CHAPTER 4

RESULT

Sub-study 1: Epidemiological study

1. Sample size

The census of poultry raisers in Chiang Mai, Lum phun and Nan were 88,012, 22,267, 44,617 respectively. A total of 15,981 poultry raisers in 3 provinces were participated into this study, 8,988 were in Chiang Mai, 2299 were in Lamphun, and 4,694 were in Nan province (Table 4). These are approximately 10% of the poultry raiser census in each study area. The results in this study are divided into 2 parts depend on study area, Chiang Mai-Lamphun and Nan.

Table 4: Number and percentage of poultry raisers and sample size in target area

Provinces	Number of poultry raisers		
	Total number	Sample size	
		Number	Percentage
Chiang Mai	88,012	8,988	10.21
Lamphun	22,267	2,299	10.32
Nan	44,617	4,694	10.52
Total	154,896	15,981	10.32

Epidemiological study composed of disease investigation, status of poultry farm management especially in disease control and prevention, and risk factors of avian influenza. The results were reported in each part depends on above and were separated depends on study area.

2. Disease investigation

The cause of disease outbreak was studied in Chiang Mai, Lamphun and Nan province. Disease Investigation was done by interviewing farmers or villagers whom affected with disease outbreak.4 Original infected districts in Chiang Mai province, Jom Tong, Hang Dong, Sankampang, and Sarapee districted were investigated. In December, 2003 quail farmer in Hang Dong brought quails which were transported from Lower Northern Thailand and placed into his farm. This province which was the source of quail was reported of chicken massive death. After that the quail were died, the farmer sold the birds shortly to 2 farms in Sarapee and Sankampanng. Then those farms faced with massive death and disease had occurred in village which farm located. The samples from farms were sent to identify the cause of the death and the results were avian influenza.

In Lamphun province, villagers in Viang Nong Long sub-district brought chicken meat to prepare food from market that had been sent from central region province of Thailand in January, 2004. After that their backyard chickens were died. The veterinary authorities collected the dead birds to the lab and identified they infected with AI.

In Nan province, in December, 2003 the middle man in Pua district brought chickens from province which located in the Lower Northern Thailand. This province is the one of provinces which had massive death of poultry. He took those chicken to slaughterhouse and sent to markets in Chiang Klang, Tung Chang, Chalermprakeat, and Bou Kluae district by using this road. After that there were reports of massive death of backyard chicken around the markets that sold chicken meat. Samples were taken by DLD provincial authorities and confirmed with H5N1.

3. Poultry farm management status and risk factors of avian influenza

3.1. Chiang Mai-Lamphun study area

3.1.1 Farm management, disease control and prevention practices

Data regarding farm management including type of poultry farm, production system, sources of animal replacement stock and feed used in farm, sources of water used, type of housing, feces management, cleaning poultry house methods, parking places, biosecurity practices, person who responsible to disease control and prevention practice during disease outbreak in nearby farms are showed in table 5.

Table 5: Management, disease control and prevention practice of poultry raiser

Characteristics	n	Number	Percentage
Type of farm	11,246		
Integrated		52	0.46
Grand parent		40	0.36
Meat type/ layer type		11,154	99.17
Type of raising	11,112		
All in all out		252	2.30
Continuous		10,687	95.70
Others		218	2.00
Sources of replacement animal	10,305		
Buy		552	5.49
Produce within own farms		7,824	73.34
Others		1,882	18.71
> 1 places		47	0.47

Table 5: (continued)

Characteristics	n	Number	Percentage
Sources of feed used	10,306		
Company		5,583	54.87
Produce within own farms		3,591	33.93
Others		1,056	10.45
> 1 places		76	0.76
Sources of water used	10,402		
Tap water		7,287	69.39
Underground water source		2,521	24.64
River-canal		78	0.77
Swamp		42	0.41
> 1 places		492	4.80
Use a community-water sources	10,915	175	1.63
Treat water before use	11,020	6,926	62.15
Type of housing	11,140		
Evaporative cooling system		188	1.73
Open-house type		4,089	35.29
Others		6,862	62.98
Have fence around farm area	10,979	1,243	11.58

Table 5: (Continued)

Characteristics	n	Number	percentage
Feces elimination method	10,324		
To dry with sunlight		251	2.49
A pond of treated feces		23	0.23
Others		5,943	58.96
> 1 method		63	37.69
Clean farm area with disinfectant	11,025	1,129	1.46
Parking place	8,609		
Inside farm		3,575	39.84
Outside farm		5,031	60.16
Disinfecting method of vehicle/equipments in-out farm	10,487		
Disinfectant pond		55	0.54
Spraying house		16	0.16
Spraying machine		326	3.15
> 1 method		40	0.39
No method		10,050	95.76
Person who responsible in disease control	10,259		
Veterinarian		151	1.47
Husbandry man		162	1.58
Others (owner)		9,371	91.34
> 1 person		575	5.60

Table 5: (Continued)

Characteristics	n	Number	percentage
Disinfecting method of person in-out farm	11,151		
Bathroom		218	0.02
Disinfecting well		228	2.13
Others		503	4.69
No method		10,058	91.82
>1 method		144	>1.35
Have disinfectant basin in every house	11,247	592	5.38
AI outbreak in nearby farm	10,174	1,396	14.00
Raising practices when disease occurred in nearby farm	1,062		
Vaccination		83	7.82
Closed farm		128	12.07
Restrict person in-out of farm		8	0.75
No specific practice		122	11.50
Other (culling)		720	67.86

3.1.2 Information of avian influenza infected area

There were 46 outbreak areas in Mueang, Jomtong, Maerim, Maewang, Sarapee, Sankampang, Sanpatong, Hangdong, and Doi Lor district. In Lamphun, the 2 outbreak areas were reported in Pasang district and Weang Nonglong sub-distrct.

Table 6: Number of HPAI outbreak area in Chiang Mai-Lamphun

Target area	The number of outbreak area
Chiang Mai	
Mueang	4
Jomtong	4
Maerim	2
Maewang	2
Sarapee	14
Sankampang	13
San Sai	3
Sanpatong	2
Hang Dong	1
Doi Lor	1
Total	46
Lamphun	
Pasang	1
Weang Nonglong	1
Total	2

3.1.3 Poultry handlings during HPAI infection of poultry farm

For poultry handling during HPAI infection of farms/flocks, Most of poultry raisers in Chiang Mai-Lamphun reported the situation to the local government officer in their district(77%), 27% called veterinarian into their farms/flocks. Meanwhile, 10% of raisers sold the animals in their farms to another farms and to slaughter, 47.9% of raisers restrict the movement of animal. (Table 7)

Data regarding sick-animal disposal methods during HPAI infection, 6.3% of raisers in Chiang Mai-Lamphun sold animals out of their farms, 12.5% slaughtered and cooked, 10.4% handed out the carcasses to neighborhoods, 6.3% cut off and sold the carcasses, 72% buried the death birds and 47.9% used the incinerator.

Table 7: Activities of raiser during HPAI infection in poultry farm

Activities	Chiang Mai-Lamphun (n=48)	
	Number	percentage
When disease occur		
Report to government officer	37	77.1
Call for veterinarian	13	27.8
Sell the animal	5	10.3
Keep the birds within farm	23	47.9
Sick-animal management		
Sold the sick bird	3	6.3
Slaughter and cooked	6	12.5
Hand out to neighborhood	5	10.4
Slaughter and sell	3	6.2
To bury	35	72.9
To burn	23	47.9
Others	4	8.3

3.1.4 The association between farm management, control and prevention practices and H5N1 outbreak in poultry farm in Chiang Mai-Lamphun study area

Chi-square test (χ^2) was used for univariate analysis of risk factors and significant level of 0.05 was used to select the variable. In this study, there were no statistical significant associations of HPAI outbreak with the treated water before used, disinfecting method of person in-out farm, use of disinfectant bath in every house and person who responsible to disease control. There were statistical significant association of HPAI outbreak with type of farm, type of raising, type of housing system, source of animal replacement stock, source of feed used, source of water used, the use of community water sources, have fence around farm area, feces elimination method, the use of disinfectant in farm, packing place, disinfecting method of equipments in-out farm, H5N1 outbreak in nearby farm, and practices when disease occurred in nearby farm (table 8).

Table 8: Farm management, disease control and prevention practices associated with HPAI infection in poultry farm

Characteristics	Disease status				P-value
	H5N1(+) farm		H5N1(-) farm		
Type of farm					
Integrated	2	4.26	50	0.45	0.0006
Grand parent	0	0	40	0.36	
Meat type/ layer type	45	95.74	11,109	99.20	
Type of raising					
All in all out	0	0	252	2.27	<0.0001
Continuous	45	100	10,642	95.77	
Others	0	0	218	1.96	
Sources of replacement animal					
Buy	37	80.43	7,587	75.90	0.0004
Produce in own farms	7	15.22	545	5.31	
Others	0	0	1,056	10.29	
> 1 places	2	4.26	74	0.72	
Sources of feed used					
Feed meal company	19	40.43	3,592	34.82	0.0044
Mixed in their farm	26	55.32	5,557	54.17	
Others	0	0	1,056	10.29	
> 1 places	2	4.26	74	0.72	

Table 8: (Continued)

Characteristics	Disease status				P-value
	H5N1(+) farm		H5N1(-) farm		
Sources of water used					
Tap water	20	44.44	7,267	70.04	0.0003
Underground	22	48.89	2,499	24.09	
River-canal	1	2.22	77	0.74	
Swamp	1	2.22	41	41	
More than 1 places	0	0	491	491	
The use of community water sources	4	8.51	171	1.57	<0.0001
Treated water before used	29	63.04	6,897	62.85	0.29
Type of housing					
Evaporative cooling system	3	6.52	185	1.67	<0.0001
Open-house	26	56.52	4,063	36.62	
Others (no house)	16	34.78	6,846	61.71	
Have fence around farm area	16	34.78	1,227	11.22	<0.0001
Feces elimination method					
To dry with sunlight	4	8.7	247	2.40	<0.0001
A well of treated feces	1	2.17	23	0.22	
To throw away	34	73.91	5,971	58.09	
Others (no method)	6	13.04	3,975	38.67	
> 1 methods	1	2.17	62	0.60	

Table 8: (Continued)

Characteristics	Disease status				P-value
	H5N1(+) farm		H5N1(-) farm		
Clean farm with disinfectant	13	28.26	1,116	10.16	0.0002
Parking place					
Inside farm	14	35.00	3,561	41.56	0.0006
Outside farm	26	65.00	5,008	58.44	
Disinfecting method of equipments in-out farm					
Disinfectant pond	0	0	55	0.53	0.0006
Spraying machine	0	0	16	0.15	
Spraying house	6	13.04	320	3.06	
Not have method	39	84.78	10,011	95.88	
Disinfecting method of person in-out farm					
Bathroom	0	0	2	0.02	0.1903
Disinfecting well	3	6.38	225	2.11	
Others	1	2.13	501	4.70	
No method	42	89.36	10,016	91.81	
>1 method	1	2.13	143	1.34	
Use of disinfectant bath in every house	2	4.26	590	5.27	0.5581

Table 8: (Continued)

Characteristics	Disease status				P-value
	H5N1(+) farm		H5N1(-) farm		
Person who responsible in disease control					
Veterinarian	2	4.76	149	1.46	0.309
Husbandry man	1	2.38	161	1.58	
Others	37	88.10	9,334	91.36	
> 1 persons	2	4.76	573	5.61	
AI outbreak in nearby farm	36	76.60	1,360	13.43	<0.0001
Practices when disease occurred in nearby farm					
Vaccination	1	2.44	82	8.04	<0.0001
Closed farm	6	14.63	43	4.22	
Restrict person in-out of farm	0	0	8	0.78	
No specific practice	15	36.59	107	10.49	
Other (culling)	19	46.34	701	68.73	

3.1.5 The association of activities and exposures and HPAI infection in poultry farms in Chiang Mai-Lamphun study area

Multivariable logistic regression was performed to identify risk factors. The risk factors associated between HPAI introduction into poultry farm and disease outbreak in nearby farm (OR 19.34, 95% CI10.04-37.26), sharing a common water source with other farms (OR 5.69, 95% CI 2.02-16.00), purchasing replacement stock (OR 3.13, 95% CI 1.40-7.04).

Table 9: Risk factors of avian influenza using multivariable logistic regression

Risk factor	OR	95% CI	p-value
AI outbreak at nearby farms	19.34	10.04-37.26	<0.0001
The use of community water sources	5.69	2.02-16.00	0.0016
purchasing replacement stock	3.13	1.40-7.04	0.0095
open-type housing system	2.37	1.31-4.28	0.0053

3.2 Nan province study area

3.2.1 Farm management, disease control and prevention practices

Farm management including type of poultry farm, production system, sources of animal replacement and feed used in farm, sources of water used, type of housing, feces management, cleaning poultry house methods, parking places, biosecurity practices, person who responsible to disease control and disease control and prevention practice during disease outbreak in nearby farms were shown in table 11.

Table10: Farm management, disease control and prevention practices in Nan

Characteristics	n	Number	percentage
Type of farm	11,246		
Integrated		52	0.46
Grand parent		40	0.36
Meat type/ layer type		11,154	99.17
Type of raising	11,112		
All in all out		252	2.30
Continuous		10,687	95.70
Others		218	2.00
Sources of replacement animal			
Buy	4,674	3,864	82.67
Produce in their farms		324	6.93
Others		467	9.99
More than 1 places		19	0.41

Table 10: (Continued)

Characteristics	n	Number	percentage
Sources of feed used			
Mixed tn their farm	4,674	3,481	74.48
Company		593	12.69
Others		460	10.48
More than 1 places		110	2.35
Sources of water used			
Tap water	4,677	2,448	52.34
Underground		1,722	36.82
River-canal		44	0.94
Swamp		22	0.47
More than 1 places		441	9.43
Used a community water sources	4,664	393	8.43
Treated water before used	4,658	2,491	53.48
Type of housing			
Evaporative cooling system	4,677	3	0.06
Open-house		2,257	48.26
Others		2,417	51.68
Have fence around farm area	4,672	129	2.76

Table 10: (Continued)

Characteristics	n	Number	percentage
Feces elimination method			
To dry	4,675	153	3.27
A well of treated feces		8	0.17
Others		2,221	47.51
> 1 method		2,284	48.86
Parking place			
Inside farm	2,325	832	35.78
Outside farm		1,493	64.22
Disinfecting method of equipments in-out farm			
Disinfectant pond	4,674	1	0.02
Spraying house		0	0
Spraying machine		18	0.39
Not have method		4,654	99.57
> 1 methods		1	0.02
Disinfecting method of person in-out farm			
Bathroom	4,675	1	0.02
Disinfecting well		3	0.06
Others		15	0.32
No method		4,654	99.55
>1 method		2	0.04

Table 10: (Continued)

Characteristics	n	Number	percentage
Cleaned farm area with disinfectant	4,676	54	1.15
Have disinfectant well in every house	4,677	5	0.11
Person who responsible in disease control			
Veterinarian		15	0.32
Husbandry man		4	0.09
Others		4,642	99.55
> 1 person		2	0.04
AI outbreak in nearby farm	4,282	1,103	25.76
Practices when disease occurred in nearby farm			
Vaccination	1,083	1	0.09
Closed farm		10	0.92
Restrict person in-out of farm		1	0.09
No specific practice		18	1.66
Other (culling)		1,053	97.23

3.2.2 Information regarding HPAI infection in Nan province

There were 76 outbreak areas in Pua, Maejarim**,** Chiang Klang**,** Chaleumprakeart**,** Borkeua. Table 12 showed the number of HPAI outbreak area in each district.

Table 11: Number of HPAI infected area in Nan province

Nan	Number of infected area
Pua	
Maejarim	3
Chiang Klang	9
Chaleumprakeart	24
Borkeua	22
Total	76

3.2.3 Poultry management during HPAI infection in poultry farm

Data regarding poultry management during HPAI outbreak in farms/flocks, Most of poultry raisers in Nan province reported the situation to the local government officer in their district (82.9%) and 23.7% of raisers restrict the movement of animal

Data regarding sick-animal disposal methods during HPAI infection, 19.7% of raisers in Nan province slaughtered and cooked, 15.8% handed out the carcasses to neighborhoods, 85.5% buried the death birds and 2.6% used the incinerator (table13)

Table 12: Poultry management during HPAI infection in poultry farm

Activities	**Nan (n=76)**	
	Number	**percentage**
When disease occur		
Report to government officer	63	82.9
Call for veterinarian	0	0
Sell the animal	0	0
Restrict of animal movement	18	23.7
Sick-animal management		
Sold out the sick bird	0	0
Slaughter and cooked	15	19.7
Hand out to neighborhood	12	15.8
Slaughter and sell	0	0
To bury	65	85.5
To burn	2	2.6
Others	9	8.2

3.2.4 The association between farm management, control and prevention practices and HPAI infection in poultry farm

Chi-square test (χ^2) was used for univariate analysis of risk factors and significant level of 0.05 was used to select the variable. In Nan study area, there were statistical significant associations of HPAI outbreak with type of farm, source of replacement animal, source of feed used, source of water used, the used of community water source, the treated of water before used, type of housing, feces elimination method, parking place, and H5N1 outbreak in nearby farm, as show in table 14.

Table 13: The association between farm management, control and prevention practices and HPAI infection in poultry farm

Characteristics	Disease status				P-value
	H5N1(+) farm		H5N1(-) farm		
Type of farm					
Integrated	0	0	354	7.71	0.0353
Grand parent	0	0	18	0.39	
Meat type/ layer type	76	100	4,222	91.90	
Type of raising					
All in all out	0	0	48	1.04	0.6673
Continuous	74	97.37	44.29	96.18	
Others	2	2.63	128	2.78	

Table 13: (Continued)

Characteristics	Disease status				P-value
	H5N1(+) farm		H5N1(-) farm		
Sources of replacement animal					
Buy	55	72.37	3,809	82.84	0.0002
Produce in own farms	15	19.74	309	6.72	
Others	6	7.89	461	10.03	
More than 1 places	0	0.00	19	0.41	
Sources of feed used					
Mixed in their farm	67	90.54	3,414	74.22	0.0154
Company	4	5.41	589	12.80	
Others	2	2.70	488	10.61	
More than 1 places	1	1.35	109	2.37	
Sources of water used					
Tap water	59	78.67	2,389	51.91	0.0003
Underground	12	16.00	1,710	37.16	
River-canal	0	0.00	44	0.96	
Swamp	0	0.00	22	0.48	
More than 1 places	4	5.33	437	9.50	
Used a community water sources	0	0	393	8.56	0.0147
Treated water before used	56	74.67	2,435	53.13	0.0003

Table 13: (Continued)

Characteristics	Disease status				P-value
	H5N1(+) farm		H5N1(-) farm		
Type of housing					
Evaporative cooling system	0	0	3	0.07	<0.0001
Open-house	0	0	2,257	49.04	
Others	75	100	2,342	50.89	
Have fence around farm area	1	1.33	128	2.78	0.7239
Feces elimination method					
To dry	0	0	153	3.32	0.0077
A well of treated feces	0	0	8	0.17	
To throw away	23	30.67	2,198	47.75	
Others	52	69.33	2,232	48.52	
> 1 method	0	0	9	0.20	
Cleaned farm area with disinfectant	2	2.67	52	1.13	0.2144
Parking place					
Inside farm	0	0	832	36.60	<0.0001
Outside farm	52	100.0	1,444	63.44	
Have disinfectant well in every house	0	0	5	0.11	1.0000
H5N1 outbreak in nearby farm	70	92.11	1,033	24.56	<0.0001

Table 13: (Continued)

Characteristics	Disease status				P-value
	H5N1(+) farm		H5N1(-) farm		
Disinfecting method of person in-out farm					
Bathroom	0	0	1	0.02	0.9548
Disinfecting well	0	0	3	0.07	
Others	0	0	15	0.33	
No method	75	100.0	4,579	99.54	
>1 method	0	0	2	0.04	
Person who responsible in disease control					
Veterinarian	0	0	15	0.33	0.9541
Husbandry man	0	0	4	0.09	
Others	72	100.0	4,567	99.54	
>1 persons	0	0	2	0.04	
Poultry handling when disease occurred in nearby farm					
Vaccination	0	0	1	0.10	0.7353
Closed farm	0	0	10	0.98	
Restricted person in-out farm	0	0	1	0.10	
No specific practice	0	0	18	1.77	
Other (culling)	66	100.0	987	97.05	

3.2.5 The association of activities and exposures and HPAI infection in poultry farms in Nan

Multivariable logistic regression was used to calculate risk factors association with H5N1 introduced to poultry farm/flock. Table 15 shows that there was significant association between HPAI introduction into poultry farm in Nan study area and disease outbreak in nearby farm (OR 10.55, 95% CI 3.40-32.82), and no method of feces management (OR 2.30, 95% CI 1.26-5.47).

Table 14: The risk factor of avian influenza using multivariable logistic regression

Risk factor	OR	95% CI	p-value
AI outbreak at nearby farms	10.55	3.40-32.82	<0.0001
No method in feces management	2.30	1.26-5.47	0.00081

3. AI prevalence among the poultry study population

In this study, 7,202 cloacal swabs were collected from poultry during August 2004- July 2005. 5,023 samples were collected from Chiang Mai-Lamphun study area and 2,179 samples were collected from Nan province. None of all samples was positive for avian influenza virus and counted 0% of total target population.

Sub-study 2: Geographic information system (GIS)

1. Components of GIS

Software

In this study, the GIS software ArcView3.1 was chosen to colleted data relating avian influenza infection in northern Thailand. ArcView3.1 is a powerful and fully functions for data entry, editing, transformation, manipulation of geographically linked attribute data, analysis, as well as spatial analysis, outbreak visualization and modulation.

Hardware

Hardware for GIS should be high performance, for rapid analysis and large capacity to database management. In this study, we used Intel Pentium 4^{R} 3.5 MHZ computers with 512 megabyte of RAM. 60 gigabyte hard disk was used to database management activities. This system runs on Microsoft Windows 2003 in Thai edition. The dataset including spatial data, administrative boundaries, and attribute data, poultry and poultry raiser census were stored in CD ROM.

Data management

The essential dataset for GIS divided to 2 parts, spatial data and non-spatial (attribute) data. Spatial data consisted of:

- geographical characteristics
- administrative boundaries
- village, poultry farm, slaughter house, market, and fighter cock place locations
- main roads and their branches
- natural water ways

The non-spatial data consisted of poultry and poultry census in each farm and village, market and fighting cock place's name and their characteristics, and outbreak data. The data was collected separately into 5 datasets using Microsoft Access which can be transformed the data into ArcView3.1 program.

Data integration, linking data from multiple sources, was processed within Arc View 3.1 program to present the output in the form of interactive on-screen maps, table, graphs, and printed maps.

2. The application of GIS in avian influenza surveillance

In this study, the result of application of GIS in avian influenza surveillance was divided into three main tropics as 1) data visualization 2) data analysis and 3) management application.

Data visualization

GIS can display the administrative boundaries, village locations main road and their branches. Administrative boundaries were displayed in polygons and linked with attribute dataset.

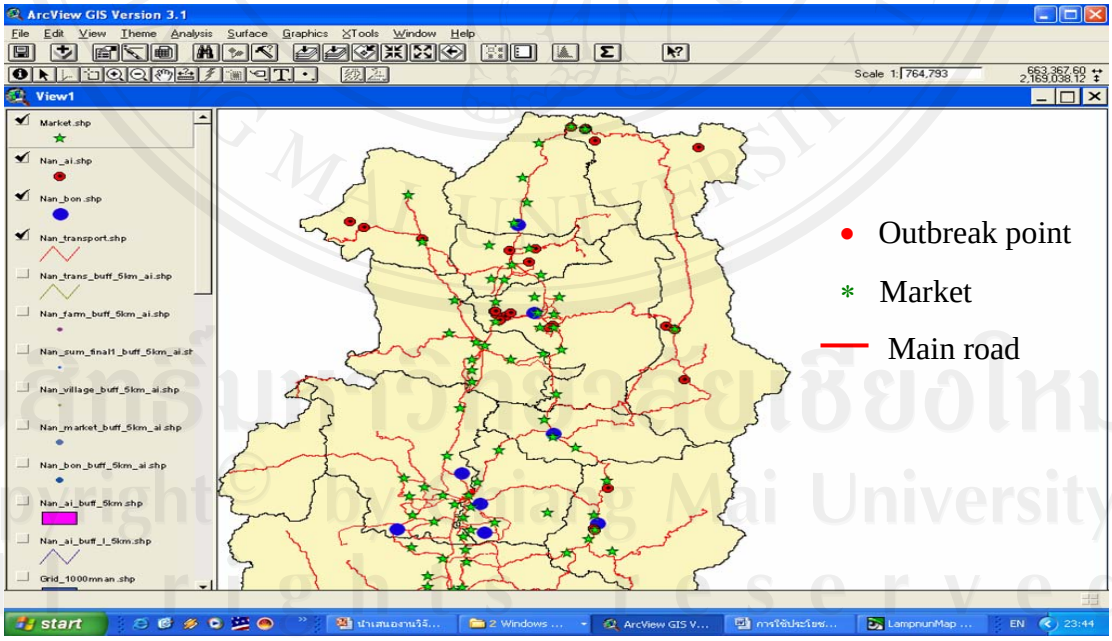
Main road and their branches were displayed in linear features and linked with attribute dataset.

Poultry farm, village, slaughter house, fighting cock place, market and avian influenza infection area were displayed in point feature and linked with attribute dataset.

Natural water ways were displayed in linear features and linked with attribute dataset.

Data analysis

In this area, for example, the data from multiple sources were integrated and analyzed in term of spatial distribution of the avian influenza outbreak. Picture 6 shows the spatial distribution of the disease outbreak in Nan province which related to the main roads and confirmed the result with the disease investigation (DLD, 2004). Avian influenza outbreak in Nan province during December 2003-January 2004 had been occurred because the middle man in Pua district brought the birds from outbreak province in lower northern Thailand to slaughtered and sent the row meat to the markets in Pua, Chaing klang, Chalemprakeart, and Bo Kluea district using the main road number 1080. After that, poultry around the markets were died. The DLD district officer collected the cloacal swab and submitted to the Northern Veterinary Research and Diagnostic Centre at Hang Chat, Lampang and the result shows positive to H5N1.



Picture 6: ArcView outbreak animation shows avian influenza spatial distribution in Nan province which related to the market and main road.

Management application

The control measures to control avian influenza occurs in poultry farm/flock are all poultry, their products, feed, bedding, waste, and manure from infected flocks were destroyed immediately. Meanwhile, a 5-km radius around the infected flocks was defined as restricted area, a restriction on moving poultry and their products, and cloacal swab from neighboring flocks were performed by DLD officers. In this area, the use of GIS as a tool in avian influenza outbreak management was processed within ArcView^{R} 3.1.

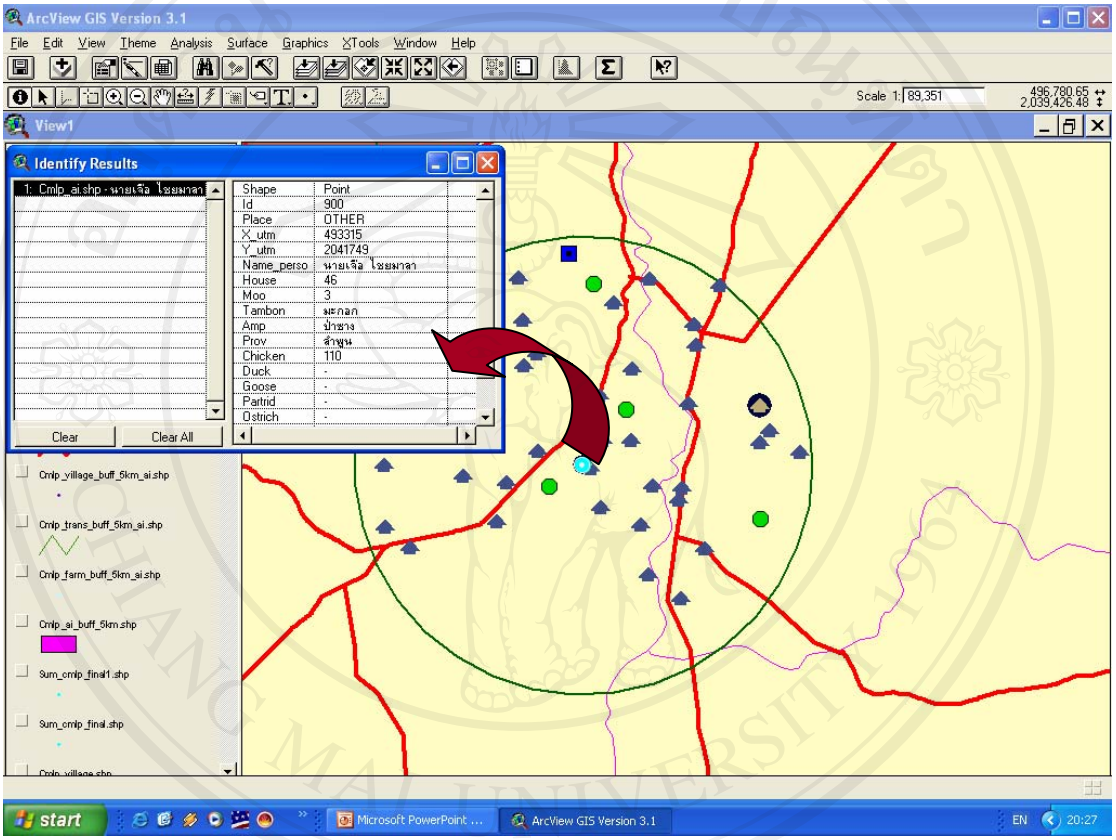
When the outbreak farm or village was reported and identified the outbreak point into GIS, restricted area within 5-km was defined using spatial analysis (buffer zone) function. The program marks the outbreak farm or village, draws the circle representing the buffer zone, and shows the results in a report window. The report contains the following section;

Outbreak farm or village: the name, sub-district, district, province of the outbreak farm or village

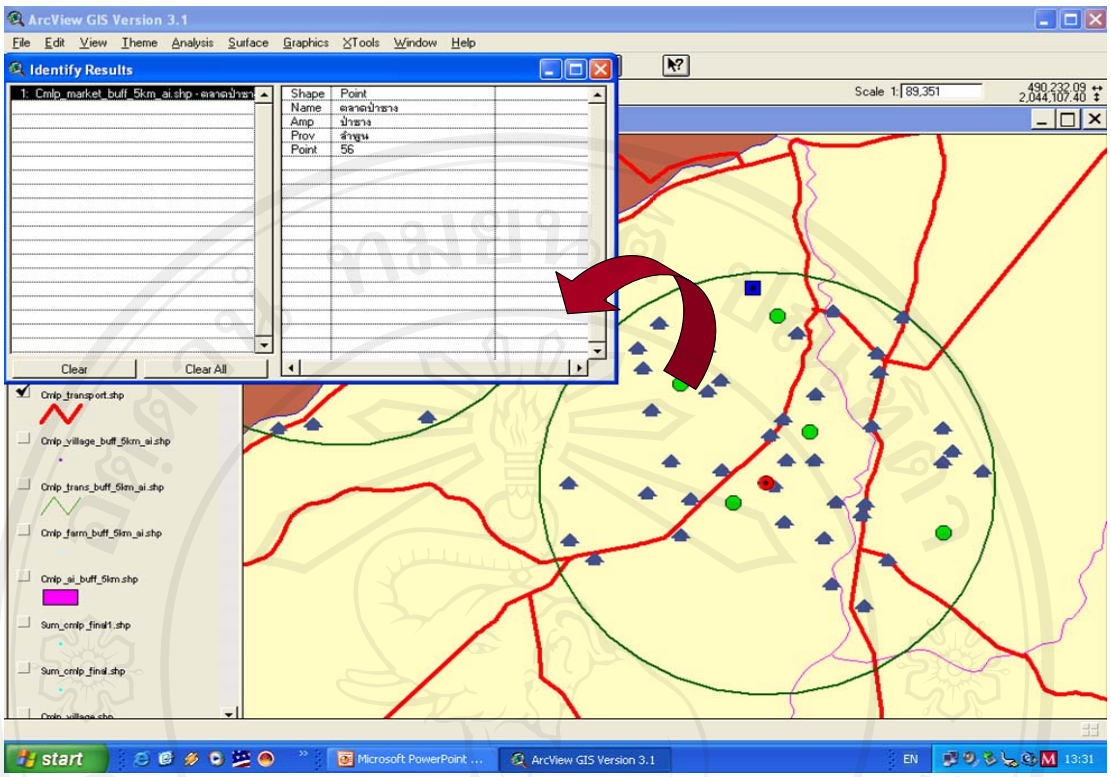
Farm, village, market, fighting cock place in the buffer zone: the total number of farm, village and associated points, the name and total number of poultry raiser and their animal census in each farm and village. These figures will be used for active surveillance, cloacal swab, in farm/flocks which locate within the buffer zone and to estimate of the total number of poultry that will be required for calculated the dose of vaccines when the government decides to use of vaccine as a tool in disease control or to massive culling of poultry within buffer zone.

Road blocks for livestock movement control: The program displays the total number and location of road blocks to prevent to movement of poultry and their

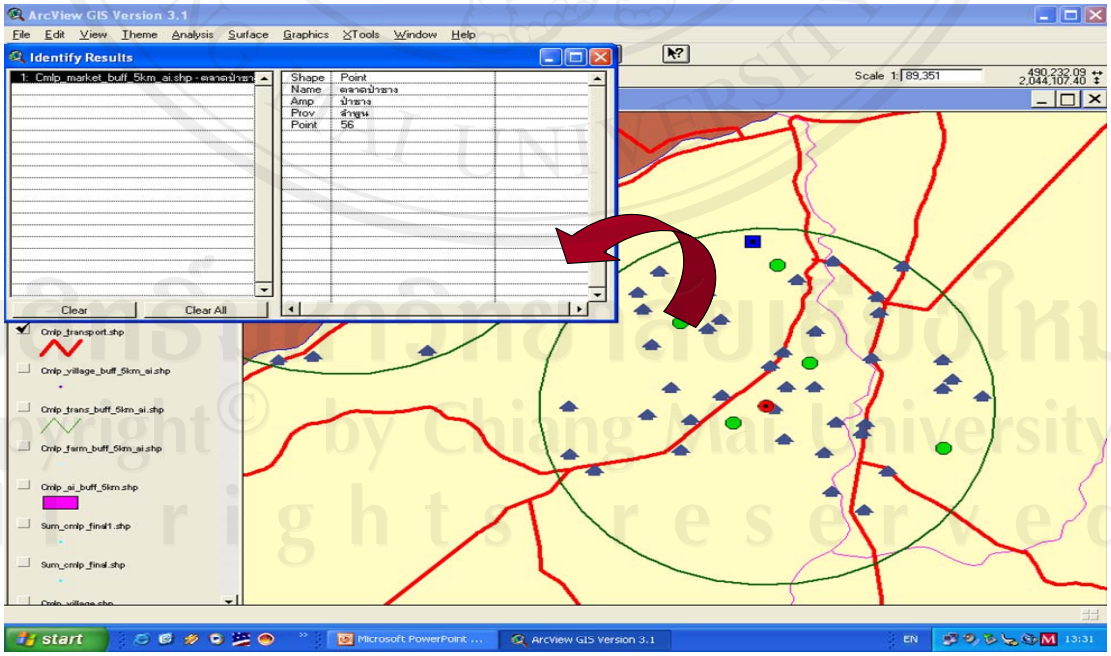
products into and out of buffer zone. The locations of road blocks are defined at the point of intersection between the circle outlining and any roads. In addition, the total number of staff requirement may be calculated for each road block point.



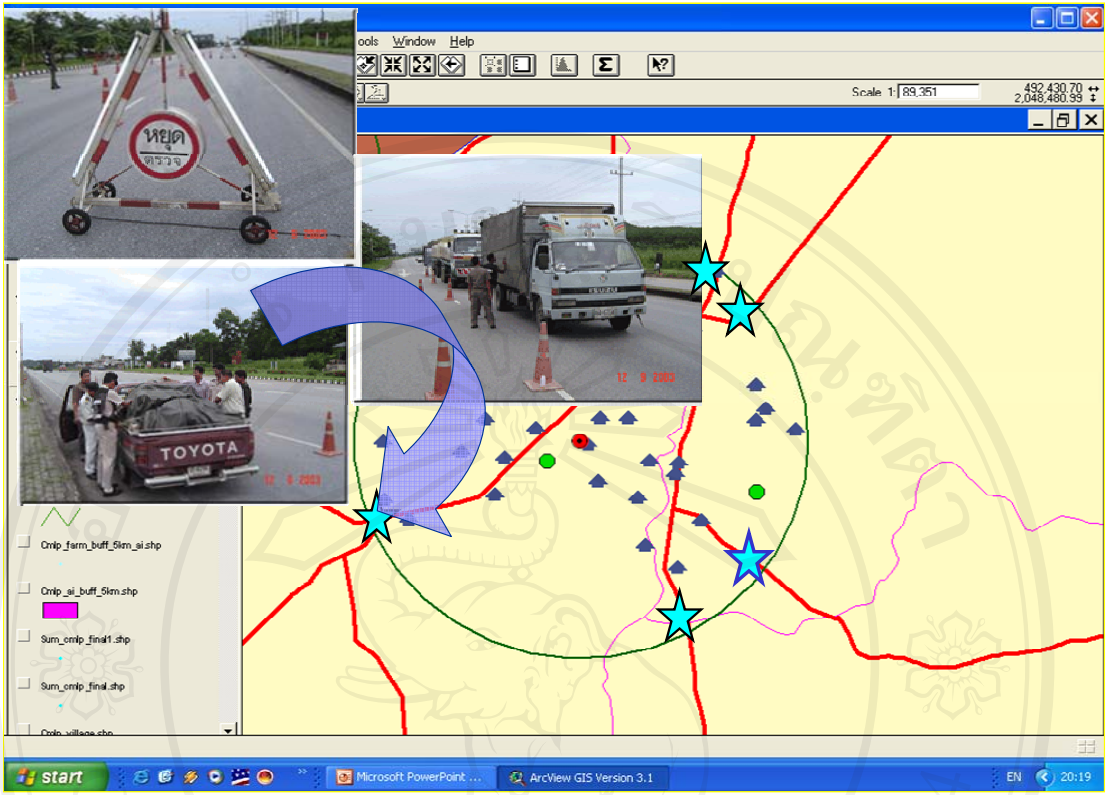
Picture 7: Shows output of outbreak management. The outbreak farm is identified and marked, all village and associated points within buffer zone are highlighted. The outbreak farm is linked to characteristic of poultry farmer.



Picture 8 : Output of outbreak management application. The location and data of market in buffer zone was highlighted.



Picture 9: Output of outbreak management application shows the main road No. 106



Picture 10: Shows output of outbreak management application. All road block locations were highlighted.

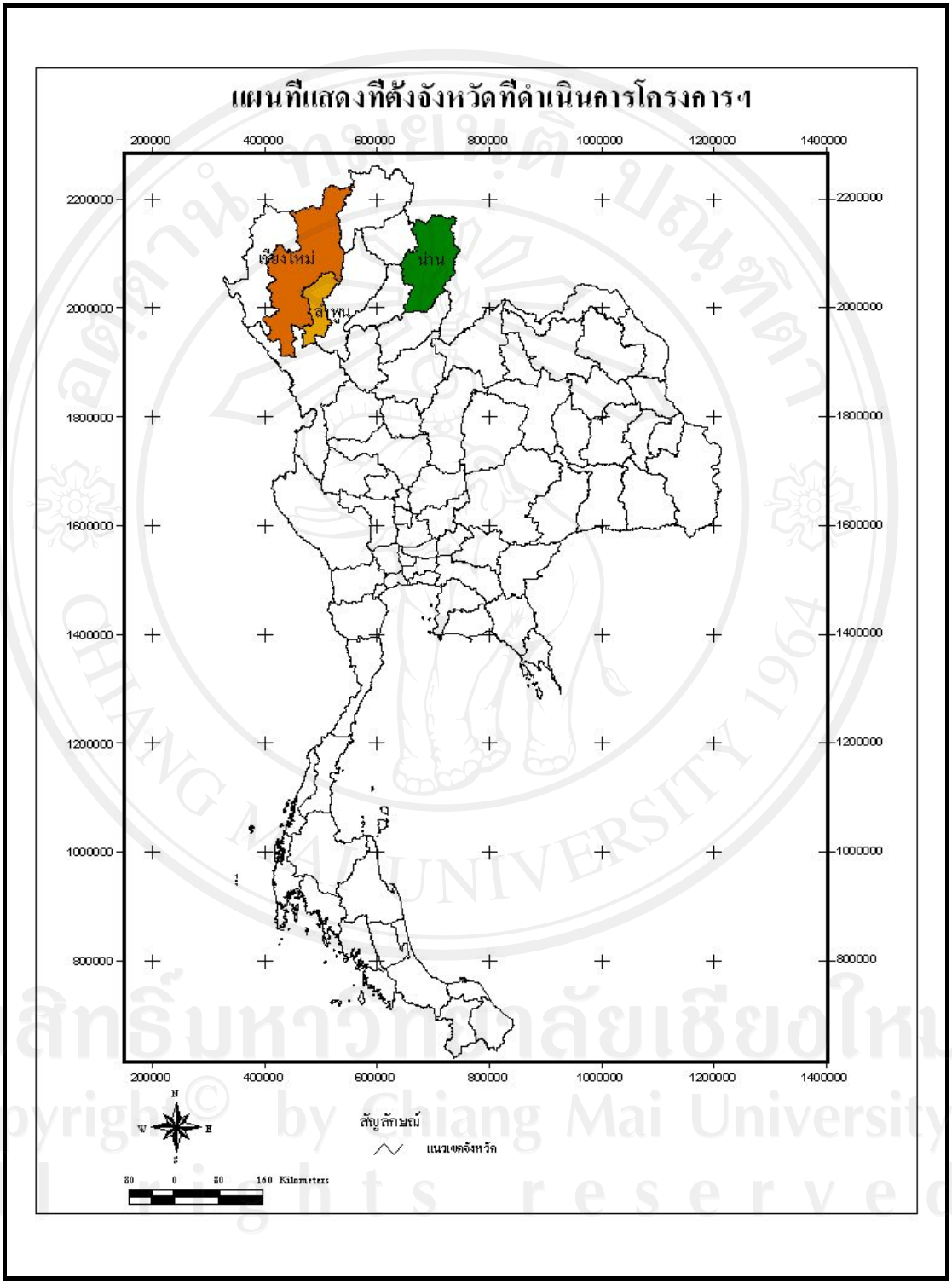


Figure 11: Map of provinces in study area

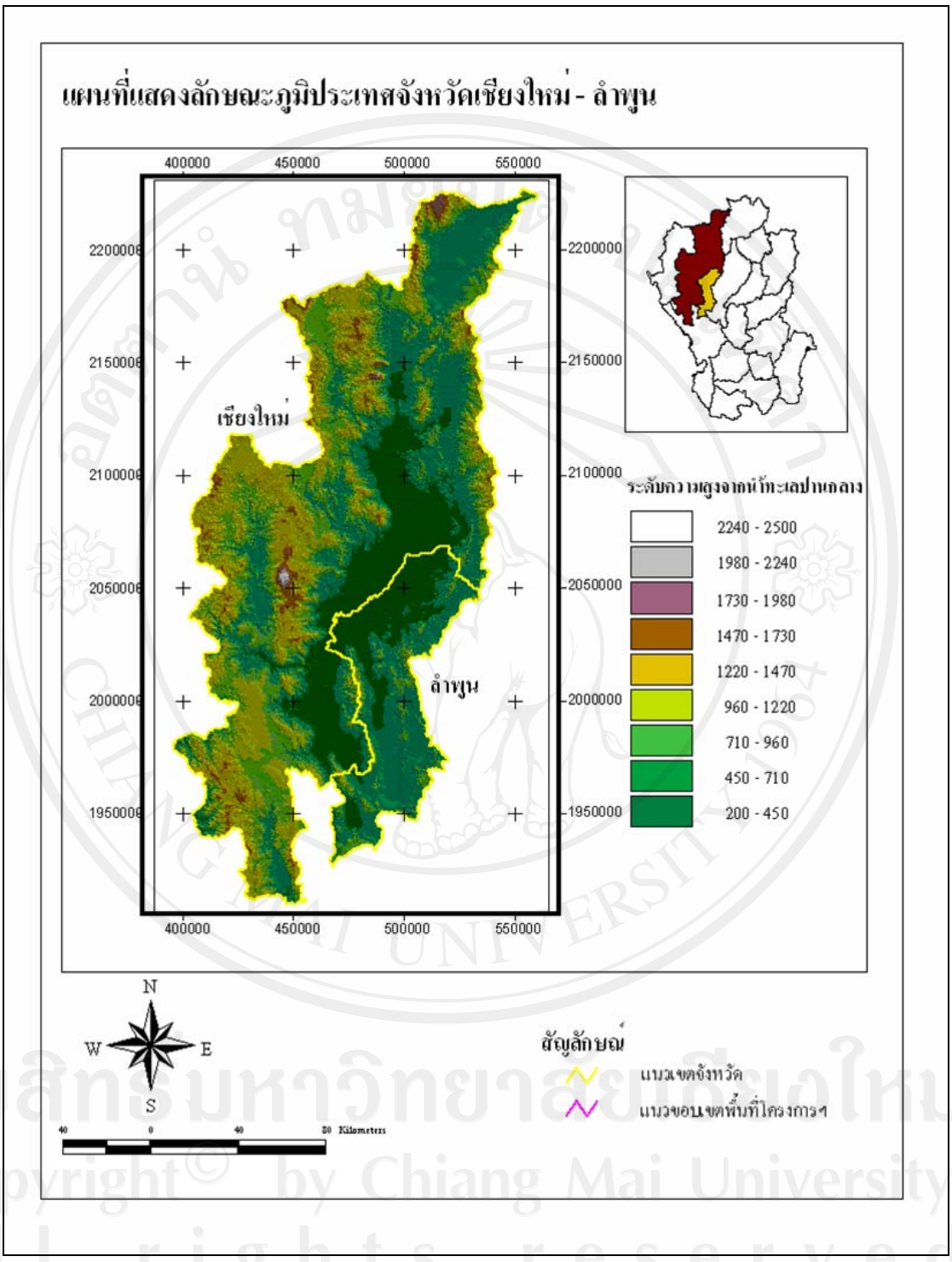


Figure 12: Map of elevation of Chiang Mai-Lamphun

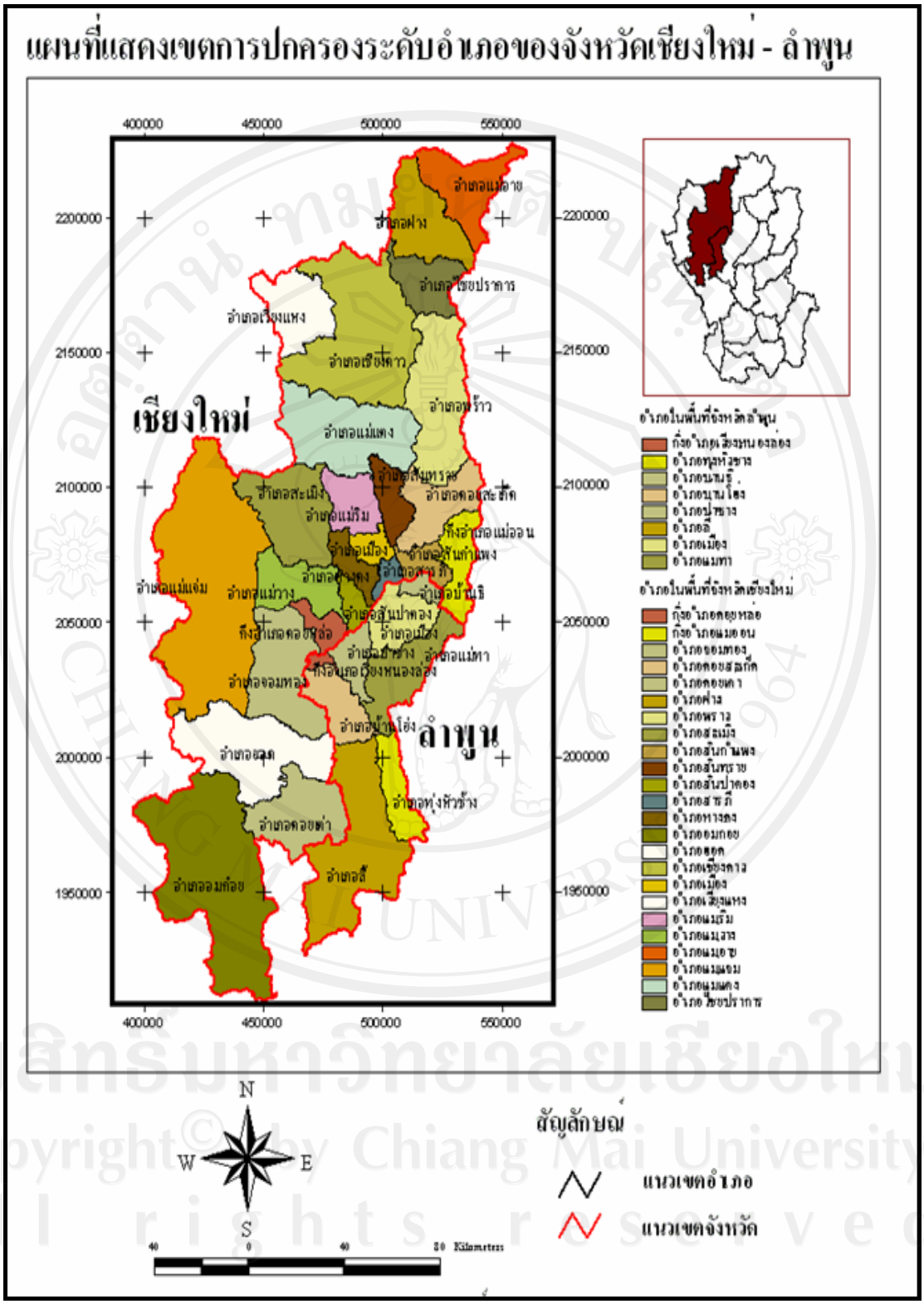


Figure 13: Map of district boundaries of Chiang Mai-Lamphun

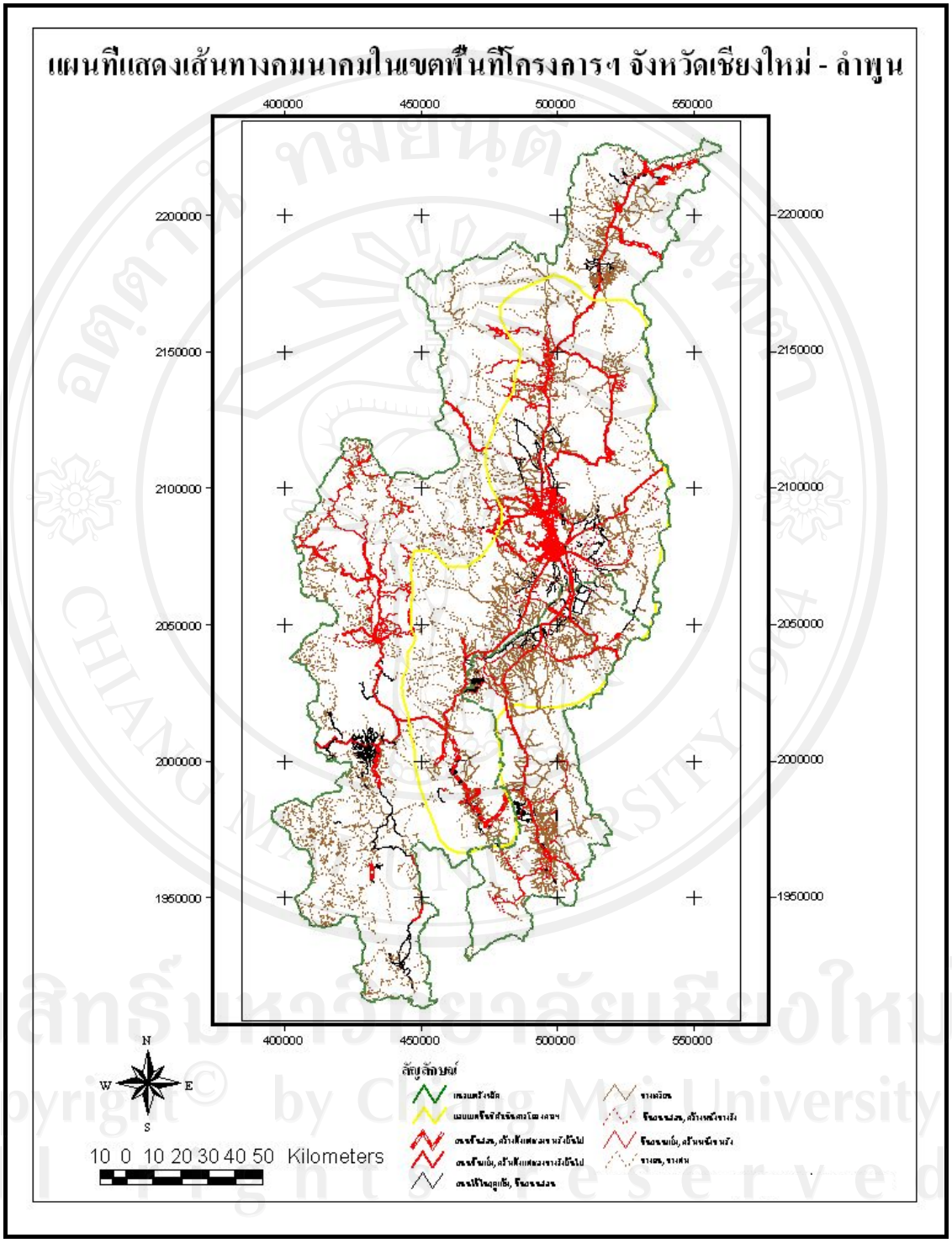


Figure 14: Map of main road and their branches in Chiang Mai-Lamphun

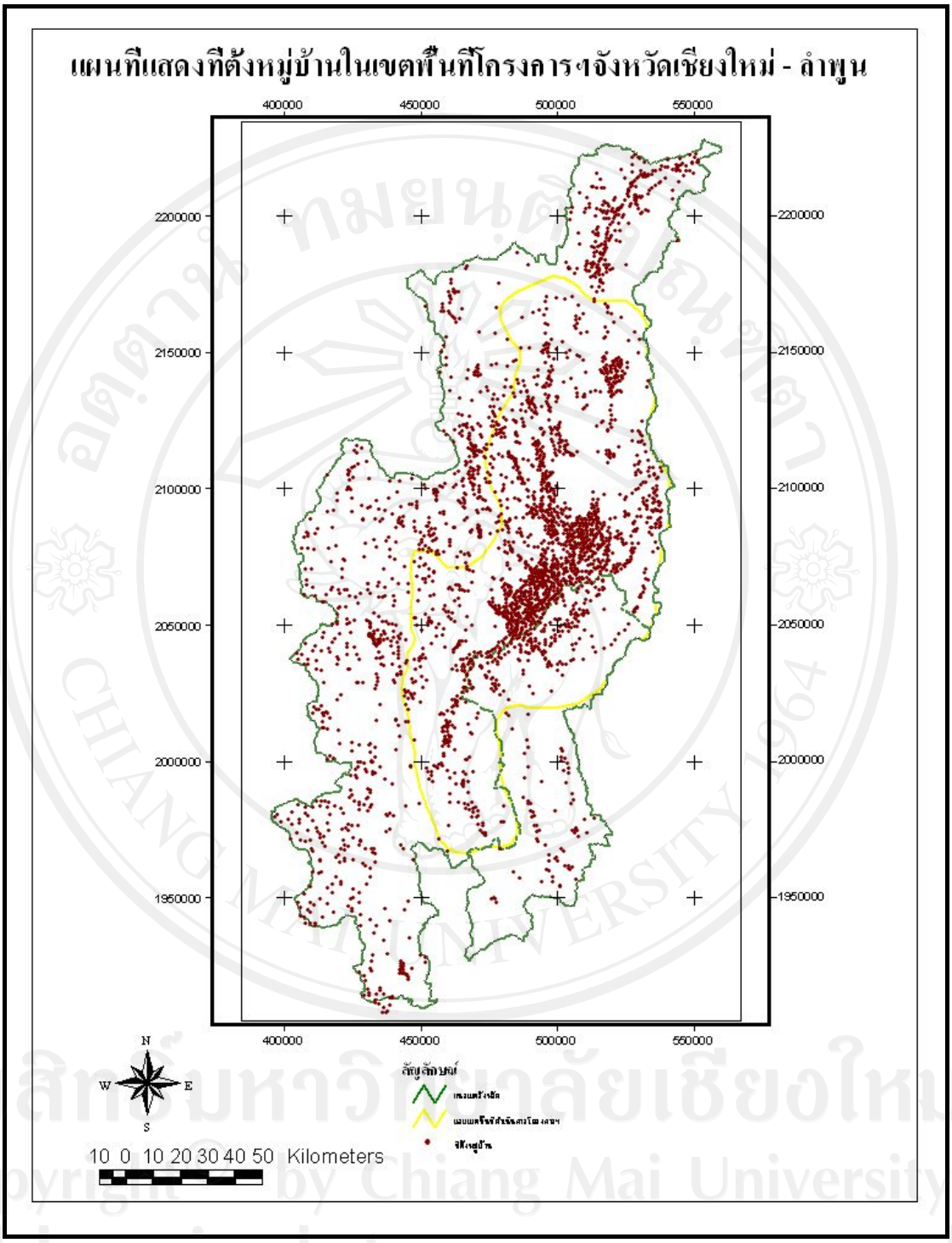


Figure 15: Point map showing the location of villages in Chiang Mai-Lamphun

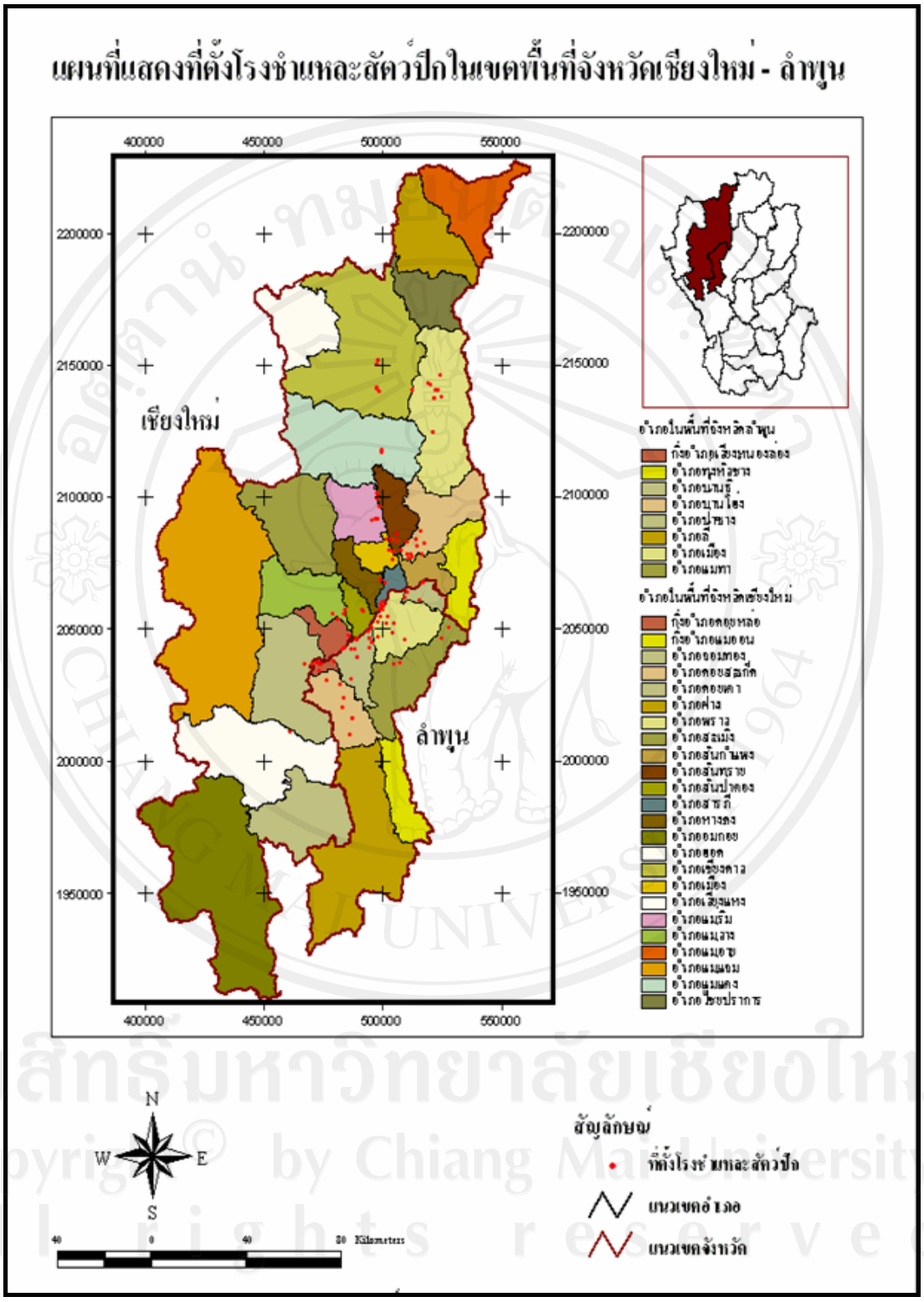


Figure 16: Point map showing the location of the slaughter houses in Chiang Mai-Lamphun

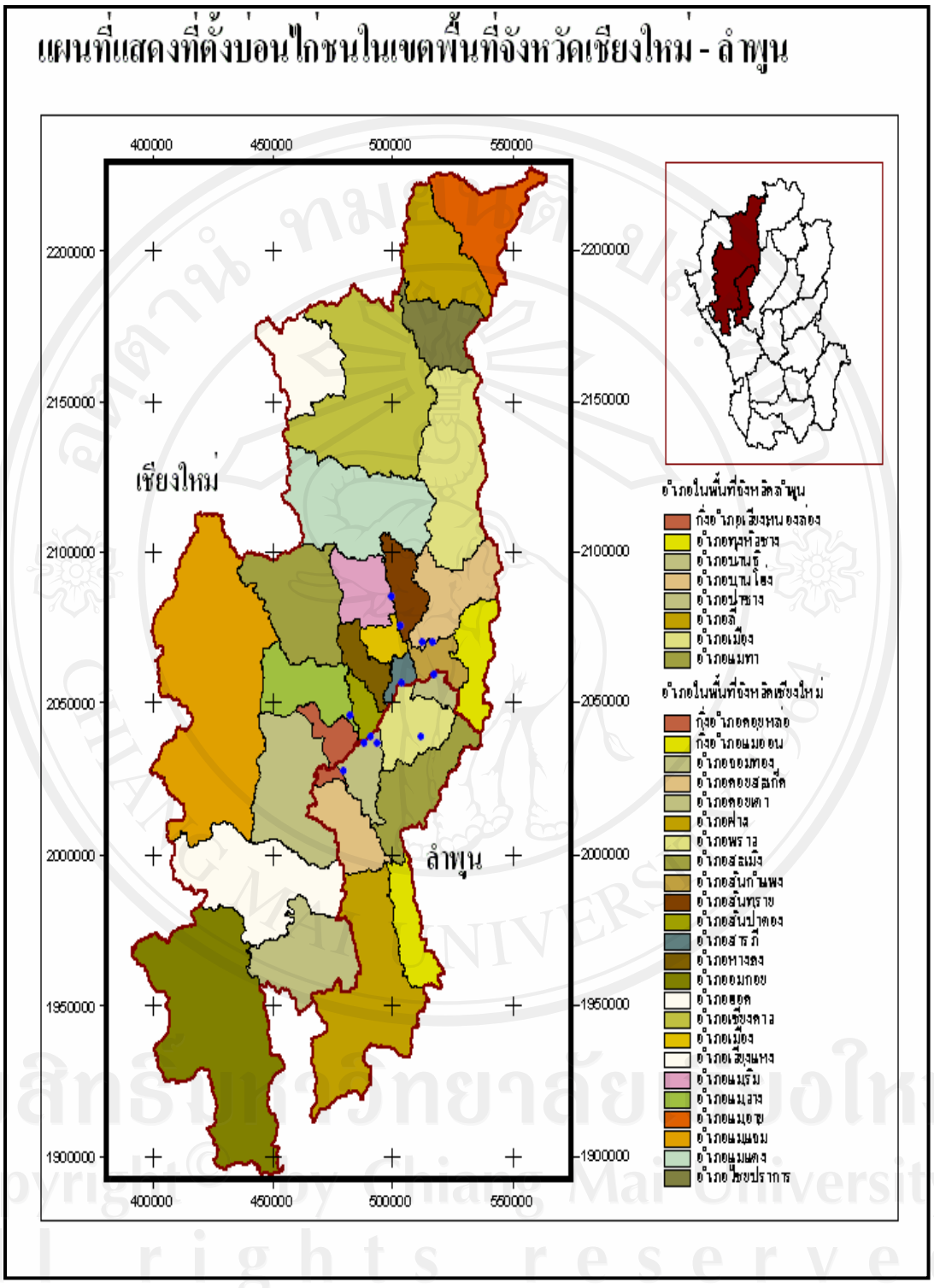


Figure 17: Map point showing the location of the fighting cock places in Chiang Mai-Lamphun

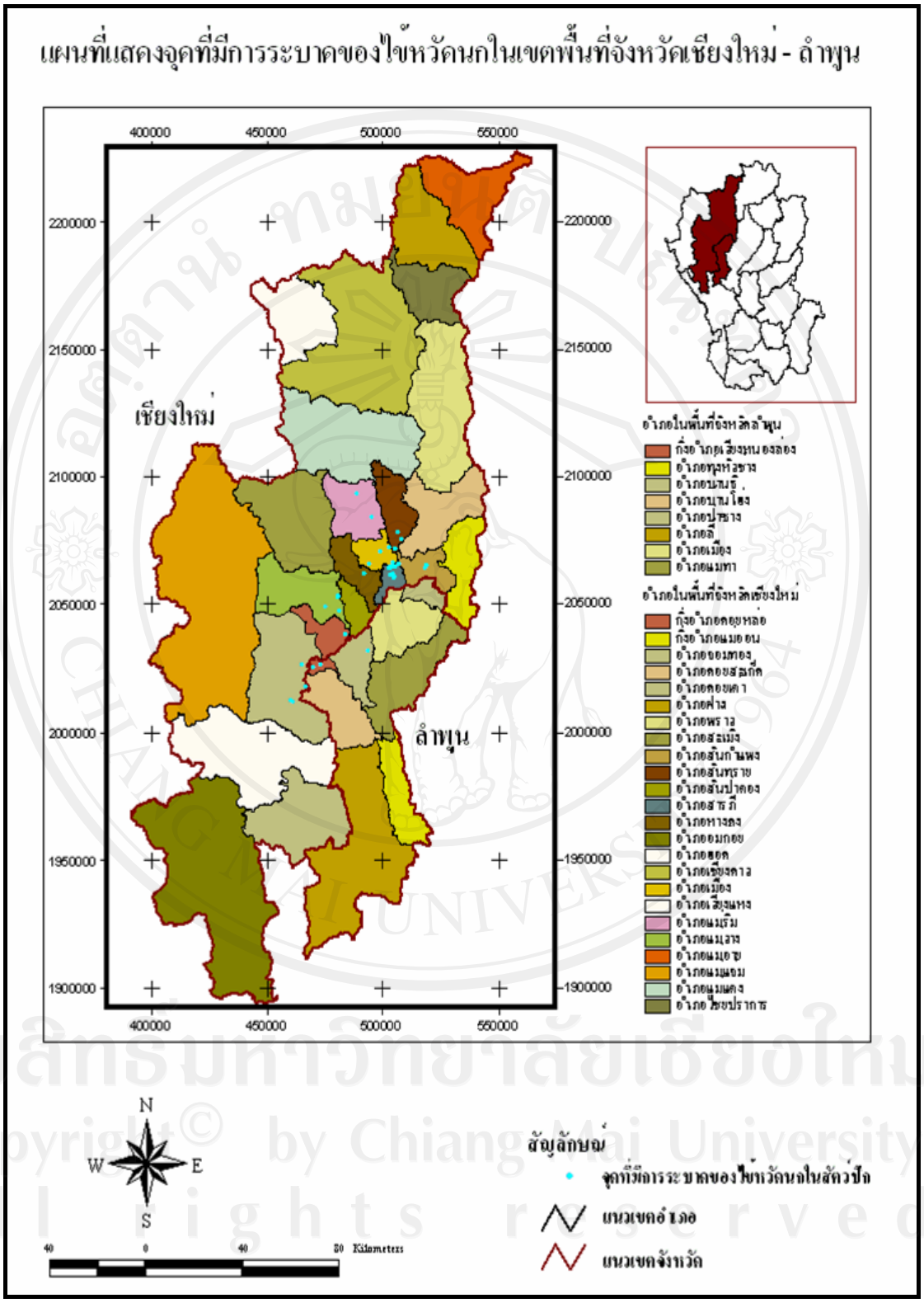


Figure 18: Point map showing the location of avian influenza infection areas in Chiang Mai-Lamphun

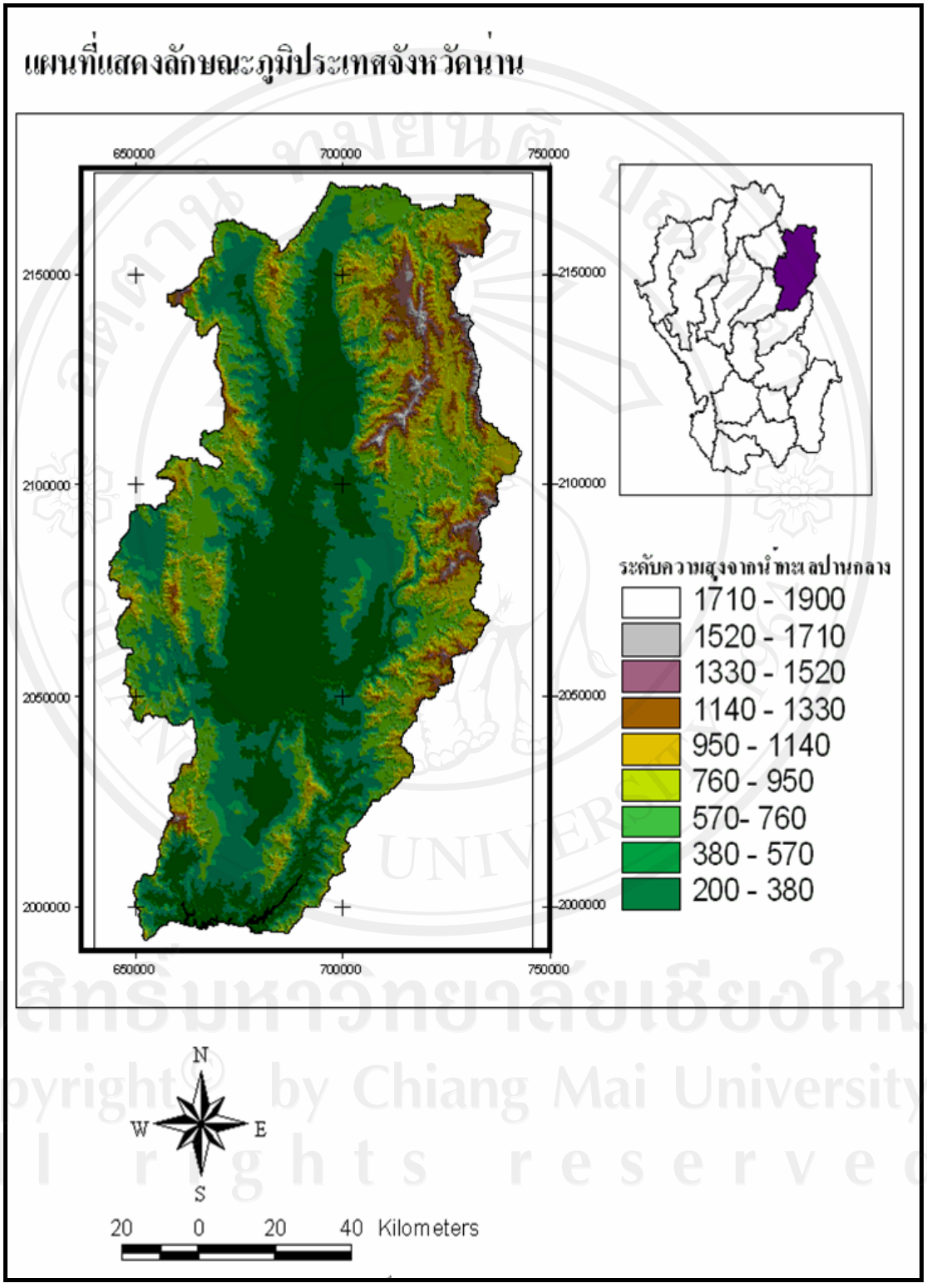


Figure 19: The elevation map of Nan province

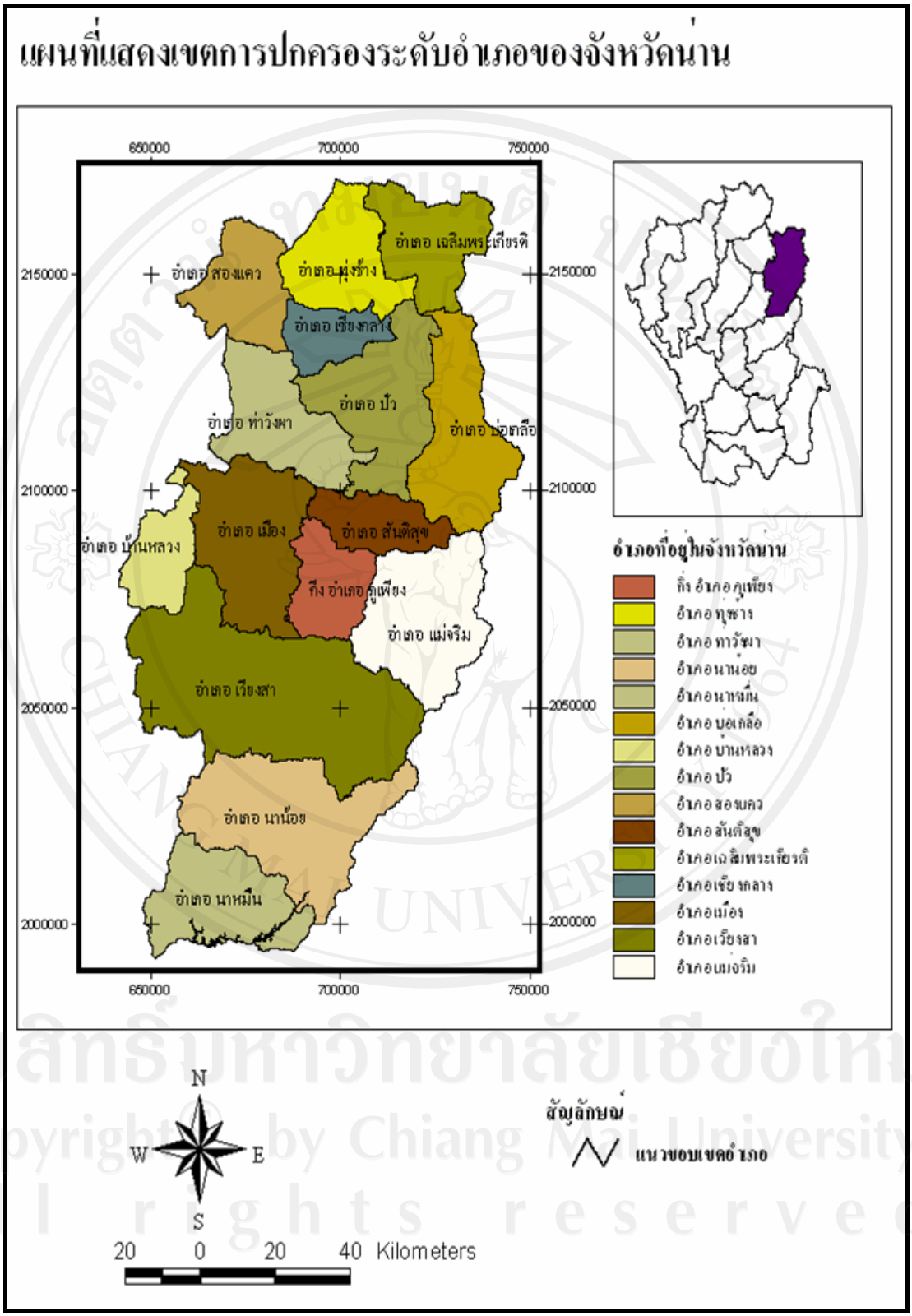


Figure 20: District boundaries of Nan province

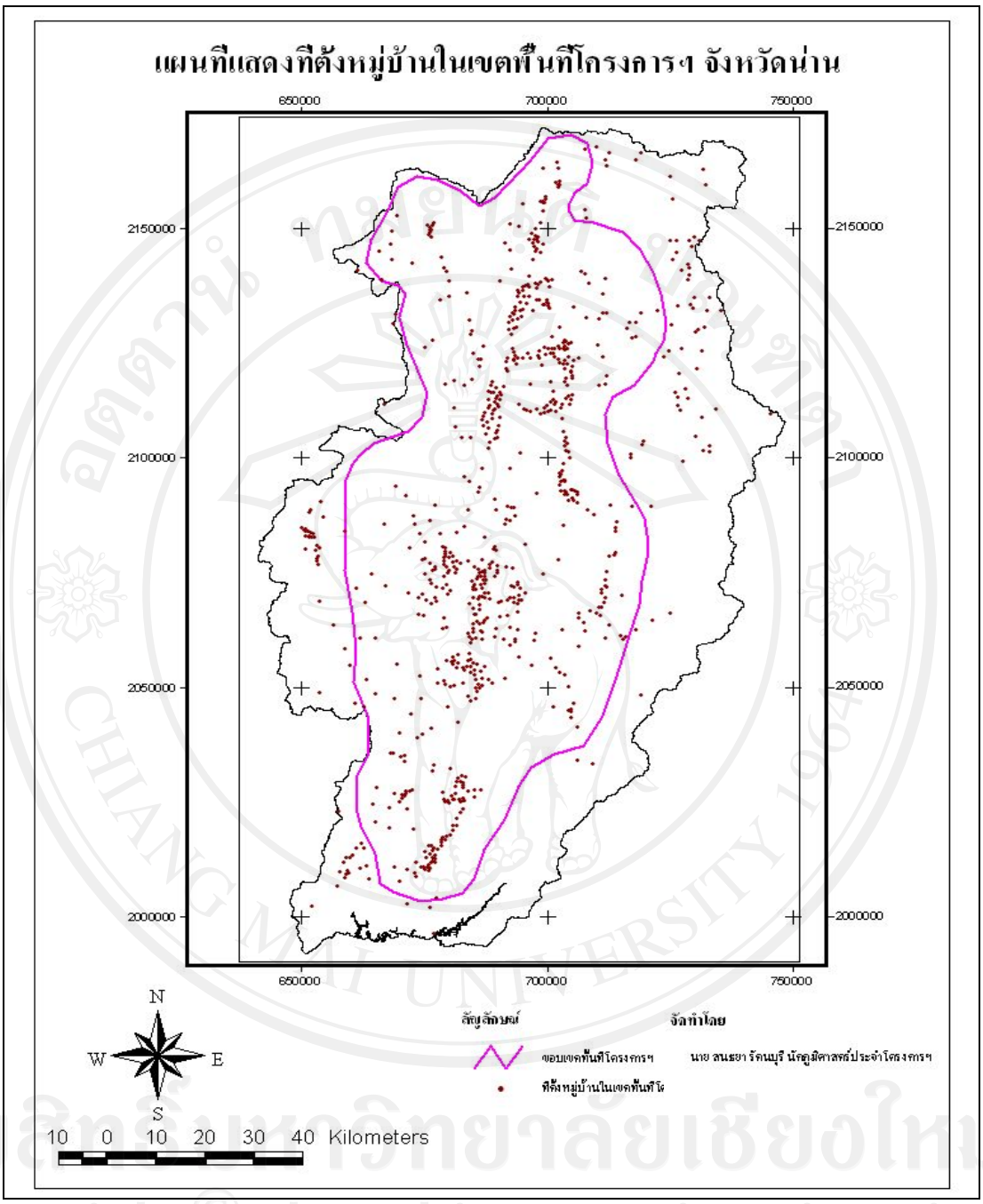


Figure 21: The point map showing the location of villages in Nan province

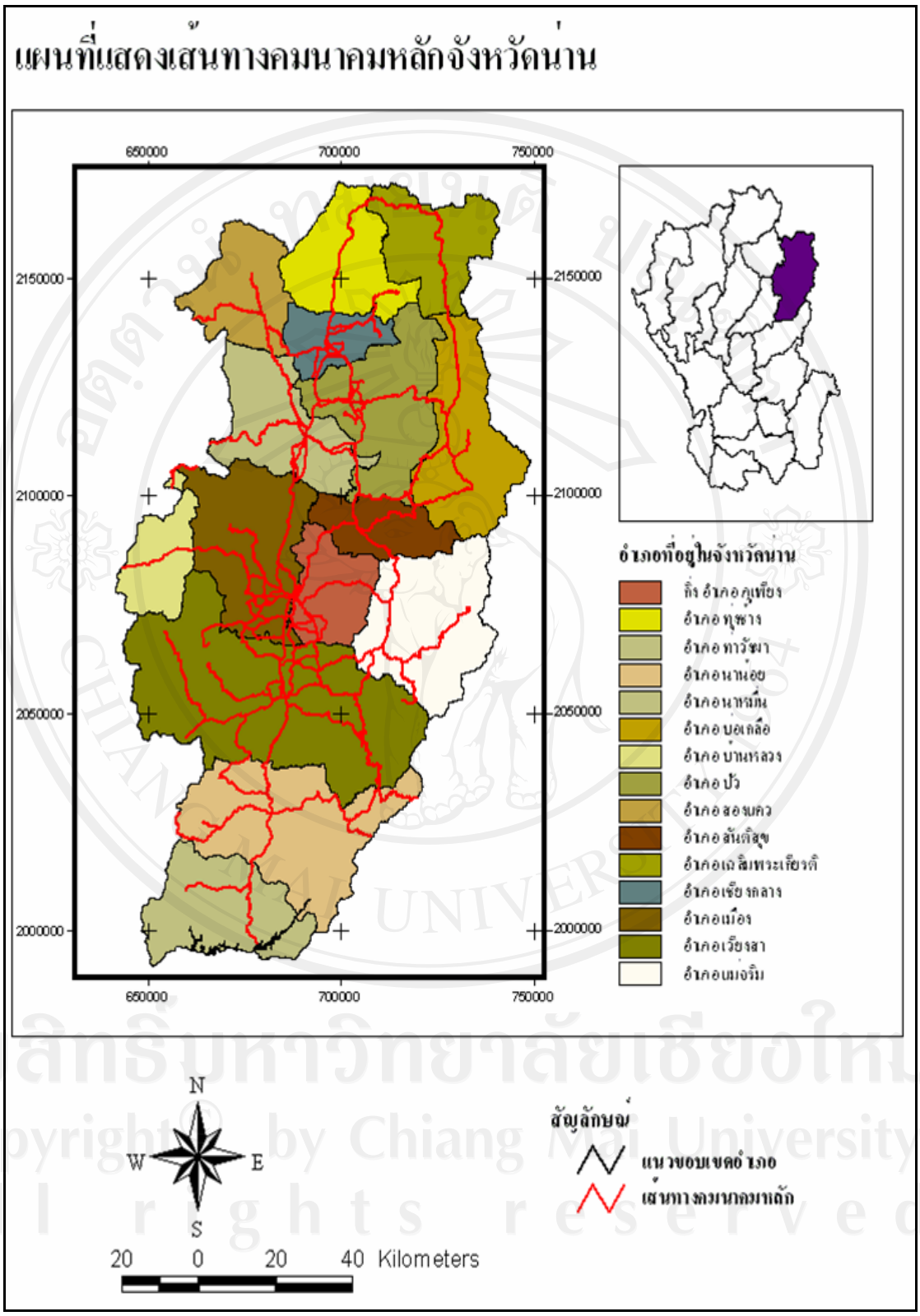


Figure 22: The main roads and their branches in Nan province

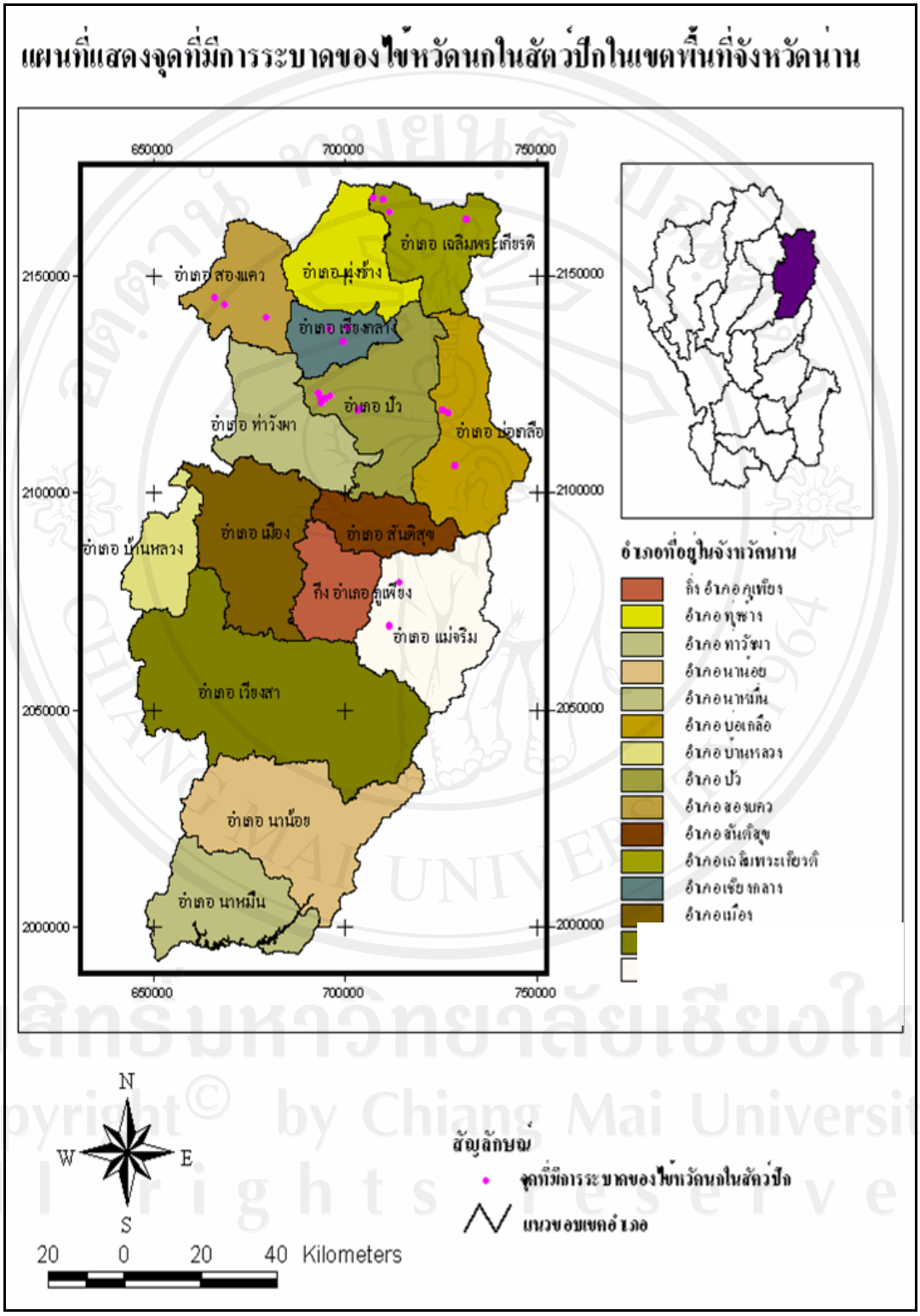


Figure 23: the point map showing the areas of avian influenza outbreak points in Nan province

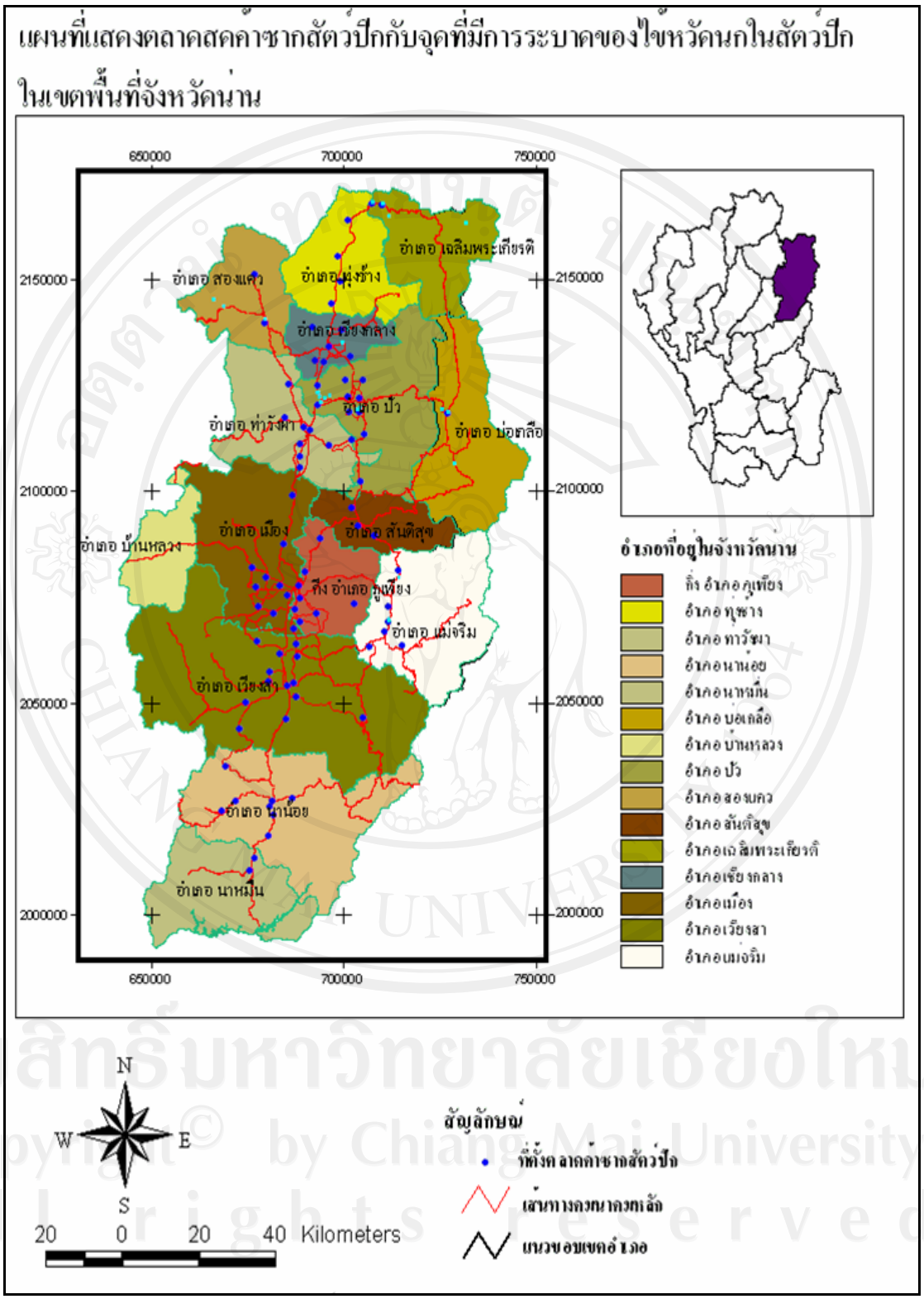


Figure 24: Point map showing the location of avian influenza outbreak areas and slaughter houses

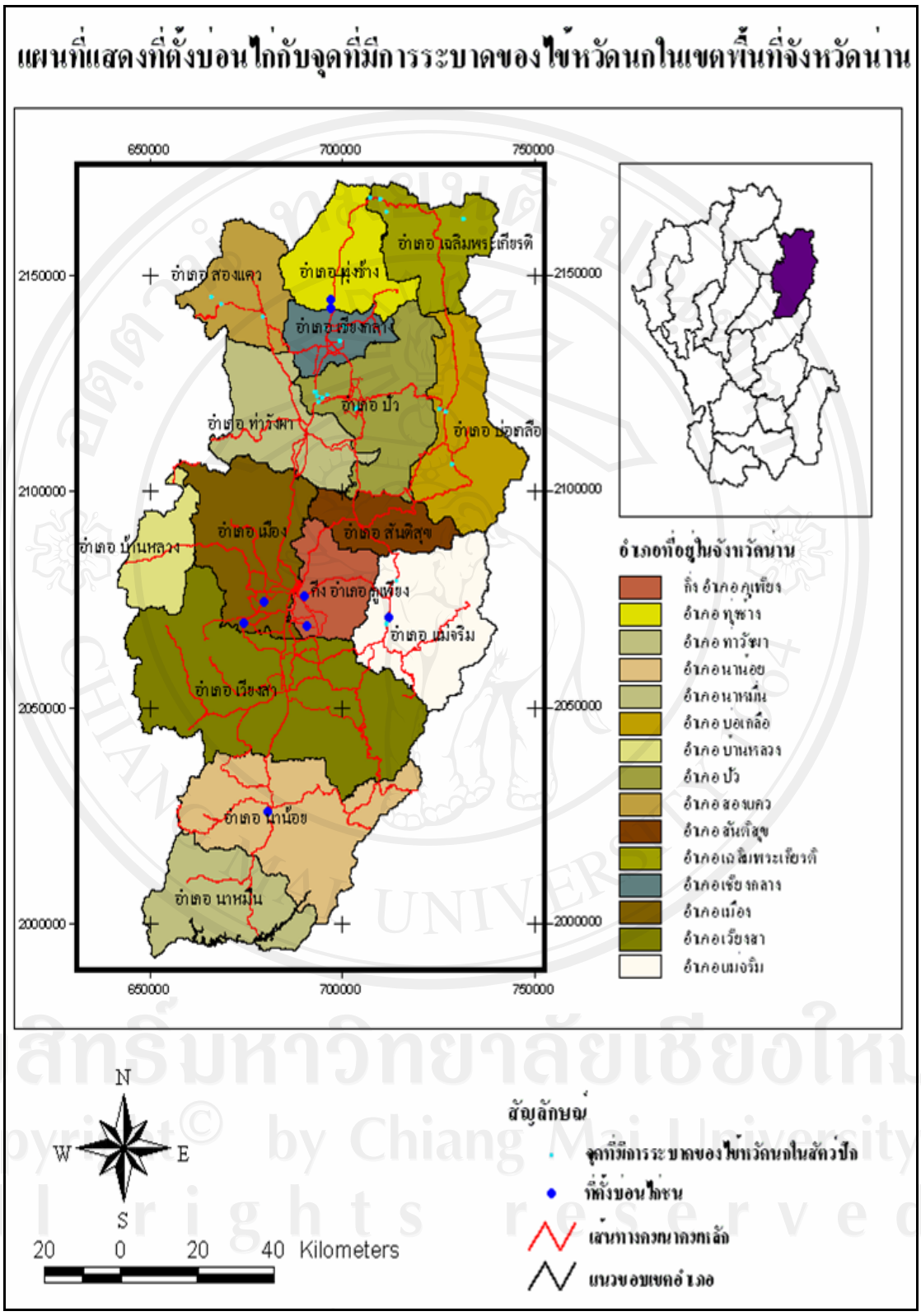


Figure 25: The point map showing the location of avian influenza outbreak areas and fighting cock places