



กรมการขนส่งทางราง

# การประชุมสัมมนาเพื่อประชาสัมพันธ์และการรับฟังความคิดเห็นของประชาชน ครั้งที่ 2

งานศึกษาเพื่อพัฒนาแบบจำลองการคาดการณ์ความต้องการเดินทางด้วยระบบรางและการพัฒนาโครงข่ายระบบขนส่งมวลชนทางรางในเขตกรุงเทพมหานครและปริมณฑล (พื้นที่ต่อเนื่อง) ระยะที่ 2

## Planning Data กับการพัฒนา Railway Demand Forecast



วันอังคารที่ 9 ถึง วันพฤหัสบดีที่ 11 พฤษภาคม 2566 (3 กลุ่ม)

โดย ดร.พีรพล สิกธีวิจารณ์ ผู้เชี่ยวชาญด้านแบบจำลองการขนส่งและจราจร



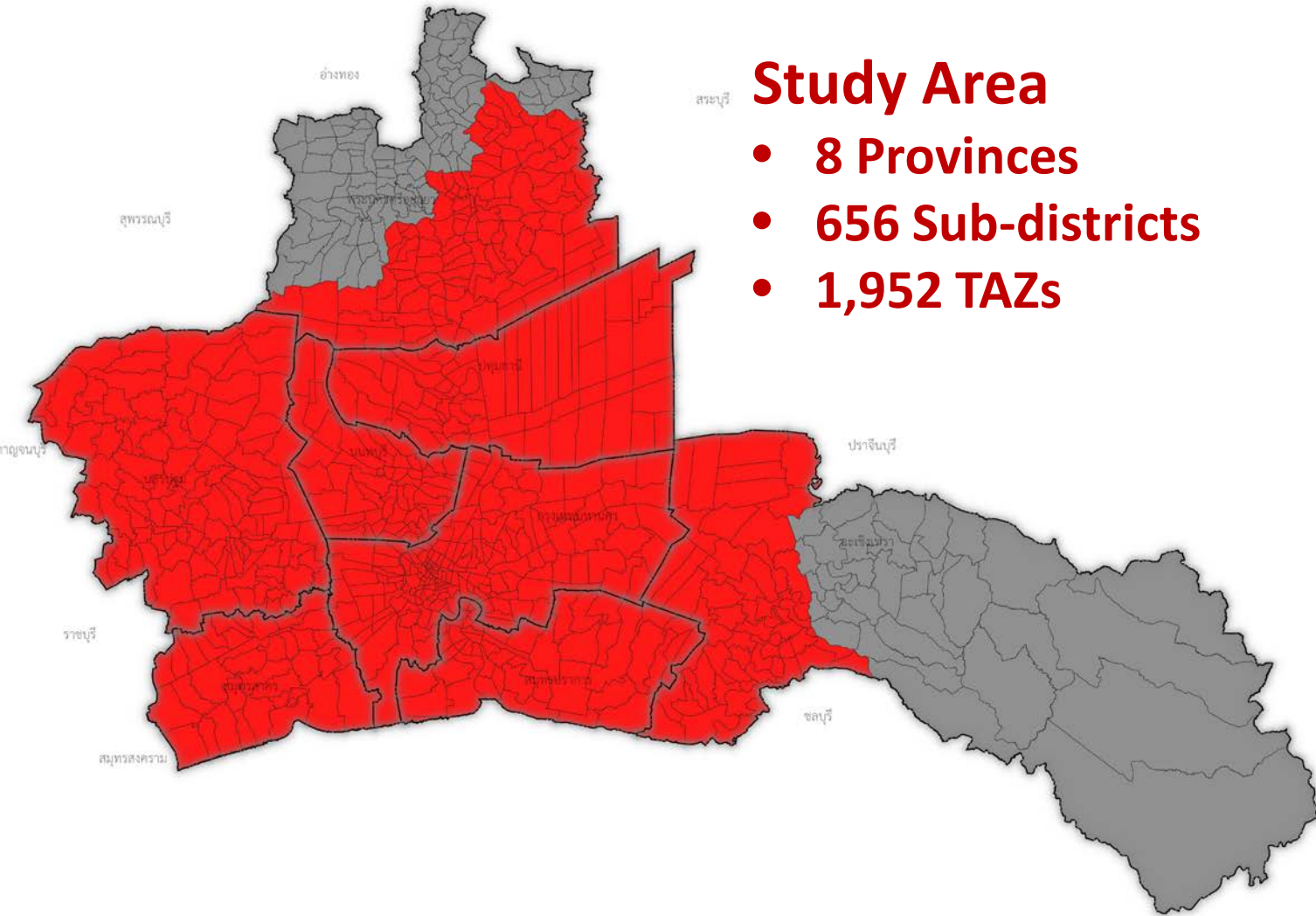


## Base-year

- **Population**
- **Student**
- **Employment**

## Future Estimation: 2020-2039

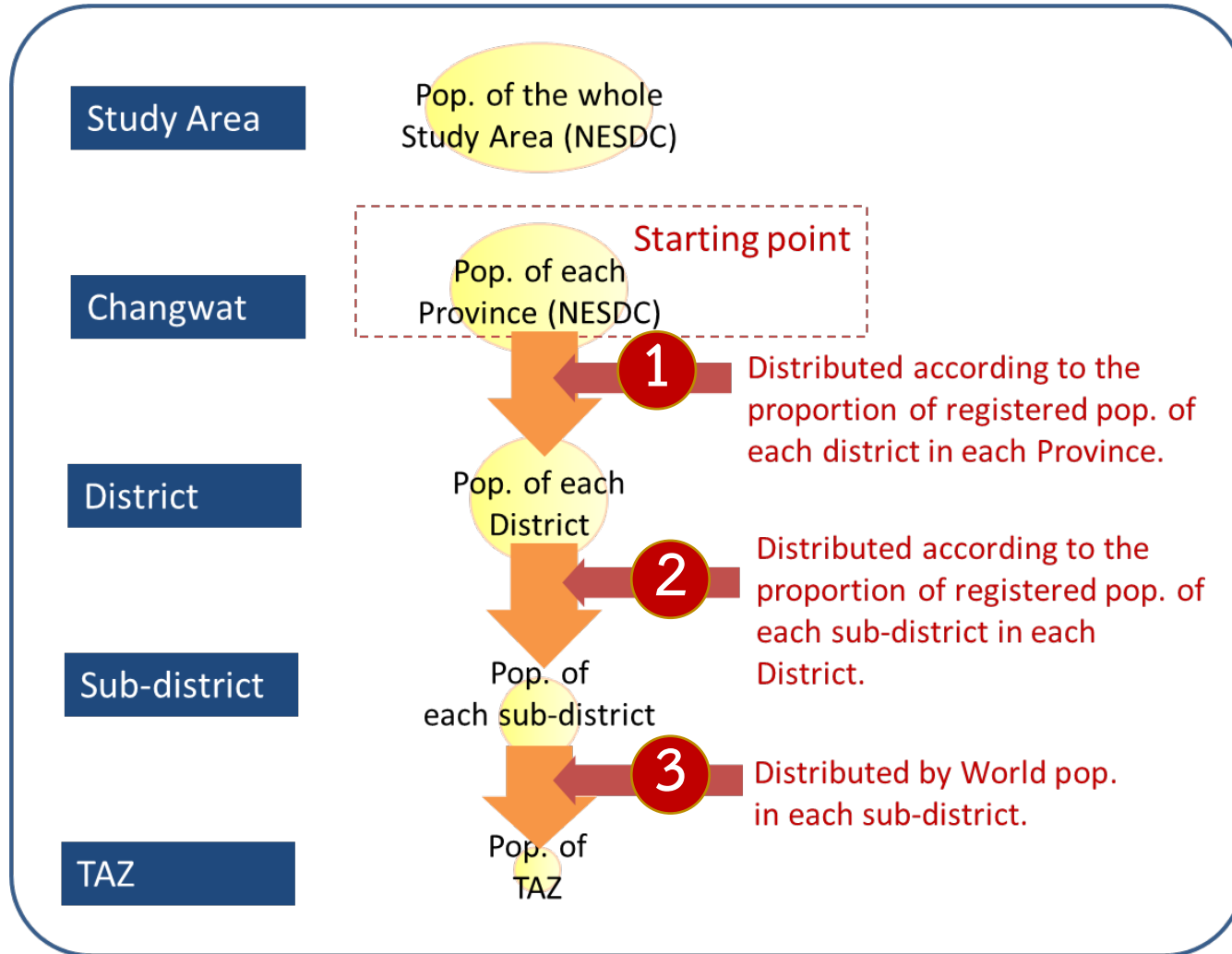
- **Population**
- **Student**
- **Employment**



	Province	No. of Sub-district	No. of TAZs
1	Bangkok	180	1,004
2	Samuth Prakarn	50	172
3	Nonthaburi	52	203
4	Pathumthani	60	188
5	Nakhorn Prathom	106	191
6	Samuth Sakorn	40	86
7	Phra Nakorn Sri Ayuthaya	110/209	69
8	Chacheongsao	58/93	39
	<b>TOTAL</b>	<b>656</b>	<b>1,952</b>



## Estimation Framework



**Base-year:  
2010, 2015 & 2019**

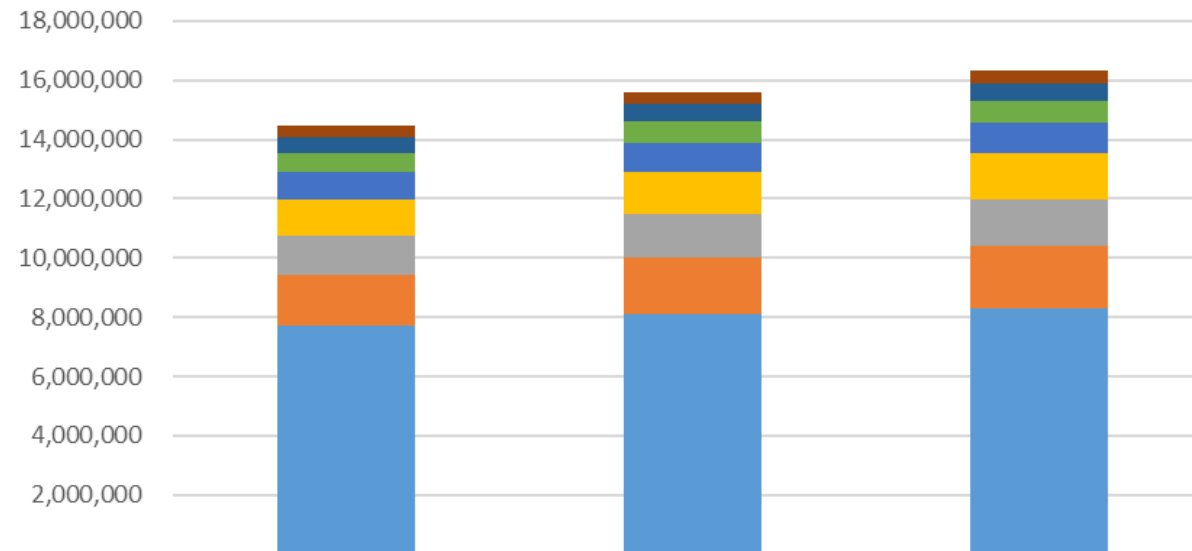
Available Data	Level	Source
Registered and Non-registered Population	Province	NESDC
Registered Population	Sub-district	NSO
Gridded Population (100 m.x100 m.)	TAZ	<a href="http://www.worldpop.org">www.worldpop.org</a>

**Status: complete**

## Registered and Non-registered Population within Study Area

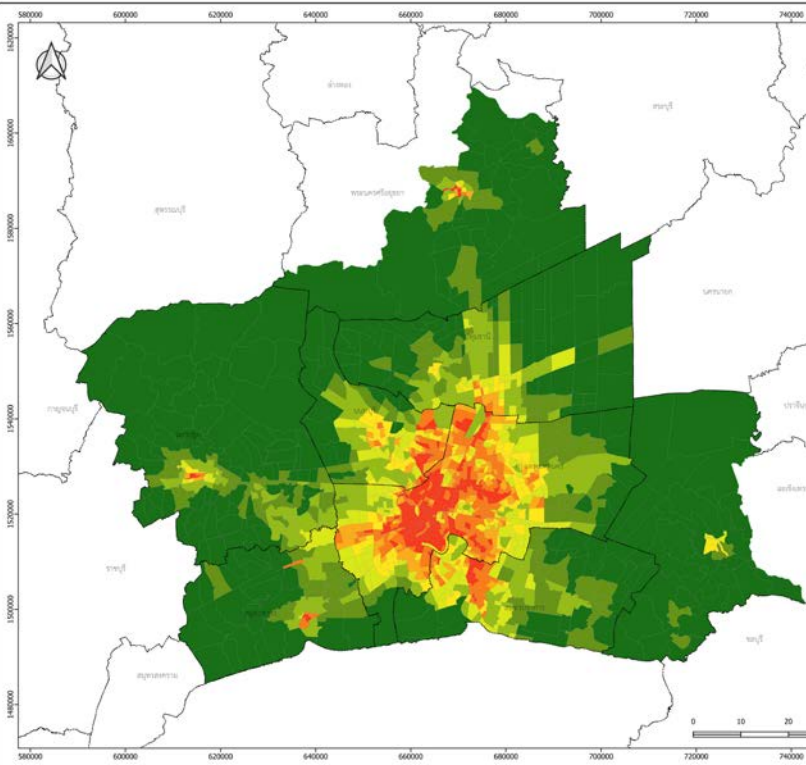
By NESDC

### Total Population within Study Area

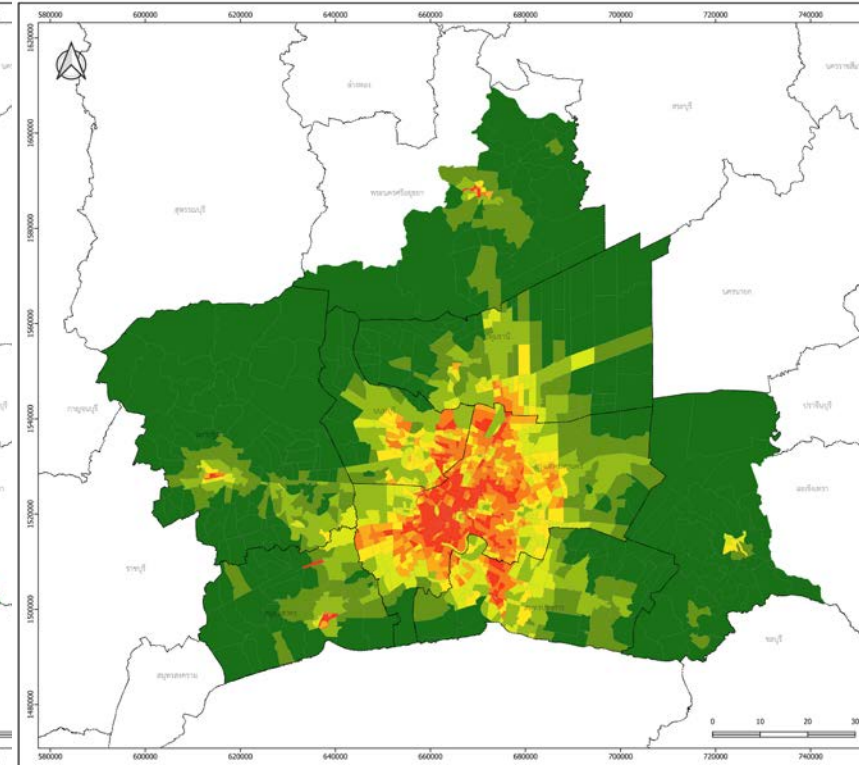


	NESDC POP 2010	NESDC POP 2015	NESDC POP 2019
Chacheongsao	382,302	414,088	434,256
Pra Nakorn Sri Ayuthaya	541,240	560,121	574,968
Samuth Sakorn	647,285	726,312	770,253
Nakorn Prathom	904,219	975,820	1,028,113
Prathumthani	1,244,635	1,423,739	1,545,064
Nonthaburi	1,304,042	1,463,953	1,583,587
Samuth Prakarn	1,736,914	1,918,361	2,075,369
Bangkok	7,691,376	8,107,418	8,318,381
	14,452,013	15,589,811	16,329,992

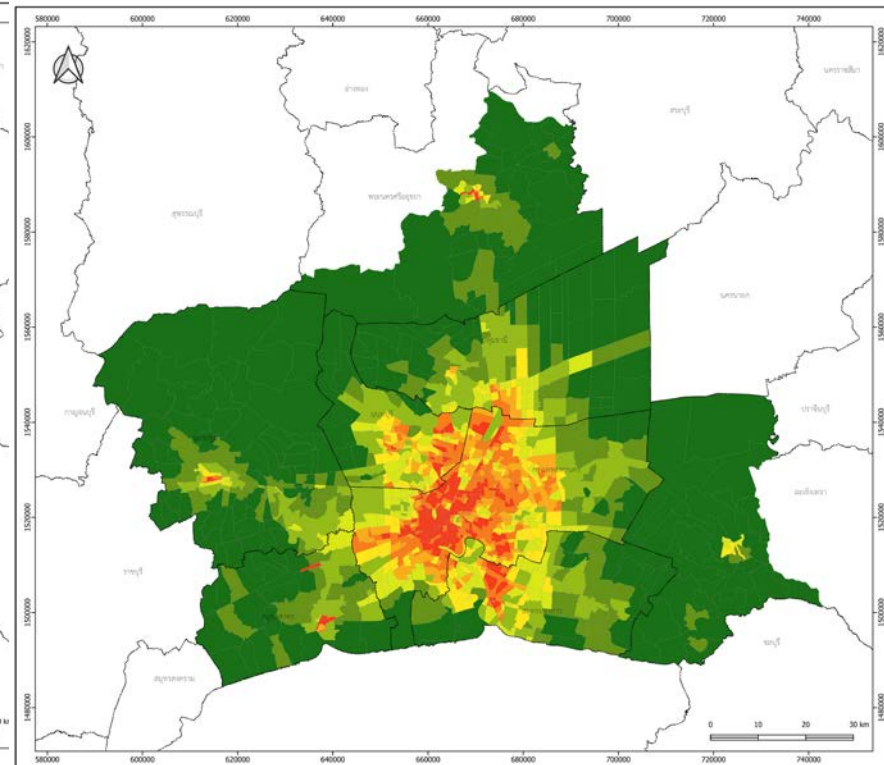
# Population Base-year



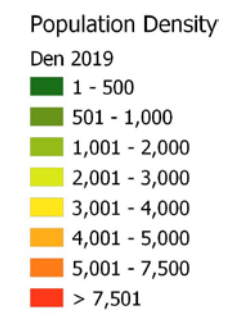
2010



2015



2019







## Framework

Base Year : 2015

Province

District

Sub-

No. of Students at all  
education levels (x,y  
coordinate)  
(NEIS + opsMHESI)



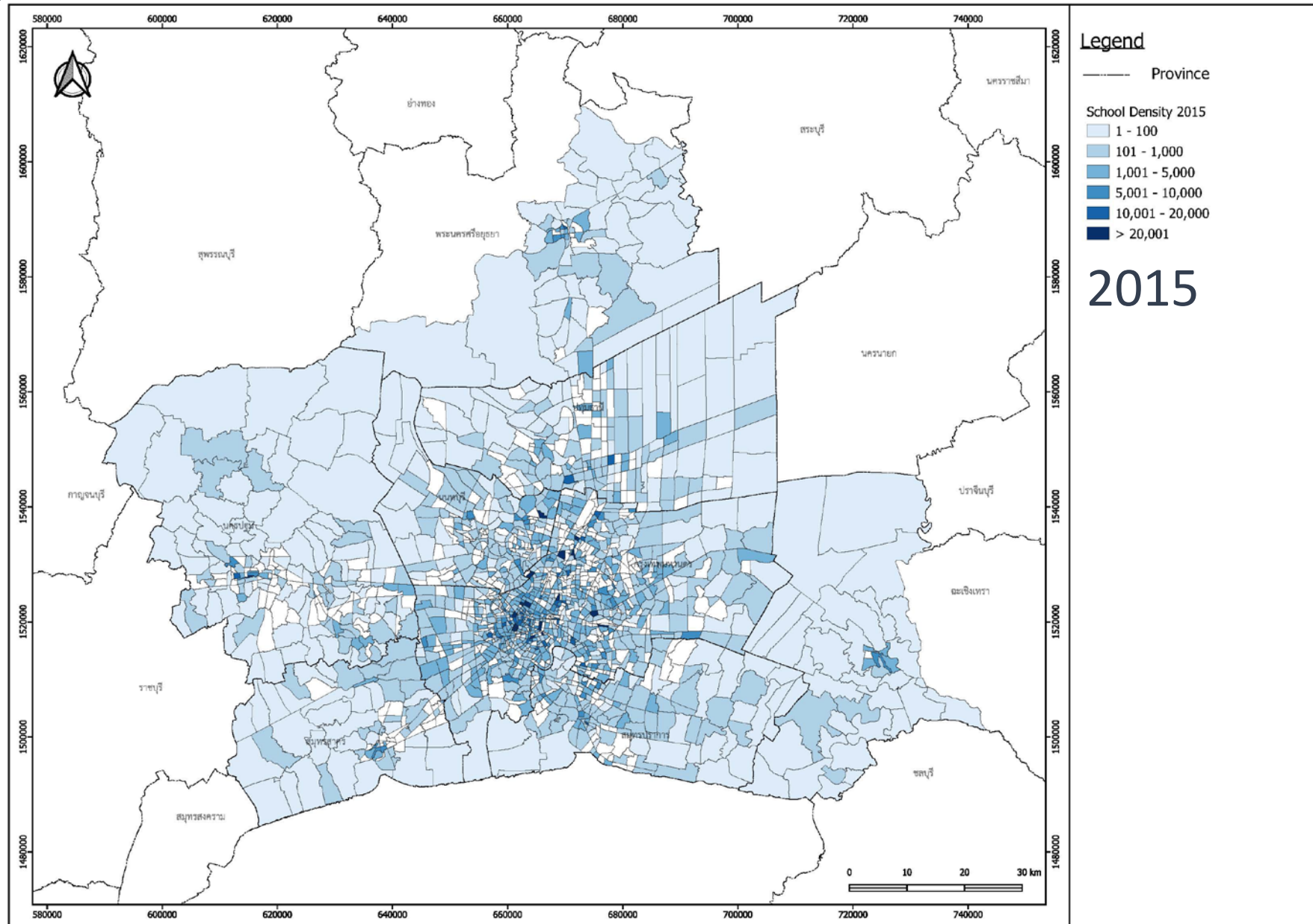
TAZ

No. of Students in  
TAZ

Province	No. of Students 2015
Bangkok	1,835,273
Samuth Prakarn	221,303
Nonthaburi	272,162
Pratumthani	297,361
Pranakorn Sri Ayuthaya	129,405
Chacheongsao	92,820
Nakorn Prathom	220,668
Samuth Sakorn	88,104
<b>Grand Total</b>	<b>3,157,096</b>

**Status: complete**

# Student Base-Year







## Base Year :

- 2015
- 2019

## 3 Sectors:

- Agriculture
- Industrial
- Service

Available Data	Level	Source	Remarks
Employment by sector (registered & non-registered) (2011, 2015 & 2019)	Province	NSO	Use as control number
Land Use (varies 2015-2021)	TAZ	LDD	collected at different time frames, and has many errors esp. industrial uses
Industrial Employment (registered only) (2015 & 2019)	TAZ	DIW	incomplete x,y coordinate, needs correction

**Status: complete**

## Employment by Sector

By NSO

2011

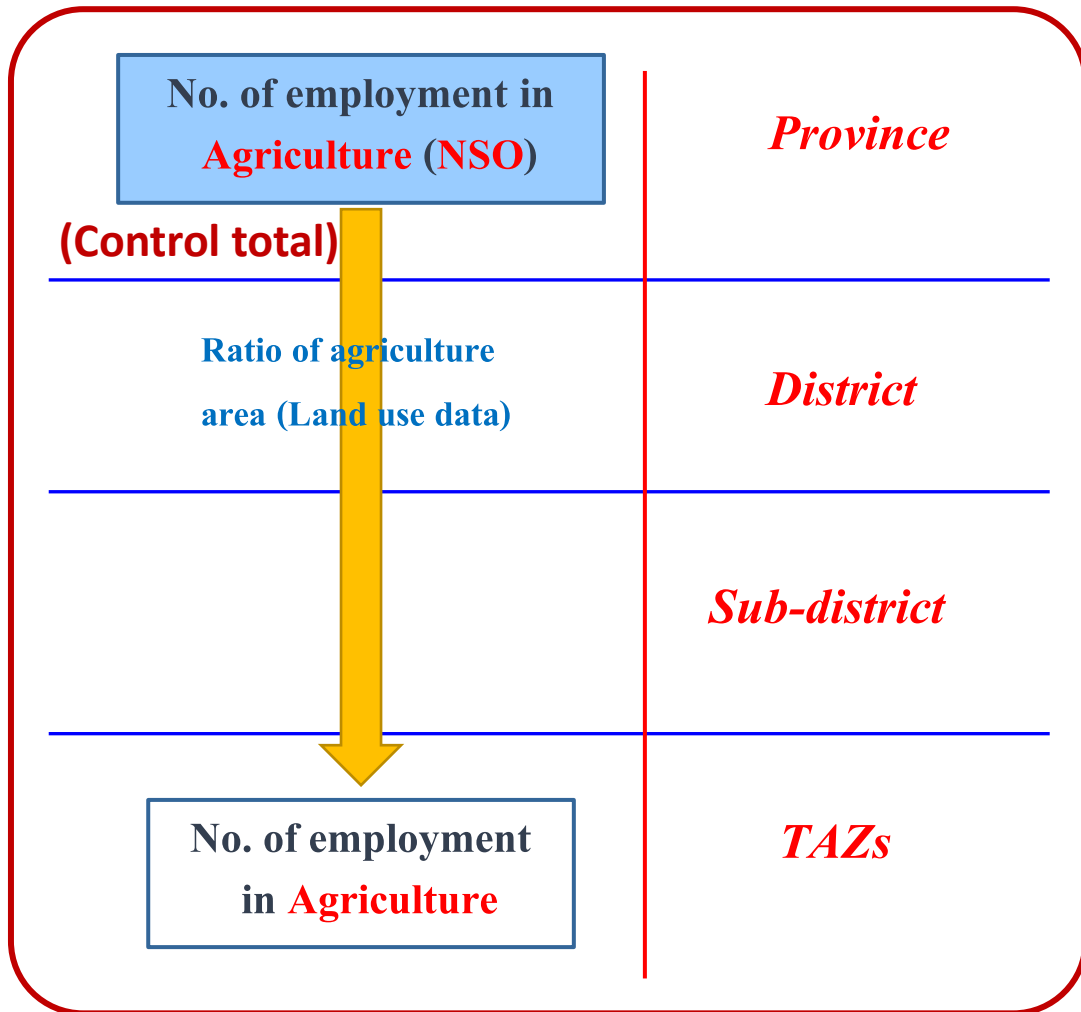
2015

2019

SECTOR	2011								2015								2019							
	กทม.	สมุทรปราการ	นนทบุรี	ปทุมธานี	นครศรีธรรมราช	ฉะเชิงเทรา	นครปฐม	สมุทรสาคร	กทม.	สมุทรปราการ	นนทบุรี	ปทุมธานี	นครศรีธรรมราช	ฉะเชิงเทรา	นครปฐม	สมุทรสาคร	กทม.	สมุทรปราการ	นนทบุรี	ปทุมธานี	นครศรีธรรมราช	ฉะเชิงเทรา	นครปฐม	สมุทรสาคร
<b>TOTAL</b>	<b>3,863,860</b>	<b>778,552</b>	<b>521,614</b>	<b>492,460</b>	<b>427,591</b>	<b>405,415</b>	<b>584,663</b>	<b>361,331</b>	<b>5,298,088</b>	<b>1,291,064</b>	<b>891,414</b>	<b>900,999</b>	<b>497,447</b>	<b>425,127</b>	<b>640,029</b>	<b>686,687</b>	<b>5,270,383</b>	<b>1,352,893</b>	<b>949,273</b>	<b>935,855</b>	<b>501,017</b>	<b>435,828</b>	<b>678,701</b>	<b>705,226</b>
	17,565	24,870	19,577	45,722	68,936	126,045	143,597	37,801	40,930	14,311	28,364	59,053	47,194	106,607	112,059	20,665	18,168	21,018	25,417	45,071	46,309	87,371	122,557	59,333
1. Agriculture, forestry and fishing	17,565	24,870	19,577	45,722	68,936	126,045	143,597	37,801	40,930	14,311	28,364	59,053	47,194	106,607	112,059	20,665	18,168	21,018	25,417	45,071	46,309	87,371	122,557	59,333
	<b>1,043,517</b>	<b>442,712</b>	<b>135,026</b>	<b>212,461</b>	<b>191,696</b>	<b>137,625</b>	<b>177,481</b>	<b>202,430</b>	<b>1,582,333</b>	<b>745,677</b>	<b>240,021</b>	<b>370,357</b>	<b>240,441</b>	<b>144,595</b>	<b>248,717</b>	<b>458,711</b>	<b>1,488,880</b>	<b>742,868</b>	<b>243,693</b>	<b>345,309</b>	<b>234,603</b>	<b>172,187</b>	<b>274,008</b>	<b>441,203</b>
2. Mining and quarrying	1,869	1,242	0	0	703	0	0	1,994	5,453	918	919	839	580	628	294	5,616	1,528	408	325	317	1,660	240	361	0
3. Manufacturing	733,291	384,290	97,986	183,464	167,456	119,858	160,110	177,740	1,069,903	642,969	170,485	311,567	213,818	127,282	227,075	428,088	958,360	612,867	164,749	262,869	207,218	153,200	253,230	411,439
4. Electricity, gas, steam and air conditioning supply	7,226	1,239	8,678	578	2,272	650	1,216	645	18,988	1,223	11,774	1,336	2,106	1,279	1,919	144	21,590	1,429	8,238	2,242	1,559	2,309	1,004	1,289
5. Water supply; sewerage, waste management and remediation activities	13,388	853	338	839	2,523	1,648	1,066	1,611	12,875	1,327	1,964	1,271	661	768	522	441	26,565	2,486	1,734	2,552	1,716	2,875	829	1,281
8. Transportation and storage	287,743	55,088	28,024	27,580	18,742	15,469	15,089	20,440	475,115	99,241	54,878	55,344	23,277	14,638	18,908	24,422	480,838	125,678	68,649	77,330	22,450	13,565	18,584	27,195
	<b>2,802,778</b>	<b>310,970</b>	<b>367,011</b>	<b>234,277</b>	<b>166,959</b>	<b>141,745</b>	<b>263,585</b>	<b>121,100</b>	<b>3,674,825</b>	<b>531,076</b>	<b>623,030</b>	<b>471,589</b>	<b>209,812</b>	<b>173,926</b>	<b>279,253</b>	<b>207,311</b>	<b>3,763,335</b>	<b>589,008</b>	<b>680,162</b>	<b>545,474</b>	<b>220,105</b>	<b>176,270</b>	<b>282,137</b>	<b>204,691</b>
6. Construction	175,522	22,840	23,731	24,435	23,024	15,284	29,632	15,621	266,585	52,269	66,104	49,987	29,146	22,099	25,363	18,467	300,488	50,767	62,670	69,350	30,934	27,886	27,372	21,579
7. Wholesale and retail trade; repair of motor vehicles and motorcycle	925,147	98,318	112,643	77,444	56,303	50,668	106,947	51,072	1,186,775	181,896	189,345	162,204	62,419	58,044	115,096	86,043	1,237,165	196,354	204,477	208,094	74,687	57,604	115,105	82,812
9. Accommodation and food service activities	547,160	59,458	33,217	45,323	22,659	32,139	38,177	24,559	541,528	87,732	73,815	70,497	23,323	32,506	51,417	37,256	549,843	117,757	79,417	71,714	35,717	27,356	49,199	36,646
10. Information and communication	75,760	2,093	15,789	4,849	786	182	3,508	339	131,398	9,780	23,528	9,013	1,081	794	1,757	2,138	104,175	6,288	19,500	11,879	1,432	275	1,214	1,240
11. Financial and insurance activities	135,596	6,242	19,177	5,138	3,041	2,263	3,920	1,431	220,510	15,188	32,301	13,535	3,891	3,443	5,068	6,166	209,130	17,079	40,008	19,937	5,935	2,613	6,150	4,738
12. Real estate activities	50,695	6,784	2,520	4,621	933	835	2,359	428	92,818	18,053	10,794	5,343	1,737	991	1,982	4,100	99,648	11,915	16,397	10,312	3,615	359	2,893	3,887
13. Professional, scientific and technical activities	135,734	6,379	11,300	1,785	446	292	5,722	1,015	180,230	9,773	32,670	17,329	1,720	5,083	3,839	4,715	183,393	19,778	31,715	18,277	788	2,148	5,130	4,034
14. Administrative and support service activities	142,084	26,115	14,358	13,209	9,157	8,174	8,057	3,559	222,953	47,869	22,220	20,737	7,990	6,693	5,392	9,377	228,255	46,591	33,906	23,614	5,202	6,611	11,499	7,671
15. Public administration and defence; compulsory social security	148,861	20,904	62,745	22,201	20,734	9,905	20,273	5,349	212,173	23,645	69,329	38,389	34,743	16,168	17,660	11,322	218,060	29,926	72,964	31,047	26,974	16,438	16,210	9,028
16. Education	121,419	18,728	27,745	12,973	13,374	8,276	16,538	3,398	166,853	18,451	36,152	27,619	17,482	9,266	24,338	6,264	162,133	30,187	34,293	26,727	14,509	11,578	19,149	10,315
17. Human health and social work activities	75,579	7,766	12,227	7,548	5,731	4,831	11,727	6,427	118,798	14,809	22,526	20,718	9,290	6,052	8,118	7,690	95,650	14,776	26,436	15,188	6,311	6,964	9,193	8,192
18. Arts, entertainment and recreation	28,550	11,576	3,798	6,997	2,827	1,533	3,422	2,017	40,623	8,663	3,847	9,043	4,250	4,213	5,885	2,987	43,445	8,844	9,221	14,810	3,802	4,157	4,884	3,600
19. Other service activities	127,809	16,431	14,348	6,981	6,205	5,990	11,016	4,822	141,855	29,267	26,088	21,670	9,648	7,667	11,384	9,135	180,960	26,128	33,254	17,584	8,720	10,151	12,019	9,120
20. Activities of households as employers; undifferentiated goods and services-producing activities of households for own use	94,248	4,039	9,837	773	1,739	1,373	2,287	1,063	101,600	6,287	11,307	4,839	1,641	907	1,956	1,653	92,465	6,062	8,251	6,268	1,479	631	2,120	1,688
21. Activities of extraterritorial organizations and bodies	3,762	0	0	0	0	0	0	0	1,930	0	0	0	0	0	0	0	2,538	328	531	0	0	0	0	0
22. Unknown	14,852	3,297	3,576	0	0	0	0	0	48,200	7,392	3,003	667	1,451	0	0	0	55,990	6,227	7,124	672	0	1,501	0	140



### Estimation Framework

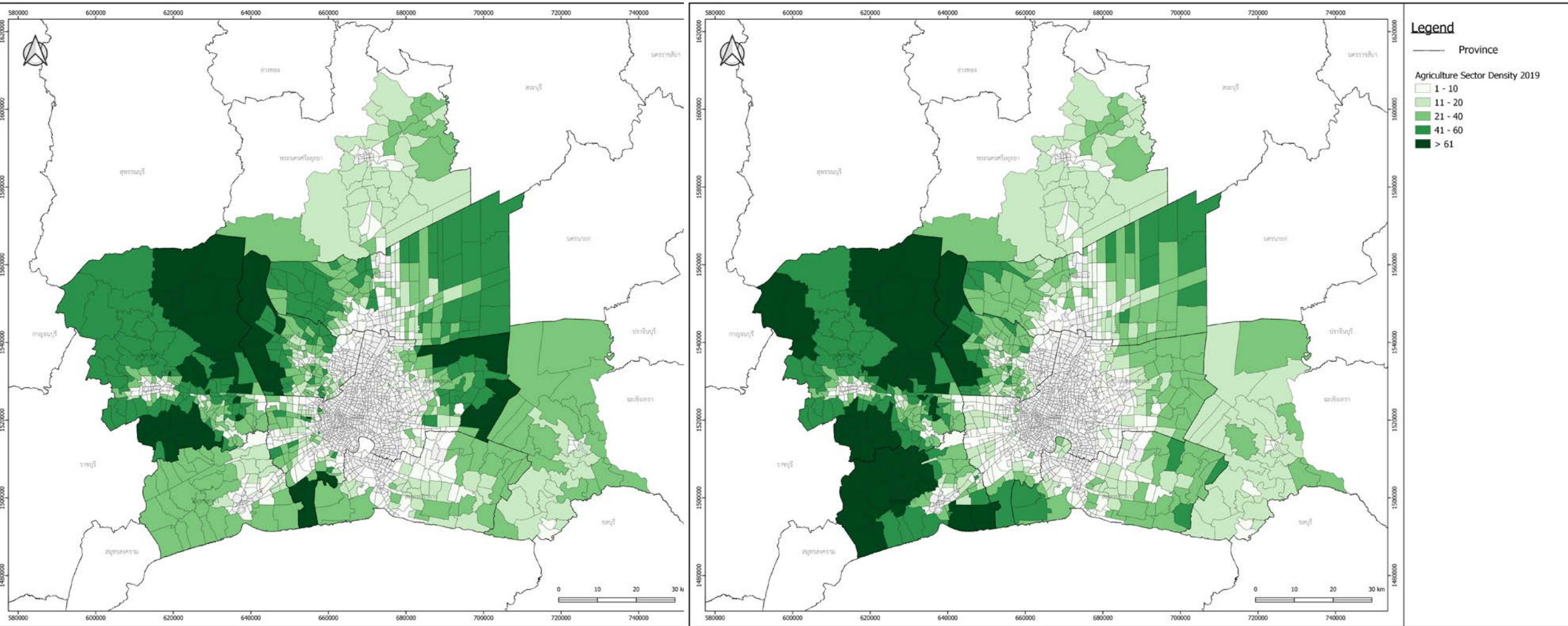


### Base Year :

- 2015
- 2019

Province	NSO Employment in Agriculture		Annual Growth
	2015	2019	
Bangkok	40,930	18,167	-18.38%
Samuth Prakarn	14,310	21,018	10.09%
Nonthaburi	28,364	25,417	-2.71%
Pathumthani	59,053	45,071	-6.53%
Pra Nakorn Sri Ayuthaya	25,884	24,764	-1.10%
Chacheongsao	29,938	24,455	-4.93%
Nakorn Prathom	112,059	122,557	2.26%
Samuth Sakorn	20,665	59,332	30.17%
<b>TOTAL in Study Area</b>	<b>331,203</b>	<b>340,782</b>	<b>0.72%</b>

**Status: complete**

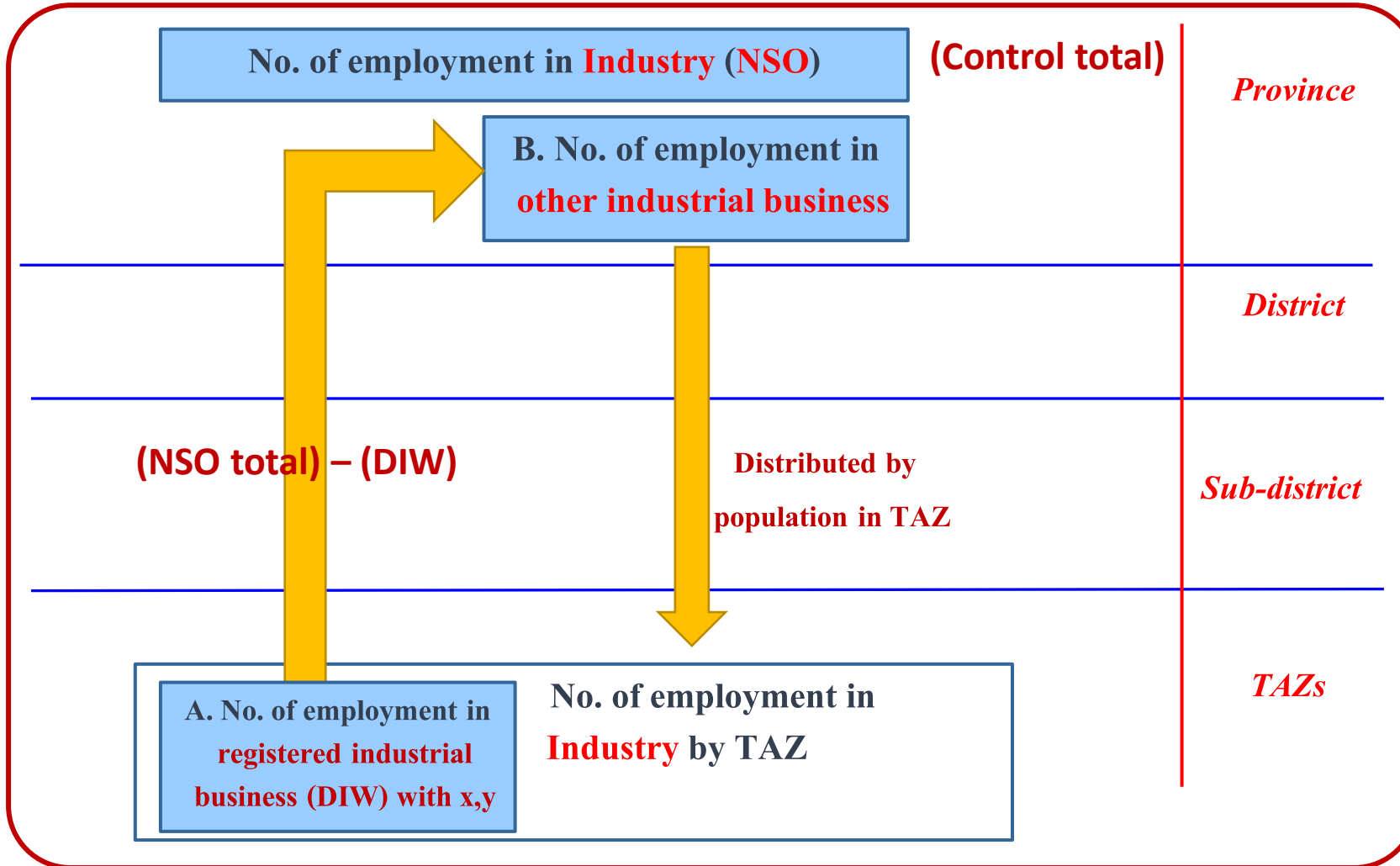


2015

2019



### Estimation Framework



**Base Year :**

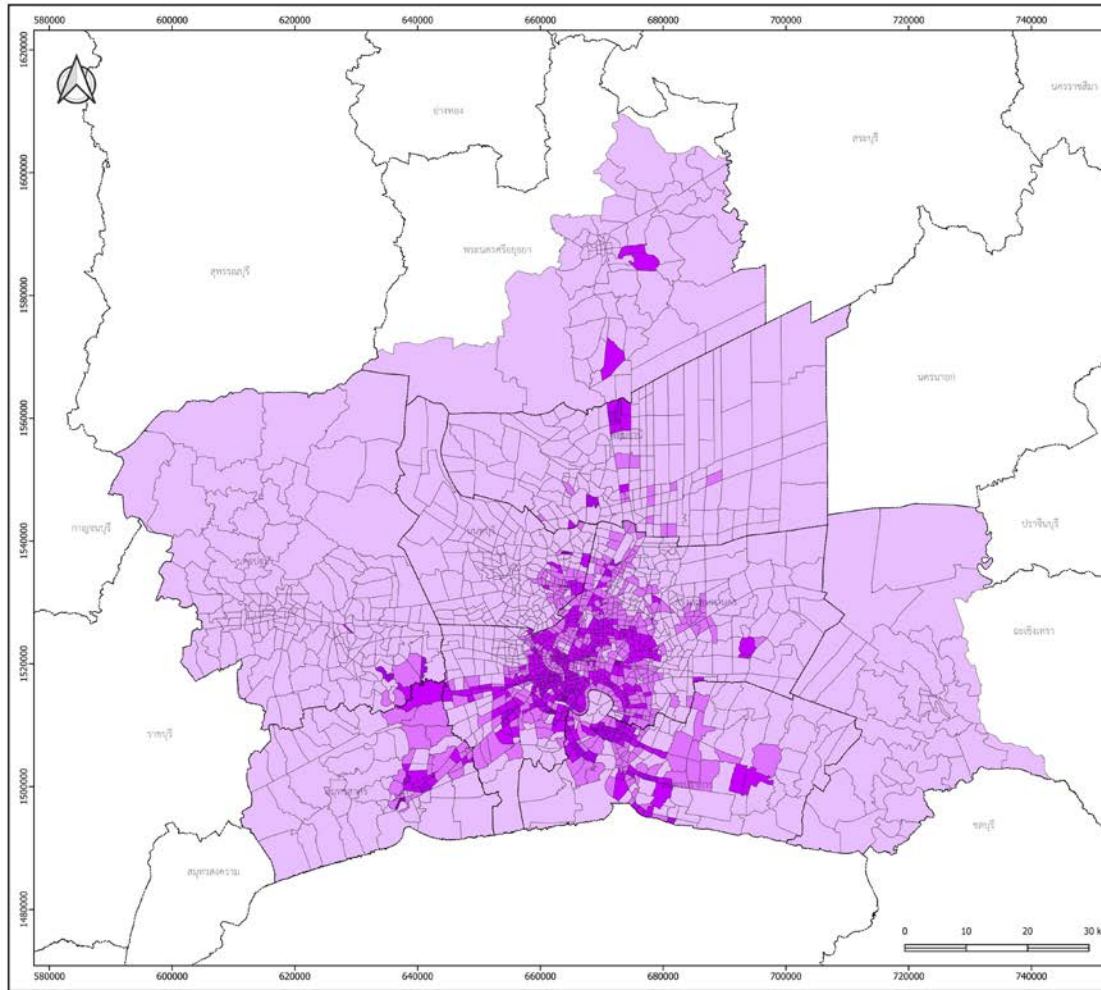
- 2015
- 2019

**Status: complete**

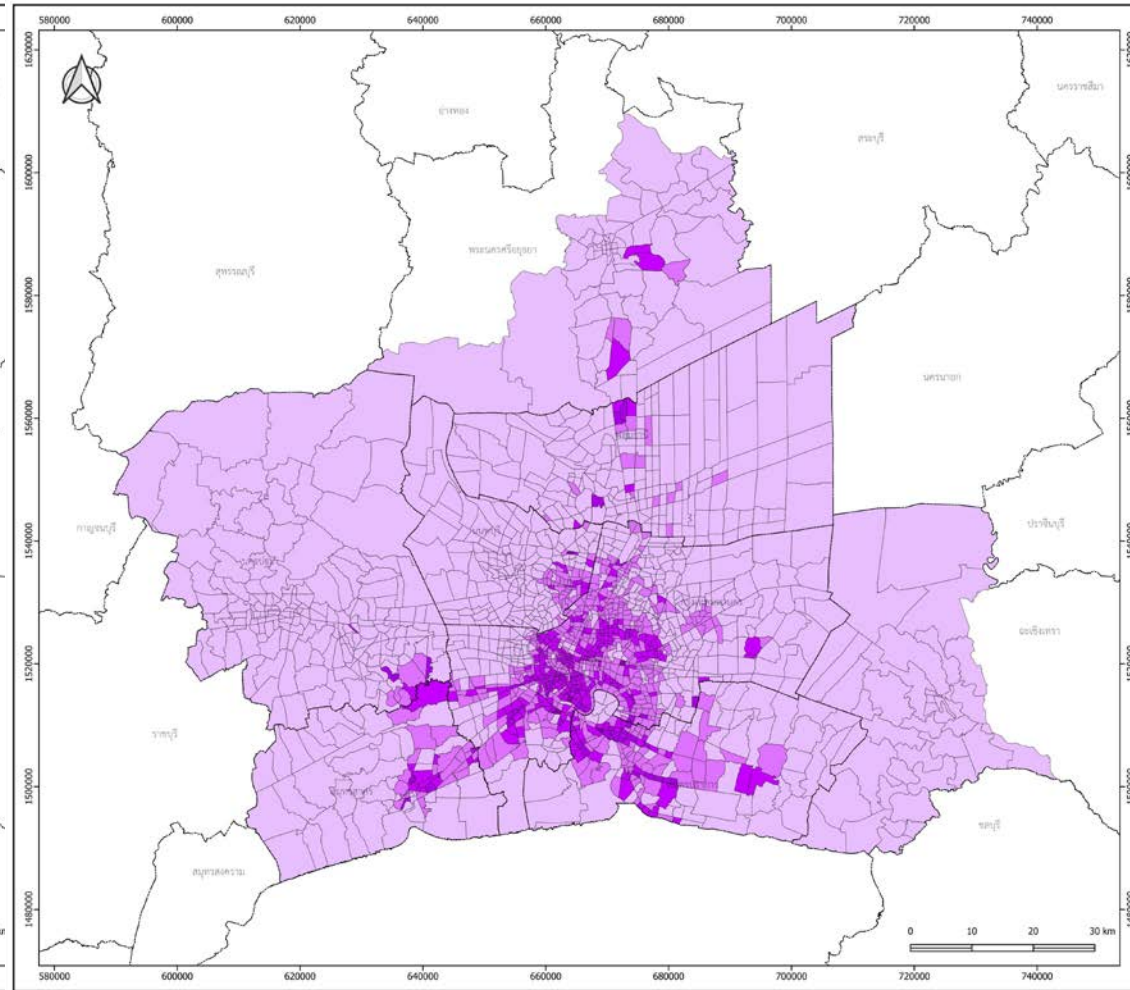


Province	2015			2019			Annual Growth Rate
	Employment in registered business (DIW)	Employment in other industrial business	TOTAL Employment in Industrial Sector	Employment in registered business (DIW)	Employment in other industrial business	TOTAL Employment in Industrial Sector	
Bangkok	528,346	1,053,993	1,582,339	500,379	988,508	1,488,887	-1.51%
Samuthprakarn	493,916	251,771	745,687	468,272	274,606	742,878	-0.09%
Nonthaburi	82,577	157,435	240,012	75,730	167,963	243,693	0.38%
Pratumthani	228,261	142,105	370,366	235,685	109,624	345,309	-1.74%
Pra Nakorn Sri Ayuthaya	195,153	12,453	207,606	207,184	-	207,184	-0.05%
Chachoengsao	119,280	2,957	122,237	106,242	22,301	128,543	1.27%
Nakorn prathom	161,631	86,971	248,602	171,192	102,701	273,893	2.45%
Samuthsakorn	325,677	133,149	458,826	351,203	90,114	441,317	-0.97%
<b>TOTAL in study Area</b>	<b>2,134,841</b>	<b>1,840,834</b>	<b>3,975,675</b>	<b>2,115,887</b>	<b>1,755,818</b>	<b>3,871,705</b>	<b>-0.66%</b>





2015



2019

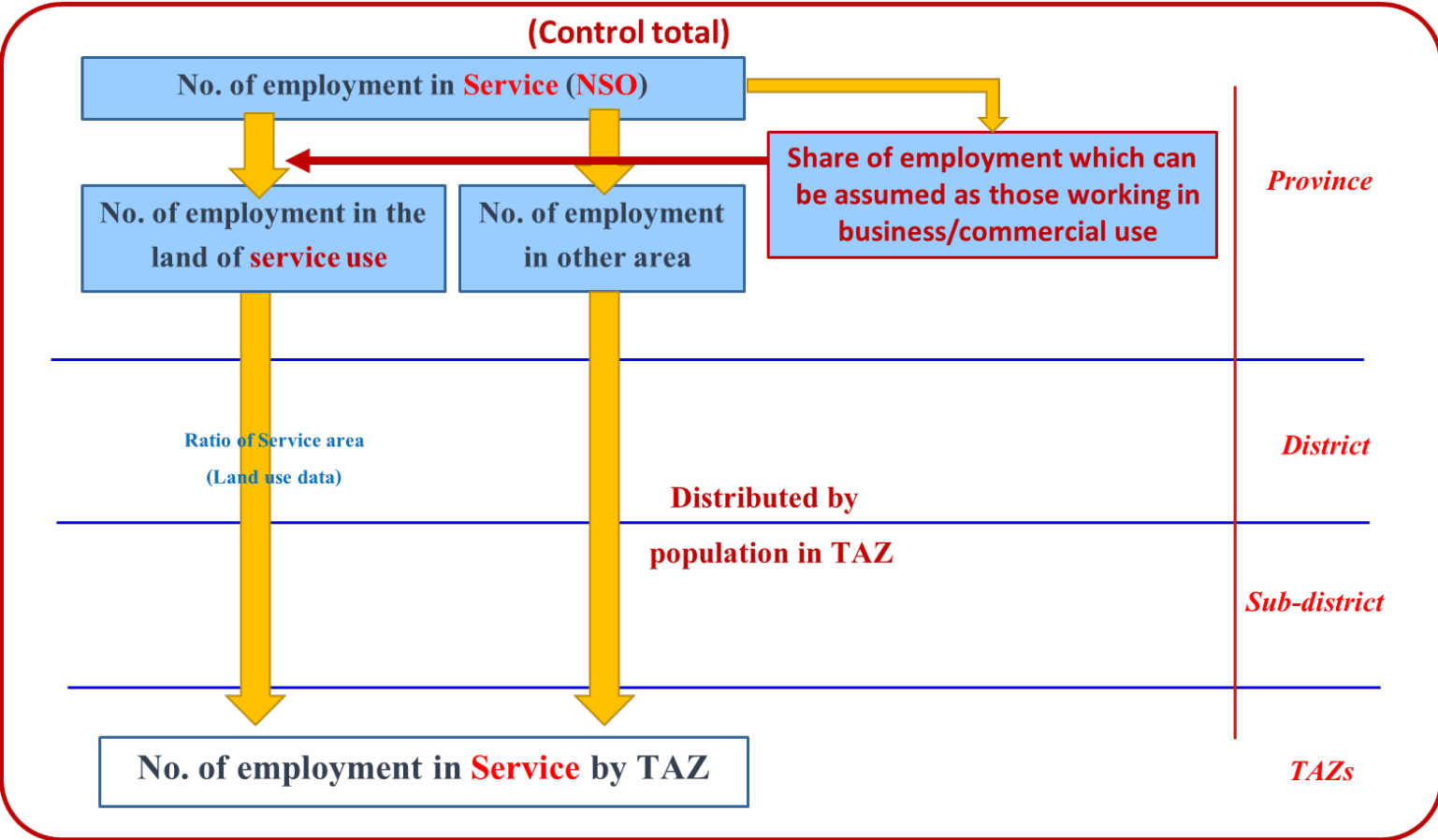
- Legend**
- Province
  - Industrial Density 2019
    - 1 - 1,000
    - 1,001 - 2,000
    - 2,001 - 4,000
    - 4,001 - 8,000
    - > 8,001



### Estimation Framework

Base Year :

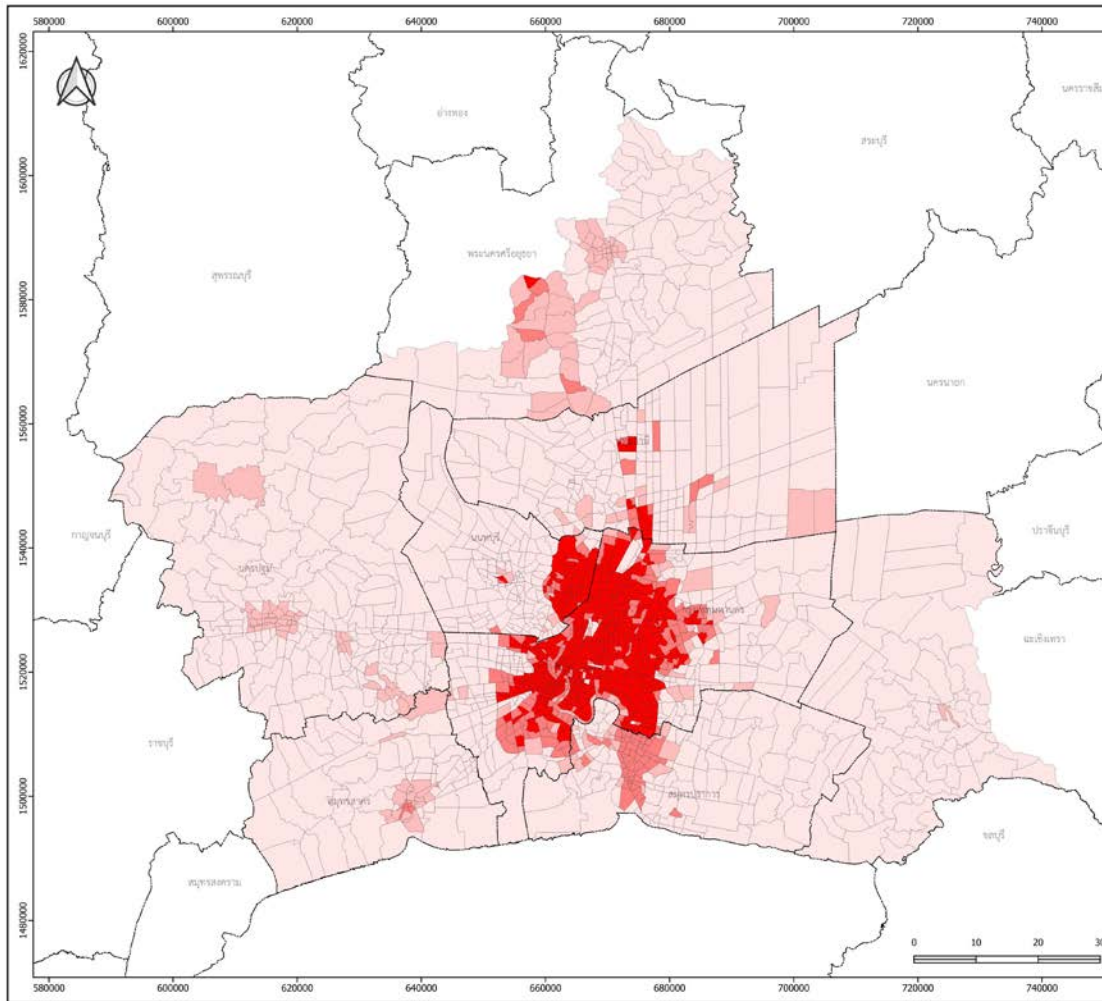
- 2015
- 2019



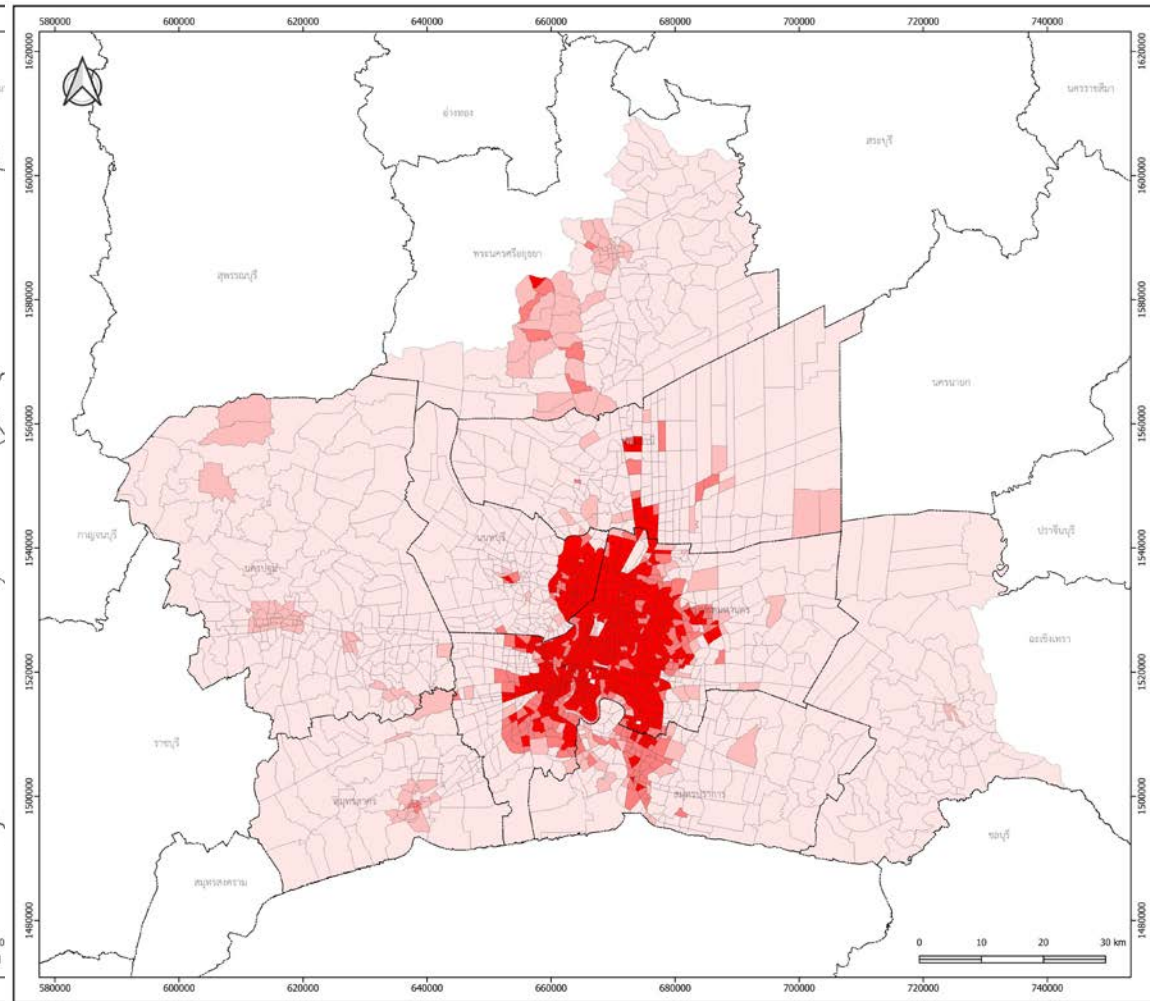
**Status: complete**



Province	2015			2019			Annual Growth Rate
	Employment in Service Land Use	Employment in Other Land Uses	TOTAL Employment in Service Sector	Employment in Service Land Use	Employment in Other Land Uses	TOTAL Employment in Service Sector	
Bangkok	3,258,202	418,315	3,676,517	3,313,577	451,480	3,765,057	0.60%
Samuth Prakarn	465,129	65,948	531,076	525,625	63,383	589,008	2.62%
Nonthaburi	542,615	80,415	623,030	601,586	78,576	680,162	2.22%
Pathumthani	453,920	55,493	509,412	510,983	76,290	587,273	3.62%
Pra Nakorn Sri Ayuthaya	673,102	18,669	691,771	702,512	18,757	721,268	1.05%
Chacheongsao	126,522	12,632	139,154	121,114	16,502	137,616	-0.28%
Nakorn Prathom	328,524	27,318	355,842	431,839	29,492	461,330	6.71%
Samuth Sakorn	187,191	20,120	207,311	181,284	23,407	204,690	-0.32%
<b>TOTAL in Study Area</b>	<b>6,035,204</b>	<b>698,910</b>	<b>6,734,114</b>	<b>6,388,519</b>	<b>757,886</b>	<b>7,146,405</b>	<b>1.50%</b>



2015



2019

### Legend

Province

Service Sector Density 2019

- 1 - 1,000
- 1,001 - 2,500
- 2,501 - 5,000
- 5,001 - 10,000
- > 10,001





## Future Estimation: 2020-2040

- **Population**
- **Student**
- **Employment**

Available Data	Level	Source	Remarks
Population Forecast by Age Group (2010-2040)	Province	NESDC	<ul style="list-style-type: none"><li>• Use as control number or control growth rate</li></ul>
Employment by Sector (2017-2037) BMR plan (BKK & Vicinities)	Province	DPT	<ul style="list-style-type: none"><li>• Use as control growth rate</li><li>• Can only be applied for BKK and 5 surrounding provinces except Ayuthaya &amp; Chacheongsao</li></ul>



## Assumptions for future population framework

Control Total  
: Pop. by province (P)



Step 1:  
Pop by province  
without urban dev.  
Project (P')



Step 2:  
Pop by sub-district



Step 3:  
Pop by TAZ

Growth Trend  
by sub-district

Growth Trend  
by TAZ

- NESDC's Population Forecast as control population number (2025, 2030, 2035, 2040)
- **New large development projects** impact population growth within the province they are located (their impacts are larger than at district level)
- **Future railway stations** impact population growth by sub-district they are located (with TOD concept (500-1000 m. radius), their impacts are at sub-district)
- **Comprehensive Plan:** No increase growth rate on sub-district designated as Agricultural Zone (Green Zone)
- **New large development projects** increase population growth in TAZs they are located directly





## *NESDC's Population Forecast*

Control Total  
: Pop. by province (P)

- Total population by province, by age group, by registered and non-registered
- 2019 to 2040 each year



1. Calculate **expected population increase of large scale urban development projects in 2025 (X)**
2. Subtract X from **total provincial pop** 2025, 2030, 2035, & 2040 (Y)
3. Provincial Pop. (as a control) in 2025, 2030, 2035, & 2040 (P')

Step 1:  
Pop by province  
without urban dev.  
Project (P')

Assuming that population increase in those new urban development project is totally different from pop growth trend and pop increase by railway.

# Step to prepare future population framework

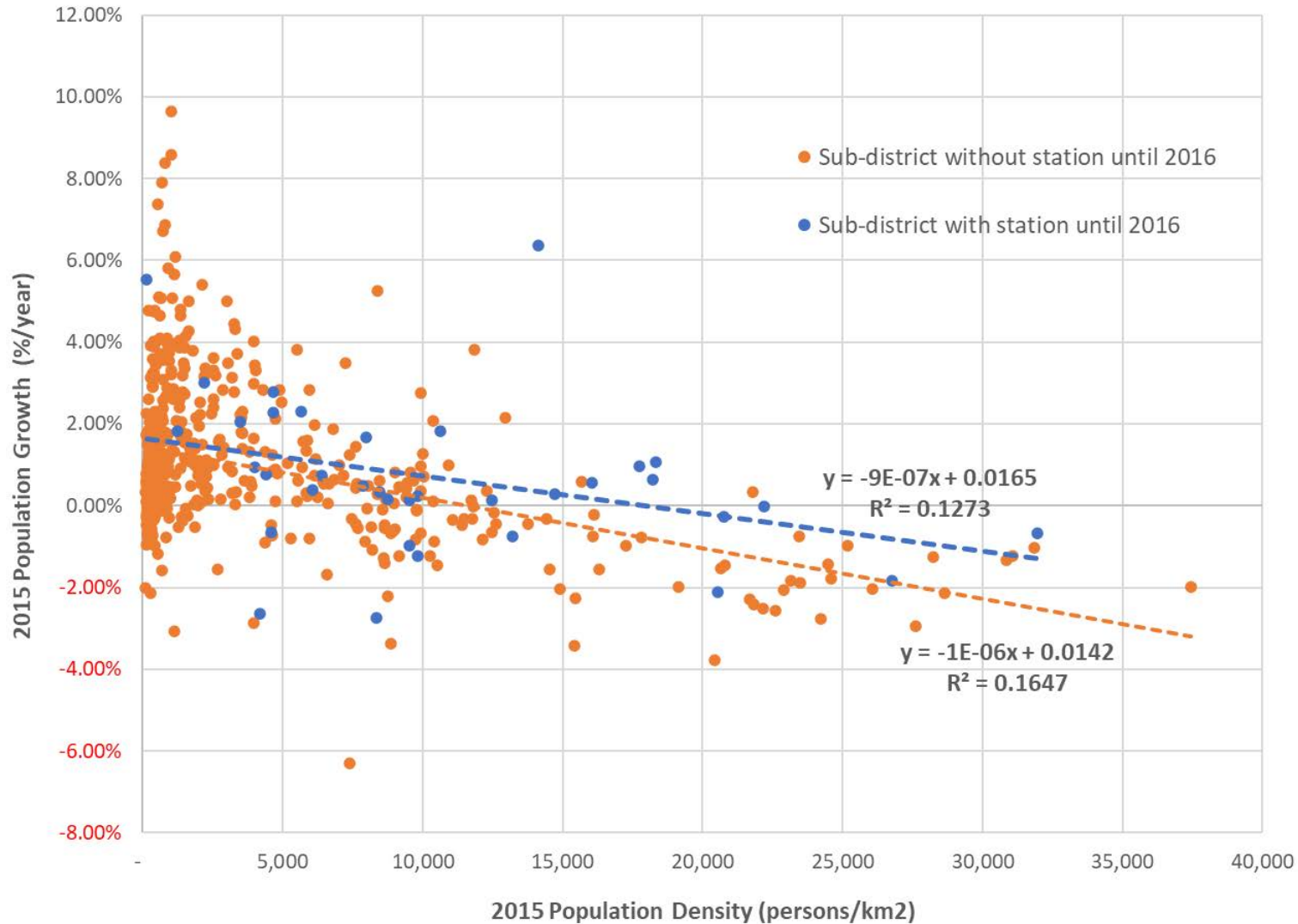


1. **Pop growth by sub-district 2015-2019 (from base year framework)**
2. **Impact of railway dev. By sub-district**
3. **City Comprehensive Plan**

Step 2:  
Pop by sub-district

1. Make population (2025) by sub-district using trend growth rate
2. Make population (2025) by sub-district based on pop-density (2019)
  - Growth rate will be calculated based on the **formula for station with railway /without railway** (2015-2019) will be applied for pop density in 2019. (assuming that pop growth depends on the existing pop density. )
  - For sub-districts **without station and** identified as green area in the City Comprehensive plan, **multiply the ratio of green area**. (for sub-district with 50% of green area  $\rightarrow r'=r*50\%$ )  
( $P_{2019} * (1+r')^6 = P_{2025}$ )
3. Add 1 + 2  $\rightarrow$  Adjust to total provincial pop. (P') (2025)  
 $\rightarrow$  Pop. framework by subdistrict in 2025
4. Make population (2030) by sub-district using trend growth rate (2020-2025)  
( $P_{2025} * (1+r)^5 = P_{2030}$ )
5. Make population (2030) by sub-district based on pop-density (2025)  
Add 4+5  $\rightarrow$  Adjust to total provincial pop. (P') (2030)

# Step to prepare future population framework



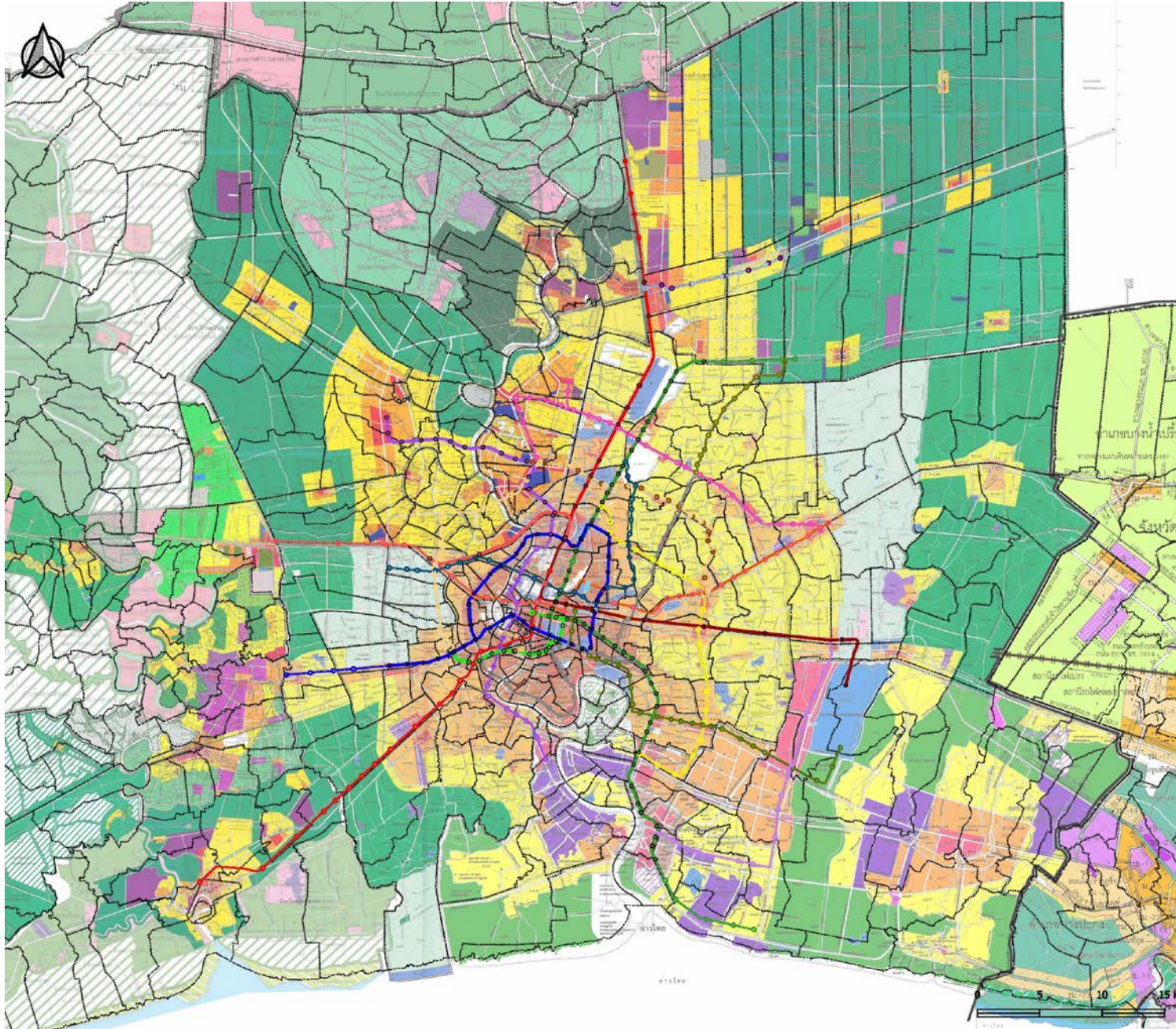
Formula for station with railway:  
 $y = -9E-07x + 0.0159$

Formula for station without railway:  
 $y = -1E-06x + 0.0142$

Y= Growth Rate  
X= Population density



# Step to prepare future population framework



Comprehensive Plan

# Step to prepare future population framework



1. **Trend pop growth by TAZ**
2. **Expected population in each urban development project**

Step 3:  
Pop by TAZ

- 0-1. 2019 base-year pop. by TAZ
- 1-1. Estimate 2025' trend TAZ pop by using pop growth rate 2015-2019 by TAZ (2025')
- 1-2. Adjust 2025' TAZ pop to fit with sub-district pop 2025 (P') (Y) (2025'')
- 1-3. **Add (X) + 2025''Y to prepare TAZ pop in 2025 (2025) → (P-2025)**
- 2-0. Calculate growth rate 2019-2025 by TAZ
- 2-1. Estimate 2030' trend TAZ pop by using pop growth 2019-2025 by TAZ (2030')
- 2-2. Calculate expected population increase of large scale urban development projects in 2030 (X)
- 2-3. Adjust 2025' TAZ pop to fit with sub-district pop 2030 (P') (Y) (2030'')
- 2-4. **Add (X) + 2030''Y to prepare TAZ pop in 2030 (2030) → (P-2030)**
3. Repeat 0-5 for 2035 and 2040.





## Assumptions for future employment framework

Control Total  
: Employment by province



- For BKK and 5 vicinity
  - NSO 2019 + growth rate of BMR Plan's Forecast by sector (2020-2037) extend annual growth rate (2032-2037) to 2038-2040
  - Total number of employment by province by sector. (E-1, E-2, E-3)
- For Ayuthaya & Chacheongsao
  - NSO 2019 \* existing land use => Base year employment as of 2019 by sector in the Study Area by TAZ.
  - Total NSO 2019 in our study area \* **growth rate of NESDC's Working Population Forecast (25-59 yrs) 2020-2040**
    - ➔ Total employment in the study area (2025, 2030, 2035. 2040)
  - Distribute to 3 sectors
    - growth rate of \*\*\*\*





## Assumptions for future employment framework



- 1. Trend employment growth by TAZ (2015-2019) by sector**
- 2. Expected employment in each urban development project**

Step 3:  
Employment by TAZ

0-1. 2019 base-year employment. by TAZ  
[Agriculture/industry]

1-1. Estimate 2025' trend TAZ employment by using employment growth rate 2015-2019 by TAZ (2025')

1-2. Adjust 2025' TAZ employment to fit with provincial employment (E-1 and E-2) (2025)

2-0. Calculate growth rate of TAZ employment (2019-2025)

2-1. Estimate 2030' trend TAZ employment by using employment growth rate 2019-2025 by TAZ (2030')

2-2. Adjust 2030' TAZ employment to fit with provincial employment (E-1 and E-2) (2030)

3-0. Repeat for 2035 and 2040



## Assumptions for future employment framework

### Step 3: Employment by TAZ

0-1. 2019 base-year employment. by TAZ

[Service]

1-0. Subtract expected employment in TAZ (E-UD-2025) from provincial employment (E-3) of 2025 (E-3' 2025')

1-1. Estimate 2025'' trend TAZ employment by using employment growth rate 2015-2019 by TAZ (2025'')

1-2. Adjust 2025' TAZ employment to fit with provincial employment (E-3') (2025)

1-3. Add (E-3') + expected employment as of 2025 (E-UD-2025) → (E-3, 2025)

2-0. Calculate growth rate of TAZ employment (2019-2025)

2-1. Subtract expected employment in TAZ (E-UD 2030) from provincial employment (E-3) of 2030 → E-3' 2030

- 1. Trend employment growth by TAZ (2015-2019) by sector**
- 2. Impact of railway development (to be considered....) ← from analysis of growth rate of service employment between sub-district w/wo stations**
- 3. Expected employment in each urban development project**

# Step to prepare future student framework



Step 1:  
Student by province



Step 2:  
Student by TAZ

1. **Assuming that student distribution will be same as of 2015**
2. **Increase of additional student in line with population growth**

- 2015 student as Base Year (real number) (2015-S)  
== % to the NESDC's 2015 population (age5-24) → X %
- [2019]
- **Control Total:** Total number of student 2019 = NESDC's Population Forecast 2019 (age 5-24 yrs) \* X%. (2019-S)
  - **Distribution:** Assuming that existing school as of 2015 will keep the same and additional students will be distributed by population increase.
    - $(2019-S) - (2015-S) = \text{Increase (15-19)} \rightarrow$  distributed by pop. increase 2015-2019 by TAZ (A)
    - $(2015-S) + (A) \rightarrow (2019-S)$  by TAZ
- [2025]
- **Control Total:** Total number of student 2025 = NESDC's Population Forecast 2025 (age 5-24 yrs) \* X%. (2025-S)
  - **Distribution:**
    - $(2025-S) - (2019-S) = \text{Increase (19-25)} \rightarrow$  distributed by pop. increase 2019-2025 by TAZ (A)
    - (2019-S) + (A) → (2025-S) by TAZ