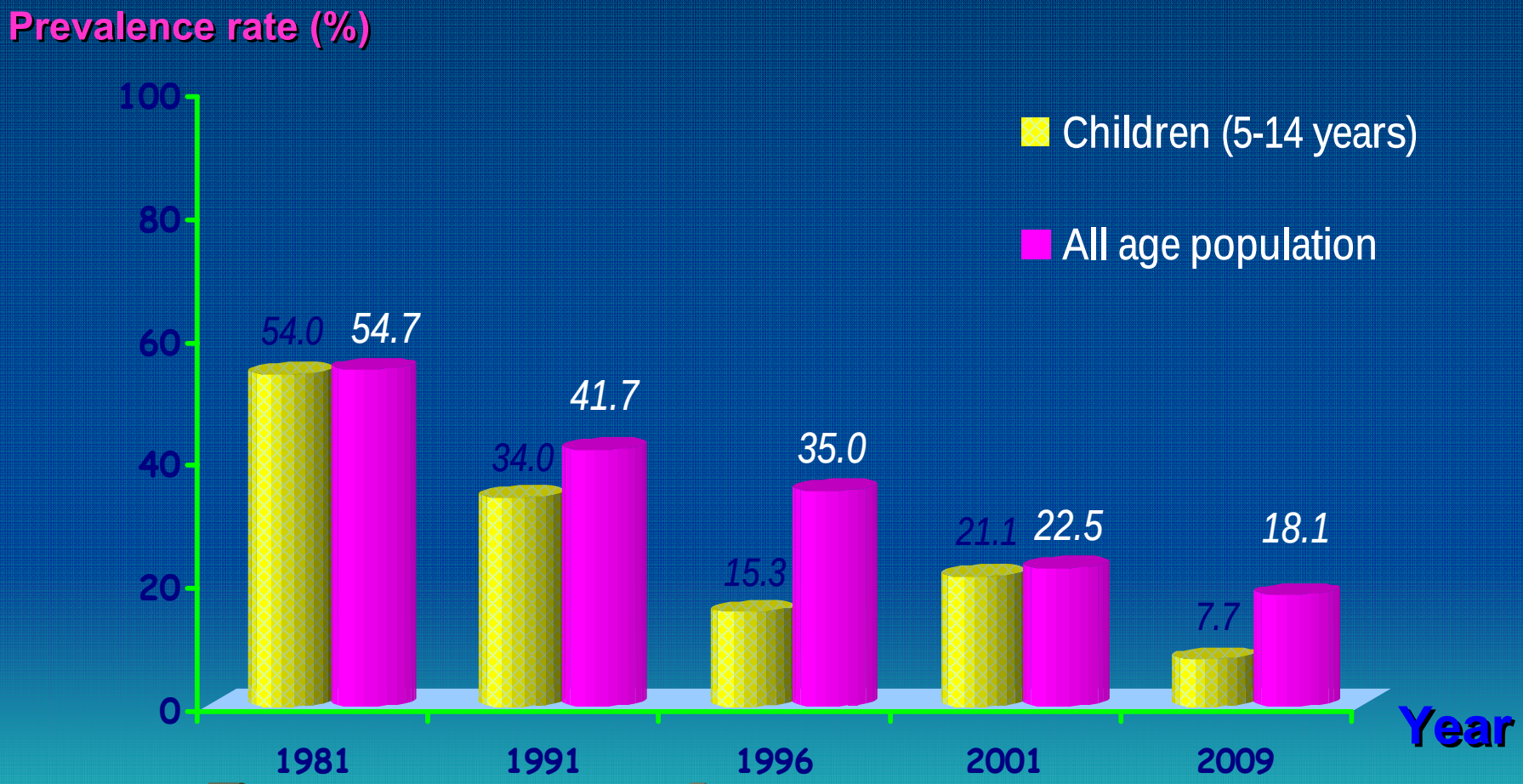
Prevalence rate of Opisthorchiasis by Public Health Region, Thailand, 2009



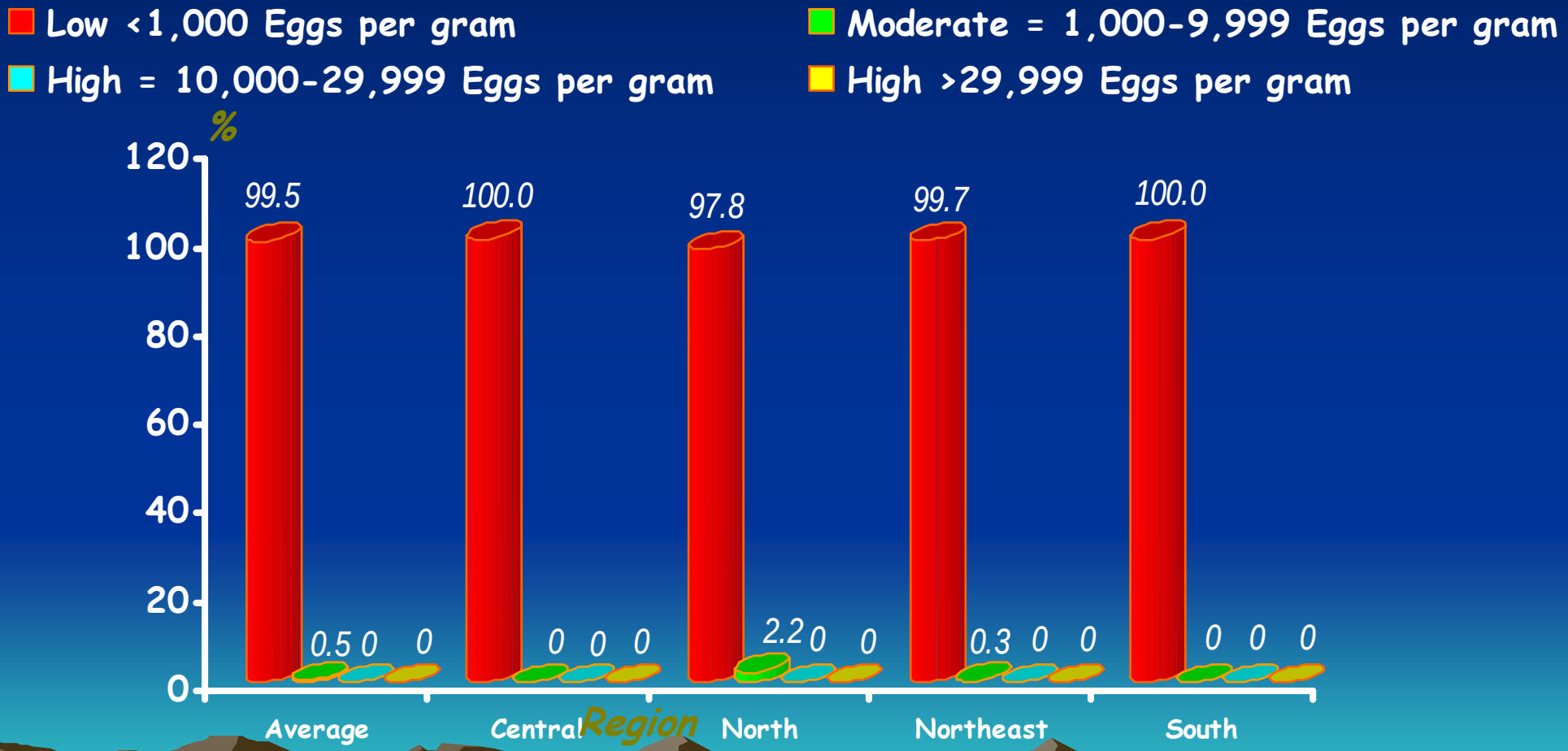
Prevalence rate of Opisthorchiasis by Age-Group, Thailand, 2009



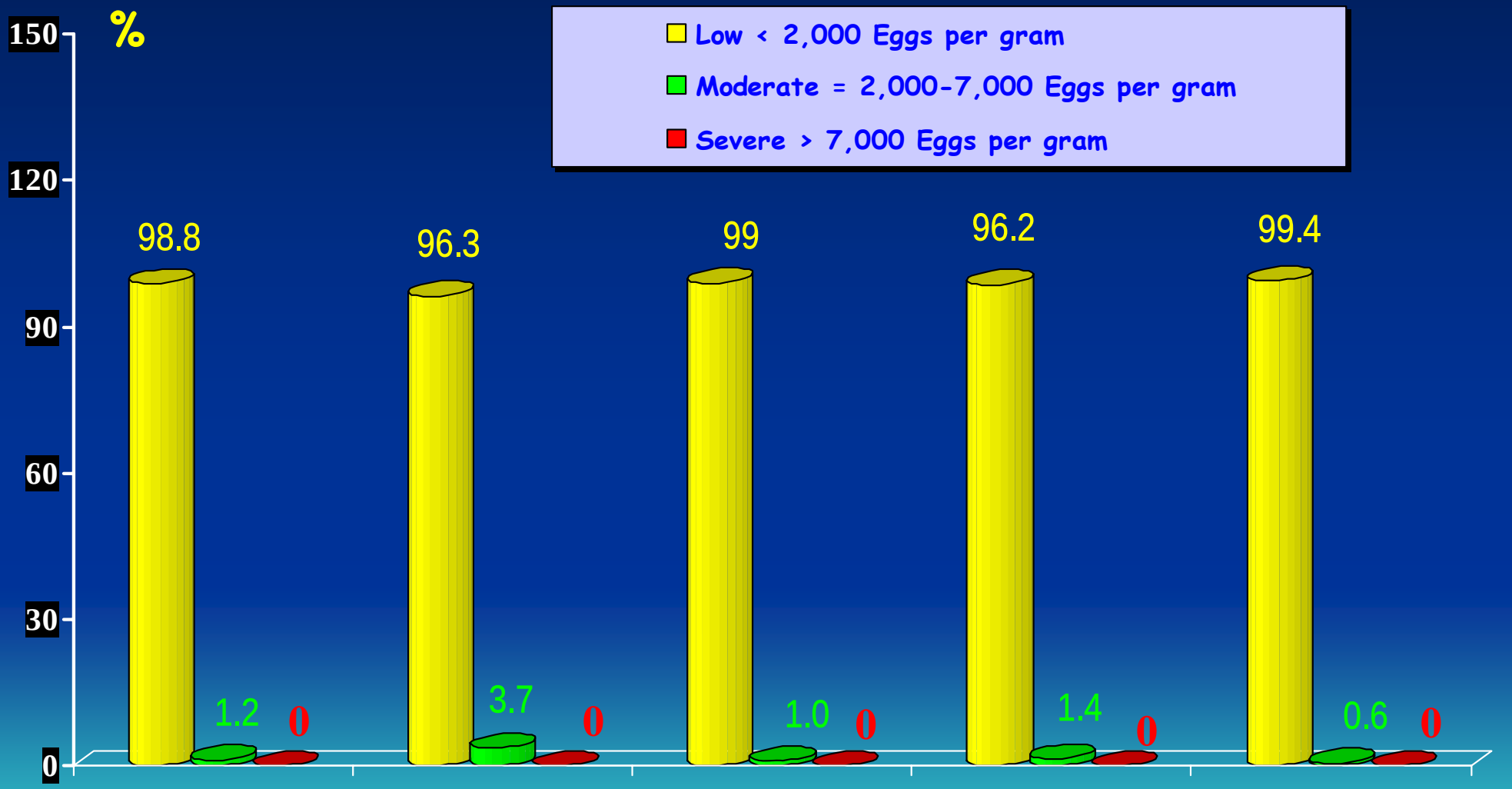
Prevalence rate of Overall Helminthiasis among Primary school-age children (5-14 years) and all age population by years in Thailand



Intensity of Opisthorchiasis by Region Thailand, 2009



Intensity of Hookworm Infection in Thailand, classified by Region in 2009



National Helminthiasis survey

Health Behavior of Thai people who properly washed before eating in routine and proper cook with heat of fish and meat to prevent from contaminated egg or larvae of helminthes

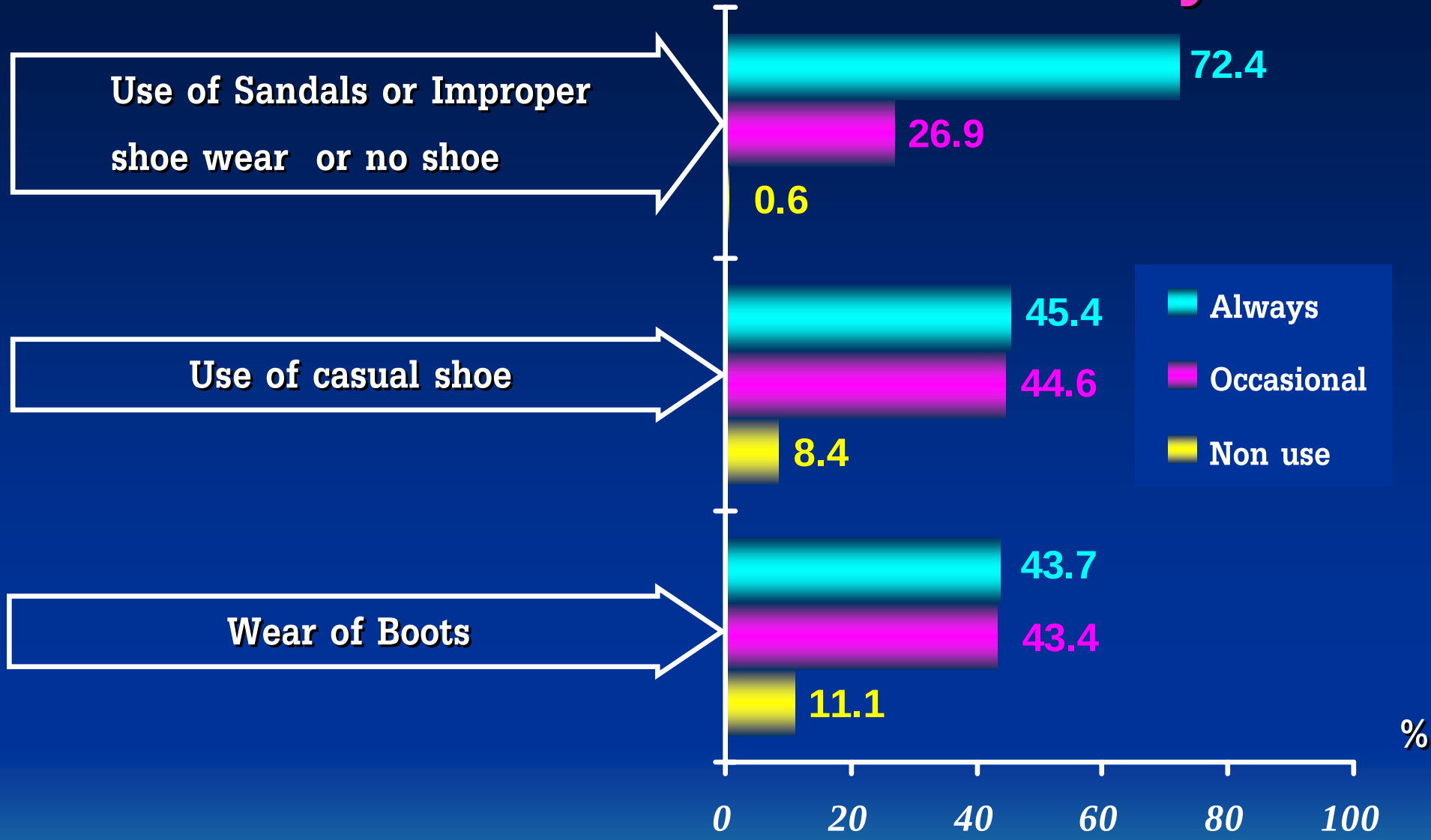
Results

(Behaviors)

Variable		N	%	Result			
				OV Positive		MIF Positive	
				n	%	n	%
Risk Behavior	Low level	1723	46.1	95	5.5	25	1.5
	Medium level	1017	27.2	120	11.8	38	3.7
	High level	997	26.7	180	18.1	46	4.6

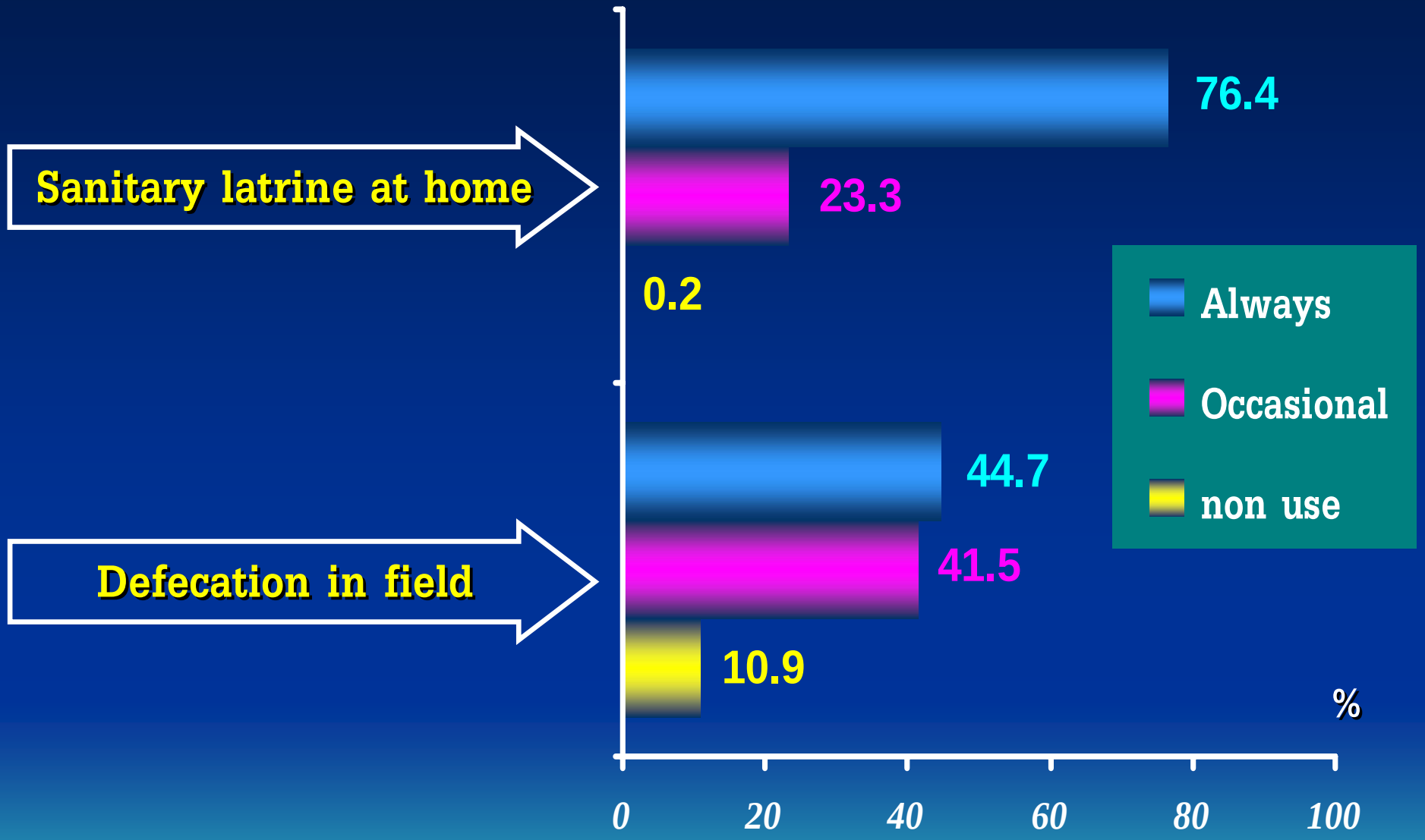
(risk behaviors with Opisthorchiasis were the consumption frequency of uncooked fish fresh water (Cyprinoids) , spicy mince salad (Lab Pla) or other products with fresh water fish)

National Helminthiasis survey



Health behavior for parasitic disease prevention among Thai people who properly shoe wearing when work out in the paddy fields

National Helminthiasis survey



Defecation Habits among Thai people in Thailand, year 2009

National Helminthiasis survey

Influencing factors with Opisthorchiasis

Variable	B	S.E.	Wald	df	p-value
Eat Koi Pla Dib	0.795	0.104	58.941	1	0.000
Eat Lab Pla Dib	0.694	0.103	45.249	1	0.000
Eat Som Tum Pla Ra Dib	1.126	0.172	42.988	1	0.000
Eat Mum Kee Pla	0.258	0.082	9.906	1	0.002
Eat Pla Ra Dib	0.347	0.113	9.371	1	0.002
Eat Pla som Dib	0.291	0.100	8.412	1	0.004
Eat Pla Jau	-0.208	0.087	5.703	1	0.017
Eat Pla Jom	0.214	0.95	5.100	1	0.024

Equation *การเกิดโรคพยาธิใบไม้ตับ = - 4.701 + (0.795) (การกินก้อยปลา) + (0.694) (กินลาบปลาดิบ) + (1.126) (กินส้มตำปลาร้าดิบ) + (0.258) (กินหม่ำขี้ปลา) + (0.347) กินปลาร้าดิบ)+ (8.412) (กินปลาส้มดิบ) + (-0.208) (กินปลาเจ่า) + (0.214 (กินปลาจ่อม)*

National Helminthiasis survey

Influencing factor with Hookworm

Variable	B	S.E.	Wald	df	p-value
Defecate in proper latrine	1.196	0.108	21.916	1	0.000
Defecate out of latrine	0.292	0.087	11.345	1	0.001
Bare Feet when out	0.213	0.69	9.584	1	0.002
Stool examination history	0.332	0.169	3.836	1	0.050

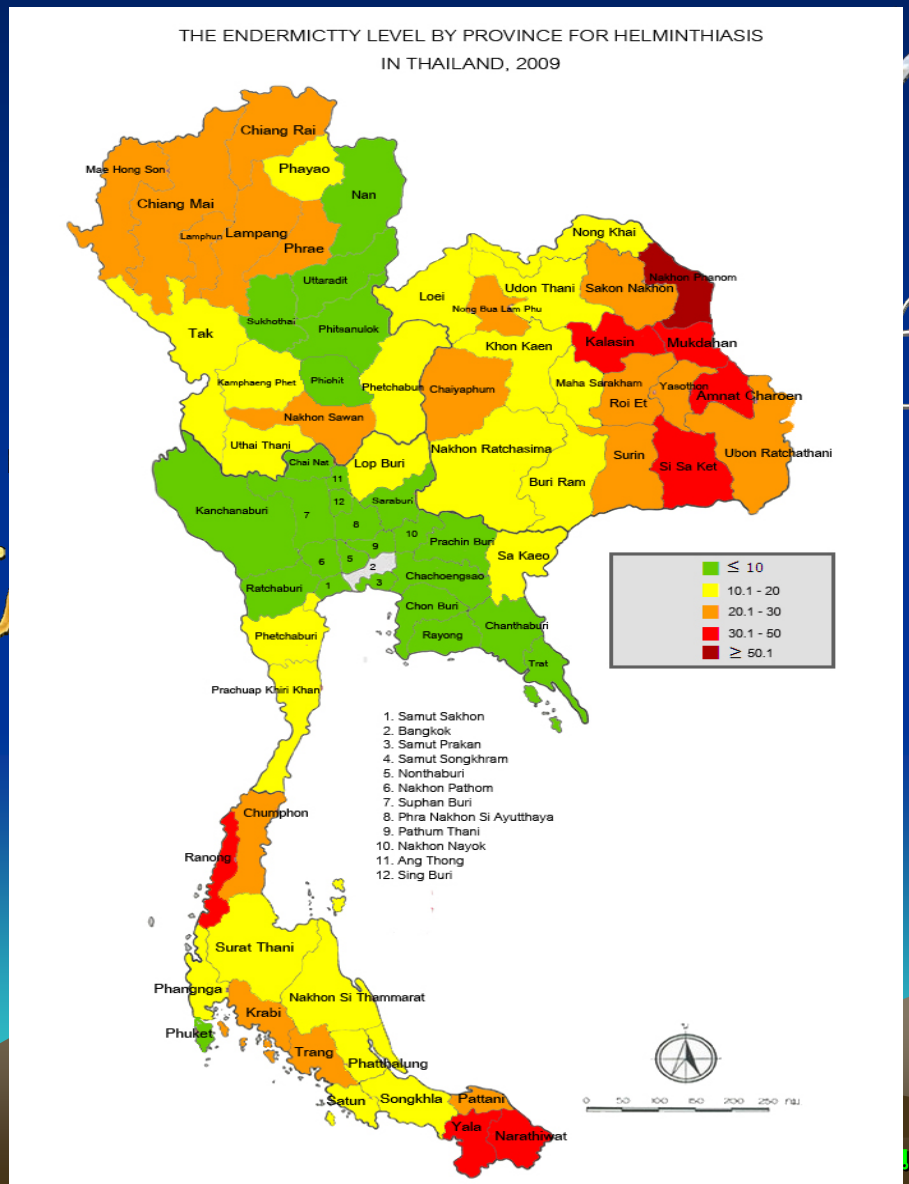
Equation : การเกิดโรคพยาธิปากขอ = - 3.674 + (1.196) (การขับถ่ายในส้วมที่ถูกสุขลักษณะ) + (0.292) (การขับถ่ายนอกส้วมเมื่อออกไปทำงานนอกบ้าน) + (0.213) (การเดินเท้าเปล่าเมื่อออกนอกบ้าน) + 0.332) (ประวัติการตรวจอุจจาระ)

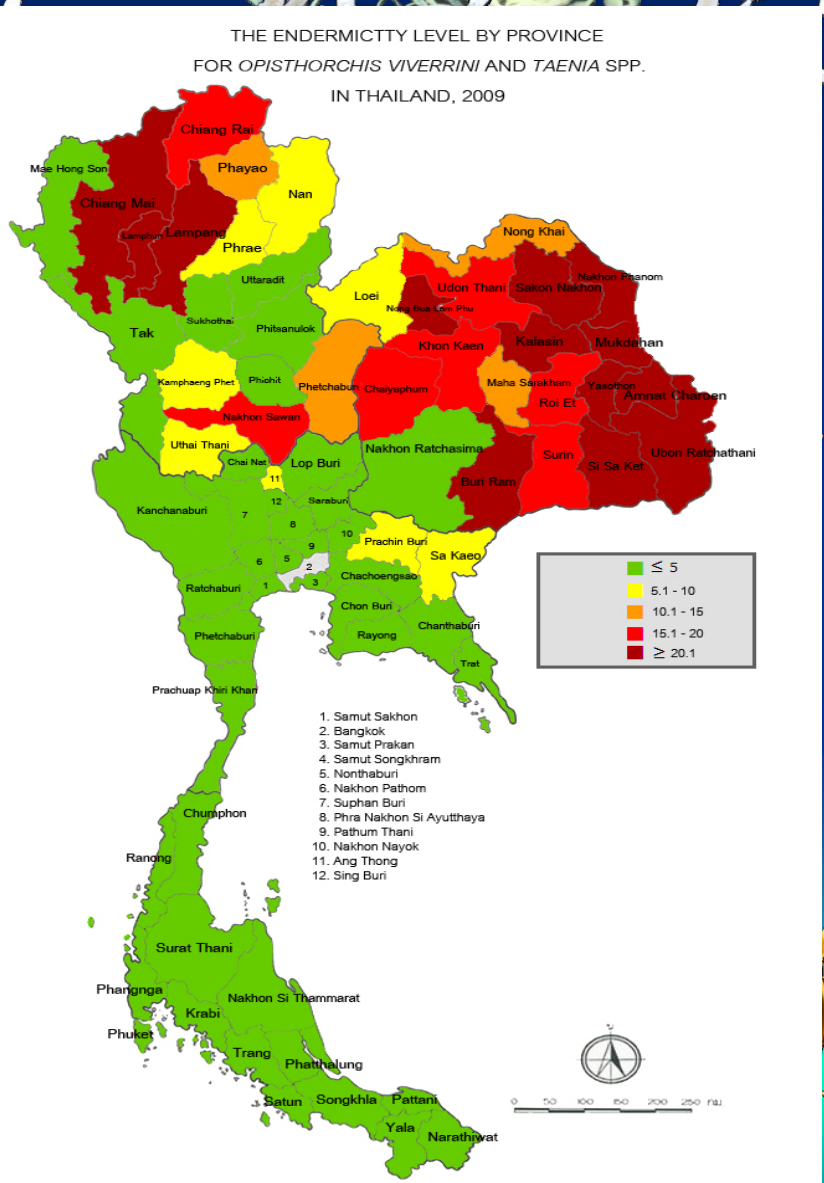
GIS

A GIS database for the study of OV/ STH *by* using the ArcGIS desktop program

Geographic coordinates of each area were determined with a Global Positioning System. The generated georeferenced database was overlaid on the digitized state coverage of remotely sensed satellite sensor environmental data.

The national survey of helminthiasis associated with Geographic Information in Thailand





The influencing factor

NORTH

Orchard, Organic soil of land use and forest zone

correlated with the prevalence of OV infection **in people norththern, Thailand.**

Prevalence of fish borne parasitic infections correlated with the soil organic because they are the primary decomposer of organic matter in the soil. That is suitable for farm or plant.

NORTH

80 % of land areas was forest and high hills that are important fountainheads for rivers, there are many species of natural fresh fish water support parasite infections in people who consumed uncooked fresh water fish

Consumption frequency of uncooked fish fresh water is main cause of MIF and *O. viverrini* infection.

The influencing factor

NE : STH

Mean rain, Residence and Clay had correlated with the prevalence of STH in people northeast Thailand.

{The multi coefficient of Opisthorchiasis was 0.466 and it can 21.7 percent predicting the prevalence of helminthiasis with statistical significantly (p-value < 0.001) the standard deviation for prediction as ± 13.787 and predict equation for helminthiasis prevalence when knew geography data and soil type was Y = 16.576 – 0.081 (mean rain)- 6.038 (residence) – 0.961 (clay)}

The influencing factor

NE : OV

For predict the influencing among prevalence of trematode and geography were analyzing by stepwise regression analysis

Loam had correlated with the prevalence of Opisthorchiasis in people north east Thailand.

The multi coefficient of Opisthorchiasis was 0.250 and it can 6.3 percent predicting the prevalence of Opisthorchiasis with statistical significantly (p-value < 0.019), the standard deviation for prediction as ± 15.685 and predict equation for helminthiasis prevalence was $Y^{1} = 12.055+9.518$ (loam)

The influencing factor

South : STH

Clay and clay with mountain soil correlated with the prevalence of hookworm and *strongyloides stercoralis* infection **in people southern, Thailand.**

(The multi-coefficient of hookworm and *strongyloides stercoralis* infection **was 0.497 and it can 24.7 percent predicting the prevalence of** hookworm and *strongyloides stercoralis* infection **with statistical significance (p-value < 0.001) the standard deviation for prediction as ± 8.624)**

Predict equation for hookworm and *strongyloides stercoralis* infection

Y = 17.825(Clay)+8.995(mountain soil)

Discussion

In the South, Laboratory analysis by using formalin ether concentration technique revealed a 19.8% overall prevalence (with 15.8% of hookworm infection and 0.5% of *Strongyloides stercoralis*.)

The prevalence of hookworm and *Strongyloides stercoralis* showed **geographical heterogeneity with the highest prevalence in clay and mountain soil types.**

In conclusion, this results demonstrate that spatial analysis can help to identify patterns of high risk for hookworm and *Strongyloides stercoralis* in order to facilitate prevention and control.

Discussion

Although the control program on hookworm by Ministry of Public Health has been implemented continuously, the disease is still widely distributed. This is because most of the people do not change their habits of defecating outside the latrines and not wearing shoes outside the house.

People should, therefore, be educated on how to protect themselves against the helminth infection rather than self-treatment with drugs after infection.

They should also have a chance to participate in the prevention and control program in their own community, otherwise the program will never be successful.

Other factors influencing the infection rate may include personal hygiene, levels of parental care, social interactions and parental knowledge of hygiene e.g food-cooking, hand-washing and bathing.

Conclusion

The study results showed a high prevalence of liver fluke and hookworm infections associated with health behaviors and GIS geographic

Currently, *Opisthorchis viverrini* , Hookworm and *strongyloides stercoralis* are important helminthiasis in Thailand and they require surveillance and control in certain high risk area and high risk groups.

Additional, *Ascaris lumbricoides* and *Trichuris trichiura* were also gave the high prevalence more than 50% within the village at south.

Their occurrence can be reduced by motivating individuals in high risk areas to change their habits with regard to proper cooked fish and the habits of of wearing shoes and improving their knowledge, attitudes about sanitation and waste disposal.

Lesson Learn from National survey 2009

- High endemic area (prevalence > 20 %) about 21 of 75 provinces due to the low priority in national plan.
- The result of stool examination from researcher team gave the big difference from routine report at the provincial level (85% from researcher report while the local PH officer showed the data only 1.1% of OV infection), therefore QC need to be performed.
- People not awareness for severity of liver fluke infection. Thus, health risk behavior should be discussed.

National Policy of FBT Control Program in Thailand from 2010

Decrease prevalence of *Opisthorchis viverrini* cases for decrease the morbidity and mortality of CCA in the certain high endemic areas of Thailand by ↴

Strategies :

- Decentralized program management to Provincial level
- Better Targeting with Community Participation and Empowerment
- School-Based and Community Based Approach Concept to the Provincial Program Manager
- Diagnosis and Treatment 100 %
- Social Model Study for Community Guideline Practice
- Eliminate of FBT in low endemic areas

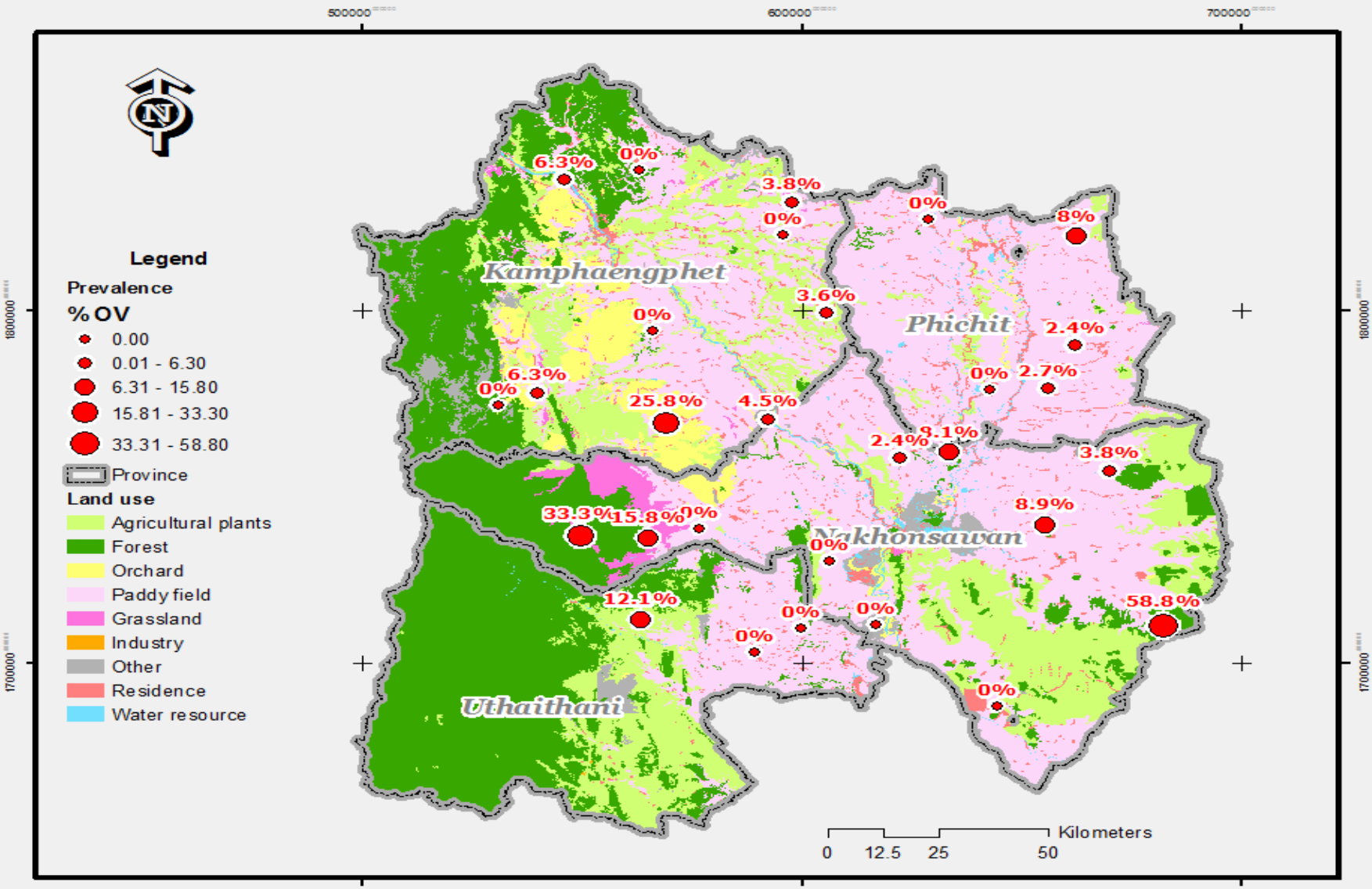
Way forward and proposal improvement

- Community based and school based integrating strategies
- Social model development project to eliminate the OV infection in target village with emphasize on community participation.
- Integrated study concluded 5 activities: Human, Fresh-water fish, Snail, Animal reservoir (dog ,cat)
- Coverage of stool examination and treatment 100%.

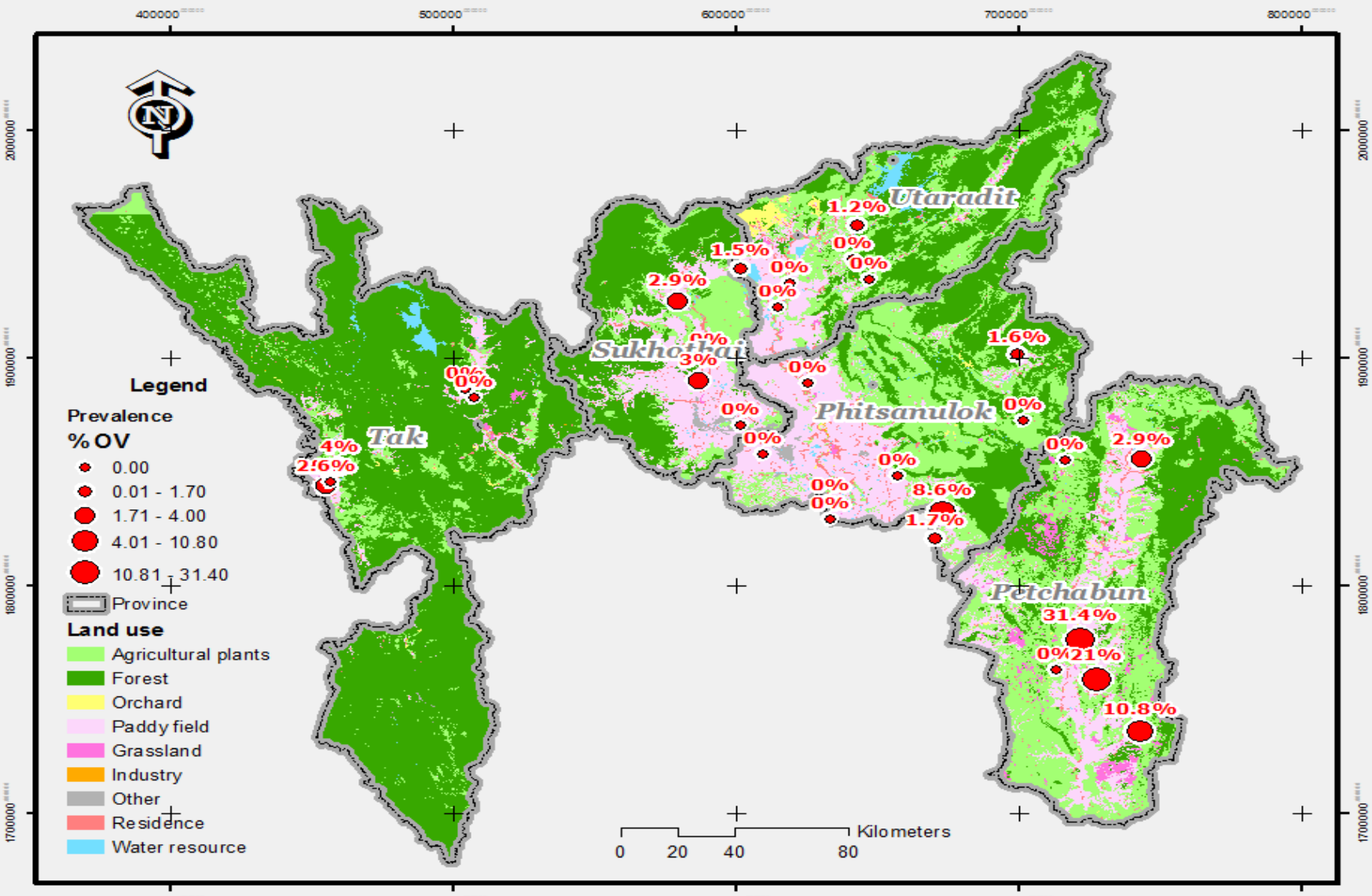
National Helminthiasis survey

Thank you

Results
(Prevalence of OV and land use)



Results
(Prevalence of OV and land use)



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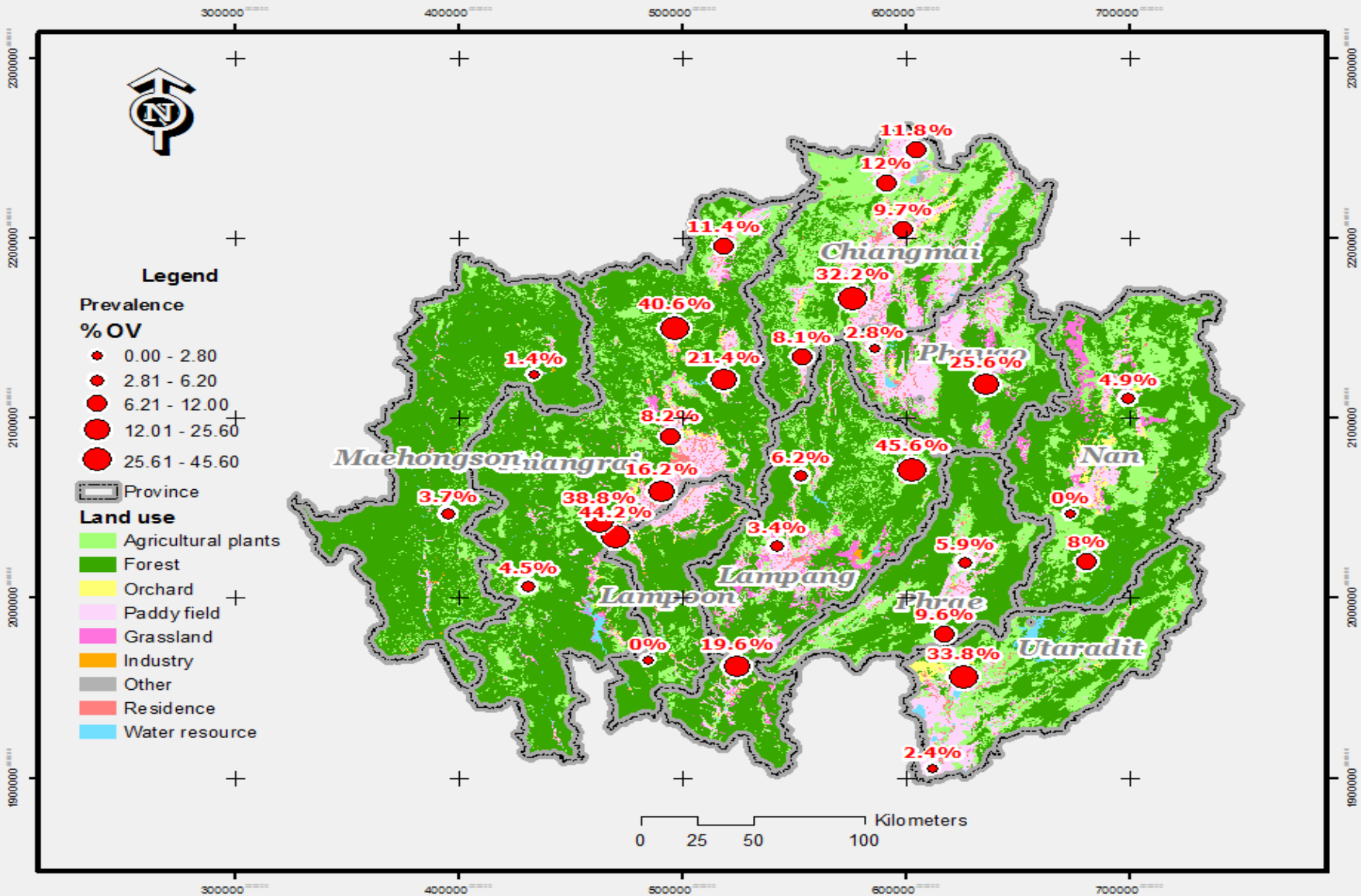
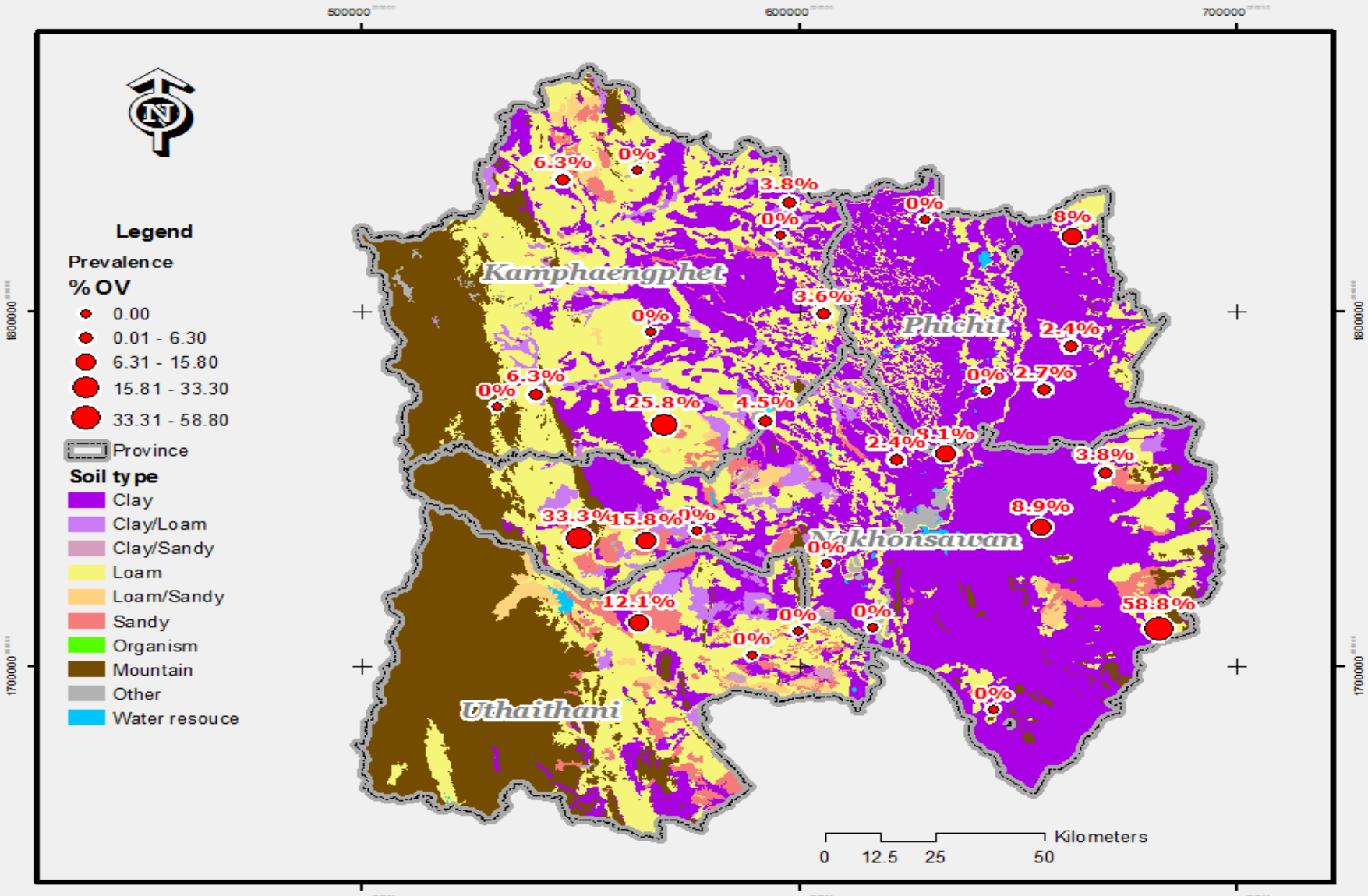


Results

(Prevalence of OV and Soil type)



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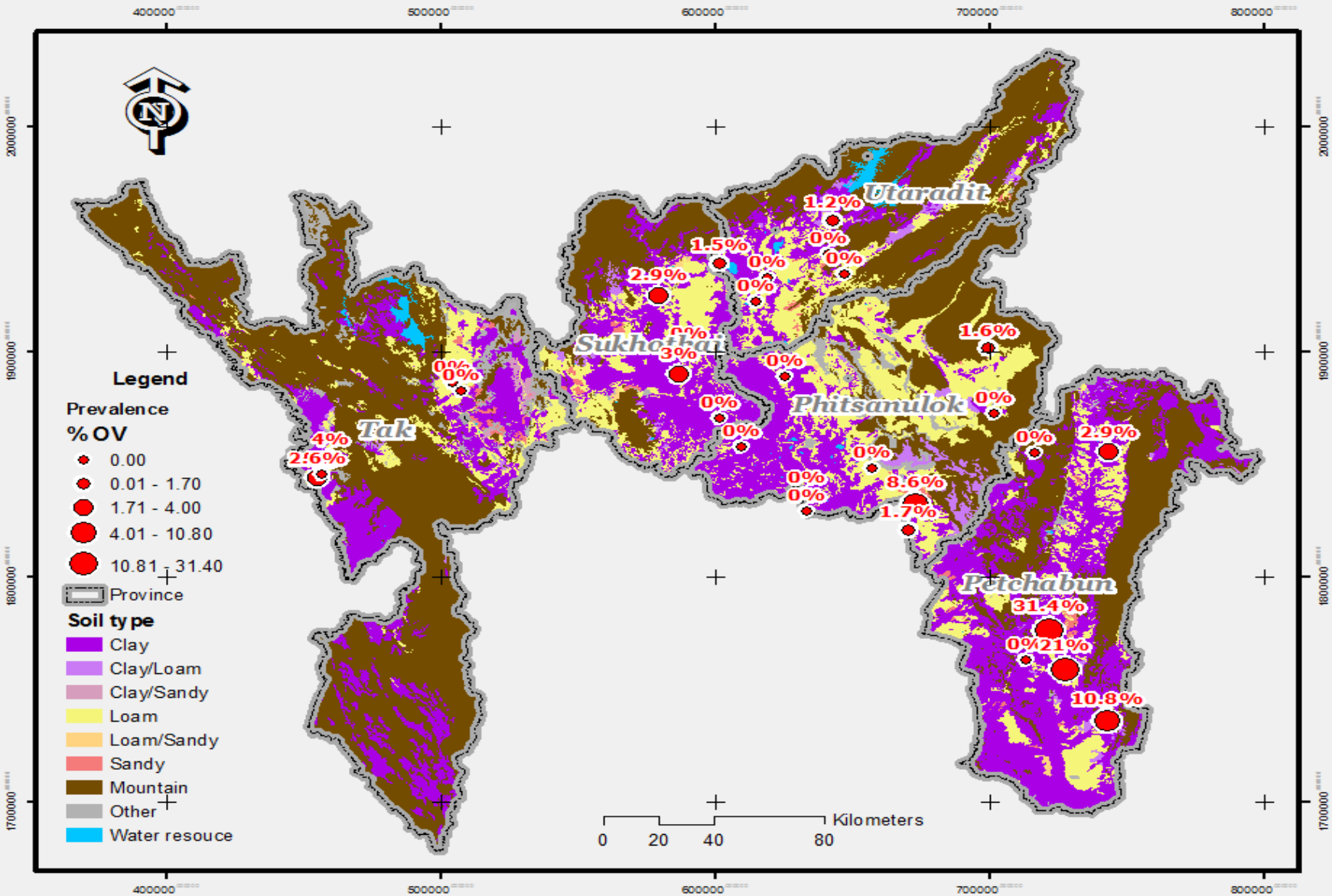
(Prevalence of OV and Soil type)



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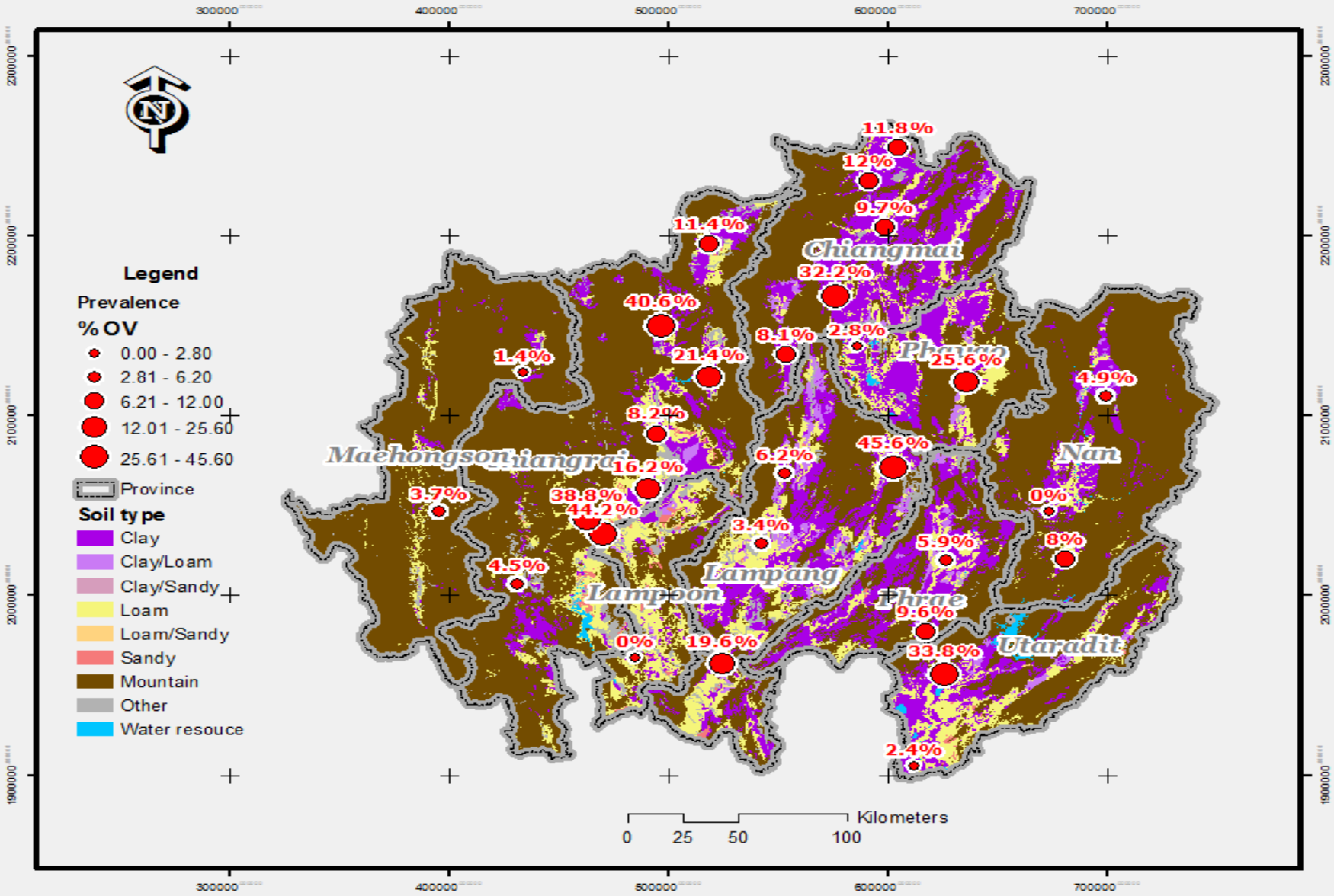
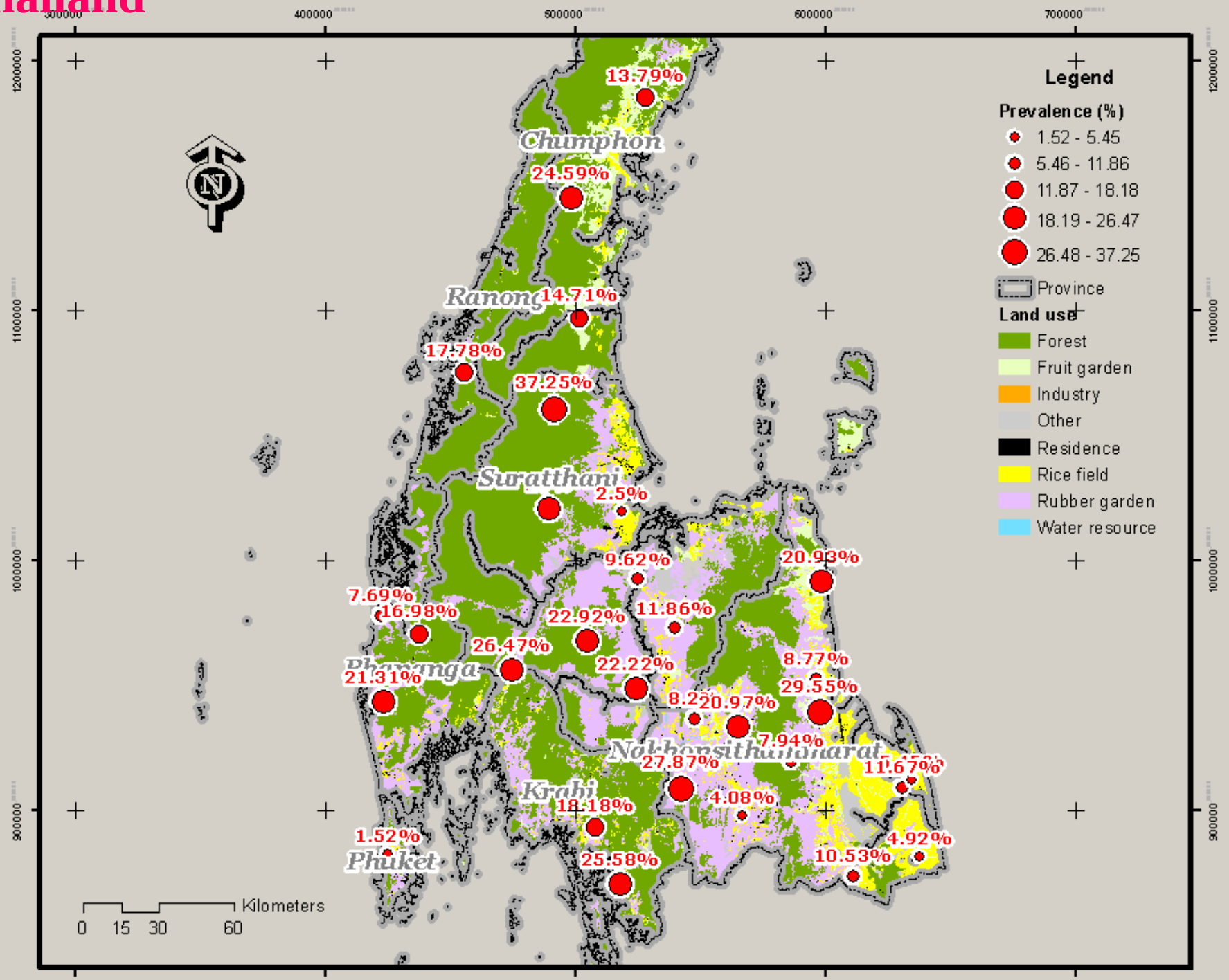
(Prevalence of OV and Soil type)



Geographic information of helminthiasis in region 11, South, Thailand



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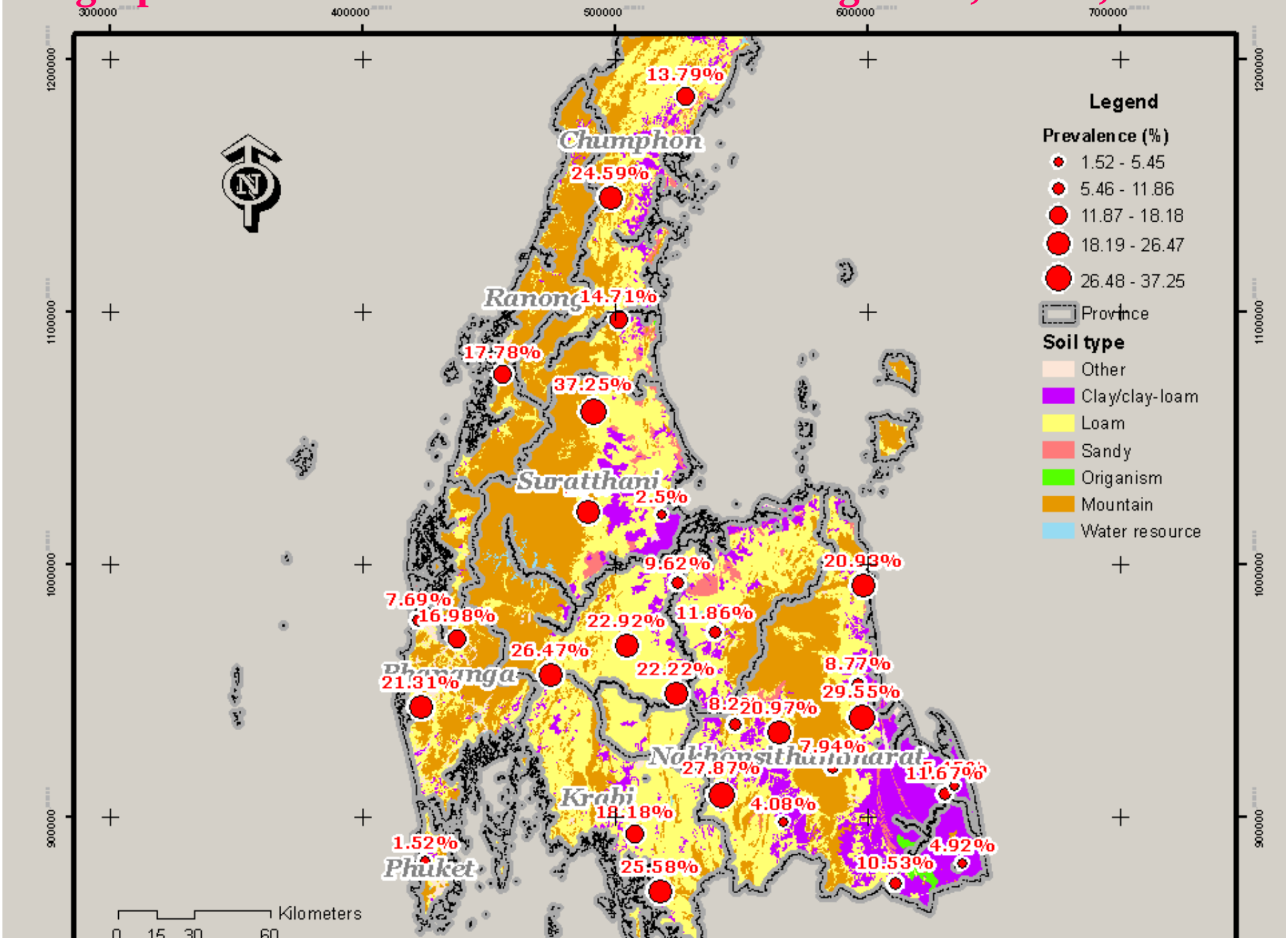
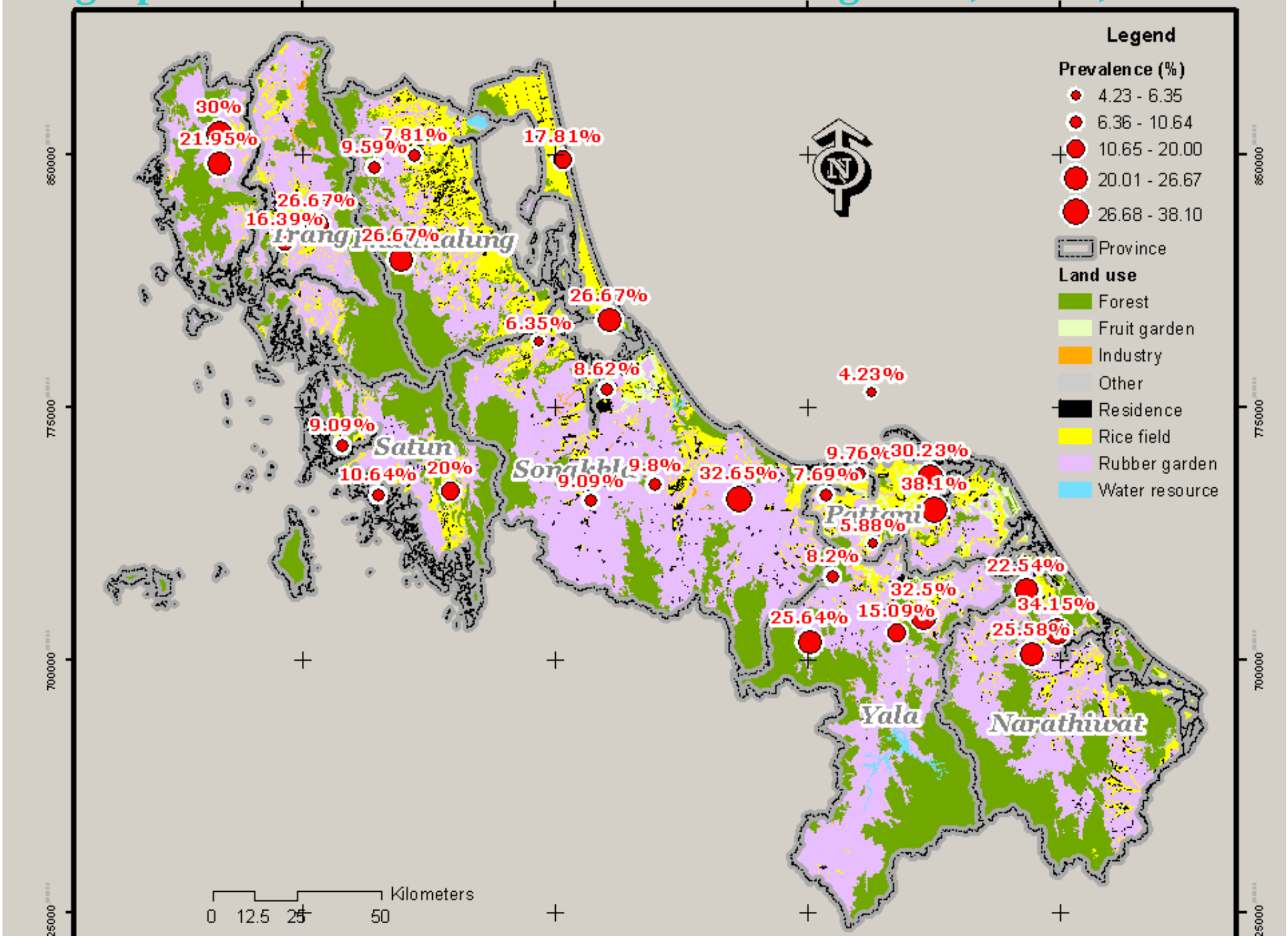
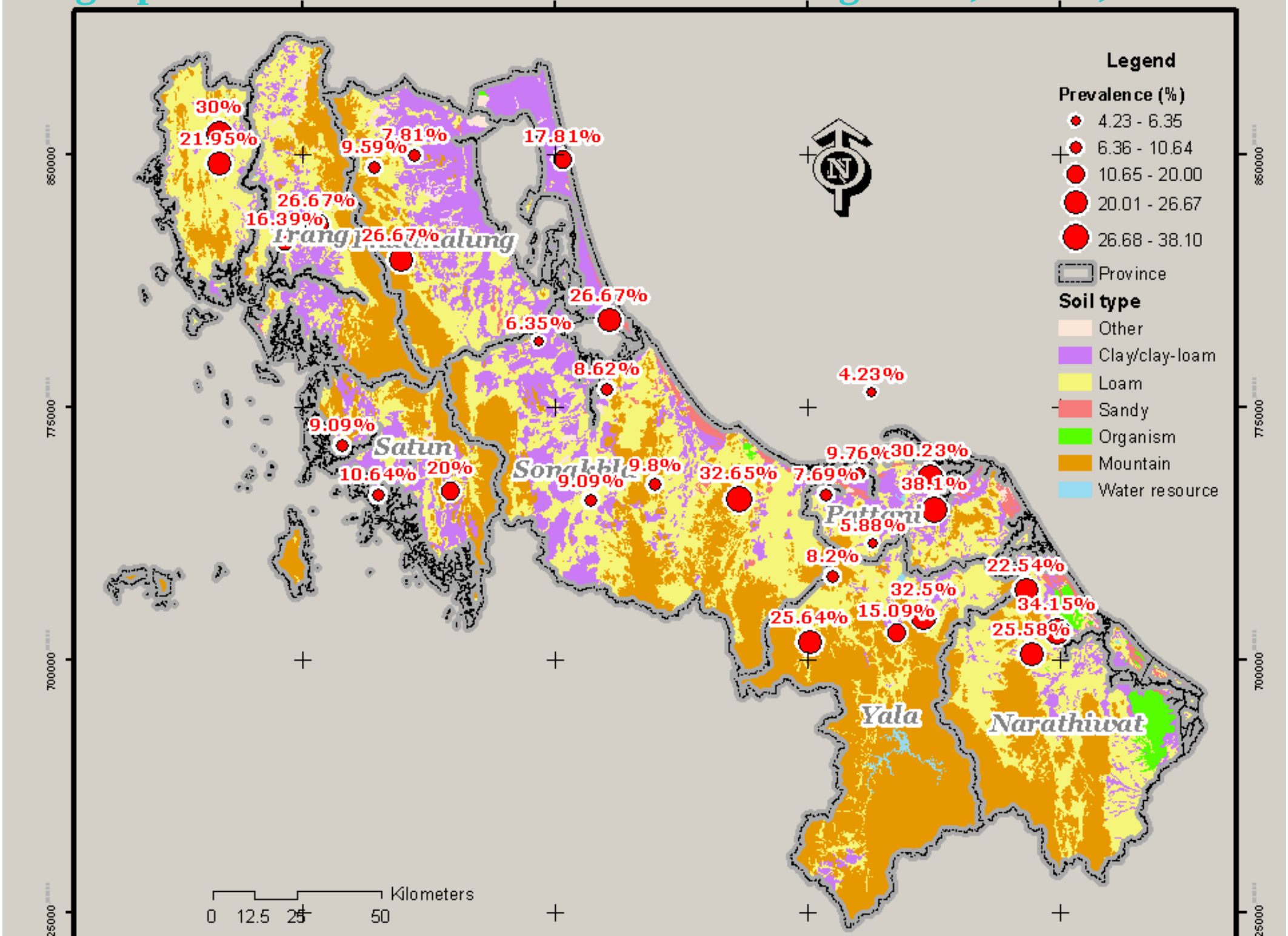


Geographic information of helminthiasis in region 12, South, Thailand



Geographic information of helminthiasis in region 12, South, Thailand



Region5 / Place	Hight sea level	Prevalence	meantemp	meanrain	Land use	Soil type
.Khok khwan	187	12.5	28.1	81.7	agriculture	sandy soil
.Ban-saong	166	14	28.1	81.7	agriculture	clay
.Donplai health center	180	13.7	28.1	81.7	agriculture	loam
. Sa-wan	263	22.4	28.1	81.7	agriculture	clay
. Shee-wan	151	25.9	28.1	81.7	residence	clay
. Nong-kham	209	25.6	28.1	81.7	agriculture	loam
. Plai-daab	223	15.1	28.1	81.7	agriculture	sandy soil
. Gud-piman	205	10.5	28.1	81.7	residence	loam
. Mai-naree	179	20.8	28.1	81.7	residence	clay
10.Sung-naen	**216**	**2.1**	**28.1**	**81.7**	**residence**	**loam**
11.Ban-song-hong	148	25.6	28.1	81.7	agriculture	loam
12. Khok-lam	178	2.2	28.1	81.7	agriculture	loam
13. Ron-thong	151	33.3	28.1	81.7	agriculture	loam
14. Jorakhae-maak	183	12.3	28.1	81.7	agriculture	loam
15. Khok-mai-dang	**219**	**56.1**	**28.1**	**81.7**	**residence**	**loam**
16. don arang	239	10.9	28.1	81.7	agriculture	clay
17. wang-kaum-pang	241	25.5	28.1	81.7	forest	loam
18. Sa-see-liam	216	32.8	28.1	81.7	agriculture	loam
19. wang-ta-khae	297	24.4	28.1	81.7	forest	loam
20. Ban-pa-khaiet	266	32.6	28.1	81.7	agriculture	loam
21.Cham-moon-nak	204	20.8	28.1	81.7	agriculture	clay
22.Khae-wa-sirin	147	10.7	28.1	81.7	forest	loam
23. Ban-yang	137	36.7	28.1	81.7	agriculture	loam
24. Soom-rawee	141	37.9	28.1	81.7	agriculture	loam
25. Daan	205	39.1	28.1	81.7	agriculture	loam
26. Kra-baeng	132	19.2	28.1	81.7	agriculture	clay
27.Ban-dom	185	25.9	28.1	81.7	agriculture	loam

	Hight sea level					
1. Pra-cha-a-sa	150	11.3	29.3	107.4	residence	loam
2. Nong-phue	155	25.1	29.3	107.4	forest	loam
3. Muang-hong	149	13.3	29.3	107.4	residence	sandy soil
4. Ban-nong-jok	149	29.5	29.3	107.4	argriculture	loam
5. Pai-san	135	50	29.3	107.4	argriculture	loam
6..Nam-pong	176	11.3	29.3	107.4	residence	loam
7. Ubonrat hospital	198	24.6	29.3	107.4	argriculture	sandy soil
8. Nong-wang-rue	186	26.4	29.3	107.4	argriculture	loam
9. Noen-sawang	142	14.6	29.3	107.4	residence	loam
10. Nong-kae	**144**	**6.7**	**29.3**	**107.4**	**argriculture**	**loam**
11.Ban-nong-pan	168	23.8	29.3	107.4	argriculture	loam
12. kham-pom	167	10	29.3	107.4	water resource	loam
13. Ban-kung-kao	185	39.4	29.3	107.4	argriculture	loam
14.Gud-don	187	12.3	29.3	107.4	argriculture	loam
15. Khok-see	156	38.1	29.3	107.4	argriculture	loam
16. Nong-pan	**143**	**62.2**	**29.3**	**107.4**	**argriculture**	**loam**
17. Dan-see-suk	197	20	29.3	107.4	argriculture	loam
18. Nong-ga-luem	189	19.4	29.3	107.4	argriculture	loam
19. Nong-wae-joom-pon	242	24.4	29.3	107.4	residence	loam
20.Na-nong-toom	236	30.2	29.3	107.4	argriculture	loam
21.Ban-pon	251	13.2	29.3	107.4	argriculture	clay
22. Puen-pu	331	15.8	29.3	107.4	argriculture	clay
23.Jorakhae	202	20.6	29.3	107.4	argriculture	loam
24.Ban-nong-wang-rue	175	26	29.3	107.4	residence	
25.Na-kang	162	11	29.3	107.4	water resource	
26. Choom-chang	175	18.5	29.3	107.4	argriculture	loam
27.Ban-due	174	9.1	29.3	107.4	argriculture	clay
28.Chiang-da	171	12.9	29.3	107.4	argriculture	loam

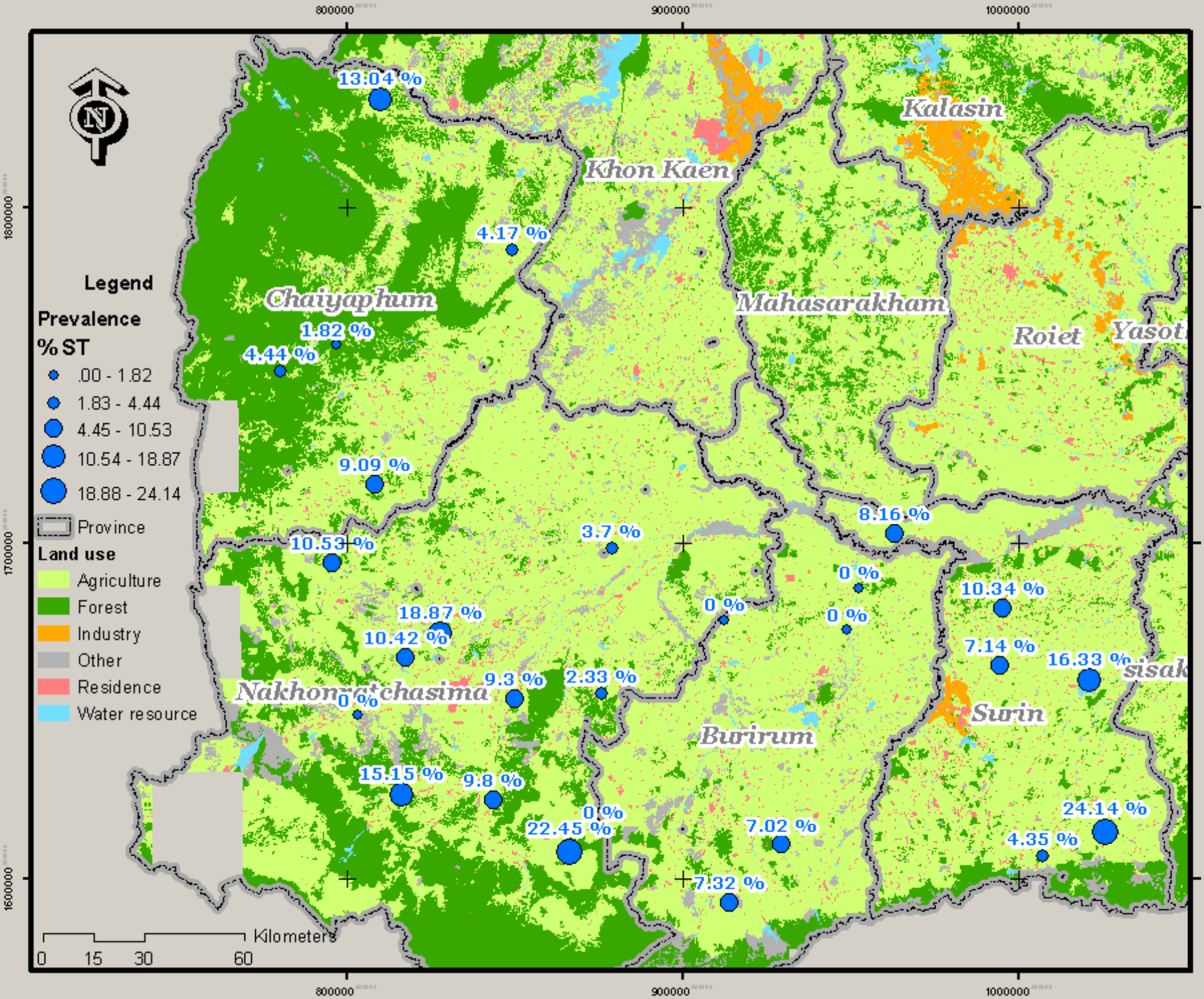
1. Nong-wang	160	71	28.2	246.2	agriculture	loam
2. Na-hua-bo	158	38.6	28.2	246.2	agriculture	clay
3. Ku-su-man	169	31.3	28.2	246.2	agriculture	loam
4. Chok-um-nuey	178	51.8	28.2	246.2	forest	loam
5. Dong-charoen	136	18.9	28.2	246.2	forest	loam
6. Ta-hai	125	22.6	28.2	246.2	residence	loam
7. Ta-chang	130	16.7	28.2	246.2	agriculture	loam
8. Bu-puey	211	29.5	28.2	246.2	agriculture	clay
9. Ban-nong-yaaw	151	24.2	28.2	246.2	agriculture	loam
10. Sri-dai	126	30	28.2	246.2	agriculture	loam
11. Yang-lum	135	44.5	28.2	246.2	agriculture	loam
12. Pa-lai	158	44.5	28.2	246.2	agriculture	loam
13. PCU. Kra- tuen	139	18.5	28.2	246.2	agriculture	loam
14. Nong-mok	146	23	28.2	246.2	forest	loam
15. Huey-lhue	163	32.3	28.2	246.2	water resource	organism
16. Ban-pan-na	**165**	**14**	**28.2**	**246.2**	**residence**	**loam**
17. Tad-pon-pai	181	30.3	28.2	246.2	agriculture	loam
18. Tad-ton-pai	311	28.5	28.2	246.2	agriculture	loam
19. Non-sung	**161**	**85.3**	**28.2**	**246.2**	**agriculture**	**loam**
20. Gan-tora-lax	152	53	28.2	246.2	agriculture	loam
21. Ban-pa-wae	147	22.5	28.2	246.2	agriculture	loam
22. Po-sai	143	38.2	28.2	246.2	agriculture	loam
23. Non-sawan	168	34.1	28.2	246.2	agriculture	loam
24. Nong-koo	150	37	28.2	246.2	agriculture	loam
25.Gan-lueng	132	25.9	28.2	246.2	agriculture	loam
26. Sang-pi	129	51	28.2	246.2	agriculture	loam
27. Huey-na	180	60.4	28.2	246.2	forest	loam
28. Ban-som-boon	160	40.5	28.2	246.2	agriculture	sandy soil

Public Health Office	High Sea level	Landuse	soilgrp	Prevalence
Thamnop	5	Rice field	Clay	26.67
Klong-ngae	70	Rubber plant	Loam	9.8
Wang Yai	116	Rubber plant	Mountain soil	32.65
Wat Son	7	Residence	Clay	17.81
Ban Nuaw Klong	50	Rubber plant	Loam	30
Kao Wi Set	18	Rubber plant	Loam	21.95
Ban Kuan Kaem	11	Rubber plant	Loam	16.39
Khog Sa Ba	26	Rubber plant	Loam	26.67
Kuan Roo	20	Rice field	Clay	6.35
Klong Hae	16	Rice field	Loam	8.62
Phang La	35	Residence	Clay/Loam	9.09
Ban Suan Knod	83	Rubber plant	Clay/Loam	9.59
Ban Kao Yang	18	Rice field	Clay	7.81
Klong Sai Kaow	57	Rubber plant	Loam	26.67
Ban Thang Yang	14	Rubber plant	Clay	10.64
Kuan Duon	32	Rice field	Loam	20
PCU Kam Paeng	10	Rice field	Clay	9.09
Nong Jig Hospital	2	Rice field	Clay	9.76
Bang Kraow	16	Rubber plant	Loam	7.69
PCU Kaow Jan	**7**	**Residence**	**Loam**	**38.1**
Pi Ya Mu Mung	6	Forest	Sand	30.23
Go Ta Ba Roo	60	Rubber plant	Mountain soil	32.5
Tha Chee	93	Rubber plant	Loam	8.2
Lauw Mu	46	Rubber plant	Loam	15.09
Yee Ngaw Hospital	**22**	**Residence**	**Loam**	**34.15**
Ma Lauw Bo Tok	88	Rubber plant	Mountain soil	25.58
Ban Khog Meay	0	Rubber plant	Mountain soil	4.23
Mee Lan	27	Rice field	Loam	5.88
Bala	69	Residence	Loam	25.64
Loo Buaw La wau	140	Rubber plant	Mountain soil	22.54

Public Health Office	High Sea Level	Landuse	soilgrp	Prevalence
Tha Ley Sub	105	Fruit Garden	Loam	13.79
Ban Kwun Sa Mug kee	63	Forest	Loam	24.59
Cha Lerm Pra Kiet	22	Forest	Clay/Loam	14.71
Ng-auw	22	Forest	Loam	17.78
Bang Muang	9	Industry	Clay/Loam	7.69
Laey	19	Forest	Loam	16.98
Thung Ma Phaw	19	Residence	Clay/Loam	21.31
Ma Nig	34	Rubber plant	Loam	1.52
Ban Na	74	Rubber plant	Loam	26.47
Ban Kwan Nog Whaw	21	Rice field	Loam	18.18
Ban Na Klong Thom	32	Rubber plant	Loam	25.58
Ban Na San	66	Forest	Loam	22.92
Ta Kug Nuaw	138	Forest	Mountain soil	20
Kwun Su Phan	39	Residence	Clay/Loam	11.86
Tha Sa Thon	5	Rice field	Clay	9.62
Tha Keay	4	Rice field	Clay	2.5
Klong Sod	**124**	**Forest**	**Loam**	**37.25**
Jom Pi Boon	8	Fruit Garden	Sand	20.93
Ban Tung chon	15	Rice field	Loam	8.77
Ban Mai Rieng	11	Fruit Garden	Loam	29.55
Ban Pru Kam	56	Fruit Garden	Loam	7.94
Ban Ma Prang Ngam	56	Rubber plant	Mountain soil	20.97
Kwun Fa Mee	68	Fruit Garden	Loam	27.87
Ban Ma Kam Rieng	4	Rice field	Clay	5.45
Ban Tham Thong	3	Rice field	Clay	11.67
Nang Long	7	Rubber plant	Clay	10.53
Lai Kab	39	Forest	Loam	22.22
Prak Klang	51	Residence	Loam	8.2
Kwun Raed	49	Rice field	Loam	4.08
Khaw Pung Klai	4	Fruit Garden	Clay	4.92

Public Health Office	High Sea level	Landuse	soilgrp	Prevalence
Thamnop	5	Rice field	Clay	26.67
Klong-ngae	70	Rubber plant	Loam	9.8
Wang Yai	116	Rubber plant	Mountain soil	32.65
Wat Son	7	Residence	Clay	17.81
Ban Nuaw Klong	50	Rubber plant	Loam	30
Kao Wi Set	18	Rubber plant	Loam	21.95
Ban Kuan Kaem	11	Rubber plant	Loam	16.39
Khog Sa Ba	26	Rubber plant	Loam	26.67
Kuan Roo	20	Rice field	Clay	6.35
Klong Hae	16	Rice field	Loam	8.62
Phang La	35	Residence	Clay/Loam	9.09
Ban Suan Knod	83	Rubber plant	Clay/Loam	9.59
Ban Kao Yang	18	Rice field	Clay	7.81
Klong Sai Kaow	57	Rubber plant	Loam	26.67
Ban Thang Yang	14	Rubber plant	Clay	10.64
Kuan Duon	32	Rice field	Loam	20
PCU Kam Paeng	10	Rice field	Clay	9.09
Nong Jig Hospital	2	Rice field	Clay	9.76
Bang Kraow	16	Rubber plant	Loam	7.69
PCU Kaow Jan	**7**	**Residence**	**Loam**	**38.1**
Pi Ya Mu Mung	6	Forest	Sand	30.23
Go Ta Ba Roo	60	Rubber plant	Mountain soil	32.5
Tha Chee	93	Rubber plant	Loam	8.2
Lauw Mu	46	Rubber plant	Loam	15.09
Yee Ngaw Hospital	**22**	**Residence**	**Loam**	**34.15**
Ma Lauw Bo Tok	88	Rubber plant	Mountain soil	25.58
Ban Khog Meay	0	Rubber plant	Mountain soil	4.23
Mee Lan	27	Rice field	Loam	5.88
Bala	69	Residence	Loam	25.64
Loo Buaw La wau	140	Rubber plant	Mountain soil	22.54

Public Health Office	High Sea Level	Landuse	soilgrp	Prevalence
Tha Ley Sub	105	Fruit Garden	Loam	13.79
Ban Kwun Sa Mug kee	63	Forest	Loam	24.59
Cha Lerm Pra Kiet	22	Forest	Clay/Loam	14.71
Ng-auw	22	Forest	Loam	17.78
Bang Muang	9	Industry	Clay/Loam	7.69
Laey	19	Forest	Loam	16.98
Thung Ma Phaw	19	Residence	Clay/Loam	21.31
Ma Nig	34	Rubber plant	Loam	1.52
Ban Na	74	Rubber plant	Loam	26.47
Ban Kwan Nog Whaw	21	Rice field	Loam	18.18
Ban Na Klong Thom	32	Rubber plant	Loam	25.58
Ban Na San	66	Forest	Loam	22.92
Ta Kug Nuaw	138	Forest	Mountain soil	20
Kwun Su Phan	39	Residence	Clay/Loam	11.86
Tha Sa Thon	5	Rice field	Clay	9.62
Tha Keay	4	Rice field	Clay	2.5
Klong Sod	**124**	**Forest**	**Loam**	**37.25**
Jom Pi Boon	8	Fruit Garden	Sand	20.93
Ban Tung chon	15	Rice field	Loam	8.77
Ban Mai Rieng	11	Fruit Garden	Loam	29.55
Ban Pru Kam	56	Fruit Garden	Loam	7.94
Ban Ma Prang Ngam	56	Rubber plant	Mountain soil	20.97
Kwun Fa Mee	68	Fruit Garden	Loam	27.87
Ban Ma Kam Rieng	4	Rice field	Clay	5.45
Ban Tham Thong	3	Rice field	Clay	11.67
Nang Long	7	Rubber plant	Clay	10.53
Lai Kab	39	Forest	Loam	22.22
Prak Klang	51	Residence	Loam	8.2
Kwun Raed	49	Rice field	Loam	4.08
Khaw Pung Klai	4	Fruit Garden	Clay	4.92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Prevalence
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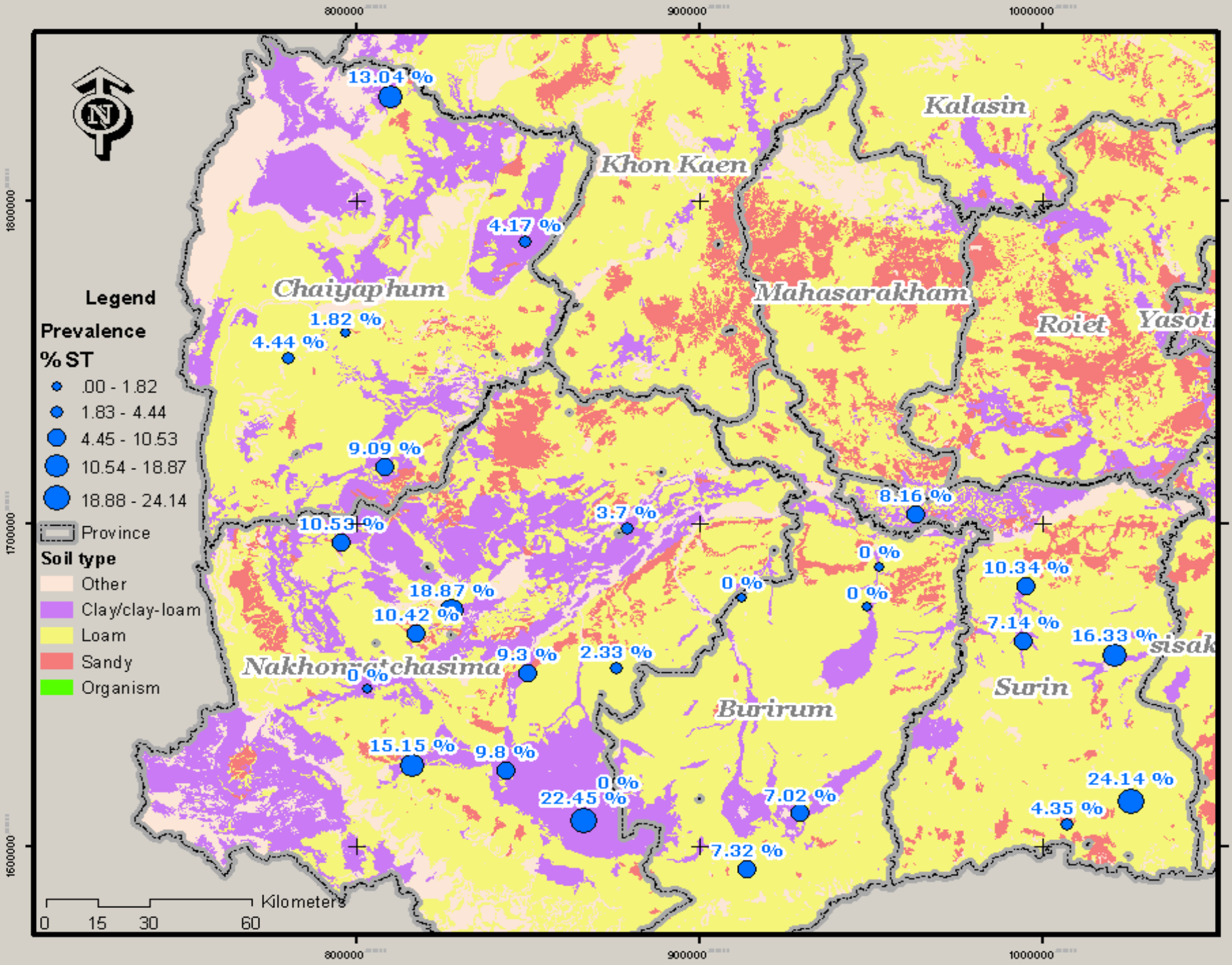
4.45 - 10.53
10.54 - 18.87
18.88 - 24.14
Province
Land use
Agriculture
Forest
Industry
Other
Residence
Water resource
Kilometers
0 15 30 60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Legend
Prevalence
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.00 - 1.82
1.83 - 4.44
4.45 - 10.53
10.54 - 18.87
18.88 - 24.14
Province
Soil type
Other
Clay/clay-loam
Loam
Sandy
Organism
Kilometers
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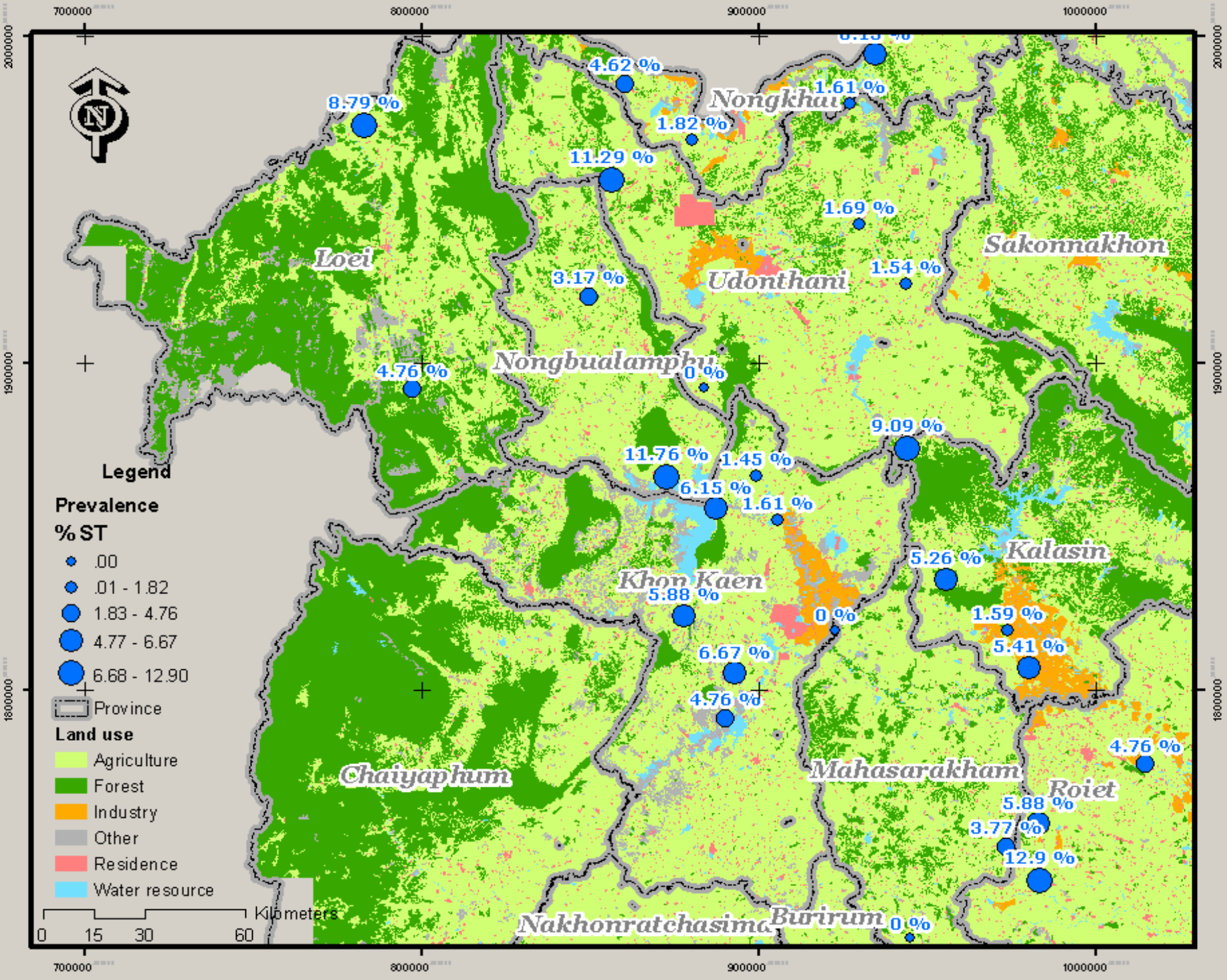
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Prevalence
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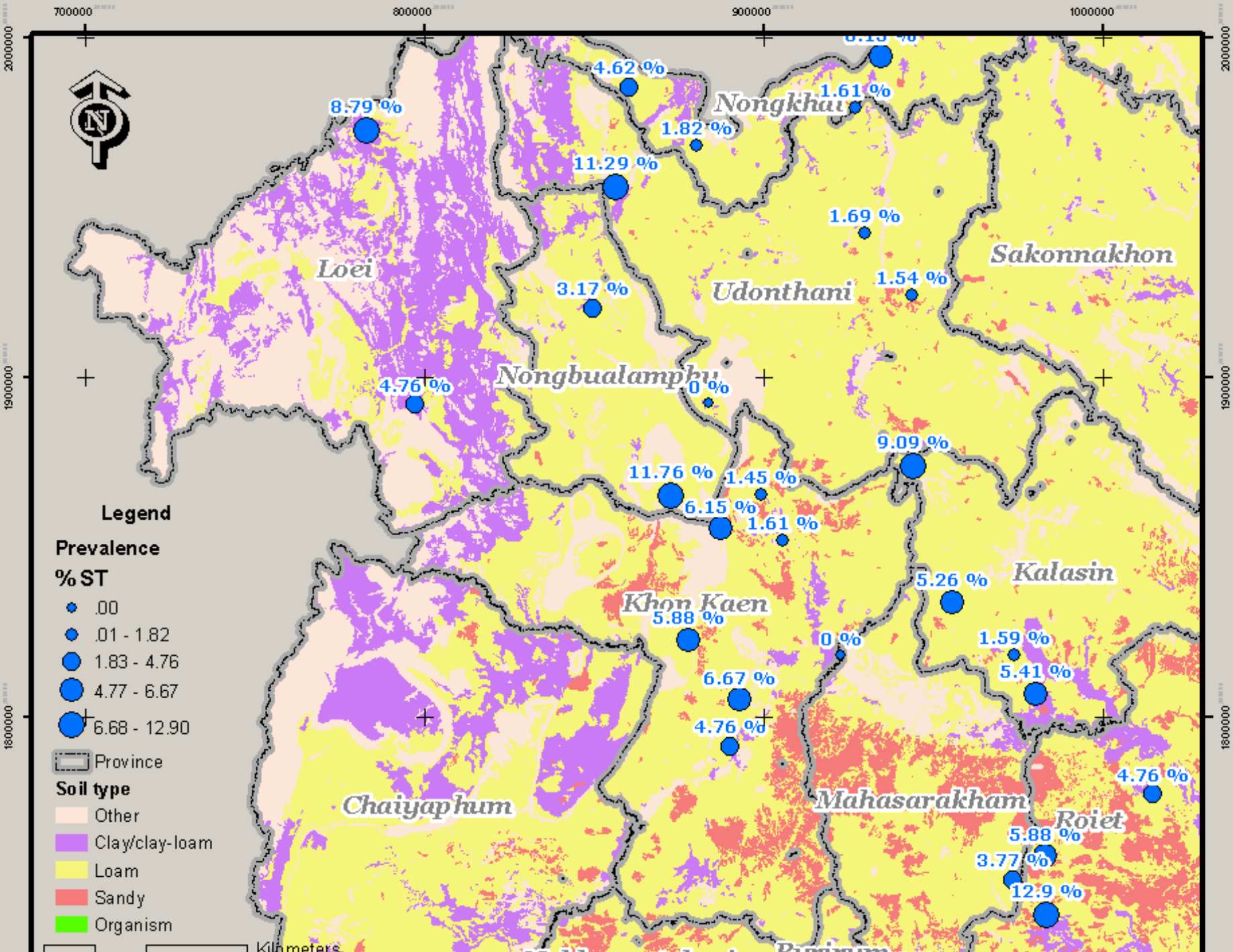
Province
Land use
Agriculture
Forest
Industry
Other
Residence
Water resource
Kilometers
0 15 30 60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Prevalence
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.00
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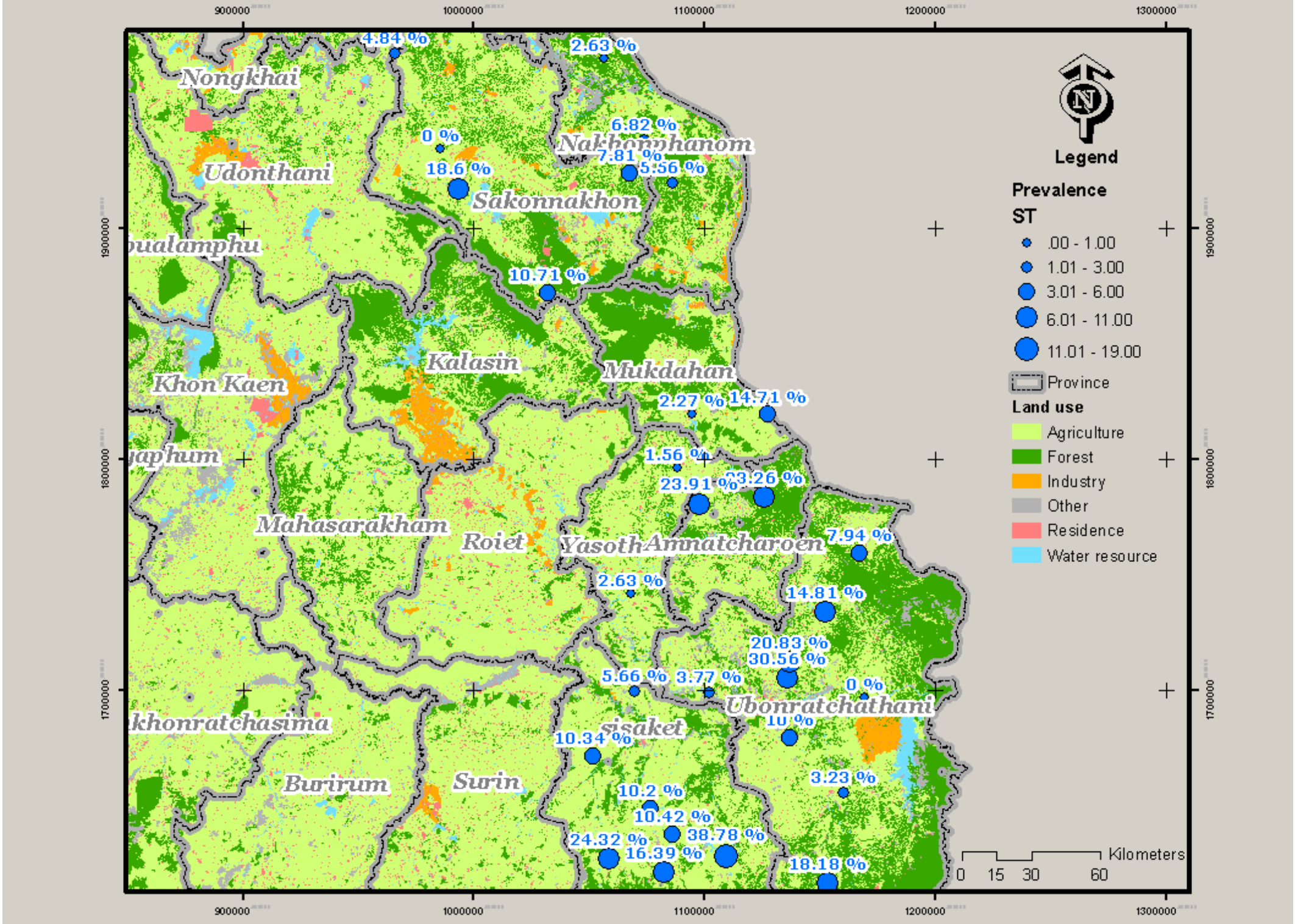
Province
Soil type
Other
Clay/clay-loam
Loam
Sandy
Organism
Kilometers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Legend
Prevalence
ST
.00 - 1.00
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3.01 - 6.00
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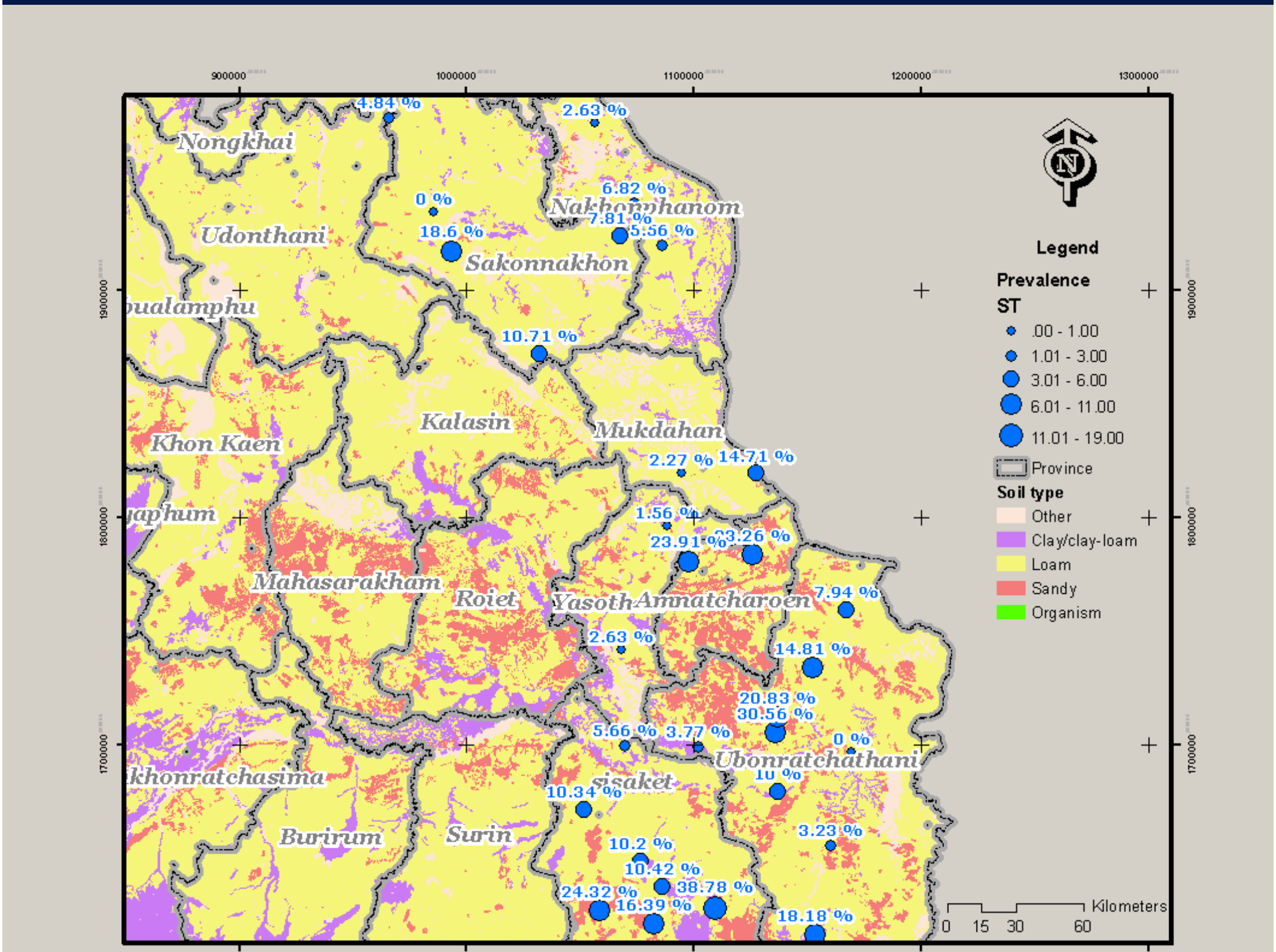
Province
Land use
Agriculture
Forest
Industry
Other
Residence
Water resource
Kilometers
0 15 30 60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Legend
Prevalence
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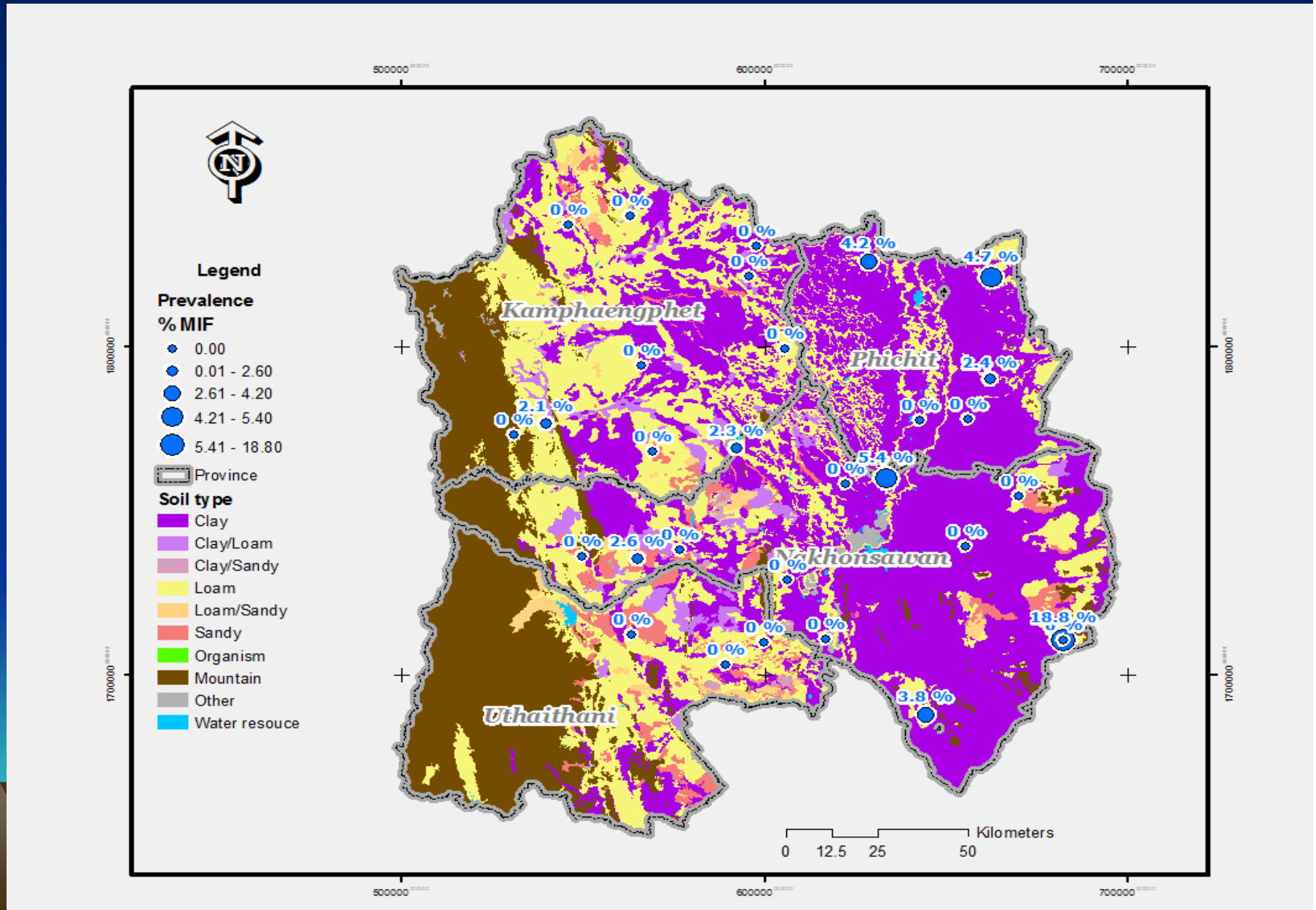
.00 - 1.00
1.01 - 3.00
3.01 - 6.00
6.01 - 11.00
11.01 - 19.00
Province
Soil type
Other
Clay/clay-loam
Loam
Sandy
Organism
Kilometers
0 15 30 60

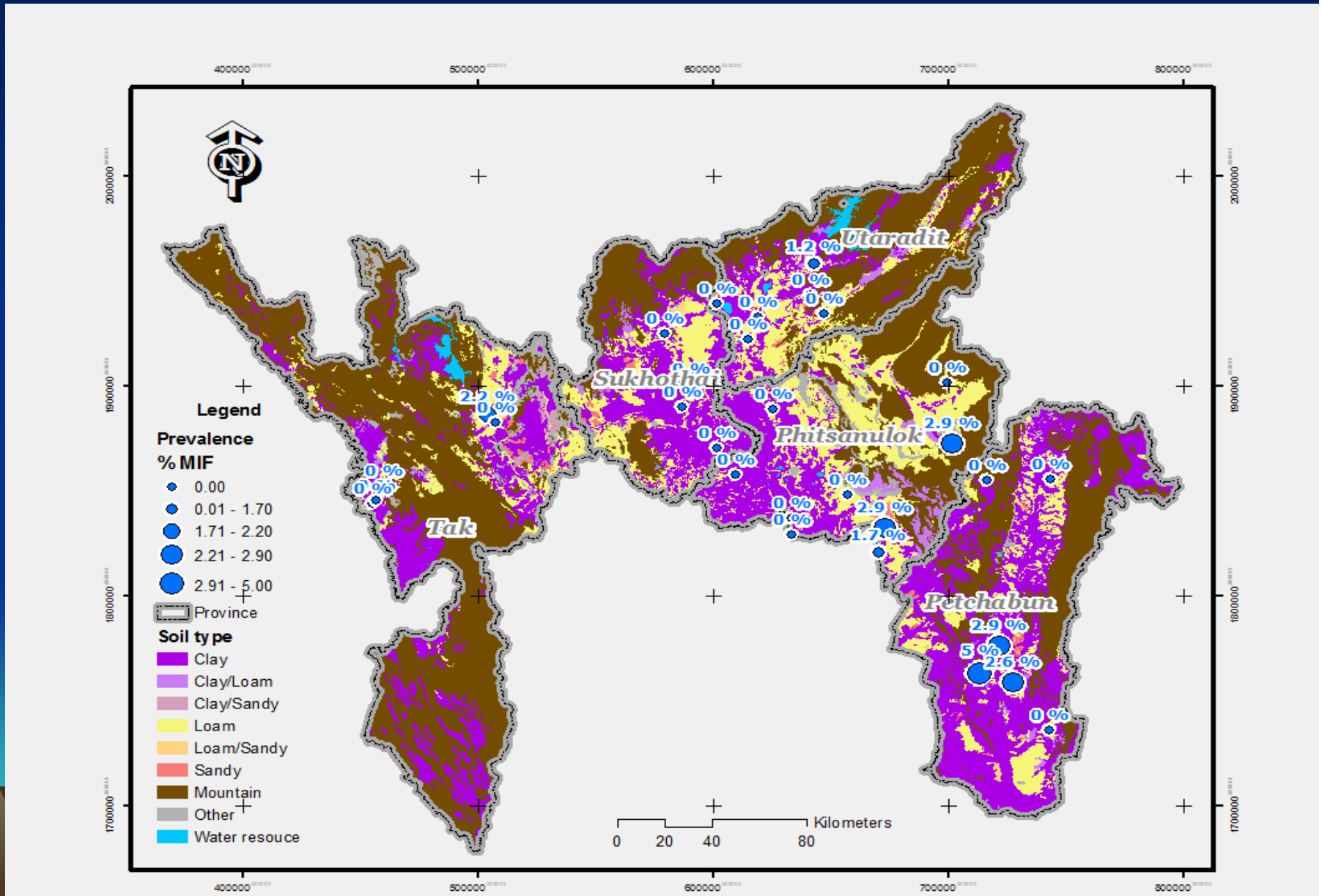
Results

(Prevalence of MIF and Soil type)



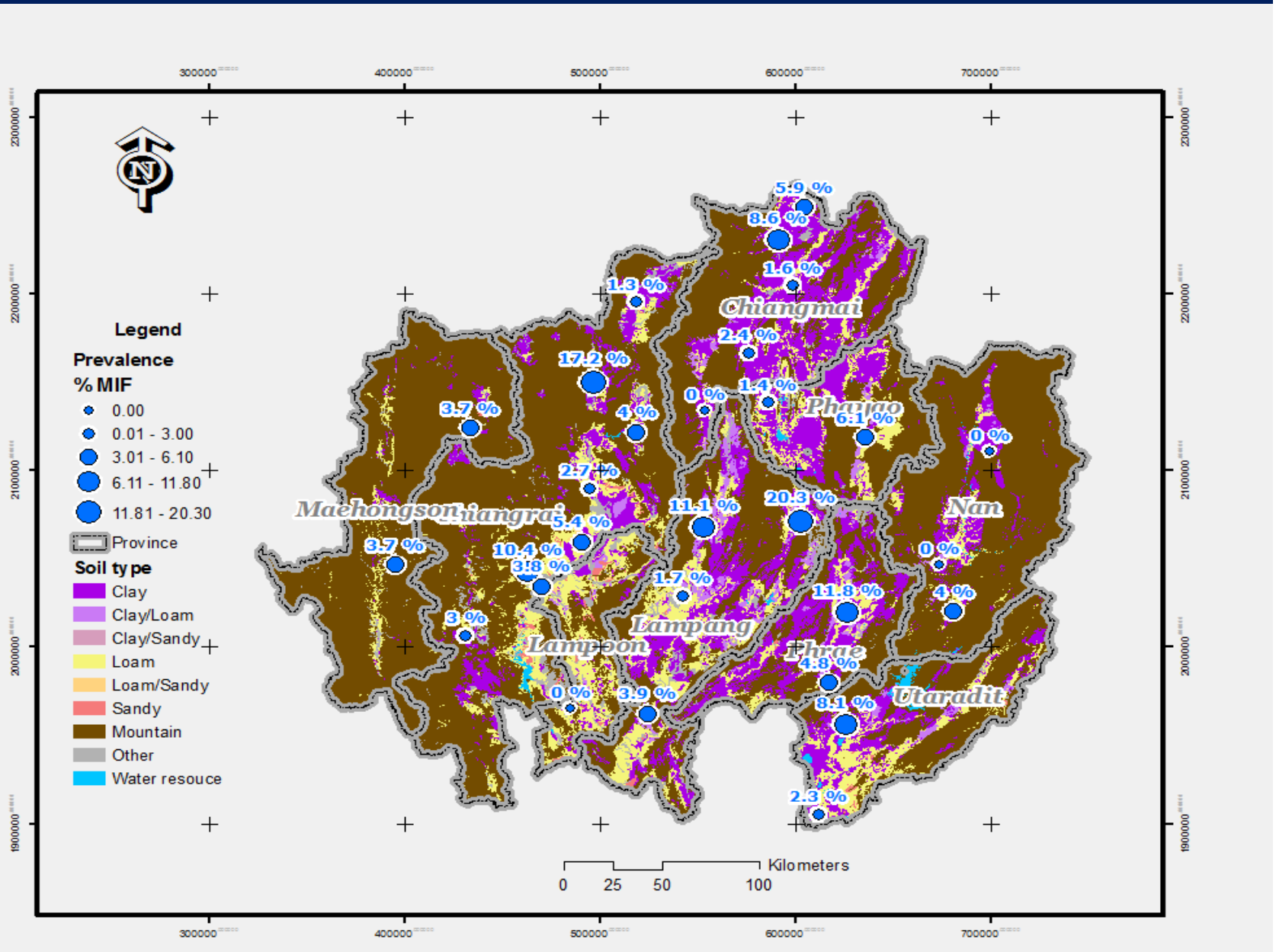
Results

(Prevalence of MIF and Soil type)



Results

(Prevalence of MIF and Soil type)



National Helminthiasis survey

Intensity of liver fluke (*Opisthorchis viverrini*) in Thailand, 2009

Region	Number	MEPG	SD	Level of Intensity							
				Low (<1000 epg)		Medium (1,000 -9,999 epg)		High (10,000 -29,999 epg)		Very High (>29,999 epg)	
				No	%	No	%	No	%	No	%
Central	28	99.39	148.23	28	100.0	0	0.0	0	0.0	0	0.0
North	94	424.16	3642.40	92	97.8	2	2.2	0	0.0	0	0.0
NE	626	364.20	1162.94	624	99.7	2	0.3	0	0.0	0	0.0
South	3	17.33	24.91	3	100.0	0	0.0	0	0.0	0	0.0
Total	751	418.23	1,675.47	747	99.5	4	0.5	0	0.0	0	0.0

National Helminthiasis survey

Intensity of Hookworm in Thailand, 2009

Region	Number	MEPG	SD	Level of Hookworm Intensity							
				Low (<1000 epg)		Medium (1,000 -9,999 epg)		High (10,000 -29,999 epg)		Very High (>29,999 epg)	
				No	%	No	%	No	%	No	%
Central	28	99.39	148.23	28	100.0	0	0.0	0	0.0	0	0.0
North	94	424.16	3642.40	92	97.8	2	2.2	0	0.0	0	0.0
NE	626	364.20	1162.94	624	99.7	2	0.3	0	0.0	0	0.0
South	3	17.33	24.91	3	100.0	0	0.0	0	0.0	0	0.0
Total	751	418.23	1,675.47	747	99.5	4	0.5	0	0.0	0	0.0