STUDY ON AWARENESS AND UNDERSTANDING OF HEALTH PROTECTION MEASURE FROM HAZE

BY

KANCHANOK ROONGRUANGSAENG

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF ENGINEERING (ENGINEERING TECHNOLOGY)

SIRINDHORN INTERNATIONAL INSTITUTE OF TECHNOLOGY

THAMMASAT UNIVERSITY

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A Thesis Presented

By

KANCHANOK ROONGRUANGSAENG

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Abstract

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Master of Engineering (Engineering Technology), Sirindhorn International Institute of Technology, Thammasat University, 2017

Haze is an important issue in Southeast Asia as it occurs regularly and affects many aspects of human well-being. In Thailand, haze often occurs in summer from a forest fire and burning of agricultural residues in the north. These areas located in the river basin and surrounded by mountains, thus, haze could not spread out and accumulated in the atmosphere. In 2015 there were more than 800,000 patients affected during haze period. Diseases related with haze including cardiovascular, respiratory, dermatitis, and inflammatory eye diseases. The objectives of this study were to understand health impact from haze and practice of the people to protect their health and compare the instructions given by health authority to public for protecting their health from the haze. The study took place in Nan province. The area is surrounded by mountains and forests, and floodplain in the central valley. Primary data collection was done by questionnaires and interview with people in the affected area. Four hundred and nine questionnaires were distributed in Mueang district, Nan province. The questionnaires include 5 major section: which are; general information of respondents, understanding the impact of health problems caused by haze, the practice in health protection during haze period, effects of haze situation on the respiratory system, the recommendations to the research. Results found that respondents have knowledge

about the haze. However, for practice related to health protection, they know only using a mask for protecting their health. Majority of respondents also do not know about indoor health protection measures. Moreover, the respondents know how to protect their health, but they do not practice because it is not convenient for their daily life. We recommend to develop the health protection measures that are suitable for their daily activity as well as to provide more knowledge of indoor air pollution problems.

Keywords: Haze, Health awareness, Protection measures, Air pollution

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Chapter 1
Introduction

1.1 Introduction

Haze is an important environmental issue in Thailand and Southeast Asia region because it occurs regularly and affects many aspects of human well-being. Haze is a phenomenon where dust, smoke, and particles suspended in the atmosphere and gathered in the closed weather conditions. Haze occurrence can be found in areas with certain topographical characteristic, such as areas between the valley, and the atmosphere above the landscape has the temperature inversion layer. According to the theory, the cold air mass is close to the ground because they are dense and weighs more than hot air mass. If the hot air mass moves faster and more furious, it can block heat transfer and suspended particles in the lower atmosphere flow up to the top. However, with temperature inversion suspended particles remain in the lower atmosphere.

For northern Thailand, haze will occur during dry season annually because the weather is dry and stable, so the haze can be suspended in the lower atmosphere for a long time. It also found that increases in the amount of dry biomass because the drought has resulted in more forest fires. During the same season, farmers would also burn their agricultural waste to prepare the area for farming in the rainy season. Haze often occurs in the northern province of Thailand, including Chiang Mai, Chiang Rai, Mae Hong Son, Lamphun, Lampang, Phayao, Phrae, and Nan, because these areas located in the river basin, surrounded by mountains. This geographical characteristic does not allow haze to spread out of the area. Normally haze and other air pollutants will rise into the atmosphere but high mountain blocks them from further dispersion, therefore haze and pollutants accumulate in the atmosphere causing impacts on human health and environment.

Haze consists of particulate matter (PM) and toxic gases such as carbon monoxide, nitrogen dioxide, Polycyclic Aromatic Hydrocarbons (PAH). These pollutants can be passed into the body by inhalation that causes acute respiratory disease and easily lead to death in patients with chronic diseases such as heart disease, lung

disease, and asthma. In addition, the haze has affect the business, tourism, and services, including land and air transportation as well.

For the health effects, research has confirmed that exposure to PM10 whether in a short time or a long time is all worsening the illness and death increased (Pisoni, 2009). The higher concentrations of PM uptake, the higher the risk of disease associated with the respiratory, coronary heart disease (Pope, 2006).

So, whether it was more or less amount of haze, it is harmful to health because they are small. PM can accumulate in the respiratory system, causing irritation and inflammation (Xing, 2016). Office of Disease Prevention and Control at the provincial level has set up monitoring system to monitor 4 major diseases related to haze problem namely: cardiovascular disease, respiratory disease, dermatitis, and inflammatory eye disease. The data were collected from health care institutions in 8 provinces in Jan – May 2012 until present year. Report in 2015stated that there are 826,247 patients recorded during due Jan – May 2015. The highest record was found in cardiovascular disease where morbidity rate was 8,291.62 per hundred thousand populations. The second largest disease impact was found in respiratory disease, morbidity rate was 5,218.89 per hundred thousand populations. Dermatitis morbidity rate was 521.05 per hundred thousand populations, and inflammatory eye disease morbidity rate was 501.47 per hundred thousand populations respectively. The province that reported the highest overall patient morbidity was Lamphun, 21,526.02 per hundred thousand populations, followed by Phrae and Lampang with the rate of 19,776.58 and 18,620.50 per hundred thousand populations respectively (Office of Disease Prevention & Control, 1 Chiang Mai, 2016).

In order to reduce the severity and the morbidity rate of the people in the haze affected areas, the health authorities such as Department of Health, Department of Disease Control, and Pollution Control Department issued guidances for taking care and protection of health for local citizen during the haze period. Although the recommendation to the public for protecting their health was released but there were still many patients with respiratory disease and other diseases that are haze related every year. It was not clear to the authority on the effectiveness of the recommended guidances as there were no data on the level of understanding of local people on the health impacts from haze. So, this study aims to study the understanding and practice

for health protection of the people during the haze period and propose correction measures to improve public health situation.

1.2 Objectives

1. To study the understanding and practice of the people regarding haze and its health impacts.

2. To compare the practice of people regarding haze and health impacts with health data from health authority.

3. To develop recommendation for local community to prevent health impact from haze problem.

1.3 Scope of study

1. The study were taken at Mueang district, Nan province.

2. The research involved both qualitative and quantitative study, collect data by questionnaires (closed-ended questions) and interview with people in Mueang district, Nan province.

3. The study compared the instructions that was recommended by health authority to public for protecting health from haze with the real practice of a people during the haze.

4. The study compared the practice of people regarding haze and health impacts with health data and recommendation from health authority.

1.4 Framework of study

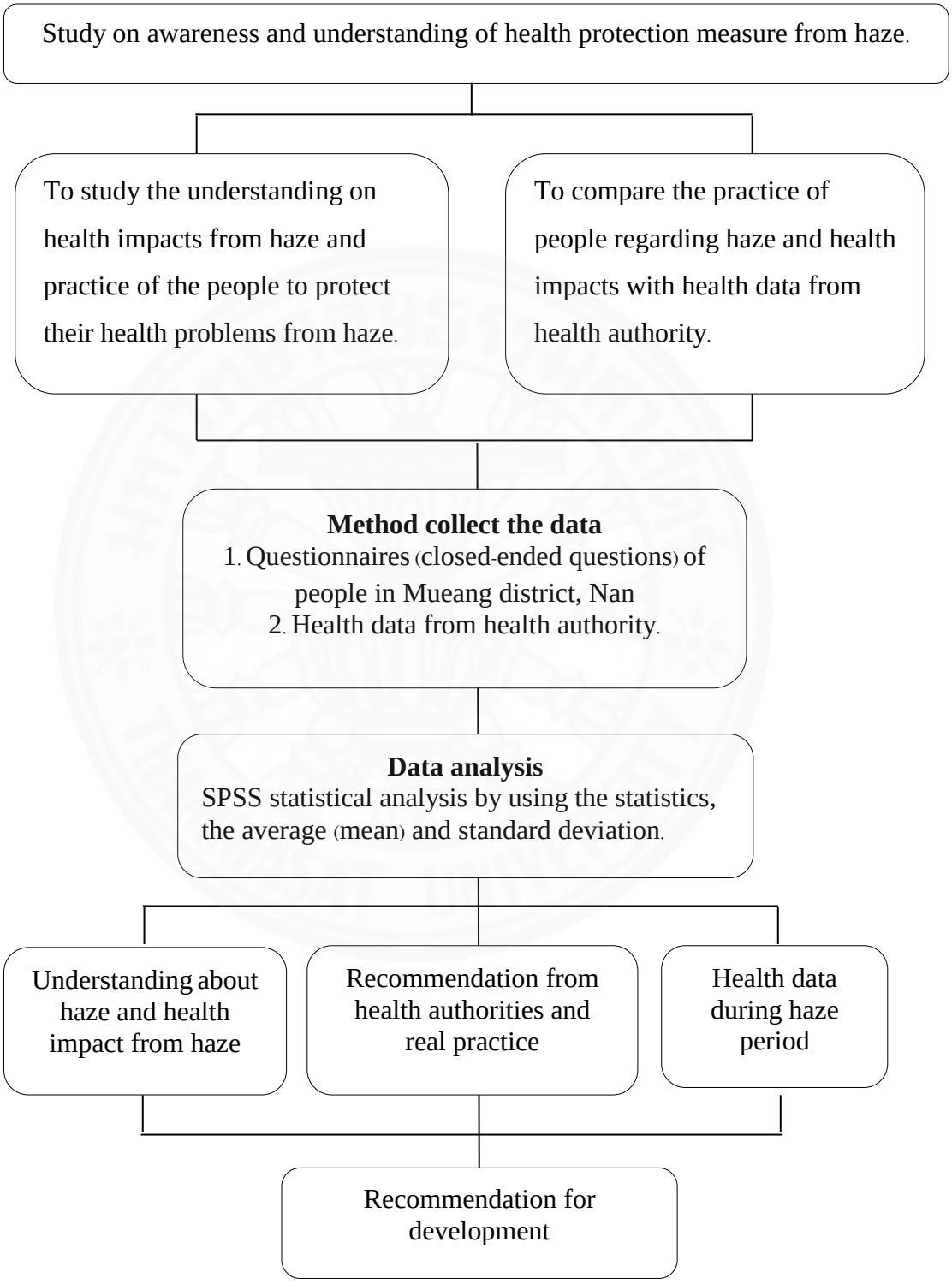

Figure 1.1 Diagram of framework of study

Chapter 2
Literature review

2.1 The definition and meaning of haze

2.1.1 Air Pollution

Air pollution is a mixture of natural and man-made substances in the air that we breathe. It is typically separated into two categories are outdoor and indoor air pollution.

Outdoor air pollution involves exposures that take place outside of the building or in environment including fine particles produced by the burning of fossil fuels (i.e. the coal and petroleum used in traffic and energy production), noxious gases (i.e. sulfur dioxide, nitrogen oxides, carbon monoxide, and chemical vapors), ground-level ozone (i.e. a reactive form of oxygen and a primary component of urban smog), and tobacco smoke.

Indoor air pollution involves exposures to particulates, carbon dioxide, and other pollutants carried by indoor air or dust including gases (carbon monoxide, radon, etc.), household products and chemical, building materials asbestos, formaldehyde, and lead), outdoor and indoor allergens (cockroach and mouse dropping), tobacco smoke, mold, and pollen (NIH, 2016)

2.1.2 Fog, Mist

The cloud in a near ground level which reduce visibility or worsening vision is dangerous, both by land and air transportation. Under humid air and clear skies conditions in the day, the ground will cool quickly and make the vapors in the air condenses into water droplets above the soil in the night. The fog formed by low temperature, high density, and movement into the low area. when the fog restricts visibility by 1000 meters or less, it is considered as fog. When the visibility is greater than 1000 meters, it is instead called a mist.

2.1.3 Smoke

Smoke is a collection of tiny solid, liquid and gas particles. Although smoke can contain hundreds of different chemicals and fumes, visible smoke is mostly carbon (soot), tar, oils and ash. Smoke occurs when there is incomplete combustion (not enough oxygen to burn the fuel completely). In complete combustion, everything is burned and producing just water and carbon dioxide. When incomplete combustion occurs, not everything is burned. Smoke is a collection of these tiny unburned particles.

2.1.4 Haze, Smog

The characteristic of air that contains small particles that cannot be seen with naked eye (such as dust, smoke from forest fires, dust from motor vehicles in large cities or the salt from the sea). A lot of drift around the air is fogged white in an atmosphere containing dust cause a reduction in visibility.

High density of dust caused by pollution that contain chemical or ozone is often called smog and dust. It is different from the typical fog is fog in a way that caused by high humidity in the air, such as early morning or after rain, but the haze is caused by small particles, in dry air.

2.2 Haze situation

2.2.1 Haze problem

Generally, the sources of haze pollution are predominantly man-made, and naturally ignited forest fire. Haze problem caused by air pollutants accumulation, especially atmospheric fine and coarse particles (Gao et Al., 2016). The haze arisen from fire or burning of materials such as forest fire, burning of agriculture waste, and also the use of fuel in the transportation and industry. The release of air pollutants, such as high particular matter concentration, and associated with substantial elevations in gaseous pollutants including Co, NOx, SO_2, ozone (O_3), NH_3, and volatile organic compounds (VOCs) accumulated in the atmosphere (Gao et Al., 2014; Huang et al., 2014). So, it can be affected to health, economic, transport, and lifestyle (E. Quah et al., 2001; Tim Forsyth, 2014).

2.2.2 Factors affecting the haze

Factors that affect haze problems are temperature, humidity, air pressure, wind direction, the pan basin area, and building structure. In some areas, the severity of haze problems can be higher than other areas. For example, in the valley that surrounded by mountain, will have higher chance of more severe haze problem, and in the days with high air pressure or the wind is not blowing through will have haze will covered in areas longer than the days with the clear air, wind blowing through, or high humidity.

The generally of the fire and smoke dispersion is the wind will be a support the causes of decrease haze concentrations because smoke is diluted when air volume is increase. In the heat, especially during the first stages of burning, the smoke will rise up and stable until cold then gradually low down, diluted and more spread. In the sunny or hot weather, the air will float up and will bring dust and smoke floats up too. After that, during the sun begins to fall, temperature on the ground will begin to cool down and the air will low down in the valley area. So, in the evening, the temperature near the ground is colder than the air above affecting the haze accumulated in the valley during the night. Therefore, the severity of haze problems will depend on many factors. So, the haze levels in each area cannot be predicted, and the concentration of haze pollution will vary depending on wind conditions in each area (Health Impact Assessment Division, 2015).

2.2.3 Environmental problem situation

Haze situation in Thailand most often take place in the northern areas of the country. The haze often occurs during the dry season (January to April) annually. The haze and forest fires in northern Thailand occurred as a result of burning agricultural areas which have a weed and agriculture wastes as fuel and burning in the forest area with debris twigs and leaves as the fuel. The topography of river basin and surrounding with mountains, it increases the severity of the haze problem. It was also found that in some areas of the southern part of Thailand such as Yala, Narathiwat, Pattani, and Songkhla provinces have haze problem as well. This is due to cross-border haze problems from forest fires in Sumatra Island, Indonesia. It affects people in

Indonesia and Southeast Asian countries including Thailand, Singapore, Malaysia, and Brunei. (PCD, 2013)

2.2.4 Haze situation in northern Thailand

Comparative of data from the haze period, start from the day of high particle matter exceeds the standard until the situation returned to normal in 3 years back found the particle matter begins to exceed the standard in January and continued until April. This is depending on atmospheric conditions such as humidity, temperature, and air pressure in each year.

In 2014, the situation of air quality in upper northern province of Thailand, which including Chiang Mai, Chiang Rai, Lamphun, Lampang, Phayao, Phrae, Nan, Mae Hong son and Tak, since 1 January – 30 April 2014 found that the average 24 hour of particulate matter smaller than 10 microns was highest 318 $\mu g/m^3$ at Jong Kham sub-district, Mae Hong Son province on 21 March 2014. When compare the amount of particulate matter with 2013 data in the same period found that the highest amount of particulate matter was 432 $\mu g/m^3$ at Jong Kham sub-district as well. In the comparison of the highest amount of particulate matter in each province, it was found that the highest amount of particulate matter was decrease in Lamphun, Lampang, Chiang Rai, Phrae, and Nan. The comparison of the amount of particulate matter in the day which PM10 average 24 hours exceeds the standard of PCD (120 $\mu g/m^3$) found that the province that the lesser the number of days which PM10 exceed the standard are Lamphun, Mae Hong Son, Chiang Rai, and Phrae. The data are shown in Table 2.1

Table 2. 1 The comparison of the day which PM10 average 24 hours exceed the standard of PCD (120 µg/ m^3) in northern 9 provinces in 2013- 2014 (1 January – 30 April)

Provinces	The Maximum amount of PM (µg/m^3)		The number of the days exceeding the standard (day)	
	2013	2014	2013	2014
Chiang Mai	229	275	21	21
Lamphun	192	175	12	11
Mae Hong Son	432	318	35	23
Lampang	337	229	30	37
Chiang Rai	308	253	29	21
Phayao	208	298	16	22
Phrae	225	184	27	23
Nan	264	159	21	22
Tak	113	144	0	5

Source: Ministry of Natural Resources and Environment, 2014.

In 2014, Lampang had the amount of PM10 exceeded the standard for 37 days, which was the highest among the 9 provinces. Also, Phayao, Nan and Tak had experienced increasing number of days with PM10 exceeded the standard.

In 2014, in the eastern region of northern province including Phrae, Phayao, and Nan began to particle matter exceeds the standard before the western region including Mae Hong Son, and Tak. For Chiang Rai, Chiang Mai, Lamphun, and Mae Hong Son were started the haze crisis slower than 2013, because of the rain continually from the end of 2013 until January 2014, making fuel had high humidity and cannot be burned in January - February 2014 (Health Impact Assessment Division, 2015).

2.2.5 Health impact situation

Office of Disease Prevention and Control 10, Chiang Mai, monitored 4 major diseases related to haze problem, namely: cardiovascular disease, respiratory disease, dermatitis, and inflammatory eye disease. They were 1,433,632 patients. The morbidity rate from the 4 diseases was 29,665. 10 per hundred thousand populations. The highest record was found in cardiovascular disease where morbidity rate was 10,502. 45 per hundred thousand populations. The second largest was respiratory disease, morbidity rate was 7,829. 13 per hundred thousand populations. Next was dermatitis with the morbidity rate was 771. 99 per hundred thousand populations, and inflammatory eye disease, morbidity rate was 624.84 per hundred thousand populations respectively. The province that had the highest number of patients was Lamphun, where the morbidity rate was 41,889.65 per hundred thousand populations. The second largest was Mae Hong Son and Phrae, the morbidity rates were 34,767. 66 and 32,465. 77 per hundred thousand populations respectively.

The number of patients in 2012 – 2014 reported was more than that of 2010 and 2011 because the monitoring system was established and the data were collected effectively. The comparison of median found that cardiovascular and respiratory systems had higher number of patients during the haze period more than normal.

When considering disease type, it was reported that the highest morbidity rate from cardiovascular disease can be found in Phrae province at 20073. 41 per hundred thousand populations. The highest morbidity rate from respiratory disease can be found in Mae Hong Son province was 15,480.30 per hundred thousand populations. The highest morbidity rate from dermatitis at 1,713. 25 per hundred thousand populations, and. The highest morbidity rate from inflammatory eye disease was 1,203.19 per hundred thousand populations. It was more than other provinces in upper northern region (Office of Disease Prevention & Control, 1 Chiang Mai, 2016).

2.3 Cause and Effect of Haze

2.3.1 Causes of haze

2.3.1.1 Forest fire

The forest fire is a major cause of haze. Due to the Burning fuels, such as wood, leaves, debris, and weeds, causing a haze cover the area of fires and nearly area. The cause of forest fires are 2 main reasons; natural forest fire and man-made forest fire (C. Chandrasekharan, Undated; Datendra, 2014).

Natural causes- Many forest fires start from natural causes such as lightning which set trees on fire. However, rain extinguishes such fires without causing much damage. High atmospheric temperatures and dryness (low humidity) offer favorable circumstance for a fire to start (Rai Technology University, Engineering minds, Undated).

Man-made causes- Fire is caused when a source of fire like naked flame, cigarette or bidi, electric spark or any source of ignition comes into contact with inflammable material (Rai Technology University, Engineering minds, Undated). Human is primary cause of forest fires in tropical developing countries. In Thailand, the statistics of forest fire since 1985-1999 recorded that from the total of 73,630 forest fire, the fires were caused by thunderbolt 4 times at Phu Kradueng (Loei province), Huai Nam Dang (Chiang Mai province), Tha Sae (Chumphon province), and Khao Yai (Nakhon Ratchasima province). Therefore, most of forest fires in Thailand caused by human. There are various causes, including the burning of agricultural waste, gathering of forest products, weeding, careless, and hunting (Health Impact Assessment Division, 2015).

2.3.1.2 Burning of agricultural waste

The study revealed that one of the reasons that cause haze problem is burning debris, weeds and agricultural materials such as rice straw, corncob, and burning grass beside the street. Because farmers believe that burning can eliminate weeds, debris, and bacteria in the soil. Open biomass burning is a common method for eliminating crops before and after harvesting for controlling of crop residues and weeds in the field after harvesting is completed (Phairuang et al., 2017), because this method

is easy, convenient, and cheap. The air quality monitoring report of PCD found that in the areas with a lot of agriculture activities such as Pathum Thani, Ang Thong, Ratchaburi, Chiang Mai, and Khon Kaen, will have high concentration of haze in dry season. Because the weather was dry and stable, cause the dust can suspended in the atmosphere for long time because farmers burn agricultural waste for prepare the area for cultivate in rainy season (Health Impact Assessment Division, 2015).

2.3.1.3 Burning of solid waste in community

Burning of solid waste is one source of release air pollutants into the atmosphere. The total amount of solid waste generated in the community, only 70-80 percent are collected, and among that only 30 percent are disposed appropriately. The remaining waste will be handled by open dumping burning. Solid waste burning are sources of air pollutants that include fine particulate matter ($PM_{2.5}$), volatile organic compounds (VOCs), nitrogen oxides (NO_x), and—due to incomplete combustion—carbon monoxide (CO) and polycyclic aromatic hydrocarbons (PAHs) (Vreeland et al., 2016). These particularly caused risk to human health such as pollutants, dust, soot, smoke, gases and vapors risk to human health in both the short and long terms, causing various respiratory and cardiovascular diseases (Maasikmets et al., 2016). According to a recent study found that 1 kg of waste burning generate 19 grams of small particles that harm to health, or equal to 45.7 grams / household / day (Production rate of household 2-5 kg / day, Air Quality and Noise Management Bureau, PCD, 2011). In addition, waste mixed with plastic that is burnt in the open air will generate 14 grams of volatile organic compounds from 1 kg of solid waste, or about 35 grams / household / day. The toxins founded are benzene and dioxins, both of which are carcinogens (Health Impact Assessment Division, 2015).

2.3.1.4 Transportation

Transportation is one reason that cause air pollution, especially in the city when the use of vehicles in the transportation is high because fossil fuels (gasoline and diesel) burned in road vehicles (cars, trucks, buses, taxis, etc.) result in direct emissions of pollutants (Kishimoto et al., 2017). Pollution from automobile exhaust pipe contains substances that in huge amount, including hydrocarbons, such as aromatic - hydrocarbons, soot, nitric oxide, nitrogen dioxide, and carbon monoxide. Traffic is the major source of PM mainly originating from the exhaust pipe of vehicle components such as brakes and tires as well as suspension of road dust, the amount of pollutants has a relationship with the complete fuel combustion engine (Kim, K. H., 2015).

2.3.1.5 Industry

Industries such as smelting and metallurgy, oil refining, chemical industry, and food industry are important source of air pollution. Major air pollutants from industries including dust, soot, smoke, sulfur dioxide, carbon monoxide, carbon dioxide, nitrogen dioxide, and other toxic gases are released from the stack.

2.3.2 Air pollutants and health effects from haze

Air pollution caused by the haze problem is often pollutants arising from the incomplete combustion such as leaves, twigs, agricultural crops, and fossil fuel. The standard Air Quality Index (AQI) was 5 types of air pollutants to calculate the interpret the quality of air. The 5 pollutants are ozone (O_3) at 1- hour average, nitrogen dioxide (NO_2) at 1- hour average, carbon monoxide (CO) at 8- hours average, sulfur dioxide (SO_2) at 24 – hours average, and particles smaller than 10 microns (PM10) at 24 – hours average. However, there is also an air pollutant that occurred and affected to health are 2 types including carbon dioxide (CO_2) and Polycyclic aromatic hydrocarbons (PAHs) are as follows:

Ozone

Ozone at ground level or bad ozone is not emitted directly into the air, but is created by chemical reactions between oxides of nitrogen (NOx) and volatile organic compounds (VOC) in the presence of sunlight. Exhausted from industrial facilities and electric utilities, motor vehicle exhaust, gasoline vapors, and chemical solvents are some of the major sources of NOx and VOC. Breathing ozone can trigger a variety of health problems, particularly for children, the elderly, and people of all ages who have lung diseases such as asthma. ground level ozone can also have harmful effects on sensitive vegetation and ecosystems.

Ozone in the air at ground level can harm to health. People most at sick from breathing air containing ozone include people with asthma, children, elderly, and people who are active outdoors, especially outdoor workers. In addition, people with certain genetic characteristics, and people with reduced intake of certain nutrients, such as vitamins C and E, are at greater risk from ozone exposure. Breathing ozone can trigger a variety of health problems including chest pain, coughing, throat irritation, and airway inflammation. It also can reduce lung function and harm lung tissue. Ozone can worsen bronchitis, emphysema, and asthma, leading to increased medical care (US EPA, Undated).

Nitrogen dioxide

Nitrogen dioxide (NO_2) is one of a group of highly reactive gasses known as "oxides of nitrogen", or "nitrogen oxides (NOx)". Other nitrogen oxides include nitrous acid and nitric acid. EPA's National Ambient Air Quality Standard uses NO_2 as the indicator for the larger group of nitrogen oxides (US EPA, Undated). These gases are emitted from motor vehicle exhaust, combustion of coal, oil or natural gas, and industrial processes such as welding, electroplating, and dynamite blasting. Although most NOx is emitted as NO, it is readily converted to NO2 in the atmosphere (New Jersey Department of Environmental Protection, 2014). This gas can enter the body by breathing directly or in the form of vapors of dust or nitric acid nitrile said. After the gas gathering with spray water or moisture and cause severe irritation to the respiratory system, eye, nose, mucous membranes, and skin (US EPA, Undated).

Exposure to low concentration for a long period of time may cause the yellow skin and teeth. If the high concentration will irritate the lungs severely and

hemoglobin in the blood, mate the acute toxicity to feel uncomfortable, the skin is dark blue from lack of oxygen, cough, shortness of breath, the dyspnea, fever, headaches, nausea, vomiting, and even death In the case of low concentration may irritate the trachea. Symptoms of pulmonary edema and chronic lesions. Contact with liquid will cause severe corrosion eyes and skin (Health Impact Assessment Division, 2015).

Carbon monoxide

Carbon monoxide (CO) is a colorless, odorless gas emitted from combustion processes. Nationally and, particularly in urban areas, the majority of CO emissions to ambient air come from mobile sources. CO can cause harmful health effects by reducing oxygen delivery to the body's organs (like the heart and brain) and tissues. At extremely high levels, CO can cause death.

CO can cause harmful health effects by reducing oxygen delivery to the body's organs (like the heart and brain) and tissues at extremely high levels, CO can cause death. Exposure to CO can reduce the oxygen- carrying capacity of the blood. People with several types of heart disease already have a reduced capacity for pumping oxygenated blood to the heart, which can cause them to experience myocardial ischemia (reduced oxygen to the heart), often accompanied by chest pain (angina), when exercising or under increased stress. For these people, short-term CO exposure further affects their bodies already compromised ability to respond to the increased oxygen demands of exercise or exertion (Health Impact Assessment Division, 2015).

. **Sulfur dioxide**

Sulphur dioxides (SO_2) is one of pollution concern over the environmental impact, and used as the indicator for larger group of gaseous sulfur oxide (SOx). Further oxidation of SO_2, usually in the presence of a catalyst such as NO_2, forms H_2SO_4, and thus acid rain (Amee K. Pate et al., 2014). SO_2 is the component of greatest concern and is used as the indicator for the larger group of gaseous sulfur oxides (SOx). Other gaseous SOx (such as SO_3) are found in the atmosphere at concentrations much lower than SO_2.

Control measures that reduce SO_2 can generally be expected to reduce people's exposures to all gaseous SOx. This may have the important co-benefit of reducing the formation of particulate Sox such as fine sulfate particles.

Emissions that lead to high concentrations of SO_2 generally also lead to the formation of other SOx. The largest sources of SO_2 emissions are from fossil fuel combustion at power plants and other industrial facilities.

The largest source of SO_2 in the atmosphere is the burning of fossil fuels by power plants and other industrial facilities. Smaller sources of SO_2 emissions include: industrial processes such as extracting metal from ore; natural sources such as volcanoes; and locomotives, ships and other vehicles and heavy equipment that burn fuel with a high sulfur content.

SO_2 can affect both health and the environment. Short-term exposures to SO_2 can harm the human respiratory system and make breathing difficult. Children, the elderly, and those who suffer from asthma are particularly sensitive to effects of SO_2.

SO_2 emissions that lead to high concentrations of SO_2 in the air generally also lead to the formation of other sulfur oxides (SOx). SOx can react with other compounds in the atmosphere to form small particles (US EPA, Undated).

Particulate Matter (PM)

Particulate Matter (PM) is a mixture of liquid and solid particles of different sizes and chemicals that founded in the air. Some particles, such as dust, soot, or smoke are large and dark enough to be seen with naked eyes. Others are so small they can only be detected using an electron microscope.

The source of PM can be explained as direct emission from fuel combustion by mobile sources (cars, trucks, and buses) (Ostro B., 2005), and also conversion from gaseous precursors released from both anthropogenic and natural sources (Atkinson et al., 2010).

Particle pollution includes:

PM_{10}: inhalable particles, with diameters that are generally 10 micrometers and smaller.

$PM_{2.5}$: fine inhalable particles, with diameters that are generally 2.5 micrometers and smaller.

These particles come in many sizes and shapes and can be made up of hundreds of different chemicals. Some are emitted directly from a source, such as construction sites, unpaved roads, fields, smokestacks or fires. Most particles form in the atmosphere

as a result of complex reactions of chemicals such as sulfur dioxide and nitrogen oxides, which are pollutants emitted from power plants, industries and automobiles.

Particulate matters are so small that can be inhaled and cause serious health problems. Particles less than 10 micrometers in diameter pose the greatest problems, because they can get deep into your lungs, and some may even get into your bloodstream. Fine particles ($PM_{2.5}$) are the main cause of reduced visibility (haze) in parts of the United States, including many of our treasured national parks and wilderness areas. The compartmental deposition of particulate matters is shown in Figure 2.1

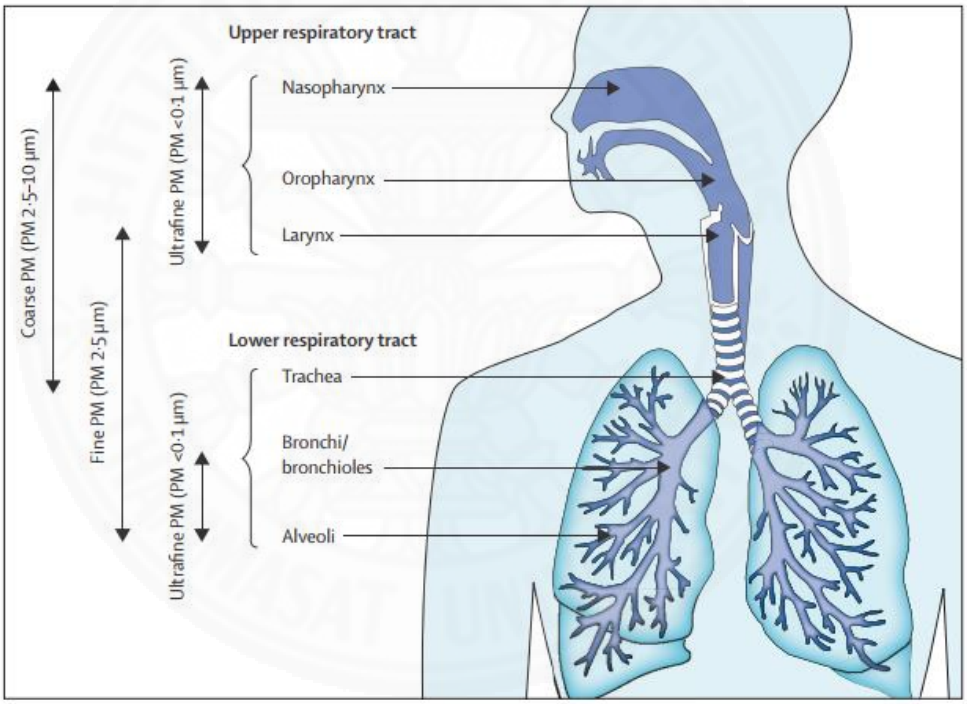

Figure 2.1 Compartmental deposition of particulate matter (Lancet, 2014)

Carbon dioxide

Carbon dioxide (CO_2) is the primary greenhouse gas emitted through human activities. In 2014, CO_2 accounted for about 80.9% of all U.S. greenhouse gas emissions from human activities. Carbon dioxide is naturally present in the atmosphere as part of the Earth's carbon cycle (the natural circulation of carbon among the atmosphere, oceans, soil, plants, and animals). Human activities are altering the carbon cycle–both by adding more CO_2 to the atmosphere and by influencing the ability of natural sinks, like forests, to remove CO_2 from the atmosphere. While CO_2 emissions come from a variety of natural sources, human-related emissions are responsible for the increase that has occurred in the atmosphere since the industrial revolution.

Carbon dioxide in its gas form is an asphyxiate, which cuts off the oxygen supply for breathing, especially in confined spaces. Exposure to concentrations of 10 percent or more of carbon dioxide can cause death, unconsciousness, or convulsions. Exposure may damage a developing fetus. Exposure to lower concentrations of carbon dioxide can cause hyperventilation, vision damage, lung congestion, central nervous system injury, abrupt muscle contractions, elevated blood pressure, and shortness of breath. Exposure can also cause dizziness, headache, sweating, fatigue, numbness and tingling of extremities, memory loss, nausea, vomiting, depression, confusion, skin and eye burns, and ringing in the ears.

Polycyclic aromatic hydrocarbons (PAHs)

Polycyclic aromatic hydrocarbons (PAHs) are a class of chemicals that occur naturally in coal, crude oil, and gasoline. They also are produced when coal, oil, gas, wood, garbage, and tobacco are burned. PAHs generated from these sources can bind to or form small particles in the air. High-temperature cooking will form PAHs in meat and in other foods. Naphthalene is a PAH that is produced commercially in the United States to make other chemicals and mothballs. Cigarette smoke contains many PAHs.

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meat and in other foods. Naphthalene is a PAH that is produced commercially in the United States to make other chemicals and mothballs. Cigarette smoke contains many PAHs.

Human health effects from environmental exposure to low levels of PAHs are unknown. Large amounts of naphthalene in air can irritate eyes and breathing passages. Workers who have been exposed to large amounts of naphthalene from skin contact with the liquid form and from breathing naphthalene vapor have developed blood and liver abnormalities. Several of the PAHs and some specific mixtures of PAHs are considered to be cancer-causing chemicals.

2.3.3 Sensitive populations

In general, when the body has touched or inhaled smoke into the body in a short time. It can affect the health, including little nose, sneeze, and cough, which the general public with a healthy will have the ability to adapt and rehabilitation quickly and does not affect the long-term health. But in the population at risk when get touch or inhaled smoke into the body health problems may arise from exposure to smog, both short and long term. It can be classified into 4 sensitivity populations, as follows:

2.3.3.1 Children

In children, although never has a problem with chronic illness or disease before considered at risk due to the developing lungs of children making more vulnerable to air pollution than adults which healthy physical factors that contribute to children at risk of exposure than adults because

- Children often spending time doing activities outside the home or outdoors than adults, such as playgrounds, sports, and activities.
- Children often have more active than adult activities such as running, jumping, and climbing.
- Children will have the breathing volume of air into the body more than adults.

It also found that the pollution caused by dust or particles are associated with increased respiratory symptoms and reduced pulmonary performance, the symptoms such as coughing, breathing difficulties, which the study found that in every

1 ppb increase of sulfur gas was reduced the lungs performance of children with pulmonary asthma decreased 2.12 liters per minute. It also found that every 1 ppb of ozone gas and sulfur dioxide increased was reduced the lungs performance of children 0.16 and 1.60 liters per minute, respectively. In a synergistic manner (Phongthep and Other, 2011) and many research of air pollutants found that the pollutants which harmful to children's health are many kinds of PM10, PM2.5, SO_2, NO_2, and O_3. There are affects many aspects of the child's illness, including respiratory disease, premature morbidity from respiratory disease, hospitalization from respiratory diseases (Nittaya, 2008).

2.3.3.2 Elderly

The death of the elderly caused exposure to air pollution or dust. A rate of about 10: 1000 each year in the elderly often have the performance of lung and heart problems. The risk to health from exposure to dust more than any other group. This is because the performance of the defense system of the lungs decreases as age increases.

2.3.3.3 Pregnant

The study on health effects and exposure to haze in the pregnant women is very little but there are many studies that show evidence of health effects from exposure to cigarette smoke repeatedly, both direct and indirect exposure among pregnant women. The composition of the forest fire smoke is similar with the composition of cigarette.

There are also many other information sources that show that exposure to air pollution in cities affects the weight of the baby and often premature babies. Therefore, it is necessary to consider pregnant women is an important sensitivity population as well.

2.3.3.4 People with chronic disease.

The diseases associated with cardiovascular diseases such as coronary heart disease, brain vascular, respiratory diseases, and allergies. They are a group at risk of harm from exposure to haze. They should receive health care closely. The academic research related are follow:

(1) Patients with cardiovascular disease, it is a chronic disease that affects cause temporary chest pain, heart attack, cardiac arrhythmia, or heart failure. In the United States, cardiovascular disease is the major cause of death or about 30-40 percent of all deaths. The majority of deaths usually occurred to people aged over 65 years, the study found that rural dust levels increase the risk of heart disease, palpitations, symptoms and other effects related to cardiovascular disease. The chronic disease with heart or lung disease often have the following symptoms for at least one or more respiratory symptoms in short, angina, chest, neck, shoulder, arm, steady heartbeat, headaches, or fatigue disorders.

(2) Patients with chronic obstructive pulmonary disease (COPD) is a group of diseases with abnormal patients will have symptoms, cough, difficulty breathing, and there is a lot of phlegm will have symptoms similar to many diseases, respiratory diseases, such as chronic bronchitis, emphysema, and asthma, to suit the characteristics of the disease. So, a definition of chronic obstructive pulmonary disease that is chronic bronchial tubes have more obstructive slowly from the lung parenchyma occurs via little inhale and bulging in the lungs get smaller and permanently.

(3) Patients with asthma. When incentive to the lining of the trachea, bronchus, swelling, and bronchoconstriction narrow, the inflammation makes the trachea is sensitive to stimulation and response by muscle contraction and bronchial stenosis trachea put down again. The trachea inflammation is the secretion of mucus, the breath stenosis and also muscle contraction. All of this caused dyspnea, cough, wheezing, shortness of breath and feel the whistle chest pains. In patients with severe symptoms may find the lips and nails are green and dark. (Marlier et al., 2014.)

2.3.4 Effect of Haze

Air pollution caused by the activity, and the origin of both natural and human activities. Cause several side effects, which can be summarized by the following details:

2.3.4.1 Health effect

Exposure to haze may cause a variety of adverse health effects because haze is composed of microscopic solids or liquid droplets that are so small that they can get deep into the lungs and cause serious health problems. When inhaled, they can enter the bloodstream and get absorbed by underlying tissue, potentially interacting with other compounds and substances in the body, for example 'bad' cholesterol, to produce damaging effects such as inflammation.

Short term effects of exposure to haze

• Eye irritation, watering eyes, and/or conjunctivitis (a type of eye inflammation)

• Running nose, stuffy nose, sneezing, and/or post-nasal drip

• Throat irritation, dry throat, sore throat and/or coughing, phlegm

• Headache, dizziness, fatigue and/or stress

• Decreased lung function, depressed respiratory immune defenses, chest tightness, chest pain, shortness of breath, bronchitis (lung inflammation)

These symptoms are usually mild and will subside if exposure to haze is limited by staying indoors. However, in susceptible individuals (e.g. diabetics, elderly) and those suffering from chronic disease, especially respiratory and heart disease (e.g. coronary artery disease, asthma and chronic obstructive pulmonary disease), their condition may be worsened by haze and are more likely to experience more severe haze-related effects than healthy people.

Long term effects of exposure to haze

A large number of particles in a haze are below 2.5 micrometers in diameter. Therefore, these ultra-small particles stay in the air longer and are easily carried over long distances, increasing their chances of being inhaled by humans.

The long-term risks associated with exposure to fine particles:

• Faster rate of thickening of the arteries compared to others, promoting the development of vascular diseases.

• Increases the risk of death by cardiovascular disease and reduces life expectancy by several months to a few years

• May contribute to the development of diabetes

• Spontaneous abortion, under-weight infants, birth defects and infant death (Wee Peng Ho, Undated).

In healthy people who long-term exposure to PM were decreased lung volume and pulmonary function (T. Padkao et al., 2013).

2.3.4.2 Environmental effect

(1) Visibility impairment

Fine particles (PM2.5) are the main cause of reduced visibility (haze) in parts of the United States, including many of our treasured national parks and wilderness areas.

The federal government has been monitoring visibility during haze in national park and wilderness area founded that the haze degrades visibility. The figure 2.2 Shown the Great Smoky Mountains National Park in clear day compare with hazy day.

Source: http://alg.umbc.edu/usaq/archives/2015_07.html

Figure 2.2 The Great Smoky Mountains National Park in clear day vs hazy day.

(2) Environmental damage

Particles can be carried over long distances by wind and then settle on ground or water. Depending on their chemical composition, the effects of this settling may include:

- Making lakes and streams acidic
- Changing the nutrient balance in coastal waters and large river basins
- Depleting the nutrients in soil
- Damaging sensitive forests and farm crops
- Affecting the diversity of ecosystems
- Contributing to acid rain effects.

(3) Materials damage

PM can stain and damage stone and other materials, including culturally important objects such as statues and monuments. Some of these effects are related to acid rain effects on materials (EPA, 2016).

2.3.4.3 Traffic and tourism effect

Forest fire and haze problems occur impacting business travel and business-related services due to the haze problem, such as airlines have to omit some flights by passengers for security reasons. In addition, the impacts on traffic. Highway between the provinces and the news about the amount of haze and dust can affect the quality of air may result in omission of tourists or postpone travel plans go out. (Kasikorn Research Center co., Ltd.). If the haze covered in the northern zone to be continuously until the Songkran and distributed to various provinces in the north. Each year, this will damage the tourist businesses by evaluating a number of tourists and the tourist's expenditures in the range. Only in the province, which is a tourist attraction of Mae Hong Son, Chiang Mai and Chiang Rai, is a key to the problem haze and dust particles will cause the number of. Tourists in the year 2550 in these provinces decreased 25.0% compared to the forecast that the number of tourists visiting these 3 provinces during March- April 2550 is equivalent to 1.05 million, which resulted in all three provinces, this loss will be reduced from current spending of Phuket's tourist attractions to business to the service. Approximately, nearly 2,000 million, or 25.0 per cent decrease, this is

because during the months of March-April every year during long holidays and summer vacation, and the major tourist attractions of the North, especially the Songkran Festival (Thailand-Kasikorn Research Center co., Ltd., 2007).

2.3.4.4 Economic effect

Effects of air pollution, especially in the year which a lot of haze than normally. Contribution to the income to the tourism sector fell unexpectedly. Any range affected by air pollution. If the number of tourism decreased, it will affect to the unemployment of many people.

2.4 The monitoring of health and the environment

2.4.1 The environmental monitoring

Air quality index, as reported in the air quality in a format that is easy the understanding of the general public in order to promote to the public has been alerted to the situation of air pollution in each of the areas that are in any level and health effects of air quality index, which is a universal format that is widely used in many countries such as United States, Australia, Malaysia, Singapore, and Thailand.

The air quality index in Thailand is calculation from the air quality standards in an ambient air. In general, air pollution is 5 types of ozone (O_3) at 1-hour average, nitrogen dioxide (NO_2) at 1-hour average, carbon monoxide (CO) at 8-hour average, sulfur dioxide (SO_2) at a 24-hour average, and particles matter of 10 microns (PM10) at 24-hour average. Air quality index, calculated air pollution substances of any type with the highest value is used as the air quality index of the day.

Air Quality Index of Thailand is divided into five levels ranging from 0 to 300, where each level has a corresponding color level comparison of the impact on health, shown in Table 2.2, the air quality index of 100 is equivalent to normal standard air quality. If the index is higher than 100, shows that the concentration of air pollutants exceeds air quality standards and that day will start with health effects.

Table 2.2 The criteria of the air quality index for Thailand

Value	Air Quality Index Levels of Health Concern	Color	Meaning
0 – 50	Good	Blue	Air quality is considered satisfactory, and air pollution poses little or no risk
51 – 100	Moderate	Green	Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution.
101 – 200	Unhealthy	Yellow	Everyone may begin to experience health effect; members of sensitive group may experience more serious health effects.
201 – 300	Very Unhealthy	Orange	Health alert; everyone may experience more serious health effects.
> 300	Hazardous	Red	Health warnings of emergency conditions. The entire population is more likely to be affected.

The calculation of daily air quality index of each type of air pollutants (i)

Calculated from the concentrations of pollutants from the air, the air quality measurement results data. Calculation formula are as follows:

$$I_i = \frac{I_{ij+1} - I_{ij}}{X_{ij+1} - X_{ij}}\left(X_i - X_{ij}\right) + I_{ij}$$

Where;

X_i = the rounded concentration of pollutant

X_{ij} = the breakpoint that is greater than or equal to X_i

X_{ij+1} = the breakpoint that is less than or equal to X_i

I_i = the index for pollutant

I_{ij} = the AQI value corresponding is less or equal to I_i

I_{ij+1} = the AQI value corresponding is greater or equal to I_i

AQI = Air Quality Index

2.4.2 Health monitoring

The area is experiencing a haze problem is an impact on public health, especially in areas that are experiencing the haze for a long time in which population as sensitivity populations include children, elderly, pregnant women, and people with chronic disease such as respiratory disease, cardiovascular disease, etc., there will be a risk to health of the affected more than other people.

In order to reduce the violence and the morbidity rate of the people in the haze affected areas, the health authorities such as Department of Health, Department of Disease Control, and Pollution Control Department recommended the guidance for taking care and protect the health of people during the haze period should follow to avoid the effects of dust in the air as follows:

1. Avoid live the place with haze or dust. If need to be in place with haze or dust, need to use a mask, which can be obtained at all hospitals or health facilities. If don't have a mask or cannot to obtain, need to use a damp cloth to close mouth and nose instead. For the empty space, should cover crops on soil for reduce the likelihood that dust would float up in the air,

2. Close the door and the window on the way which blew the haze into the house and open the door and the window on the opposite wind direction.

3. Avoid live in areas with haze covered. Especially sensitivity populations such as children, elderly, patients with allergies and asthma.

4. Open fan in the building which the wind blows through the surface water. This reduces the amount of dust in the air.

5. The patient with asthma, heart disease, lung disease, children and the elderly should stay indoors and prepare medicines and equipment needed to be ready.

6. Use water gargle and rinse clean waste per day 3 to 4 times. Don't swallow.

7. Refrain from smoking, and often drinking water in during the haze.

8. Avoid exercise and hard work that much exertion outdoors and the haze area.

9. When an abnormal respiratory system and eyes after inhalation and live in the haze should seek medical attention.

10. Refrain from using rainwater temporarily. If necessary, should using the rainwater after rainfall at least 1 hour before consuming.

11. Do not burn trash, leaves, grass, and debris, as well as helping reduce forest fires.

12. Attention to the news and information from the government.

For people with chronic diseases such as high blood pressure, allergies, should prepare the medication to prevent and treat exacerbations. Despite inevitable pollution from haze. If know how to adapt and protect yourselves reduces the danger of haze and if symptoms such as difficulty breathing, chest pain, should seek medical attention at the nearest hospital or health facilities. (Chantana, 2015).

Table 2.3 The recommendations for public health protection in case of haze situation. Prepared by Department of Health, Department of Disease control, and Pollution Control Department.

24-hour average PM10 levels (m^3).	Air Quality Index Levels of Health Concern	Health Effects	Health protection measures for people
0 – 50	Good	No health effects	Always monitor air quality to protect your health.
51 – 100	Moderate	There are risks to the health of sensitivity population such as patients with cardiovascular disease, and respiratory diseases. - There are health effects in the initial symptoms, including upper respiratory tract. (Coughing, dyspnea), eye irritation	Sensitivity population (elderly, children, pregnant women, patients with cardiovascular disease, respiratory diseases) 1. Always follow the situation to keep up with your health or to avoid a place where there is haze. 2. People at risk should limit their exercise time or reducing strenuous physical activity. 3. Patients with cardiovascular disease or respiratory disease should be noted their symptoms such as Frequent cough, difficulty breathing, or chest pain, irregular heartbeat, nausea, tired easier than usual, or start having headaches and should prepare the necessary medicines and equipment. General population 1. Always follow the situation to keep up with your health. 2. No burning activities

24-hour average PM10 levels (m^3).	Air Quality Index Levels of Health Concern	Health Effects	Health protection measures for people
101 – 200	Unhealthy	<u>There are affected to the health of the people at risk.</u> - There are health effects in the initial symptoms, including upper respiratory tract. (Coughing, dyspnea), eye inflammation, angina, headache, cardiac arrhythmia, nausea, fatigue, fatigue.	<u>Sensitivity population</u> 1. Reduce or reschedule exercise or strenuous activity. 2. Limit activities outside of your home or building. 3. Wear a dust protection mask in case outside the building or area with high dust content. 4. If symptoms are abnormal, consult a physician or go to a public health facility. <u>General population</u> 1. No activities that cause dust, such as no burning all types. 2. Do not use rainwater consumption. 3. Close the window, not to smoke or smoke into the building. 4. Avoid activities outdoor for a long time. 5. If symptoms are abnormal, consult a physician or go to a public health facility.

24-hour average PM10 levels (m^3).	Air Quality Index Levels of Health Concern	Health Effects	Health protection measures for people
201 – 300	Very Unhealthy	<u>There are affected to the health of the people at risk, and risks to the health of general population.</u> - There are affected the health, including the severity of cardiac or respiratory symptoms (cough, dyspnea), eye inflammation, angina, heartbeat, abdominal pain, nausea, tiredness, fatigue, headache, dizziness, blurred vision, pneumonia, asthma. - Patients with heart and lung disease and the elderly have a higher risk of acute heart attack. - Pregnant women are at risk for low birth weight.	<u>Sensitivity population</u> 1. Migration accommodation supplied to the safety or air quality normal. <u>General population</u> 1. Reduce or reschedule exercise or strenuous activity, and limit outdoor activities. 2. Wear a dust protection mask in case outside the building or area with high dust content. 3. If you have difficulty breathing, nausea, fatigue should consult a doctor.

24-hour average PM10 levels (m^3).	Air Quality Index Levels of Health Concern	Health Effects	Health protection measures for people
> 300	Hazardous	There are affected to the health of people at risk and general population. - There are affected the health, including the severity of cardiac or respiratory symptoms (cough, dyspnea), eye inflammation, angina, heartbeat, abdominal pain, nausea, tiredness, fatigue, headache, dizziness, blurred vision, pneumonia, asthma. - Patients with heart and lung disease and the elderly are at increased risk of acute heart attack. - Pregnant women are at risk for low birth weight. - People at risk have acute myocardial infarction or if they have been on long term lung cancer risk. - Death	1. Avoid all kind of outdoor activities. 2. If you have difficulty breathing, nausea, fatigue should consult a doctor. 3. Living in clean building or room without the dust. 4. If the situation continued worsens should be moved to a safe place or regular air quality areas.

Source: Health Impact Assessment Division

2.5 Related policies and measures

Cabinet resolution on measures to prevent pollution and haze from nine northern provinces in 2013

The essence.

1. The framework of measures to prevent pollution and haze from nine northern provinces in 2013 based on the integration of government agencies related such as the ministry of Natural Resources and Environment, the ministry of the Interior, the ministry of Agriculture, the ministry of Transport, the ministry of Defense, the ministry of Health, The ministry of international affairs, the ministry of Education, Prime Minister's Office, the ministry of Information and Communication, and including private and public sector. By using the principles 2P2R are prevention, preparation, response, and recovery.

The objectives are as follow:

1. 1 Prevent and control pollution from haze by focusing on the measures taken to control the burning in the community, agricultural and forest.

1. 2. Strengthen the participation of all sectors to prepare for the haze to occur in 2013.

1. 3. Promote and encourage cooperation in managing transboundary haze pollution in the ASEAN.

1. 4. Reduce and control the situation and prevent haze impacts to public health.

2. Goal is the quality of ambient air, which dust particle size: PM10, are the non-hazardous to the health not less than 90 percent over the period 80 dangerous days (January 21, 2013 to April 10, 2013) in 9 northern provinces, including Chiang Mai, Lamphun, Lampang, Phrae, Nan, Phayao, Mae Hong Son and Tak

3. Measures to prevent pollution and haze from 9 northern provinces. Follow the 2P2R principles include 8 measures include

Measures 1 Control the burning of the first "80 dangerous days"

Measures 2 Prevent and resolve forest fire intensively

Measures 3 Support the community standards of Zero burning village

Measures 4 Promoting the private sector and partnership network to participate in preventing and mitigating pollution from haze

Measures 5 Communications aggressive towards targeted

Measures 6 Alert the situations of haze

Measures 7 Expand cooperation with neighboring countries to reduce transboundary haze

Measures 8 Established the center for the prevention of pollution haze nine northern provinces.

The principle 2P2R measures as follows.

3.1 Prevention, operation to prevent pollution haze from forest fire and burning in the open, in order to reduce the impact on health, social, and economic. The measures consist of

3.1.1) Control the burning range "80 dangerous days."

3.1.2) Prevent and solve the problems of forest fire intensely.

3.1.3) Support "Community standards, zero burning village."

3.1.4) Promote the private sector and partnership network to prevent and solve the haze.

3.1.5) Proactive promote to target group.

3.2 Preparation, integration of information to analyze and command by processing the data of air quality, meteorological data, the number of hotspot. Preparation for the deterrence caused by forest fire and burn in the open. There is also a preparation in alert situation haze for disseminate information to people thoroughly consists of

3.2.1) Prevent and solve the problems of forest fire intensely.

3.2.2) Proactive promote to target group.

3.2.3) Alert the situation of haze.

3.2.4) Expand cooperation with neighboring countries to reduce transboundary haze.

3.2.5) Established the center for the prevention of pollution haze 9 northern provinces, separate into provincial, district, and sub-district.

3. 3 Response, integration by using the single command system to control and incident command in case of haze consists of

3.3.1) Prevent and solve the problems of forest fire intensely.

3.3.2) Alert the situation of haze.

3.3.3) Promote private sector and network to cooperate to prevent air pollution from the haze.

3.3.4) Proactive promote to target group.

3.3.5) Established the center for the prevention of pollution haze 9 northern provinces. the ministry of natural resources and environment and the minister of interior as the chairman.

3. 4 Recovery, operated by the participation of all sectors in the recovery of natural resources, the environment, and health lighten the miseries of population from the haze. Promoting public and partnership networks participation in preventing and solving the problem of pollution from haze.

4. Implementation of measures to prevent and solve the problem of pollution from haze in 9 northern provinces. The relevant authorities need to integrate and coordinate to ensure implementation of the prevention of haze as efficiently and achieve the goals set.

2.6 Information of Nan province

The study of data commonly associated with Nan province. To engage in a report on the results of this study, which are as follows

2.6.1 Location, Size, and borders

Nan is located in the upper north of Thailand. It's 668 kilometers from Bangkok and 200 - 300 meters above sea level. The total area is 11,472. 076 square kilometers or approximately 7,170,045 acres.

Nan administratively divided into 15 districts are Mueang, Wiang Sa, Mae Charim, Na Noi, Tha Wang Pha, Ban Luang, Chiang Klang, Pua, Thung Chang, Na Muen, Bo Kluea, Phu Phiang, Song Khwae, Santi Suk and Chaloem Phra Kiat district.

Source: https:// http://www.guidetothailand.com

Figure 2.3 Map of Nan province

The territory of Nan province

North: consist of Chiang Klang, Pua, Thung Chang, Chaloem Phra Kiat, and Bo Kluea district. There are border special economic zone Xienghone-Hongsa (PDR.Laos)

East: consist of e Phu Phiang, Santi Suk and Mae Charim, Wiang Sa district. There are border Xainabouli province (PDR. Laos).

South: consist of Na Noi and Na Muen district are border Uttaradit province. Na Noi and Wiang Sa district are border Phrae province.

West: consist of Ban Luang district border Chiang Muan district, Phayao province. Tha Wang Pha district border Pong district, Phayao province. And Song Khwae district border Chiang Kham district, Phayao province.

Both North and East are border Laos, the distance is 227 km.

2.6.2 Topography

The general topography is forest and mountain 3 part and plain 1 part. The density of forest and mountain are in the north, northeast, and south of the province. The plain is in the east along with the river. The area is slope from north to south. The general terrain is mostly mountain range complex. The plain suitable for cultivation is less. The important mountains are Phu Wae, Phu Kha, and Doi Ki. The important river is Nan river.

Nan has a total area of 11,472.07 km^2 or 7,170,045 rai, are classified by

1. Forests and Mountain 3,437,500 rai, 47.94 percent of the province
2. Deforested 2,813,980 rai, 39.24 percent of the province
3. Agricultural areas 876,043 rai, 12.22 percent of the province
4. Residential areas and other 43,522 rai, 0.60 percent of the province

Source: https://www.nan.go.th

Figure 2.4 The Topograghy of Nan

2.6.3 Land Used

The land – used practices and land cover structure in Nan province underwent substantial changes. A reduction of the territories occupied by natural forests, with an increase in cultivated lands. The change of land use in Nan Province was the forest area has been decreased for 7.37 percent, and the maize growing area for feeding animals has been increased to 8.15 percent [K. Somsopa et al., 2016]. The change in areas of agricultural lands where the proportion of agricultural lands increased from 7.9 percent in 1995 to 15.3 percent in 2012. In this case, peasants strive to use such fields to grow maize that gives stable yields and produces by fodder maize have increased considerably. Land use and land cover changes are shown in Figure 2.4

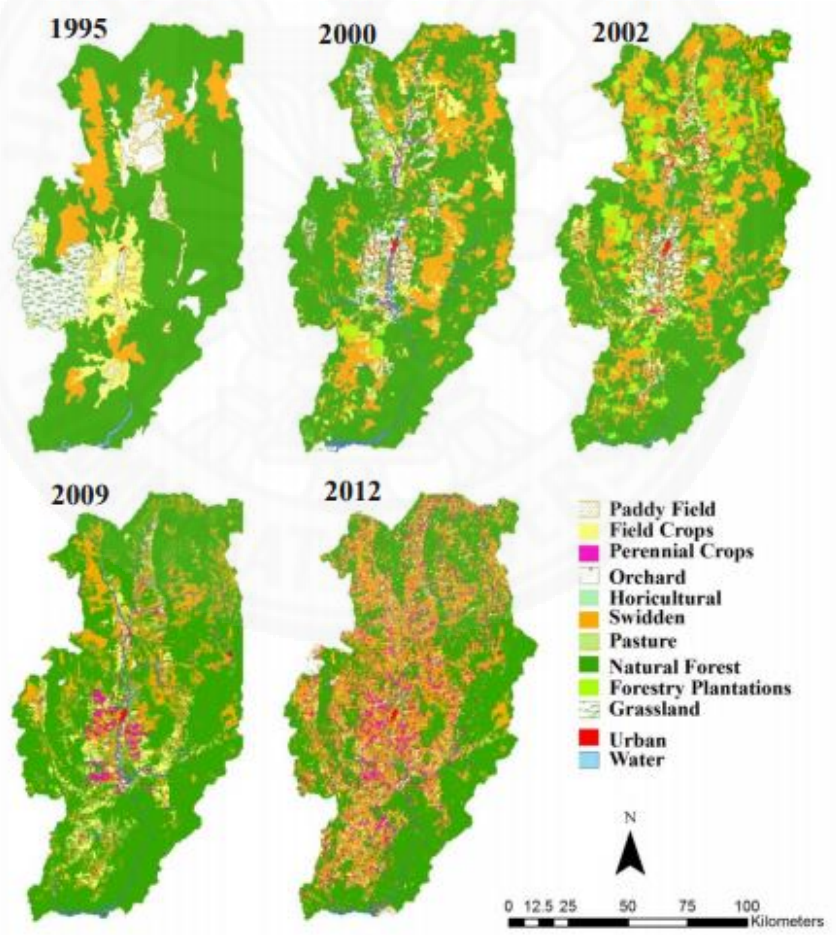


Figure 2.5 Land use and land cover changes in Nan province (1995-2012) (W. Baicha, 2015)

Furthermore, land use changes are much influenced by economic factors, such as an increased need for cash and more access to markets for agricultural products. Cultivation of marketable crops was encouraged by agroindustry companies, so that there occurred an increase in cultivation of field crops, maize in particular. The companies provided farmers with seed, fertilizers and chemicals and purchased their produce at prices not lower than those guaranteed by the State. It is also caused by the government policy through the promotion of cash-crop cultivation and permanent fields. The lack of land rights may force people to clear forest for cultivating because that it is the only way for their survival and slash-and-burn cultivation is probably the best method (W. Baicha, 2015). As shown if Figure 2.4, Increasing cultivation land used cause generates more agricultural waste, and the simple way to eliminate agricultural residues before and after harvesting is burning in the field (Phairuang et al., 2017); Therefore, this situation leads to haze problem in Nan province.

2.6.4 Weather

The weather depends on the influence of the monsoon which blows two seasons. First is the northeast monsoon which blow cold and dry air from China covered Thailand during the winter season. It's making Nan is cold and dry in general. Second is the southwest monsoon which blow moisture and air from the sea and oceans covered during the rainy season (Official website of Nan province, 2016).

2.6.5 Population

The data of population and administrative district of Nan in 2016 from Central Office of Civil Registration Interior Ministry reported population of Nan is 476,036 people, Divided into male 239,612 people and female 236,424 people. The population in each district is shown in Table 2.3

Table 2.4 The Data of population and administrative district of Nan in 2016

No.	District	Male	Female	Total	The number of household
1	Mueang Nan	40,456	39,934	80,390	21,372
2	Mae Charim	7,128	6,728	13,856	3,761
3	Ban Luang	5,961	5,831	11,792	3,851
4	Na Noi	15,199	15,156	30,355	9,890
5	Pua	27,008	26,984	53,992	15,301
6	Tha Wang Pha	22,917	22,786	45,703	13,750
7	Wiang Sa	34,125	33,701	67,826	23,361
8	Thung Chang	7,720	7,545	15,265	4,807
9	Chiang Klang	,986	8,952	17,938	5,528
10	Na Muen	7,477	7,186	14,663	4,375
11	Santi Suk	8,137	7,730	15,867	4,868
12	Bo Kluea	7,678	7,321	14,999	4,580
13	Song Khwae	6,346	5,932	12,278	3,561
14	Phu Phiang	18,087	18,011	36,098	12,673
15	Chaloem Phra Kiat	5,012	4,802	9,814	3,225
Total		239,612	236,424	476,036	146,572

Source: National Statistical Office of Thailand, the data as of October 2016

The research area is Mueang district. Population is 80,390 people, divided into male 40,456 people and female 39,934 people.

2.6.6 Occupations

Gross Provincial Product (GPP) on the gross domestic product by the year 2008 in the gross domestic product, equivalent to 24,263 million baht. In agriculture 38.23 percent, followed by retail and wholesale trade 12.15 percent with an average income per capita was 49,827 baht per person per year. Most of the population of the province are farmers including cultivation and domesticate animal. The handicraft and weaving are the second career.

Agriculture is the main occupation of the province. The major agricultural are cultivation, animal husbandry, fishery and forestry. The main cultivation are rice, corn, cotton, and tobacco. The main fruits are durian and mangos teen. For animal husbandry mainly adopted homes to consume and use labor rather than to trade. The animal farmers popular culture is chicken, pig, cattle, and duck.

Industry, mostly in household or handicraft include making Mauhom (Thai indigo), Teak furniture, and wood carving.

Commercial, mostly small businesses and the business sector to purchase agricultural products such as corn, soy, shellac, and other crops. As well as wholesale and retail consumer products. (Official website of Nan province, 2016)

2.6.7 Haze situation of Nan province

The haze situation in Thailand since February of 2013 - 2015 in the upper North of Thailand. The haze density is a wide area. The main causes from burning in the open, solid waste burning in the community, burning of agricultural waste such as stubs, rice straw for agriculture, and forest fire. The air quality monitoring in the atmosphere by pollution control department found that the particulate matter smaller than 10 microns (PM 10) average 24-hours was exceed the standard, which more effect to people and visibility in communication and transportation, both land and air.

The situation of forest fires and the haze problem of Nan province was intensifying. Nan province is regarded as an area that is experiencing the haze and forest fires in the increasingly each year and more affect the health of the public. It's also affecting agriculture, which is the main occupation of the population in Nan. Forest fire and haze have huge amount of PM particle continuously. The topography of Nan is the pan basin, dry weather conditions, and still include high air pressure that covered. Making the dust suspended in the atmosphere. Affect to environmental quality, economic, business of tourism, and the health of people living in the specific area causing respiratory diseases, haze problem is a visibility to transportation, both land and air. The severity of haze during the dry season from February to April of every year. So, Forest fires take place in Na Muen, Na Noi, Wiang Sa, Mueang Nan district. For Mae Charim, Phu Phiang, and Wiang Sa district have smuggled of forest fires, both day and night. There are cause of accumulated a lot of haze and covered in wide area.

So, it's causing the increase in patients with respiratory. The results of monitoring the air quality in the atmosphere of the pollution control department found the quantity of dust smaller than 10 microns (PM 10) average 24-hour was exceed the standard, which affects the health of the population and visibility to transportation, both land and air.

In 2016, the situation of haze and forest fire in Nan province is continues to spread and the pollution value was high. Therefore, open integrated prevention and solve the problem of haze and forest fire in the area of upper northern provinces. Enhance the training plan about protection and solve the problem of haze and forest fire in Nan. As a practicing procedure to obtain emergency forest fire situation, preparation of command experience situation, coping with emergencies in the haze situation, and the prevention of forest fire and haze problem for reduce the loss of life and property of the people (Nan Provincial office of Natural Resources and Environment Nan, 2016)

Chapter 3
Research methodology

In order to achieve the objectives of the study in assessing the awareness and acknowledge on health protection during haze crisis at Mueang district, Nan province, the study follow the methodology described below. The methodology is divided into 5 sections as followed.

3.1 Secondary data

3.2 Study site selection

3.3 Respondents selection

3.4 Tools Development

3.5 Data collection and analysis

3.6 Recommendation development

3.1 Secondary data

This research study about health impacts from haze situation in northern Thailand from monitoring report of the effect of haze on health from haze in the upper north of Thailand during haze in 2016. The data were collected from health care institutions in 8 upper northern provinces in Jan – May 2012 until present year.

3.2 Study site selection

The haze in northern Thailand is caused by a combination of factors. The burning of agricultural residues is the main reason. Slash and burn farming techniques have been common over the centuries in the northern region of Thailand as well as neighboring Burma and Laos. Some years, the smoke from the fires lingers because of climatic conditions. Lower than usual humidity levels, lack of wind and higher than average summer temperatures can all combine to exacerbate the effects of the pollution. Because of the topography of northern Thailand, the mountains tend to hem in the smoke which nestles in the valleys below. The smoke and haze affect number 8

provinces in northern Thailand. As the major city in the north, Chiang Mai often makes the headlines during what some experts call the 'smoky season'. Although the haze is a real problem throughout Chiang Mai province, official statistics over the years show that the pollution is usually more severe in the provinces of Mae Hong Son, Chiang Rai, Lampang, Lamphun, Phrae, Phayao and Nan.

The situation of forest fires and the haze problem of Nan province was intensifying every year. Nan province is regarded as an area that is experiencing the haze and forest fires increasingly each year and more effect on health of the population.

In Nan, forest fires take place in Na Muen, Na Noi, Wiang Sa, Mueang Nan district. For Mae Charim, Phu Phiang, and Wiang Sa district both day and night. These are causes of accumulated of haze and covered in wide area. Therefore, the number of patients affected with respiratory disease also increased.

Study site

Muang Nan district is one of 15 districts of Nan province with an area of 919 Km2. The area is surrounded with mountains and forests, while the flood plain area can be found along the Nan river bank. This flood plain area locates 200-300 meters above mean sea level. When see from top view the district is surrounded by mountains and forests and flood plain in the central valley.

Location and territory.

District office of Mueang Nan is located 4.3 kilometers away from City Hall and 668 kilometers from Bangkok. The territory of distance as follows;

North borders Pong district (Phayao province), Tha Wang Pha, and Santi Suk district (Nan province).

South borders Wiang Sa district (Nan province).

East borders located nearby Phu Phiang district (Nan province).

West borders Ban Luang district (Nan province).

Nan Province has a tropical savanna climate. Temperatures rise until April, which is very hot with the average daily maximum temperature at 37.0 °C (98.6 °F). The monsoon season runs from late April through October, with heavy rain.

The district is subdivided into 11 sub-districts, which are Nai Wiang, Bo, Pha sing, Chai Sathan, Thuem Tong, Rueang, Na Sao, Du Tai, Kong Khwai, Bo Suak, and Sanian sub-district.

As of October 2016, the population of Mueang district are 80,390 people, divided into male 40,456 people and female 39,934 people.

Source: https://en.wikipedia.org/wiki/Mueang_Nan_District

Figure 3.1 Boundary map of Mueang Nan district

3.3 Respondents selection

Number of respondents in the study area have been identified based on the statistic of population in Mueang Nan district.

Population and sample size

The representative communities in research are people in Mueang district with the total population of 80,390 people.

The number of respondents in each sub district depends on the population of the area. The population of each sub-district is shown in Table 3.1

Table 3.1 The population of Mueang district, Nan province.

No.	Subdistricts	Male	Female	Total
1.	Nai Wiang	9,310	9,319	18,629
2.	Bo	2,257	2,137	4,394
3.	Pha Sing	2,406	2,419	4,825
4.	Chai Sathan	4,102	3,449	7,551
5.	Thuem Tong	1,692	1,747	3,439
6.	Rueang	2,421	2,491	4,912
7.	Na Sao	1,788	1,833	3,621
8.	Du Tai	4,087	4,399	8,486
9.	Kong Khwai	2,624	2,750	5,374
10.	Bo Suak	3,316	3,299	6,615
11.	Sanian	6,453	6,091	12,544
	Total	40,456	39,934	80,390

* the data as of October 2016

Sample size.

The size of sample can be calculated by the formula of Taro Yamane (1967), with the confidence level of 95%, and the significant level is 0.05

The formula to calculate the sample size is as follows

$$n = \frac{N}{1 + Ne^2}$$

Where; n = The number of sample

N = Total population

e = The level of significant (allowable error)

For the study, the sample size will calculate as follows;

$$n = \frac{N}{1 + Ne^2}$$

$$n = \frac{80{,}390}{1 + (80{,}390)(0.05)^2}$$

$$n = \frac{80{,}390}{201.975}$$

$$n = 398$$

From the calculation, the total of sample size is 398 people. So, the number of questionnaires were 400 copies for this research.

The number of respondents in each sub district depend on the number of population in each sub districts. They are calculated from total population of Mueang district. The number of respondent in each sub-district is shown in Table 3.2.

Table 3.2 The distribution of population and the number of respondent in each sub districts.

No.	Sub-districts	Population	Proportion of population (%)	The number of respondent
1.	Nai Wiang	18,629	23.17	96
2.	Bo	4,394	5.47	21
3.	Pha Sing	4,825	6.00	32
4.	Chai Sathan	7,551	9.39	39
5.	Thuem Tong	3,439	4.28	17
6.	Rueang	4,912	6.11	24
7.	Na Sao	3,621	4.50	18
8.	Du Tai	8,486	10.56	42
9.	Kong Khwai	5,374	6.68	26
10.	Bo Suak	6,615	8.23	32
11.	Sanian	12,544	15.60	62
	Total	80,390	100	409

The questionnaires will be distributed to sub-districts follow the number of respondents which was calculated from the proportion of population in each sub-district.

3.4 Tools Development

The tools use to collect data in this study is questionnaire (Closed Ended Question) and interview with people in Mueang district.

The questionnaire was divided into 5 sections, as follows:

Section 1: This question included questions to obtain are name, age, gender, education level, occupation, chronic medical history related with haze.

Section 2: This question included in this section were aimed to understanding of the impact of haze on health problems. Each question used rating scale of 5 levels consisting of strongly agree, agree, neutral, disagree, and strongly disagree. There are 25 questions which are divided into 6 groups as follows:

1. Causes of haze
2. Health impact from haze
3. Period of exposure to haze
4. Understanding of health protection from haze
5. Risk of health problems on the population at risk
6. Health monitoring

Section 3: The questions in this section is about the practice in health protection during haze period. The questions asked about behavior and practices during haze period. In case that respondents do not practice health protection measure. they will be asked to provide reason of not compiling with health protection recommendation. The questions are grouped into 3 aspects, as follow;

1. Personal protection. (both indoor and outdoor)
2. Indoor prevention
3. Reduction of open burning

Section 4: Effects of haze situation for the respiratory system

Section 5: The recommendations to the research.

The questionnaire was shown in the appendix A.

3.5 Data collection and analysis

The research is both qualitative and quantitative study. The research area is Mueang district, Nan province. The procedure as follow;

3.5.1 Collect data by using questionnaire and interview of respondents.

Researcher meet with community leaders and explain the objective of the research. Distribution of questionnaires were done after the discussions with villager.

Figure 3.2 Collected the data and interview with respondents

3.5.2 Analysis data from collected questionnaires.

Data collected were analyzed using SPSS statistical analysis, factors or reasons that caused respondents to avoid health protection measure were analyzed. The analysis of data was shown in appendix B.

3.6 Recommendation development

From analyzed data, the development of recommendation for local community to prevent health impact from haze problem. The majority of respondents know how to practice on health protection but some recommendation that the public health authority recommended for protecting health is not available and not convenient to follow because of the limitation of daily life and the occupation of people in research area. If the recommendation for health protection measures will be develop as more appropriate with the life style of the local people in the area with haze, so the number of patients from the haze will decrease as well.

Chapter 4
Results and discussion

This chapter describes result of the study in the following section:

4. 1 The monitoring report of the effect of haze on health from haze in the upper north of Thailand during haze in 2016.

4.2 The results of general information and haze experience of respondents.

4.3 The results of knowledge and understanding on haze and effect of haze on health.

4. 4 The results on practicing on health protection measure of the respondents during haze.

4. 5 The operation plan for 2016 to prevent and solve the Haze Problem in the Northern Region.

4.6 The comparison between the recommendations for public health protection in case of haze situation with health protection behavior of population during haze.

4.7 Health protection measures from other studies

4.8 The recommendation development.

4.1 The monitoring report of the effect of haze on health from haze in the upper north of Thailand during haze in 2016.

Since 2010, the crisis of air pollution from forest fire and the high-pressure condition in the dry season in the upper northern region of Thailand were increasing every year. The Office of Disease Prevention and Control 10 and 8 of public health network offices had jointly for monitored the illnesses that may be associated with haze condition.

The health situation in 2016, considering the occurrence of disease throughout the 4 months or 17 weeks during haze, founded that the total number of patients in 4 monitored diseases was 1,117,683 persons. It's was 19,671.35 patients per 100,000 population. The highest recorded was found from all types of cardiovascular

diseases with 11,061.69 patients per 100,000 populations, followed by all types of respiratory diseases with 7,265.26 patients per 100,000 population. Dermatitis diseases was reported the 3rd highest at 707.23 patients per 100,000 population. Inflammatory eye was reported the 4th highest at 637.18 patients per 100,000 population. Data on number of patients affected by haze each disease in northern provinces are shown in Table 4.1

Table 4.1 The number and the monitored diseases morbidity rate of patients for monitored disease in 8 upper northern provinces from Jan, 3 to April, 30, 2016.

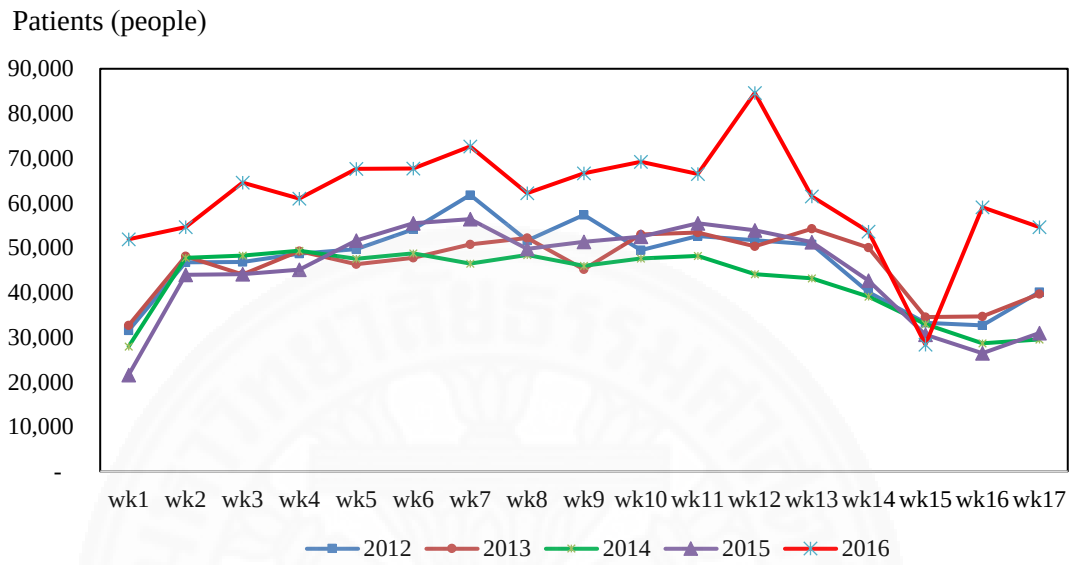
Provinces \ Diseases		Inflammatory eye	Cardiovascular	Respiratory	Dermatitis	Total 4 diseases
Chiang Mai	Patients	11,237	177,171	110,857	10,959	310,224
	Morbidity rate	678.71	10,701.0	6,695.71	661.92	18,737.3
Lamphun	Patients	2,872	62,364	43,191	4,046	112,473
	Morbidity rate	709.71	15,410.9	10,673.0	999.82	27,793.5
Lampang	Patients	3,626	96,138	54,912	4,599	159,275
	Morbidity rate	479.12	12,703.0	7,255.71	607.68	21,045.5
Mae Hong Son	Patients	1,739	22,800	18,002	2,343	44,884
	Morbidity rate	711.67	9,330.65	7,367.12	958.85	18,368.2
Chiang Rai	Patients	5,902	106,398	82,556	7,655	202,511
	Morbidity rate	491.66	8,863.38	6,877.24	637.69	16,869.9
Phayao	Patients	5,216	44,326	42,910	4,791	97,243
	Morbidity rate	1,068.59	9,080.96	8,790.87	981.52	19,921.9
Phrae	Patients	1,874	64,174	28,208	3,022	97,278
	Morbidity rate	412.70	14,132.6	6,212.08	665.52	21,422.9
Nan	Patients	3,737	55,130	32,160	2,768	93,795
	Morbidity rate	782.33	11,541.3	6,732.64	579.48	19,635.8
Total	Patients	36,203	628,501	412,796	40,183	1,117,68
	Morbidity rate	637.18	11,061.6	7,265.26	707.23	19,671.3

Source: Health monitored system from haze.

This section can be founded in Nan province as well

For Nan province, the highest number of patients was found in cardiovascular diseases with 11,541.37 patients per 100,000 population, and followed by respiratory diseases with 6,732.64 patients per 100,000 population.

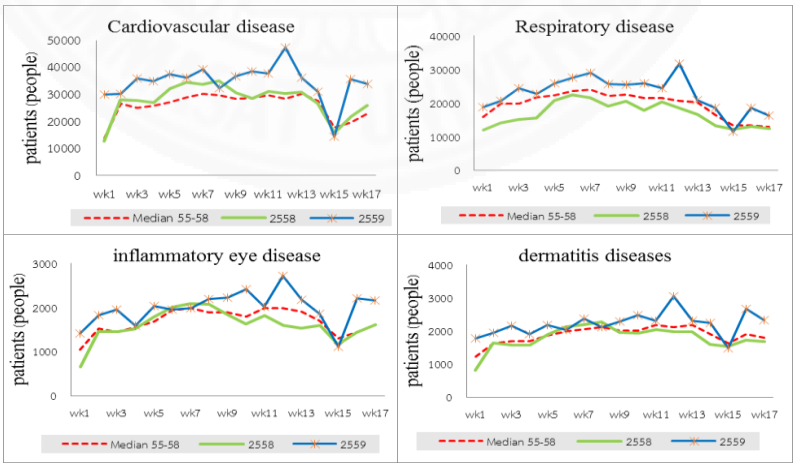
The number of patients in 2016 compared with the data during the last 4 years was in similar trend. However, record of higher number of patients, especially in week 12. (Figure 4.1)



Source: The Office of Disease Prevention and Control 10,2016

Figure 4.1 The number of patients that affected on health during the haze in the 8 provinces in the upper northern, during 2012 – 2016

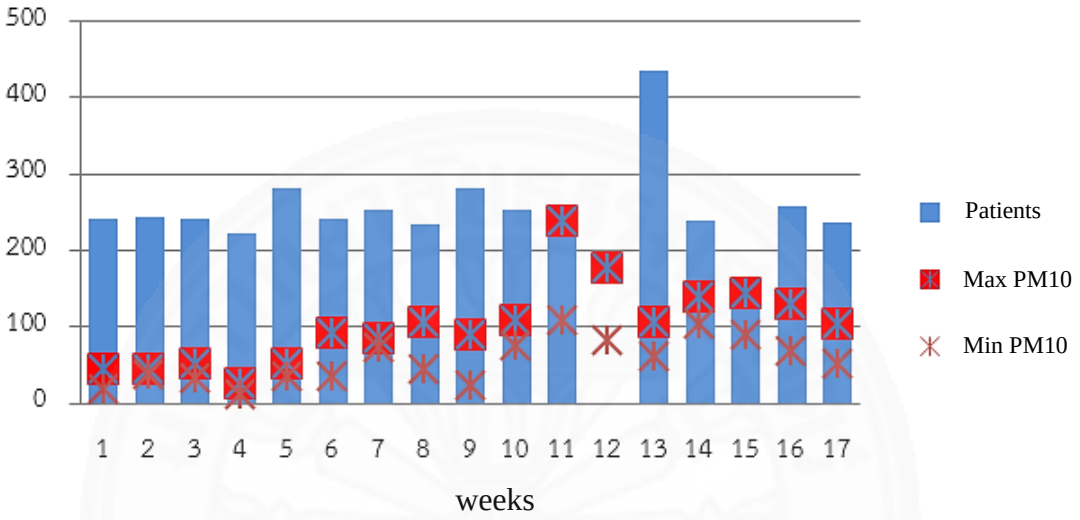
Considering separated by the diseases found that all of 4 monitored diseases had the number of patients more than the median throughout the haze. (Figure 4.2)



Source: The Office of Disease Prevention and Control 10,2016

Figure 4.2 The number of patients with monitored diseases during haze in the 8 upper northern provinces separated by weekly in 2016, in comparison with 2015 and the median during 2012 - 2015.

However, when look at data of patients with asthma and Chronic Obstructive Pulmonary Disease (COPD) in Nan province, in comparison with level of PM10 measured by Pollution Control Department (PCD) found that the level of PM10 and the number of patients had the same direction. As the level of PM10 raised, the patients are increase.



Source: The Office of Disease Prevention and Control 10,2016

Figure 4.3 Number of patients with asthma and Chronic Obstructive Pulmonary Disease (COPD) that were monitored during haze in Nan province in 2016, in comparison with amount of PM10 at Nai Wiang sub district station.

4.2 The results of general information and haze experience of respondents.

This section presents, analysis of data from 409 questionnaires collected.

The general information included gender, age, education level, occupation of the respondents is shown in Table 4.2.

Table 4.2 General information of respondents.

	N (numbers)	%
Gender		
Male	158	38.6
Female	251	61.4
Age		
< 15	4	1.0
15 - 59	297	73.0
> 60	106	26.0
Education level		
Elementary school and below	206	51.2
High school	99	24.7
Certificate school	34	8.4
Bachelor degree and above	63	15.6
Occupation		
Farmers	49	12.0
Merchant	115	28.2
Hired labor	63	15.4
Government officer / State enterprise employee	64	15.7
Others e.g. students, no job, etc.	117	28.7

The majority of respondents are female (61.4percent) and age of 15 – 59 years old (73.0 percent).

The questions about education level founded that the highest education level was in elementary school (30 percent). Followed by bachelor degree at 22.2 percent.

Majority of respondents are merchant and followed by government officers or state enterprise employee, and hired labor about 28.4, 15.7, and 15.4 percent. respectively

The haze causing experience of respondents include burning of agricultural waste, burning of waste in the household or community, and burning the forest for finding some food. The majority of respondents was never doing any activities that cause the haze (80 percent). The other fractions are show in Figure 4.5

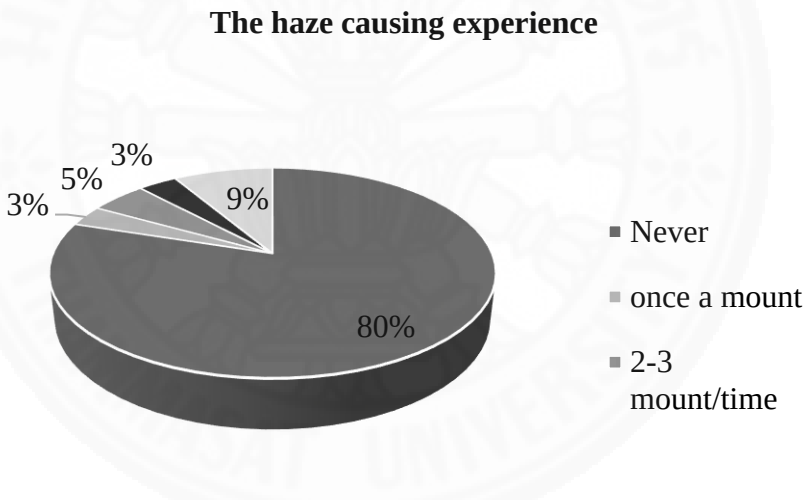


Figure 4.5 The frequency of burning activities of respondents.

Among the respondents who had burning activities 8.6 percent burn once a year. This may result from "Zero burning policy" of the government.

The Zero burning policy prohibit the burning of agricultural biomass 60 days during the haze period. The aim of zero burning policy was to reduce the origin of haze in the community. Moreover, if anyone violates the regulation, they will be fined based on the rate agreed in each village.

Over the past 5 years (2011 - 2016), 71 percent of respondents have experienced on haze situation. Most of respondents found that haze create many

problems including respiratory problem, eyes irrigation, and disturbing of daily life activities. Especially, health effects from haze is the most important problem during haze period (65.3 percent). The percentage of effect that respondents suffer from haze situation is shown in Figure 4.6

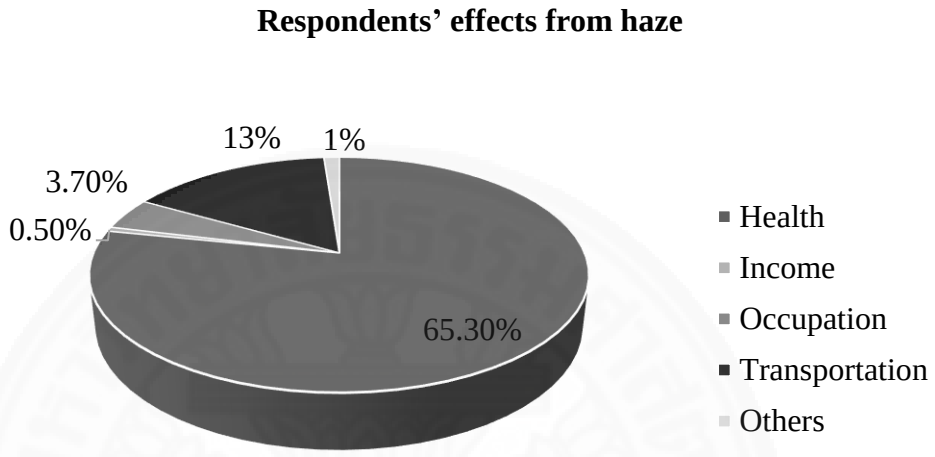


Figure 4.6 The percentage of effect that respondents suffer from haze situation.

This term of medical history of the three monitored diseases, the highest disease was found in respiratory diseases, there were 43 patients separate in haze period 24 person and another period 19 person. Follow by cardiovascular diseases, 13 patients, Nervous system disease was recorded for 1 patients in others period. (shown in Figure 4.7)

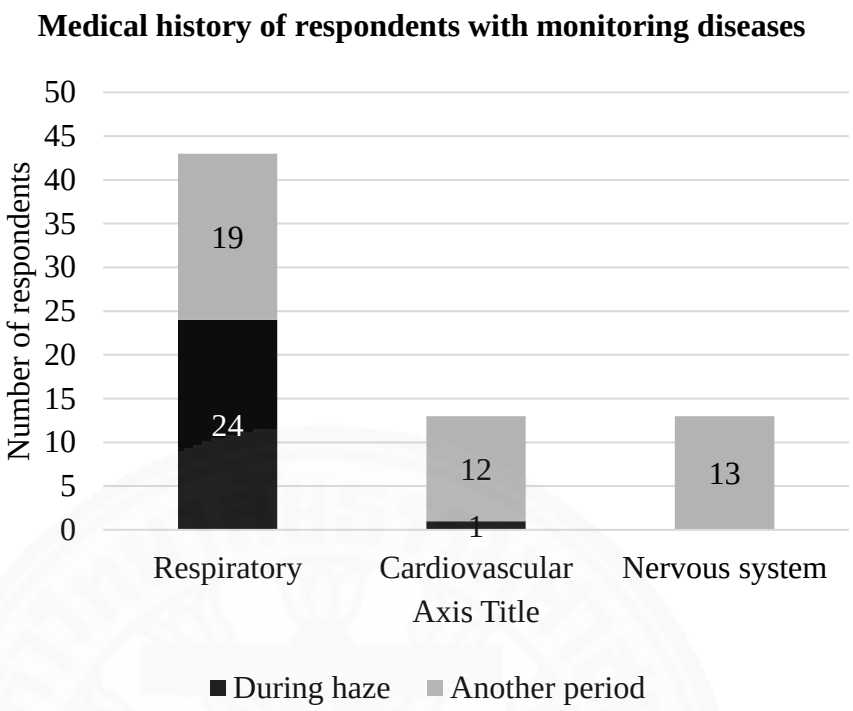


Figure 4.7 The number of respondents that having a medical history with monitored diseases.

This is in consistent with the monitoring in the upper north of Thailand during the haze in 2016, which respiratory diseases and cardiovascular diseases were the top two of monitored diseases of haze.

4.3 The results of knowledge and understanding on haze and effect of haze on health.

This section analyzes information about knowledge and understanding on haze situation and health effects caused by the haze. The questions were divided into 6 aspect included causes of haze, health effects when exposed to haze for a long time, the severity on health effects of exposure to haze, health protection in haze period, the severity on health in sensitivity population, and the monitored on health during the haze. Each question used rating scale of 5 levels; 5 means strongly agree with the issues, 4 means agree with the issues, 3 means neutral, 2 means disagree with the issues, and 1 means strongly disagree with the issues, as follow;

Aspect 1: Cause of haze

This aspect asked about knowledge and understanding on causes of haze. The average score of this aspect are shown in Table 4.3, considering in each issue founded that the respondents though burning from farming, gardening, preparing the area for agriculture is the major cause of haze with 4.29 score. The second main cause is burning the forest to find some food and take a benefit of burned forest with 4.04 score. Burning garbage in household or community is the third one with 3.14 score because at present they have waste collected service from municipality office. Haze occurs naturally is the least score of this aspect but it is a correct, since very little chance that the smog is formed naturally.

Table 4.3 The average score of knowledge and understanding about cause of haze.

Knowledge and understanding on haze	Average
Aspect 1: causes of haze	
1.1 Occur naturally	2.26
1.2 Burning garbage in household / community	3.14
1.3 Burning from farming, gardening, preparing the area for agriculture	4.29
1.4 Burning the forest	4.04

From the interview and discussion with the respondent, they know that the main cause of haze situation is burning of agricultural waste after farming season and preparing area for farming in the next season.

In addition, the main occupation of Nan is farmers, so the simple way to eliminate the waste from farming is burning because it is easy and cheap. Haze that affect Mueang Nan district usually come from another area such as burning agricultural waste from villages on mountain and then the haze flow into Mueang district. The haze which generate in local area is from factory in community such as silo plant at Chai Sathan sub district. The local factory and silo plant are shown in Figure 4.8

(a) Silo plant at Chai Sathan sub district.

(b) Local factory at Du Tai sub district

Figure 4.8 The local factory in Mueang district

Aspect 2: Health effects during the haze.

This aspect is talking about health problem and diseases cause by haze. As the average score of this aspect are shown in Table 4.4, respiratory disease is the highest score that the respondents though it is major health hazard from haze with 4.44 score. Follow by symptoms of the eyes such as eyes inflammation, and symptoms of asthma, shortness of breath, fatigue, and angina with 4.23, and 4.14 score, respectively. The respondents agreed with these 3 health effects are the most important issue because this symptom happen easily and many people have background on it. For diseases of skin with 3.25 score and cardiovascular disease with 3.18 score. The reason these 2 health effects are getting lower scores because they are not sure that if exposure to haze, they will get these 2 symptoms.

Table 4.4 The average score of knowledge and understanding about health effects during the haze.

Knowledge and understanding on haze	Average
Aspect 2: health effects during stay in the haze for a long time	
2.1 Respiratory disease	4.44
2.2 Diseases of the skin	3.25
2.3 Cardiovascular disease	3.18
2.4 Symptoms of asthma, shortness of breath, fatigue and angina.	4.14
2.5 Symptoms of the eyes, such as eye inflammation	4.23

Aspect 3: The hazard on health effects of exposure to haze.

Respondents were asked to compare between exposure to low concentration for a long-time and exposure to high concentration for a short time, which is more harmful. As The average score of this aspect are shown in Table 4.5 show that the respondents thought that the exposure to haze with high concentration for short time is more harmful with 4.12 score because it can cause acute health problem. In addition, the respondents told that if we stay in place with haze for a long time, the haze will accumulate in the body, so it can cause of health problem as well.

Table 4.5 The average score of knowledge and understanding about hazard on health when exposure to haze.

Knowledge and understanding on haze	Average
Aspect 3: the severity on health effects of exposure to haze	
3.1 Exposure in small quantities for a long time	4.12
3.2 Exposure in large quantities for a short time	3.89

Aspect 4: Health protection measures during haze period.

This aspect asked the respondents about the protection measures from haze. The average score of this aspect (Table 4.6) show that the respondents quite agree with these health protection measures with the nearly score. For the measure on do not use rainwater to consumer is the lowest score with 3.63 that the respondents agree to practice during haze because the majority of respondents use tap water for consumption, so they though this measure is not necessary to practice.

Table 4.6 The average score of66ss knowledge and understanding about health protection measures during haze.

Knowledge and understanding on haze	Average
Aspect 4: health protection in haze period	
4.1 Avoid doing activities outdoor, including strenuous activity, and limit outdoor activities	3.77
4.2 Using damp cloth cover nose and mouth, and change or wash it every 4 hours	3.76
4.3 Drink a lot of water or saline gargling to prevent a sore throat	3.79
4.4 Avoid smoking	3.79
4.5 Do not use rainwater to consumer	3.63

Aspect 5: The hazard on health in sensitivity population.

This aspect asked the respondents about sensitivity including children age 1 – 12 years old, elderly age more than 60 years old, pregnant woman, and patients with monitored disease. As the average score of this aspect are shown in Table 4.7 founded that elderly is the highest score which the respondents agree that is the most significant to exposure to haze with 4.5 score. Follow by Patients with respiratory disease, children, and pregnant woman with 4.41, 4.35, 4.12 score, respectively. As for patients with cardiovascular disease, and patients with nervous system with 3.90, and 3.41 score

respectively is the two lowest score of this aspect because the respondents though that these sensitivity population is not related with haze.

Table 4.7 The average score of knowledge and understanding about hazard on sensitivity population

Knowledge and understanding on haze	Average
Aspect 5: the severity on health in sensitivity population	
5.1 Children age 1 – 12 years	4.35
5.2 Elderly age 60 year and older	4.50
5.3 Pregnant woman	4.12
5.4 Patients with cardiovascular disease	3.90
5.5 Patients with respiratory disease	4.41
5.6 Patients with nervous system	3.41

Aspect 6: The monitoring on health during the haze.

This aspect asked about health monitoring measures during the haze such as the observation abnormalities in the family and go to consult the doctor or public health center, and listen about haze notification closely. Most respondents agree with observe abnormalities of the family, go to see the doctor or go to a public health center if find some abnormalities. And track the news and information from the government closely with 4.22, and 4.27 score, respectively. The average score of knowledge and understanding monitoring on health during haze are shown in Table 4.8

Table 4.8 The average score of knowledge and understanding monitoring on health during haze.

Knowledge and understanding on haze	Average
Aspect 6: the monitoring on health during the haze	
6.1 Observe abnormalities of the family, and go to consult a doctor or public health center.	4.22
6.2 Listen to the news and information from the government closely.	4.27

4.4 The results of practicing on health protection measure of the respondents during the haze.

This section analyzes awareness and experience on health protection measures during the haze of the population in the research area. The result of awareness and knowledge about health protection measure founded that most of the respondents know about how to practice for protect their health in haze period (85.57 percent). The details are shown in Figure 4.9

Percentage of respondents know about health protection measures from haze

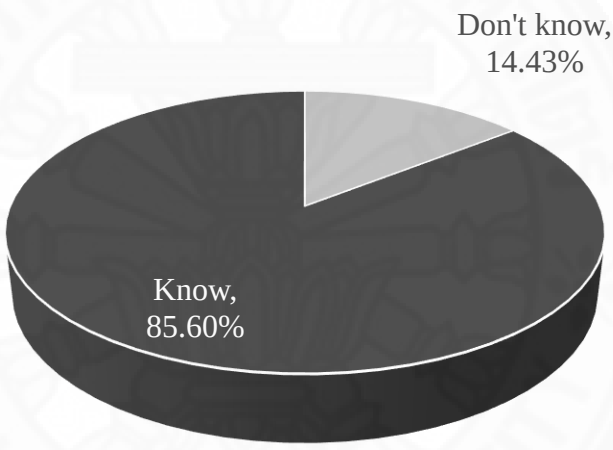


Figure 4.9 The percentage of knowledge about how to protect their health from haze.

Majority of the population in the research area know how to protect health problems from the haze situation. Further studies were used to see that when the population know how to practice health protection measure during the haze, do they actually practice those measures or not.

The results are divided into 3 parts, personal protection, indoor prevention, and reduce burning in the open air as follows;

4.4.1 The result of personal health protection measure.

The measure that majority of population in this research area failed to practice was “avoiding from doing activities outdoors”. This also includes exercise and work because most of the respondents are merchant, government officers and farmer. They need to work outdoor. The other recommendation that people do not practice in health protection is using a wet mask cover the nose and mouth and changing of wet mask every 4 hours because of inconvenience in wearing, difficulty in breathing, and not available to wash and change the wet mask every 4 hours. So, they choose to use the hygiene mask instead of wet mask because it is more convenience, but it is no more performance to protect particular matter entre the respiratory system by inhalation. The others personal health protection measure shown in Figure 4.10

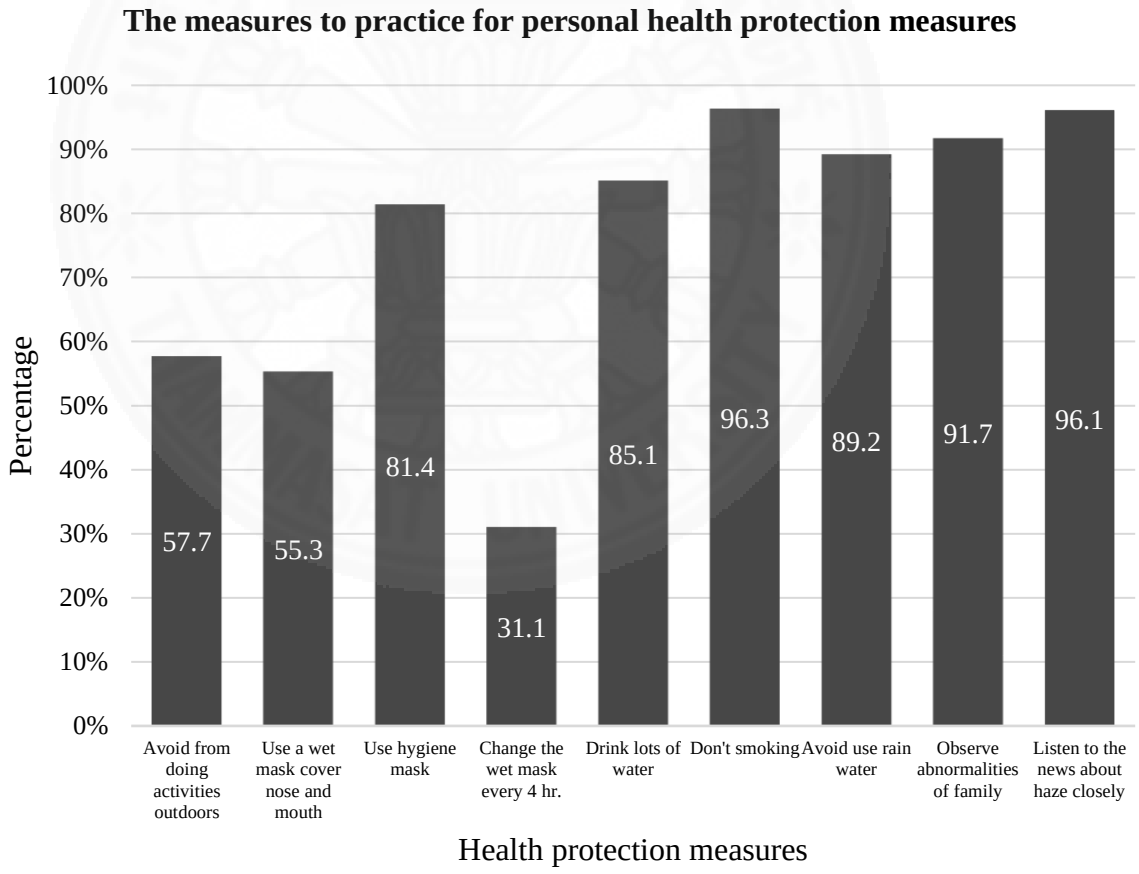


Figure 4.10 The percentage of practice on personal health protection measure

According to the practice of health protection measures from haze, most respondents began to protect their health when the haze season begin and the could notice the haze for before getting health problem. The others beginning time to protect the health are shown in Figure 4.11

Time to begin for protecting health from haze

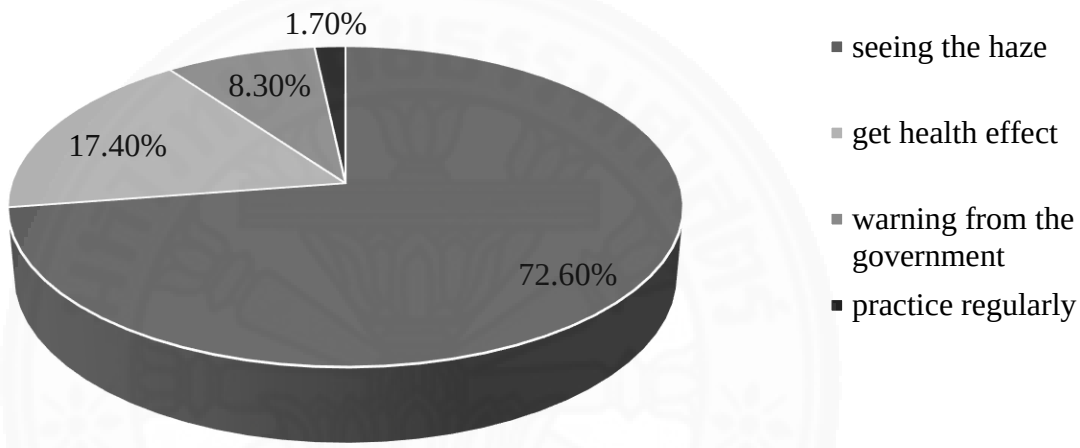


Figure 4.11 The percentage of beginning time to protect the health of respondents.

4.4.2 The result of indoor prevention measures.

The recommendation that most people do not follow is to installation an air filter in the house. The reason of not following are the cost of air filter that is expensive, and they have no more space for installing the filter. In addition, making the wet curtain for trapping the dust is one of measure that they do not follow because they think it is complicated method and they have no time to practice this method. The percentage of each practice for indoor preventing are shown in Figure 4.12

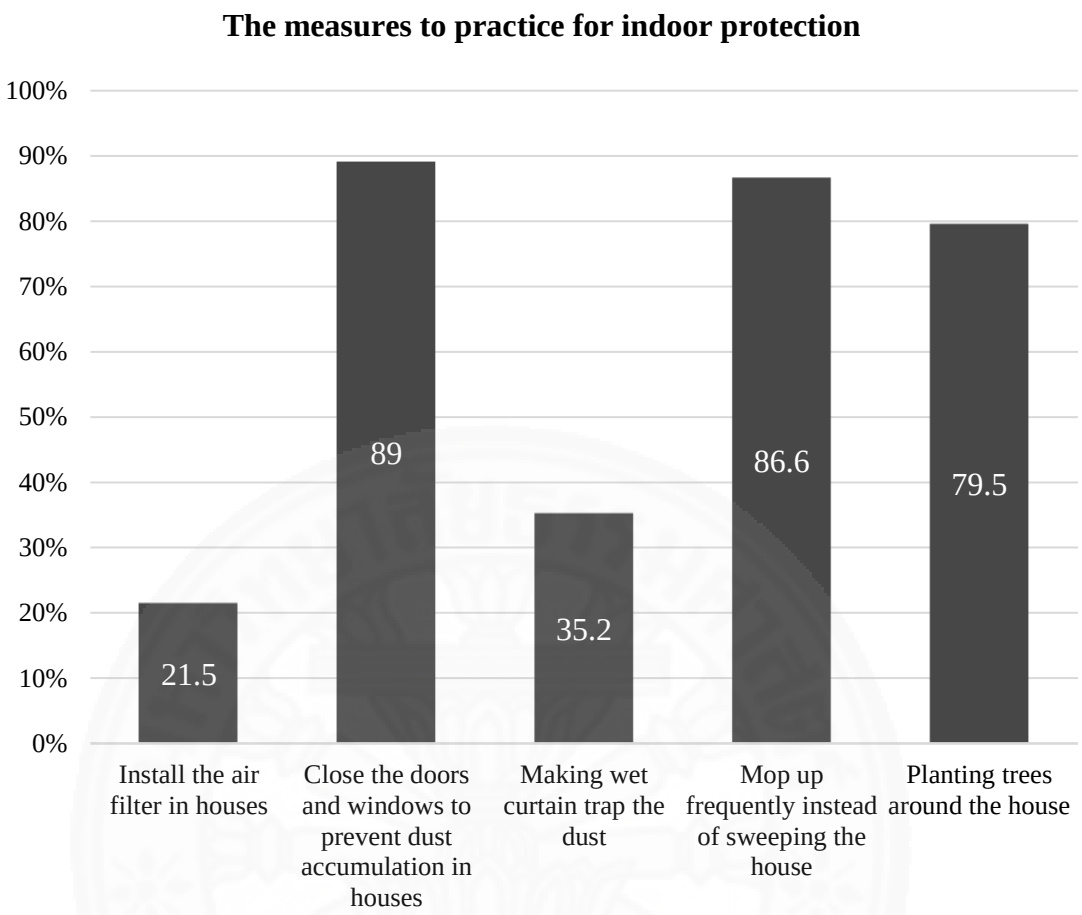


Figure 4.12 The percentage of practice on indoor prevention measures

4.4.3 The result of reduce burning in the open area.

On the awareness of reduce burning in the open area. Most respondents cooperate in the cessation of burn because in each sub district have the measures to control and prevent burning in the haze period. And they are aware of the impact of the haze crisis to themselves and society. The percentage of practices are show in Figure 4.13

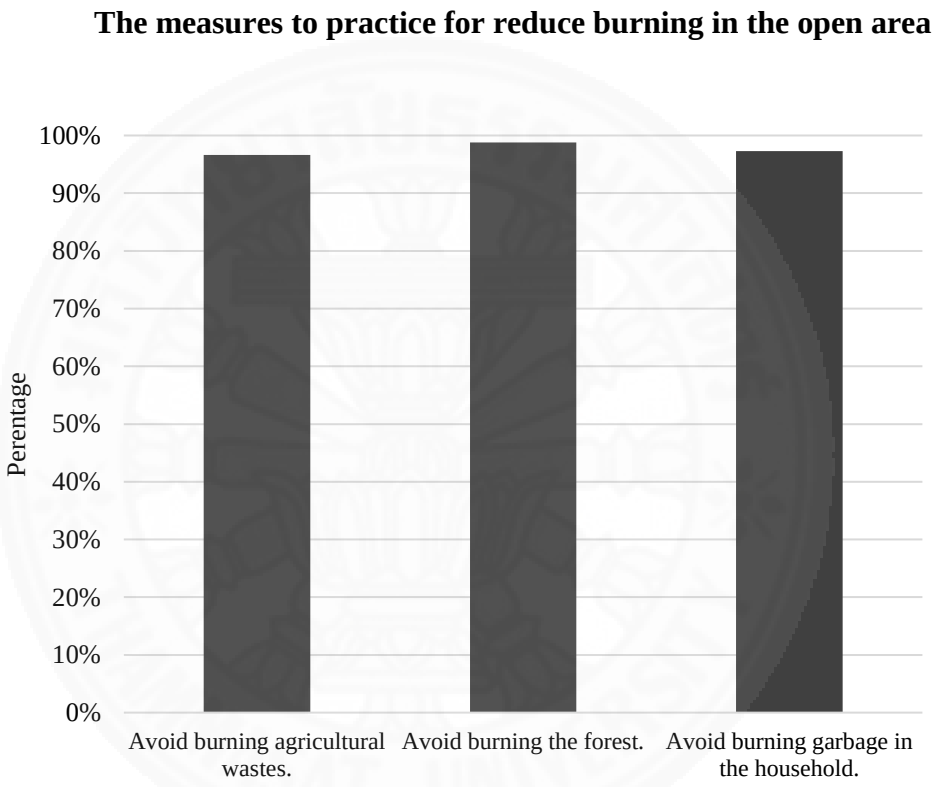


Figure 4.13 The percentage of practice on reduce burning in the open.

For the overall of the awareness and experience on health protection measures during the haze, almost respondents know how to practice on health protection but some recommendation that the public health authority give to protect their health is not available and convenient to follow because of the limitation of daily life and the occupation of people in research area.

4.5 The operation plan for 2016 to prevent and solve the haze problem in the northern region.

Table 4.9 The Operation Plan for 2016 to Prevent and Solve the Haze Problem in the Northern Region.

<table>
<tr><th colspan="5">(Draft) The Operation Plan for 2016 to Prevent and Solve the Haze Problem in the Northern Region.</th></tr>
<tr><td>Frameworks</td><td colspan="2">• Precautionary / Mobilized for monitored
• Single Command / Law enforcement
• Spatial management / All sectors participate</td><td>Vision</td><td>Cooperation for clear sky without haze</td></tr>
<tr><th colspan="5">Measures and operational guidelines</th></tr>
<tr><td rowspan="2">Preparation phase
(6 Nov 2015 – 15 Jan 2016)</td><td colspan="2">Response phase</td><td rowspan="2">Rehabilitation and Sustainability</td></tr>
<tr><td>Pre-crisis
(16 Jan -15 Feb 2016)</td><td>Crisis
(16 Feb – 15 May 2016)</td></tr>
<tr><td>• Preparation meeting
• Fuel Management (Early burning), both agricultural and forest areas
• Make a firebreak
• Mobilize networks to educate / raise awareness
• Integration of relevant information and application of geo-information</td><td>• Report data and alert the situation
• Mobilizing equipment / tools from other areas to monitor risk areas
• Reconnaissance / monitored / extinguish a fire</td><td>• Use a single command system
• Prohibit burning / Stricter law enforcement during the crisis
• Reconnaissance / monitored / extinguish a fire
• Implement measures to reduce dust / reduce health effects
• Coordinate the neighboring countries in order to reduce cross-border haze</td><td>• Forest fire rehabilitation
• Promote a network of farmers / communities free of burns.
• Promote utilization of agricultural materials.
• Promote private / public participation.
• Haze-Free ASEAN</td></tr>
</table>

The operation plan to prevent and solve the haze problem in the Northern Region in 2016 was proposed by the Ministry of Natural Resources and Environment. There focused on 9 target provinces, namely Chiang Rai, Chiang Mai, Lamphun, Lampang, Phrae, Nan, Phayao, Mae Hong Son, and Tak, which have been affected by forest fires.

According to the plan, the emphasis was placed on the prevention of burning to ensure that forest fires not spread widely. The plan aims to reduce damage that may occur in the specific areas. It also calls for the mobilization of forces from all sectors to resolve the haze situation. The members of communities would be educated in forest fire control and encouraged to participate in reducing burning throughout the critical period in 2016. Stricter law enforcements were applied to people who generate the fires. Governors of the affected provinces would adopt the "Single Command" approach to deal with the situation. The Cabinet instructed 10 relevant government agencies to work in an integrated manner to combat the haze problem.

In agricultural areas, the Ministry of Interior is working with the Ministry of Agriculture and Cooperatives in a campaign against burning, while the Ministry of Natural Resources and Environment serves as the core agency in handling the problem in national reserves and conservation areas. Forest fires in Thailand are caused primarily by human activities. It was found that collecting forest products was the main cause of forest fires, followed by hunting and clearing of land for cultivation and raising livestock. Official reports indicate that the situation of forest fires was also a result of the extreme weather and global warming effects, which have caused severe and widespread drought. As a consequence, forests are drier and the chance of fires is greater. The dry season each year, from January to April, is the critical period for forest fires and haze pollution in Thailand, especially in the North.

Meanwhile, the Northern Rainmaking Operations Center had to prepare both personnel and equipment to reduce smoke haze, increase soil moisture in forests, and add water to reservoirs. The Prime Minister instructed officials to work in a proactive manner, as the haze problem would have impacts on public health, the environment, and even tourism.

4.6 The comparison between the recommendations for public health protection in case of haze situation with health protection behavior of population during haze.

The haze situation in several northern provinces of Thailand occurs annually and directly impact the health of people exposed to the haze. Many studies have confirmed that exposure to PM10 whether in short time or long time will worsening the illness and increases death because PM10 are small and can accumulate in the respiratory system, causing irritation and inflammation.

In order to reduce the severity and the morbidity rate of the people in the haze affected area, the health authorities recommended the guidance for taking care and protect the health of people during the haze period. The recommendation to select and apply for protecting health divided into 3 sections: personal protection, household and indoor prevention, and community prevention as follow;

(1) <u>Personal protection</u>

1. Always follow the situation to keep up with your health or to avoid a place where there is haze.

2. Use clean water to gargle 3-4 time per day.

3. Refrain from smoking and reduce the burning activity that cause more haze problems.

4. Avoid exercise and strenuous activity in the area with the haze.

5. In cases that need to be in an area with haze, should use a mask cover mouth and nose, or use cloth made from several layers of cotton or linen to cover mouth and nose. Use water to rinse wet cloth to help filter and prevent dust better, and change if the mask is dirty or begins to feel uncomfortable breathing.

6. When inhaled and lived in area with haze, if the symptoms of respiratory system and vision are abnormal, so you should go to medical attention immediately.

(2) <u>Household and indoor prevention</u>

1. If there are no ventilation or air conditioning system. The door and the window must be closed to prevent smoke or haze coming into the building. If there are air conditioning or air filtration system from the outside to the building should change or keep cleaning the air filter regularly.

2. Fan opening in the building should blow down the surface of the water because water can help to reduces the amount of dust in the air.

3. Refrain from using rainwater for consumption. if you need to use the rainwater, you should be used at times ensure that rainwater leaching air pollutants in the atmosphere is gone.

(3) Community prevention

Collaboration and monitored haze not burn trash, leaves, twigs, grass, debris or anything that causes all kinds of smoke or haze.

Table 4.10 Real practice on health protection of respondents during haze compare with the recommendations for public health protection in case of haze situation.

24-hour average PM10 levels (µg/m^3).	**Air Quality Index Levels of Health Concern**	**Health Effects**	**Health protection measures for people**	**Real practice on health protection of respondents**
0 – 50	Good	No health effects	Always monitor air quality to protect your health.	- The respondents in research area usually monitoring and follow the haze situation alert.
51 – 100	Moderate	There are risks to the health of sensitivity population such as patients with cardiovascular disease, respiratory diseases. - There are health effects in the initial symptoms, including upper respiratory tract. (Coughing, dyspnea), eye irritation	Sensitivity population (elderly, children, pregnant women, patients with cardiovascular disease, respiratory diseases) 1. Always follow the situation to keep up with your health or to avoid a place where there is haze.	

24-hour average PM10 levels (µg/m^3).	Air Quality Index Levels of Health Concern	Health Effects	Health protection measures for people	Real practice on health protection of respondents
			2. People at risk should limit their exercise time or reducing strenuous physical activity. 3. Patients with cardiovascular disease or respiratory disease should be noted their symptoms such as Frequent cough, difficulty breathing, or chest pain, irregular heartbeat, nausea, tired easier than usual, or start having headaches and should prepare the necessary medicines and equipment. <u>General population</u>	

24-hour average PM10 levels (µg/m^3).	Air Quality Index Levels of Health Concern	Health Effects	Health protection measures for people	Real practice on health protection of respondents
			1. Always follow the situation to keep up with your health. 2. No burning activities	- The respondents usually follow the haze alert. - During the period of 60 day no burning, they always follow the regulation.
101 – 200	Unhealthy	<u>There are affected to the health of the people at risk.</u> - There are health effects in the initial symptoms, including upper respiratory tract. (Coughing, dyspnea), eye inflammation, angina, headache, cardiac	<u>Sensitivity population</u> 1. Reduce or reschedule exercise or strenuous activity. 2. Limit activities outside of your home or building.	

24-hour average PM10 levels (µg/m^3).	Air Quality Index Levels of Health Concern	Health Effects	Health protection measures for people	Real practice on health protection of respondents
		arrhythmia, nausea, fatigue, fatigue.	3. Wear a dust protection mask in case outside the building or area with high dust content. 4. If symptoms are abnormal, consult a physician or go to a public health facility. <u>General population</u> 1. No activities that cause dust, such as no burning all types. 2. Do not use rainwater consumption.	- During the period of 60 day for no burning, they always follow the regulation for reduce the haze and do not generate smoke or haze. - The respondents do not storage rainwater for consumption, but

24-hour average PM10 levels (µg/m^3).	Air Quality Index Levels of Health Concern	Health Effects	Health protection measures for people	Real practice on health protection of respondents
			3. Close the door and the window to prevent smoke or dust get into the building.	minority of respondent storage rainwater for watering the plants or cleaning the house. - Majority of respondents always close the door and the window to prevent the dust accumulate into the house. Those was do not practice gave the reasons for not doing that they have difficulty in breathing and ignore to this method.

24-hour average PM10 levels (µg/m^3).	Air Quality Index Levels of Health Concern	Health Effects	Health protection measures for people	Real practice on health protection of respondents
			4. Avoid activities outdoor for a long time. 5. If symptoms are abnormal, consult a physician or go to a public health facility.	- Haft of the respondents cannot avoid activities outdoor because of their work. - The respondents always monitoring themselves and family about abnormal symptoms.
201 – 300	Very Unhealthy	There are affected to the health of the people at risk, and risks to the health of general population.	Sensitivity population 1. Evacuation point should be providing until air quality become normal. General population	

24-hour average PM10 levels (µg/m^3).	Air Quality Index Levels of Health Concern	Health Effects	Health protection measures for people	Real practice on health protection of respondents
		- There are affected the health, including the severity of cardiac or respiratory symptoms (cough, dyspnea), eye inflammation, angina, heartbeat, abdominal pain, nausea, tiredness, fatigue, headache, dizziness, blurred vision, pneumonia, asthma. - Patients with heart and lung disease and the elderly have a higher risk of acute heart attack. - Pregnant women are at risk for low birth weight.	1. Reduce or reschedule exercise or strenuous activity, and limit outdoor activities. 2. Wear a dust protection mask in case outside the building or area with high dust content.	- Many respondents cannot avoid activities outdoor because of their work. However, they usually ware mask or protecting equipment when they have to go outside. - The majority of the respondents often use hygiene mask for protect them health. But the measures that using a wet mask cover nose and mouth, and change or wash the wet mask every 4 hours is the measures that hard to practice because it is not convenient for daily activities.

24-hour average PM10 levels (µg/m^3).	Air Quality Index Levels of Health Concern	Health Effects	Health protection measures for people	Real practice on health protection of respondents
			3. If you have difficulty breathing, nausea, fatigue should consult a doctor.	- The respondents always monitoring themselves. If they have severe abnormal symptoms, they will go to see the doctor.
> 300	Hazardous	There are affected to the health of people at risk and general population. - There are affected the health, including the severity of cardiac or respiratory symptoms (cough, dyspnea), eye inflammation, angina, heartbeat, abdominal pain, nausea, tiredness, fatigue,	1. Avoid all kind of outdoor activities. 2. If you have difficulty breathing, nausea, fatigue should consult a doctor. 3. Living in clean building or room without the dust.	- If the situation is terrible, they will stay indoor because if you go outside it should be more hazard to your health such as eye irritation, difficulty breathing, nausea, etc. - For the house cleaning, the respondents usually mop up frequently instead of sweeping the floor for reducing dust accumulate in the house.

24-hour average PM10 levels (µg/m^3).	Air Quality Index Levels of Health Concern	Health Effects	Health protection measures for people	Real practice on health protection of respondents
		headache, dizziness, blurred vision, pneumonia, asthma. - Patients with heart and lung disease and the elderly are at increased risk of acute heart attack. - Pregnant women are at risk for low birth weight. - People at risk have acute myocardial infarction or if they have been on long term lung cancer risk. - Death	4. If the situation continued worsens should be moved to a safe place or regular air quality areas.	

4.7 Health protection measures from other studies

The crisis of haze in the north of Thailand was seem like the situation in the south of Thailand, but the problem in the south was transboundary haze pollution from neighboring countries such as Indonesia and Malaysia. Kanchanasak (1997) was studied Health and Environmental Impacts from the 1997 ASEAN Haze in Southern Thailand.

The health risk communication and public advice on protective measures are generally similar to those of ASEAN countries, covering suggestions for susceptible population groups (asthmatics and chronic bronchitis, elderly, infants and children, persons with underlying lung or hearth disease, and smokers) and general population. They include avoiding strenuous activities and smoking, staying indoors, drinking clean water and to temporary refrain from rainwater, seeking care when having symptoms or attacks, and wearing protective masks outdoors in severe haze. Because of poor visibility during the haze event, an emphasis on traffic accident awareness and prevention is also included (K. Poonboon et al., 1999).

China also affected by haze, and it has become one of the greatest challenges in China. However, there was limited attentions of measuring public environment awareness of air pollution and the relations between public environmental awareness and haze prevention in a Chinese. Yutao Wang and others studied the fact of public environmental awareness in a typical haze polluted city in China, they founded that most of respondents showed a high awareness of haze pollution and the knowledge of the health hazard of haze of the residents. The majority respondents of their study have taken individual measure for self-protection, and supported activities dealing with haze.

Comparison between the respondents of this study and the respondents in China, both group of respondents have similar haze experience and knowledge about causes and hazards of haze. However, the respondents in China have more awareness to protect themselves from hazard of haze. (Y. Wang, 2015).

4.8 The recommendation development.

The majority of the respondents have knowledge and understanding of health protection from haze, but they lack of awareness on protecting their health. The reasons for not practice were resulting from 2 factors. First factor is the lack of awareness on long term health hazard. Another factor is inconvenience of using protective equipment due to insuitability with life style.

4.8.1 The measures to develop on health awearness

The solution to solve the problem on lack of awareness on long term health hazard, so researcher purpose the solution to make respondents have greater awareness on health care during haze as 4 issues as follow;

1. Develop health protection measures which more suitable with life style of local people.

2. Establish of village health volunteer team for monitoring health effects from haze.

3.Encourage education about health hazard from haze and health protection measures to local population.

4. Provide haze monitoring station which easy to access and timely alert on haze intensity.

4.8.1.1 Develop health protection measures which more suitable with life style of local people.

One of factors which local citizen do not practice on health protection measures is the inconvenience of using protective equipment due to insuitability with life style. The reasons of no practice for protecting themselves from health hazard of haze were resulting from inconvenience for practicing health protection measures because it is not proper for their daily activities.

In addition, there are many health authoryties such as Pollution Control Department, Department of Disease Control, and Department of Health given the recomendation of health protection measures to the public. It was duplication of data and some guidances was not incomprehensive with life style of local citizen, so people

was confused to doing health protection measures from several soures. Thus, Health authorities should be integrate in one edition and provide the guidance to publice for practicing during haze situation.

To solve this situation, researcher recommend to develop the recommendation for health protection measures and health protection appliances which more suitable for daily activities of local people in affected area as well as to encourage more knowledge of indoor air pollution problems. This recommendation develops from the result of study including questionnaire and interview with respondents. As follows;

The develop recommendation about health protection measures.

1. Avoid live the place with haze or dust, and avoid activities outdoor such as exercise and hard work that much exertion outdoors and the haze area, especially sensitive population such as children, elderly, patients with allergies and asthma. If need to be in place with haze or outdoor, need to use health protection equipment.

2. Use mask (hygiene mask) to close mouth and nose instead. The mask can be obtained at all hospitals or health facilities near your household.

3. Use damp cloth to close mouth and nose instead, and change or clean it every 4 hours (if available) because damp cloth can prevent the inhalation of PMs more than hygiene mask.

4. Drink a lot of clean water,

5. Use saline gargling per day 3 to 4 times to protect a sore throat.

6. Do not or refrain from smoking

7. Refrain from using rainwater temporarily. If necessary, should using the rainwater after rainfall at least 1 hour before consuming.

8. Installations an air filter in the house. If not available,

9. Close the door and the window on the way which blew the haze into the house and open the door and the window on the opposite wind direction.

10. Open fan in the building which the wind blows through the water surface. This method can reduce the amount of dust in the air.

11. When an abnormal respiratory system and eyes after inhalation and live in the haze should seek medical attention.

12. Mop up more frequently to prevent dust spread, and reduce the accumulation of dust in the house.

13. Planting cover crops on soil for reducing the likelihood that dust would float up in the air.

14. Reduce burning in the open areas. Do not burn trash, leaves, grass, debris as well as helping reduce forest fires.

15. Observe abnormalities of the family, go to see the doctor or go to a public health center if find some abnormalities. And track the news and information from the government closely.

For people with chronic diseases such as high blood pressure, allergies, should prepare the medication to prevent and treat exacerbations. Despite inevitable pollution from haze. If know how to adapt and protect yourselves reduces the danger of haze and if symptoms such as difficulty breathing, chest pain, should seek medical attention at the nearest hospital or health facilities.

4.8.1.2 Establish of village health volunteer team for monitoring health effects from haze.

Establishment of a village health volunteer team for monitoring health effects from haze situation, should be considering as follow;

(1) Promote, develop and support activities in accordance with the performance standards of village health volunteers and standards for primary health care about haze situation.

(2) Develop and support village health volunteer groups to work as a network of village health volunteer organizations to monitor and alert villagers about haze situation.

(3) Training for Village Health Volunteers to have ability to provide knowledge about monitoring and health care during the haze to the people in the village.

4.8.1.3 Encourage education about health hazard from haze and health protection measures, and support warning system to local.

Providing knowledge to local people in affected area. Support, promote and distribute media about the impact on the health from haze to the public, especially people in the affected area. Although at present, there are many published about the

impact and hazard of haze on the Internet, but there are many people unable to access these media. Therefore, teams should be organized in order to publicize for providing accurate knowledge about the haze and the impact of haze, and health protection measured on the public during haze. This maybe supported via village health volunteers to spreading knowledge to villager.

To make accurate knowledge and understanding on protecting health from haze, the process should be requiring the participation of the community by considering the various contexts, as follow;

1. The target groups should be determined to appropriately communicate the knowledge.

2. The participation of various sectors in the community, government agencies, private sector and community representatives to offer the courses and the exchange of knowledge to synthesize the suitable and comprehensive courses including health aspects, social aspects, economic aspects, and environmental aspects.

3. Defining the role of the workforce to disseminate the curriculum to the community by having a lead person such as village health volunteer team to work fully operational.

4. Lesson learned review, and improve the curriculum to always update.

5. open to ideas from the new generation.

If we have an appropriate curriculum, it may improve local people' s knowledge and change behavior to be better (Sudchewee Chom-ngandee et al., 2010).

Moreover, there are not enough monitoring point, so the monitoring station should be provided to the local area which easy access by the public. In addition, there should be support for timely haze warning system for alert local people have more awareness to practice health protection measures.

The solution to solve the problem on the inconvenience of using protective equipment due to insuitability with life style, researcher recommend to develop new protective mask that is more effective to protect the dust than current hygiene masks. The mask should be trapped the dust on the surface and removed it by washing. The materials should be used in the polymers that can be molded into nanofiber are developed in the form of mask which easies to use, cheap, and reusable

4.8.1.4. Provide haze monitoring station which easy to access and timely alert on haze intensity.

- Provided haze monitoring station to the local area which easy access by the public.

- Support for timely haze warning system for alert local people have more awareness to practice health protection measures.

4.8.2 The measures to develop on reduce burning

The solution to reduce burning in open space, so researcher purpose the solution to solve this problem as 2 issues as follow;

1. Reduce burning in open space measure.

2. Crop replacement for maize.

4.8.2.1 The measures to reduce burning in open space.

To solve this haze situation, researcher propose these methods to reduce burning in the open space to reduce haze generation. As follows;

1.1 Prevention

Operation to prevent pollution haze from forest fire and burning in the open space, in order to reduce the impact on health, social, and economic. Through the cooperation of the people in the community and make people realize that this situation is their own problem.

1.2 Preparation

Integration of information to analyze and command by processing the data of air quality, meteorological data, the number of hotspot. Preparation for the deterrence caused by forest fire and burn in the open.

1.3 Response

Integration using a single command system to control and other cases in the event of a haze to reduce duplication and confusion in the operation. When an event occurs, they can counter the situation immediately.

1.4 Recovery

Operated by the participation of all sectors in the recovery of natural resources, the environment, and health lighten the miseries of population from the haze.

Promoting public and partnership networks participation in preventing and solving the problem of pollution from haze.

4.8.2.2 The measure to crop replacement for maize

As you can see from Figure 2.4, The changing from a subsistence crop to an economic crop has transformed the forest to the agricultural area (Poon, 2017); Therefore, there are generate more agricultural waste. The simple way to eliminate these waste is burning, so it causes the haze problem.

To reduce the burning of fuels that cause haze problems in the area, researcher suggest to find some crop for replacing maize.

(1) Crop replacement cropping suitable to replace maize.

There are many studies founded that land use and cropping pattern which is suitable for growing other crops replacing maize on slope area are banana, cashew nut, coffee seeds, and galangals (Kularod, 2016).

(2) Marketing support Farmers growing industrial drops are able to earn income and have a well living which results in a less forest invasion

(3) Encourage local farmers to grow more crops to replace maize.

Chapter 5

Conclusion and recommendation

5.1 Conclusion

Haze is an important issue in Southeast Asia as it occurs regularly and affects many aspects of human well-being. In Thailand, haze often occurs in north region during summer from a forest fire and burning of agricultural residues because these areas located in the river basin and surrounded by mountains, thus haze could not spread out and accumulated in the atmosphere. In 2015 there were more than 800,000 patients affected during haze period. Diseases related with haze including cardiovascular, respiratory, dermatitis, and inflammatory eye disease. This research aims to study awareness, understanding, and practicing of health protection measures from haze of people in Mueang district, Nan province, there were 409 respondents.

The result found that population in research area have knowledge and understanding of health protection measures from haze, but they lack of awareness on protecting their health.

The results of knowledge and understanding on haze and effect on health from haze founded that most of the respondents know about how to protect their health in haze period.

Base on the average score of knowledge and understanding on haze situation.

Aspect 1: Cause of haze situation, the result show that the respondents have a correct knowledge and understanding in cause of haze.

Aspect 2: Health effects during the haze, the result show that the respondents have good knowledge and understanding about health effect from haze. Generally, the respiratory disease and inflammatory eye diseases are the most important issue that respondents agree because this symptom happen easily and many people have background on it.

Aspect 3: The hazard on health effects of exposure to haze. the result show that the respondents thought that the exposure to haze with high concentration for short time is more harmful because it can cause acute health problem.

Aspect 4: Health protection in haze period. the result show that the respondents have a good knowledge and understanding about health protection in the haze period. Even they have a good knowledge and understand how to practice for protecting their health, but less to doing about health protection measures because of inconvenience ang ignore to protect themselves.

Aspect 5: The hazard on health in sensitivity population. the result show that the respondents have good knowledge and correct understanding about the severity from haze on the sensitivity population.

Aspect 6: The monitoring on health during the haze. the result show that the respondents have good understanding for monitoring on health during the haze.

In summary, the respondents have good knowledge and correct understanding about causes of haze, health effects during stay in the haze for a long time, the severity on health effects of exposure to haze, health protection in haze period, sensitive group on haze, and how to monitor their health during the haze**.**

The result of study on the practice of people regarding haze and its health impacts founded that the majority of population in this research area failed to practice was avoiding from doing activities outdoors, including exercise and work because most of the respondents are merchant, government officers and farmer. They need to work outdoor. The other recommendation that people do not practice in health protection is using a wet mask cover the nose and mouth and changing of wet mask every 4 hours because of inconvenience in wearing, difficulty in breathing, and not available to wash and change the wet mask every 4 hours. So, they choose to use the hygiene mask instead of wet mask, but hygiene mask cannot prevent the inhalation of PMs.

Regarding the results of indoor protection, the issues that population avoid to practice the most was installation of an air filter in the house because it is expensive and no more space to install the filter. In addition, making the wet cloth curtain to the doors and windows for trapping the dust is also avoided because they think it is a complicated method, they have no time to install it, and some of the respondents do not know about this method as well.

The result of reduction of open air burning is the most cooperated method by respondents to stop burning because of the government policy that require each sub district to have the measures to control and prevent burning in the haze period and thus local people are aware of the effect of haze crisis to themselves and their community.

Moreover, the respondents know how to protect their health, but they lack of awareness on protecting their health. The reason to avoid practicing health protection measures was due to inconvenience to practice some offer measures. If the recommendation for health protection measures can be developed in a more suitable way with the life style of the local people in the area with haze, the number of patients from the haze may be decrease as well.

5.2 Recommendation for future study

5.2.1 Develop protective equipment more suitable and appropriate with life style of local citizen.

5.2.2 More study on indoor activities causing haze.

Cooking indoor by using charcoal brazier is one of importance factor that causing dust accumulate indoor and cause health problem. The study about indoor ventilation at Nan province founded taht the activities that are done indoor for example cooking from charcoal is the way that collects dust (Supayada, 2017).

5.3 Limitation on the study

In the year of survey data collection (2016-2017), the rainy season came earlier than other year, resulting in less polluting haze. Respondents were experiencing health problems due to haze less. It may result in the perception of health problems of respondents not very serious, and think haze is not a problem for this year.

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Appendices

Appendix A
Questionnaire

- The questionnaire, Thai version
- The questionnaire, English version

Thai version

แบบสอบถามเรื่อง

ความรู้ความเข้าใจและความตระหนักในการป้องกันสุขภาพจากหมอกควันของประชาชนในพื้นที่ประสบปัญหาหมอกควันในจังหวัดน่าน

คำชี้แจง

แบบสอบถามนี้มีวัตถุประสงค์เพื่อศึกษาความรู้ความเข้าใจและความตระหนักในการป้องกันสุขภาพจากหมอกควันของประชาชนในพื้นที่ประสบปัญหาหมอกควันในจังหวัดน่าน ในช่วงเกิดวิกฤตหมอกควัน ซึ่งในแบบสอบถามนี้ประกอบด้วย 5 ส่วน ประกอบด้วย

ส่วนที่ 1 ข้อมูลส่วนบุคคลของผู้ตอบแบบสอบถาม

ส่วนที่ 2 ความเข้าใจต่อผลกระทบสุขภาพที่เกิดจากปัญหาหมอกควัน

ส่วนที่ 3 ความคิดเห็นและประสบการณ์ในการป้องกันสุขภาพในช่วงเกิดวิกฤตหมอกควัน

ส่วนที่ 4 ผลกระทบของสถานการณ์หมอกควันต่อระบบทางเดินหายใจ

ส่วนที่ 5 ข้อเสนอแนะต่องานวิจัย

โดยคำตอบทุกคำตอบถือเป็นส่วนหนึ่งในการศึกษาวิจัย เรื่อง ความรู้ความเข้าใจและความตระหนักในการป้องกันสุขภาพจากหมอกควันของประชาชนในพื้นที่ประสบปัญหาหมอกควันในจังหวัดน่าน และจะถือเป็นความลับ ไม่มีผลกระทบต่อผู้ตอบแบบสอบถามแต่อย่างใด

จึงขอขอบพระคุณเป็นอย่างสูงในการให้ความอนุเคราะห์การตอบแบบสอบถามในครั้งนี้

ขอแสดงความนับถือ

นางสาวกานต์ชนก รุ่งเรืองแสง
นักศึกษาปริญญาโท สถาบันเทคโนโลยีนานาชาติสิรินธร
มหาวิทยาลัยธรรมศาสตร์

แบบสอบถามเลขที่.....

วันที่เก็บข้อมูล.....

สถานที่.....

ชื่อผู้เก็บข้อมูล.....โทร.....

ส่วนที่ 1 ข้อมูลส่วนบุคคลของผู้ตอบบแบบสอบถาม

ชื่อ-สกุล ผู้ให้ข้อมูล.....

1. อายุ .....ปี

2. ที่อยู่: หมู่บ้าน.....ตำบล.....อำเภอ.....

จังหวัด..... เบอร์โทรศัพท์.....

3. เพศ □ ชาย □ หญิง

4. ระดับการศึกษาสูงสุด

□ ไม่ได้เรียนหนังสือ □ ประถมศึกษา ชั้น ป.....

□ มัธยมต้น ชั้น ม..... □ มัธยมปลาย ชั้น ม.....

□ ระดับประกาศนียบัตร ( ) ปวช. .....( ) ปวส. .....)

□ ปริญญาตรี □ สูงกว่าปริญญาตรี

5. อาชีพ

□ เกษตรกร ( ) ทำไร ( ) ทำนา ( ) เลี้ยงสัตว์ ( ) สวนยาง ( ) อื่น ๆ.....□ ค้าขาย □ รับจ้าง □ ราชการ/รัฐวิสาหกิจ

□ อื่น ๆ (ระบุ).....

6. ท่านเคยมีกิจกรรมที่ก่อให้เกิดปัญหาหมอกควัน เช่น การเผาวัสดุเหลือใช้ทางการเกษตร หรือไม่

□ ไม่เคย □ เคย ( ) เดือนละ 1 ครั้ง ( ) 2 – 3 เดือนครั้ง ( ) 6 เดือนครั้ง ( ) ปีละ 1 ครั้ง

7.โรคประจำตัว

□ ไม่มี

□ มี ดังนี้

โรค	ระยะเวลาที่เป็น	การรักษา (มี/ไม่มี)
1.ระบบทางเดินหายใจ		
( ) ถุงลมโป่งพอง		
( ) หลอดลมอักเสบ		
( ) หอบหืด		
( ) ภูมิแพ้		
( ) ปอดอักเสบ		
2. ระบบประสาท		
( ) โรงทางระบบประสาท ที่สามารถช่วยเหลือตนเองได้		
( ) โรคทางระบบประสาทที่ไม่สามารถช่วยเหลือตนเองได้		
3. ระบบหัวใจและไหลเวียนเลือด		
( ) โรคหลอดเลือดหัวใจ		
( ) โรคลิ้นหัวใจ		
4. อื่น ๆ ระบุ		

8. ในช่วง 5 ปีที่ผ่านมา ท่านเคยประสบสถานการณ์หมอกควันหรือไม่

☐ ไม่เคย ☐ เคย

9. ท่านคิดว่าสถานการณ์หมอกควันเป็นปัญหาหรือไม่

☐ ไม่เป็น ☐ เป็น

10. ในช่วง 5 ปีที่ผ่านมา ท่านได้รับผลกระทบจากปัญหาหมอกควันหรือไม่

☐ ไม่ได้รับ ☐ ได้รับ(ตอบได้มากกว่า 1 ตัวเลือก)

( ) ด้านสุขภาพ ( ) ด้านรายได้

( ) ด้านการประกอบอาชีพ ( ) ด้านการคมนาคม ขนส่ง

( ) อื่น ๆ.....

11. ประวัติการรับการรักษาพยาบาลด้วยโรคระบบทางเดินหายใจ

☐ ไม่มี ☐ มี ถ้ามี เกิดขึ้นช่วงใด

( ) ขณะเกิดหมอกควัน ( ) ช่วงอื่น ๆ

12. ประวัติการรับการรักษาพยาบาลด้วยโรคระบบหัวใจ หลอดเลือด

☐ ไม่มี ☐ มี ถ้ามี เกิดขึ้นช่วงใด

( ) ขณะเกิดหมอกควัน ( ) ช่วงอื่น ๆ

13. ประวัติการรับการรักษาพยาบาลด้วยโรคระบบประสาท

☐ ไม่มี ☐ มี ถ้ามี เกิดขึ้นช่วงใด

( ) ขณะเกิดหมอกควัน ( ) ช่วงอื่น ๆ

14. ท่านสูบบุหรี่หรือไม่

☐ ไม่สูบ ☐ สูบ ระยะเวลาที่สูบ..... ปี/จำนวนมวนต่อวัน .....มวน

ส่วนที่ 2 ความเข้าใจต่อผลกระทบสุขภาพที่เกิดจากปัญหาหมอกควัน

ประเด็นผลกระทบต่อสุขภาพจากปัญหาหมอกควัน	ระดับความคิดเห็น				
	มากที่สุด	มาก	ปานกลาง	น้อย	น้อยที่สุด
ประเด็นที่ 1 ท่านคิดว่าหมอกควันที่เกิดขึ้น มีสาเหตุมาจากเหตุการณ์ใด					
1.1 เกิดขึ้นเองตามธรรมชาติ					
1.2 การเผาขยะในครัวเรือน/ชุมชน					
1.3 การเผาเพื่อทำสวน ทำไร่ เตรียมพื้นที่เพื่อทำการเกษตร					
1.4 การเผาป่า					
ประเด็นที่ 2 ท่านคิดว่าหากต้องสัมผัสกับหมอกควันเป็นเวลานาน จะส่งผลต่อสุขภาพในระดับใด					
2.1 โรคระบบทางเดินหายใจ					
2.2 โรคเกี่ยวกับผิวหนัง					
2.3 โรคหัวใจและหลอดเลือด					
2.4 อาการหืดหอบ หายใจติดขัด เหนื่อยง่าย และแน่นหน้าอก					
2.5 อาการเกี่ยวกับดวงตา เช่น ตาอักเสบ					
ประเด็นที่ 3 ท่านคิดว่า การรับสัมผัสหมอกควันดังต่อไปนี้ ส่งผลต่อสุขภาพในระดับใด					
3.1 รับสัมผัสในปริมาณที่น้อย เป็นระยะเวลานาน					
3.2 รับสัมผัสในปริมาณที่มาก เป็นระยะเวลาสั้นๆ					
ประเด็นที่ 4 ถ้าหากต้องอยู่ในสถานที่ที่เกิดหมอกควัน ท่านคิดว่าวิธีป้องกันสุขภาพต่อไปนี้ สามารถป้องกันสุขภาพได้ระดับใด					
4.1 งดการทำกิจกรรมนอกอาคาร รวมถึงการออกกำลังกาย และการทำงานหนักที่ต้องออกแรงมาก					

ประเด็นผลกระทบต่อสุขภาพจากปัญหาหมอกควัน	ระดับความคิดเห็น				
	มากที่สุด	มาก	ปานกลาง	น้อย	น้อยที่สุด
4.2 ใช้หน้ากากผ้าชุบน้ำ ปิดจมูกและปาก เปลี่ยนหน้ากากชุบน้ำ ทุก 4 ชั่วโมง					
4.3 ดื่มน้ำมาก หรือใช้น้ำเกลือกลั้วคอ เพื่อป้องกันการเจ็บคอ					
4.4 งดเว้นจากการสูบบุหรี่					
4.5ไม่รองรับน้ำฝนไว้อุปโภค บริโภค					
ประเด็นที่ 5 ท่านคิดว่าบุคคลที่เป็นกลุ่มเสี่ยงต่อไปนี้ เสี่ยงต่อการเกิดปัญหาสุขภาพระดับใด					
5.1 เด็กเล็ก อายุ 1 – 12 ปี					
5.2 ผู้สูงอายุ อายุ 60 ปีขึ้นไป					
5.3 หญิงตั้งครรภ์					
5.4 ผู้ป่วยโรคระบบหัวใจและหลอดเลือด					
5.5 ผู้ป่วยโรคระบบทางเดินหายใจ					
5.6 ผู้ป่วยโรคระบบประสาท					
ประเด็นที่ 6 ในช่วงการเกิดหมอกควัน ท่านมีวิธีการเฝ้าระวังสุขภาพอย่างไร					
6.1 สังเกตอาการผิดปกติของคนในครอบครัว หากมีอาการจะปรึกษาแพทย์หรือไปที่สถานบริการสาธารณสุข					
6.2 ติดตามรับฟังข่าวสารและข้อมูลจากทางราชการอย่างใกล้ชิด					

ส่วนที่ 3 ความคิดเห็นและประสบการณ์ในการป้องกันสุขภาพในช่วงเกิดวิกฤตหมอกควัน

ท่านทราบวิธีปฏิบัติเพื่อแก้ไขหรือป้องกันปัญหาหมอกควันหรือไม่

☐ ไม่ทราบ ☐ ทราบ

ประเด็นคำแนะนำในการป้องกันสุขภาพ	การปฏิบัติตามคำแนะนำ		ถ้าไม่ปฏิบัติตามคำแนะนำ โปรดระบุเหตุผลที่ไม่ปฏิบัติ (ระบุได้มากกว่า 1 ข้อ)
	ปฏิบัติ	ไม่ปฏิบัติ	
ประเด็นที่ 1 การป้องกันส่วนบุคคล			
1.1 งดเว้นการทำกิจกรรมนอกอาคาร รวมถึงการออกกำลังกาย และการทำงานหนักที่ต้องออกแรงมาก			☐ จำเป็นต้องทำงานนอกอาคาร ☐ ชอบทำกิจกรรมกลางแจ้ง ☐ ไม่สนใจ
1.2 ใช้หน้ากากหรือผ้าชุบน้ำปิดจมูกและปาก			☐ หายใจไม่สะดวก ☐ รำคาญ ☐ ไม่สนใจ ☐ หาวัสดุในการทำหน้ากากไม่ได้
1.3 สวมหน้ากากอนามัย (สีเขียว)			☐ หายใจไม่สะดวก ☐ รำคาญ ☐ หน้ากากมีราคาแพง ☐ ไม่สนใจ
1.4 เปลี่ยนหน้ากากชุบน้ำ ทุก 4 ชั่วโมง			☐ ไม่สะดวกต่อการเปลี่ยน ☐ ไม่มีเวลา ☐ ไม่สนใจ
1.5 ดื่มน้ำมาก ๆ หรือใช้น้ำเกลือกลั้วคอเพื่อป้องกันการเจ็บคอ			☐ ไม่มีเวลา ☐ ไม่สะดวก ☐ ไม่สนใจ
1.6 งดเว้นจากการสูบบุหรี่			☐ ติดบุหรี่ ☐ ไม่สนใจ
1.7 ไม่รองรับน้ำฝนไว้อุปโภค บริโภค			☐ ไม่มีน้ำประปาใช้ ☐ ไม่สนใจ ☐ เป็นน้ำแหล่งเดียวที่ใช้อุปโภค บริโภค ในครัวเรือน
1.8 สังเกตอาการผิดปกติ หากมีอาการให้ปรึกษาแพทย์หรือไปที่สถานบริการสาธารณสุข			☐ ไม่มีเวลาไปสถานบริการสุขภาพ ☐ อยู่ไกลจากสถานบริการสุขภาพ ☐ เดินทางไปลำบาก ☐ ไม่สนใจ
1.9 ติดตามรับฟังข่าวสารการแจ้งเตือนและข้อมูลคุณภาพอากาศจากทางราชการอย่างใกล้ชิด			☐ ไม่มีโทรทัศน์/วิทยุ ฯลฯ ☐ ไม่เข้าใจข้อมูลที่แจ้ง ☐ ไม่สนใจ
แนวทางปฏิบัติดังกล่าว ท่านเริ่มปฏิบัติเมื่อใด ☐ เมื่อเริ่มมีหมอกควัน ☐ เมื่อได้รับผลกระทบทางร่างกาย ☐ เมื่อมีการแจ้งเตือนจากภาครัฐ ☐ อื่น ๆ			

ประเด็นคำแนะนำในการป้องกันสุขภาพ	การปฏิบัติตามคำแนะนำ		ถ้าไม่ปฏิบัติตามคำแนะนำ โปรดระบุเหตุผลที่ไม่ปฏิบัติ (ระบุได้มากกว่า 1 ข้อ)
	ปฏิบัติ	ไม่ปฏิบัติ	
ประเด็นที่ 2 การป้องกันฝุ่นละอองภายในอาคารบ้านเรือน			
2.1 ติดตั้งเครื่องกรองอากาศในอาคารบ้านเรือน			☐ เครื่องกรองอากาศมีราคาแพง ☐ ไม่มีพื้นที่สำหรับติดตั้ง ☐ ไม่สนใจ
2.2 ปิดประตูหน้าต่าง เพื่อป้องกันฝุ่นสะสมในอาคารบ้านเรือน			☐ หายใจไม่สะดวก ☐ ไม่สนใจ
2.3 ใช้ผ้าชุบน้ำ ทำเป็นม่านปิดประตูหน้าต่าง เพื่อเป็นแนวกันฝุ่นเข้าสู่อาคารบ้านเรือน			☐ มีเครื่องกรองอากาศแล้ว ☐ ไม่มีเวลา ☐ ไม่สนใจ ☐ หาอุปกรณ์เพื่อทำม่านไม่ได้
2.4 ถูบ้านแทนการกวาดบ้าน และถูบ่อยขึ้น เพื่อป้องกันฝุ่นละอองฟุ้งกระจาย และลดการสะสมฝุ่นในบ้าน			☐ ไม่มีเวลา ☐ ไม่สะดวก ☐ ไม่สนใจ
2.5 ปลูกต้นไม้ใหญ่ และไม้พุ่ม รอบบริเวณบ้านเรือน			☐ ไม่มีพื้นที่สำหรับปลูกต้นไม้ ☐ บดบังทัศนียภาพรอบบ้าน ☐ ไม่สนใจ
ประเด็นที่ 3 การลดการเผาในที่โล่ง			
3.1 งดการเผาเศษวัสดุเหลือใช้ทางการเกษตร			☐ ความเคยชิน ☐ จำเป็นต้องเผา ☐ ไม่มีวิธีอื่นในการกำจัด ☐ ไม่สนใจ
3.2 งดการเผาเพื่อหาของป่า			☐ ความเคยชิน ☐ ไม่สนใจ ☐ จำเป็นต้องเผา เพื่อหาของป่า
3.3 งดการเผาขยะในครัวเรือน/ชุมชน			☐ ความเคยชิน ☐ ไม่มีวิธีอย่างอื่น ☐ ไม่สนใจ

ส่วนที่ 4 ผลกระทบของสถานการณ์หมอกควันต่อระบบทางเดินหายใจ

4.1 ท่านมีอาการคัดจมูก แสบจมูก หรือแสบคอ หรือไม่

☐ ไม่มี ☐ มี

ถ้ามี มีอาการดังกล่าวนานกี่วัน ( ) 1 – 7 วัน ( ) 8 – 14 วัน ( ) 15 – 21 วัน ( ) 22 – 30 วัน ( ) 1 เดือนขึ้นไป

ถ้ามี ท่านทราบวิธีการบรรเทาอาการดังกล่าวหรือไม่ □ ทราบ □ ไม่ทราบ

และท่านได้ปฏิบัติตามวิธีการนั้นหรือไม่ □ ปฏิบัติ □ ไม่ปฏิบัติ เพราะเหตุใด.....

4.2 ท่านมีอาการหอบ เหนื่อย หายใจไม่สะดวก ขณะสัมผัสหมอกควัน หรือไม่

□ ไม่มี □ มี

ถ้ามี มีอาการดังกล่าวนานกี่วัน ( ) 1 – 7 วัน ( ) 8 – 14 วัน ( ) 15 – 21 วัน ( ) 22 – 30 วัน ( ) 1 เดือนขึ้นไป

ถ้ามี ท่านทราบวิธีการบรรเทาอาการดังกล่าวหรือไม่ □ ทราบ □ ไม่ทราบ

และท่านได้ปฏิบัติตามวิธีการนั้นหรือไม่ □ ปฏิบัติ □ ไม่ปฏิบัติ เพราะเหตุใด.....

4.3 ท่านมีการหายใจติดขัด มีเสียงวี้ดในลำคอ หรือไม่

□ ไม่มี □ มี

ถ้ามี มีอาการดังกล่าวนานกี่วัน ( ) 1 – 7 วัน ( ) 8 – 14 วัน ( ) 15 – 21 วัน ( ) 22 – 30 วัน ( ) 1 เดือนขึ้นไป

ถ้ามี ท่านทราบวิธีการบรรเทาอาการดังกล่าวหรือไม่ □ ทราบ □ ไม่ทราบ

และท่านได้ปฏิบัติตามวิธีการนั้นหรือไม่ □ ปฏิบัติ □ ไม่ปฏิบัติ เพราะเหตุใด.....

4.4 ท่านมีอาการไอ หรือไม่

□ ไม่มี □ มี

ถ้ามี มีอาการดังกล่าวนานกี่วัน ( ) 1 – 7 วัน ( ) 8 – 14 วัน ( ) 15 – 21 วัน ( ) 22 – 30 วัน ( ) 1 เดือนขึ้นไป

ถ้ามี ท่านทราบวิธีการบรรเทาอาการดังกล่าวหรือไม่ □ ทราบ □ ไม่ทราบ

และท่านได้ปฏิบัติตามวิธีการนั้นหรือไม่ □ ปฏิบัติ □ ไม่ปฏิบัติ เพราะเหตุใด.....

4.5 ท่านมีน้ำมูกหรือเสมหะ หรือไม่

□ ไม่มี □ มี

ถ้ามี มีอาการดังกล่าวนานกี่วัน ( ) 1 – 7 วัน ( ) 8 – 14 วัน ( ) 15 – 21 วัน ( ) 22 – 30 วัน ( ) 1 เดือนขึ้นไป

ถ้ามี ท่านทราบวิธีการบรรเทาอาการดังกล่าวหรือไม่ □ ทราบ □ ไม่ทราบ

และท่านได้ปฏิบัติตามวิธีการนั้นหรือไม่ □ ปฏิบัติ □ ไม่ปฏิบัติ เพราะเหตุใด.....

ส่วนที่ 5 ข้อเสนอแนะต่องานวิจัย

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******* ขอขอบพระคุณเป็นอย่างสูงในการให้ความอนุเคราะห์การตอบแบบสอบถาม ********

English version

Questionnaire
Study on awareness and understanding of health protection measure from haze.

Explanation

This questionnaire aims to study on awareness and understanding of health protection measure from haze in Nan province during the haze. This questionnaire is divided into 5 sections:

Section 1: General information

Section 2: The question about understanding of the impact of haze on health problems.

Section 3: The questions about the practice in health protection during haze period.

Section 4: Effects of haze situation for the respiratory system

Section 5: The recommendations to the research.

All of the answers are considered of the research of study on awareness and understanding of health protection measure from haze. So, the questionnaire will be confidential and no impact on respondents

Thank you for corporation on this research.

Best regards,

(Ms. Kanchanok Roongruangsaeng)
Graduate students at Sirindhorn International Institute of Technology, Thammasat University

Date……
Place……..……..…
Name of collector…… Tel…….…….…..…
section 1 General information of respondents
Name of respondent…….……

1. Age ……. year
2 Address: …….
3. Gender □ Male □ Female
4. Education level
□ No studying □ Elementary school
□ Junior high school □ Senior high school
□ Certificate school (□ Vocational certificate
□ High Vocational school)
□ Bachelor degree □ Higher than Bachelor degree
5. Occupation
□ Farmer □ Salesperson
□ Hired labor
□ Government officer/State Enterprise employee
□ Other…….
6. Did you had activities that cause of haze such as burning of agricultural waste, or not?
□ No □ Yes ( ) Once a month ( ) 2 – 3 months
( ) 6 months ( ) Once a year
7.Congenital disease
□ No
□ Yes as follows

Diseases	Time	Treated (Yes/No)
1.Respiratory System		
( ) Emphysema		
( ) Bronchitis		
( ) Asthma		
( ) Allergy		
( ) Pneumonia		
2. Nervous System		
( ) Neurological disorder that can help themselves		
( ) Neurological disorder that cannot help themselves		
3. Cardiovascular Disease		
( ) Coronary artery disease		
( ) Heart valve disease		
4. Others		

8. Experienced on haze situation, over past 5 years.

□ No □ Yes

9. Do you think haze is a problem.

□ No □ Yes

10. Over past 5 years, do you have effected on haze.

□ No □ Yes (Can choose more than 1)

( ) On health ( ) On income

( ) On occupation ( ) On transportation

( ) Others……..

11. Medical history with respiratory disease

□ No □ Yes, ( ) during haze ( ) other period

12. Medical history with cardiovascular Disease

□ No □ Yes, ( ) during haze ( ) other period

13. Medical history with Nervous System

□ No □ Yes, ( ) during haze ( ) other period

14. Do you smoking or not

□ No □ Yes, for …years, cigarettes per day.....

Section 2: questions about understanding the impact of health problems caused by haze.

Aspects	Level of agreement				
	strongly disagree	disagree	neutral	agree	Strongly agree
Aspect 1 What do you think about causes of haze?					
1.1 Occur naturally					
1.2 Burning garbage in household / community					
1.3 Burning from farming, gardening, preparing the area for agriculture					
1.4 Burning the forest					
Aspect 2 If exposed to haze for a long time, that will be affected on these follows health effect in which level?					
2.1 Respiratory disease					
2.2 Diseases of the skin					
2.3 Cardiovascular disease					
2.4 Symptoms of asthma, shortness of breath, fatigue and chest					
2.5 Symptoms on the eyes, such as eye inflammation					
Aspect 3 How about the health effect when expose to haze as follows?					
3.1 Exposure in small quantities for a long time					

Aspects	Level of agreement				
	strongly disagree	disagree	neutral	agree	Strongly agree
3.2 Exposure in large quantities for a short time					
Aspect 4 If you need to be in place that the haze, these follows preventions can protect your health in which level?					
4.1 Avoid from doing activities outdoor, including exercise and work hard to exert					
4.2 Mask use wet cloth off the nose and mouth. And change of plating water, every 4 hours					
4.3 Drink more water or saline gargling to prevent a sore throat					
4.4 Avoid smoking					
4.5 Avoid storage rain water for consumer					
Aspect 5 In your opinion, haze will be affected on the sensitivity population's health as follows in which level?					
5.1 Children age 1 – 12 years					
5.2 Elderly age 60 year and older					
5.3 Pregnant woman					
5.4 Patients with cardiovascular disease					
5.5 Patients with respiratory disease					
5.6 Patients with nervous system					
Aspect 6 During the haze, how about your practice on health surveillance?					
6.1 Observe abnormalities of the family, and go to consult a doctor or public health center.					
6.2 Listen to the news and information from the government closely.					

Section 3 the questions about the practice in health protection during haze period.

Do you know how to protect your health from haze?

□ No □ Yes

The advice on health protection	practice		If do not practice on health protection measure, please choose the reason (can choose more than 1)
	Yes	No	
1. Personal protection. (both indoor and outdoor)			
1.1 Avoid doing activities outdoor, including exercise and strenuous activity			□ Need to work outdoor □ Like outdoor activity □ Ignore
1.2 Use mask or wet cloth cover the nose and mouth			□ Breathing is not easy □ Nuisance □ Ignore
1.3 Use hygiene mask (green mask)			□ Breathing is not easy □ Nuisance □ Mask is expensive □ Ignore
1.4 Change the mask or wet cloth every 4 hours			□ Difficult to change □ Have no time □Ignore
1.5 Drink clean water or saline gargling to prevent a sore throat			□ Have no time □ inconvenient □ Ignore
1.6 Do not smoking			□ Addicted to smoking □ Ignore
1.7 Avoid using rain water			□ No water supply □ Ignore □ Have only one water uses in household
1.8 Observe abnormalities of the family. consult a doctor or go to a public health center.			□ Have no time to go health center □ Far from health center □ Inconvenient transportation □ Ignore
1.9 Listen to the news and information from the government closely.			□ No television, radio, □ Ignore □ Don't understand about information/ the information is hard to understand.
As the practice, when does you begin to protect yourself □ Starting the haze period □ Getting health effects □ Announcement from the governor □ others			

The advice on health protection	practice		If do not practice on health protection measure, please choose the reason (can choose more than 1)
	Yes	No	
2. Indoor protection			
2.1 Installation air filter in the house			□ The air filter is expensive □ Have no space for install the air filter. □ Ignore
2.2 Close the doors and windows to prevent dust accumulate in houses			□ Breathing is not easy □ Ignore
2.3 Making wet curtain trap the dust before enter to the house			□ Have the air filter □ Have no equipment to do the curtain □ Have no time □ Ignore
2.4 Mop more frequently to prevent dust spread, and reduce the accumulation of dust in the house			□ Have no time □ Inconvenient □ Ignore
2.5 Planted tree and shrub around the house			□ No space for tree planting □ Rippling around the house □ Ignore
3. Reduction of open burning			
3.1 Avoid burning agricultural waste			□ Habit □ Need to burning □ Ignore □ Have no other method to eliminate it
3.2 Avoid burning forest to get out of the forest food or other			□ Habit □ Ignore □ Need to burning for forest food
3.3 Avoid burning garbage in the household / community			□ Habit □Have no other method □ Ignore

Section 4: Effects of haze situation to the respiratory system during the haze.

4.1 Do you have a stuffed nose or sore throat?

□ No □ Yes

If yes, how long that symptom stay?

( ) 1 – 7 days ( ) 8 – 14 days ( ) 15 – 21 days ( ) 22 – 30 days ( ) more than 1 month

Do you know about how to relieve symptoms?

□ Yes □ No

Do you practice follow the way that you know or not?

□ Yes □ No, why……

4.2 Do you have a pant, tired, or difficulty in breathing during the haze?

□ No □ Yes

If yes, how long that symptom stay?

( ) 1 – 7 days ( ) 8 – 14 days ( ) 15 – 21 days ( ) 22 – 30 days ( ) more than 1 month

Do you know about how to relieve symptoms?

□ Yes □ No

Do you practice follow the way that you know or not?

□ Yes □ No, why……

4.3 Do you have wheeze or suffocate?

□ No □ Yes

If yes, how long that symptom stay?

( ) 1 – 7 days ( ) 8 – 14 days ( ) 15 – 21 days ( ) 22 – 30 days ( ) more than 1 month

Do you know about how to relieve symptoms?

□ Yes □ No

Do you practice follow the way that you know or not?

□ Yes □ No, why……

4.4 Do you have a cough?

□ No □ Yes

If yes, how long that symptom stay?

( ) 1 – 7 days ( ) 8 – 14 days ( ) 15 – 21 days ( ) 22 – 30 days ( ) more than 1 month

Do you know about how to relieve symptoms?

□ Yes □ No

Do you practice follow the way that you know or not?

□ Yes □ No, why……

4.5 Do you have a snot or phlegm?

□ No □ Yes

If yes, how long that symptom stay?

( ) 1 – 7 days ( ) 8 – 14 days ( ) 15 – 21 days ( ) 22 – 30 days ( ) more than 1 month

Do you know about how to relieve symptoms?

□ Yes □ No

Do you practice follow the way that you know or not?

□ Yes □ No, why……

Section 5: the recommendations to the research.

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********** Thank you for corporation on this questionnaire **********

Appendix B

- Table I show the analysis of general information of respondents.
- Table II show the analysis of knowledge and understanding of respondents.
- Table III show the analysis practicing on health protection measure of the respondents during the haze.

Table I show the analysis of general information of respondents.

Item	Number (% of Total)											Total
	Nai Wiang	Bo	Pha Sing	Chai Sathan	Thuem Tong	Rueang	Na Sao	Du Tai	Kong Khwai	Bo Suak	Sanian	
General information of the respondents												
1. The number of respondents												
N= 409	96	21	32	39	17	24	18	42	26	32	62	409
	23.5%	5.1%	7.8%	9.5%	4.2%	5.9%	4.4%	10.3%	6.4%	7.8%	15.2%	100.0%
2. Gender												
Male	25	3	14	23	10	9	7	19	9	21	11	151
	6.1%	0.7%	3.4%	5.6%	2.4%	2.2%	1.7%	4.6%	2.2%	5.1%	2.7%	36.9%
Female	71	18	18	16	7	15	11	23	17	11	51	258
	17.4%	4.4%	4.4%	3.9%	1.7%	3.7%	2.7%	5.6%	4.2%	2.7%	12.5%	63.1%
3. Education level												
No studying	3	0	0	1	0	0	0	2	0	2	4	12
	0.7%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.5%	0.0%	0.5%	1.0%	2.9%
Elementary school	29	13	12	19	5	2	4	13	7	1	33	138
	7.1%	3.2%	2.9%	4.6%	1.2%	0.5%	1.0%	3.2%	1.7%	0.2%	8.1%	33.7%
Junior high school	13	3	3	3	3	4	2	4	2	4	6	47
	3.2%	0.7%	0.7%	0.7%	0.7%	1.0%	0.5%	1.0%	0.5%	1.0%	1.5%	11.5%
Senior high school	12	2	6	7	3	2	3	6	3	13	4	61
	2.9%	0.5%	1.5%	1.7%	0.7%	0.5%	0.7%	1.5%	0.7%	3.2%	1.0%	14.9%
Vocational certificate	5	1	3	3	1	1	0	0	2	1	3	20
	1.2%	0.2%	0.7%	0.7%	0.2%	0.2%	0.0%	0.0%	0.5%	0.2%	0.7%	4.9%
High Vocational school	4	0	0	2	1	3	2	1	2	1	2	18
	1.0%	0.0%	0.0%	0.5%	0.2%	0.7%	0.5%	0.2%	0.5%	0.2%	0.5%	4.4%
Bachelor degree	28	2	7	4	4	4	4	14	9	5	10	91
	6.8%	0.5%	1.7%	1.0%	1.0%	1.0%	1.0%	3.4%	2.2%	1.2%	2.4%	22.2%
Higher than Bachelor degree	2	0	1	0	0	8	3	2	1	5	0	22
	0.5%	0.0%	0.2%	0.0%	0.0%	2.0%	0.7%	0.5%	0.2%	1.2%	0.0%	5.4%
4. Occupation												
Farmer	2	0	6	4	0	0	4	12	0	2	18	48
	0.5%	0.0%	1.5%	1.0%	0.0%	0.0%	1.0%	2.9%	0.0%	0.5%	4.4%	11.8%
Merchant	43	18	9	14	6	4	2	1	7	1	11	116
	10.5%	4.4%	2.2%	3.4%	1.5%	1.0%	0.5%	0.2%	1.7%	0.2%	2.7%	28.4%
Hired labor	12	1	3	8	2	4	3	7	9	4	10	63
	2.9%	0.2%	0.7%	2.0%	0.5%	1.0%	0.7%	1.7%	2.2%	1.0%	2.5%	15.4%
Government officer	5	1	3	4	1	12	6	9	6	7	10	64
	1.2%	0.2%	0.7%	1.0%	0.2%	2.9%	1.5%	2.2%	1.5%	1.7%	2.5%	15.7%
Others	34	0	11	9	8	4	3	13	4	18	13	117
	8.3%	0.0%	2.7%	2.2%	2.0%	1.0%	0.7%	3.2%	1.0%	4.4%	3.2%	28.7%
5. Have been doing the activities cause of haze												
No	87	14	26	27	13	19	16	32	22	26	45	327
	21.3%	3.4%	6.4%	6.6%	3.2%	4.6%	3.9%	7.8%	5.4%	6.4%	11.0%	80.0%
Yes												
Once a month	1	0	4	2	0	0	0	1	1	0	4	13
	0.2%	0.0%	1.0%	0.5%	0.0%	0.0%	0.0%	0.2%	0.2%	0.0%	1.0%	3.2%
2 – 3 months	2	0	0	1	1	1	0	2	2	3	8	20
	0.5%	0.0%	0.0%	0.2%	0.2%	0.2%	0.0%	0.5%	0.5%	0.7%	2.0%	4.9%
6 months	1	2	0	4	1	1	1	3	1	0	0	14
	0.2%	0.5%	0.0%	1.0%	0.2%	0.2%	0.2%	0.7%	0.2%	0.0%	0.0%	3.4%
Once a year	5	5	2	5	2	3	1	4	0	3	5	35
	1.2%	1.2%	0.5%	1.2%	0.5%	0.7%	0.2%	1.0%	0.0%	0.7%	1.2%	8.6%
6. Congenital disease												
No	60	12	20	27	13	19	15	32	21	27	34	280
	14.7%	2.9%	4.9%	6.6%	3.2%	4.6%	3.7%	7.8%	5.1%	6.6%	8.3%	68.5%

Item	Number (% of Total)											Total
	Nai Wiang	Bo	Pha Sing	Chai Sathan	Thuem Tong	Rueang	Na Sao	Du Tai	Kong Khwai	Bo Suak	Sanian	
Yes												
Respiratory system	9	7	3	3	1	2	1	2	1	2	12	43
	2.2%	1.7%	0.7%	0.7%	0.2%	0.5%	0.2%	0.5%	0.2%	0.5%	2.9%	10.5%
Nervous system	1	0	1	0	0	0	0	0	0	0	2	4
	0.2%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.5%	1.0%
Cardiovascular disease	0	0	1	3	0	1	0	0	0	0	0	5
	0.0%	0.0%	0.2%	0.7%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	1.2%
Others	26	2	7	6	3	2	2	8	4	3	14	77
	6.4%	0.5%	1.7%	1.5%	0.7%	0.5%	0.5%	2.0%	1.0%	0.7%	3.4%	18.8%
7. During 5 years, have been experienced in haze												
No	31	7	7	18	4	3	4	6	9	9	21	119
	7.6%	1.7%	1.7%	4.4%	1.0%	0.7%	1.0%	1.5%	2.2%	2.2%	5.1%	29.1%
Yes	65	14	25	21	13	21	14	36	17	23	41	290
	15.9%	3.4%	6.1%	5.1%	3.2%	5.1%	3.4%	8.8%	4.2%	5.6%	10.0%	70.9%
8. Think that the haze is a problem												
No	10	1	5	7	2	0	1	3	1	2	14	46
	2.4%	0.2%	1.2%	1.7%	0.5%	0.0%	0.2%	0.7%	0.2%	0.5%	3.4%	11.2%
Yes	86	20	27	32	15	24	17	39	25	30	48	363
	21.0%	4.9%	6.6%	7.8%	3.7%	5.9%	4.2%	9.5%	6.1%	7.3%	11.7%	88.8%
9. During 5 years, have been affected by haze												
No	32	8	10	15	4	4	4	7	7	12	20	123
	7.8%	2.0%	2.4%	3.7%	1.0%	1.0%	1.0%	1.7%	1.7%	2.9%	4.9%	30.1%
Yes	64	13	22	24	13	20	14	35	19	20	42	286
	15.6%	3.2%	5.4%	5.9%	3.2%	4.9%	3.4%	8.6%	4.6%	4.9%	10.3%	69.9%
On health	61	13	18	24	13	17	14	34	16	19	38	267
	14.9%	3.2%	4.4%	5.9%	3.2%	4.2%	3.4%	8.3%	3.9%	4.6%	9.3%	65.3%
On income	1	0	0	0	0	1	0	0	0	0	0	2
	0.2%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.5%
On occupation	4	0	1	1	1	1	1	0	2	2	2	15
	1.0%	0.0%	0.2%	0.2%	0.2%	0.2%	0.2%	0.0%	0.5%	0.5%	0.5%	3.7%
On transportation	16	0	4	4	2	6	3	5	4	3	6	53
	3.9%	0.0%	1.0%	1.0%	0.5%	1.5%	0.7%	1.2%	1.0%	0.7%	1.5%	13.0%
Others	1	0	2	0	0	0	0	1	0	0	0	4
	0.25%	0.0%	0.5%	0.0%	0.0%	0.0%	0.0%	0.25%	0.0%	0.0%	0.0%	1.0%
10. Medical history with respiratory disease												
No	87	14	29	35	15	23	17	37	24	28	57	366
	21.3%	3.4%	7.1%	8.6%	3.7%	5.6%	4.2%	9.0%	5.9%	6.8%	13.9%	89.5%
Yes												
During haze	3	5	2	3	0	1	1	2	1	4	2	24
	0.7%	1.2%	0.5%	0.7%	0.0%	0.2%	0.2%	0.5%	0.2%	1.0%	0.5%	5.9%
Another period	6	2	1	1	2	0	0	3	1	0	3	19
	1.5%	0.5%	0.2%	0.2%	0.5%	0.0%	0.0%	0.7%	0.2%	0.0%	0.7%	4.6%
11. Medical history with cardiovascular disease												
No	93	20	30	37	17	23	18	40	26	32	60	396
	22.7%	4.9%	7.3%	9.0%	4.2%	5.6%	4.4%	9.8%	6.4%	7.8%	14.7%	96.8%
Yes												
During haze	0	1	0	0	0	0	0	0	0	0	0	1
	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%
Another period	3	0	2	2	0	1	0	2	0	0	2	12
	0.7%	0.0%	0.5%	0.5%	0.0%	0.2%	0.0%	0.5%	0.0%	0.0%	0.5%	2.9%
12. Medical history with nervous system												
No	92	21	29	38	17	24	18	42	25	32	58	396
	22.5%	5.1%	7.1%	9.3%	4.2%	5.9%	4.4%	10.3%	6.1%	7.8%	14.2%	96.8%
Yes												
	0	0	0	0	0	0	0	0	0	0	0	0

Item	Number (% of Total)											Total
	Nai Wiang	Bo	Pha Sing	Chai Sathan	Thuem Tong	Rueang	Na Sao	Du Tai	Kong Khwai	Bo Suak	Sanian	
During haze	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Another period	4	0	3	1	0	0	0	0	1	0	4	13
	1.0%	0.0%	0.7%	0.2%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	1.0%	3.2%
13. Smoking habits												
NO	89	21	30	34	17	24	17	41	24	31	59	387
	21.8%	5.1%	7.3%	8.3%	4.2%	5.9%	4.2%	10.0%	5.9%	7.6%	14.4%	94.6%
Yes	7	0	2	5	0	0	1	1	2	1	3	22
	1.7%	0.0%	0.5%	1.2%	0.0%	0.0%	0.2%	0.2%	0.5%	0.2%	0.7%	5.4%

Table II show the analysis of knowledge and understanding of respondents

Knowledge and understanding on haze	Level of agreement				
	strongly agree	agree	neutral	disagree	strongly disagree
Aspect 1 What do you think about causes of haze?					
1.1 Occur naturally	27 6.6%	43 10.5%	84 20.5%	109 26.7%	146 35.7%
1.2 Burning garbage in household / community	77 18.8%	90 22.0%	101 24.7%	95 23.2%	46 11.2%
1.3 Burning from farming, gardening, preparing the area for agriculture	223 54.5%	121 29.6%	36 8.8%	18 4.4%	11 2.7%
1.4 Burning the forest	185 45.2%	119 29.1%	56 13.7%	33 8.1%	16 3.9%
Aspect 2 If exposed to haze for a long time, that will be affected on these follows health effect in which level?					
2.1 Respiratory disease	242 59.2%	123 30.1%	29 7.1%	10 2.4%	5 1.2%
2.2 Diseases of the skin	78 19.1%	108 26.4%	109 26.7%	67 16.4%	47 11.5%
2.3 Cardiovascular disease	63 15.4%	113 27.6%	114 27.9%	72 17.6%	47 11.5%
2.4 Symptoms of asthma, shortness of breath, fatigue and chest	195 47.7%	129 31.5%	49 12.0%	21 5.1%	15 3.7%
2.5 Symptoms on the eyes, such as eye inflammation	209 51.1%	125 30.6%	50 12.2%	12 2.9%	13 3.2%
Aspect 3: the violence on health effects of exposure to haze					
3.1 Exposure in small quantities for a long time	168 41.1%	152 37.2%	69 16.9%	10 2.4%	10 2.4%
3.2 Exposure in large quantities for a short time	148 36.2%	119 29.1%	103 25.2%	28 6.8%	11 2.7%
Aspect 4: health protection in haze period					
4.1 Avoid from doing activities outdoor, including exercise and work hard to exert	132 32.3%	117 28.6%	103 25.2%	47 11.5%	10 2.4%
4.2 Mask use wet cloth off the nose and mouth. And change of plating water, every 4 hours	126 30.8%	132 32.3%	95 23.2%	40 9.8%	16 3.9%
4.3 Drink more water or saline gargling to prevent a sore throat	130 31.8%	132 32.3%	97 23.7%	31 7.6%	19 4.6%

Knowledge and understanding on haze	Level of agreement				
	strongly disagree	disagree	neutral	agree	strongly agree
4.4 Avoid smoking	156 38.1%	122 29.8%	55 13.4%	43 10.5%	33 8.1%
4.5 Avoid storage rain water for consumer	133 32.5%	110 26.9%	90 22.0%	34 8.3%	42 10.3%
Aspect 5: the violence on health in sensitivity population					
5.1 Children age 1 – 12 years	218 53.3%	131 32.0%	47 11.5%	10 2.4%	3 7.0%
5.2 Elderly age 60 year and older	254 62.1%	111 27.1%	38 9.3%	5 1.2%	1 0.2%
5.3 Pregnant woman	164 40.1%	151 36.9%	78 19.1%	10 2.4%	6 1.5%
5.4 Patients with cardiovascular disease	133 32.5%	141 34.5%	105 25.7%	21 5.1%	9 2.2%
5.5 Patients with respiratory disease	232 56.7%	122 29.8%	46 11.2%	9 9.3%	0 0.0%
5.6 Patients with nervous system	92 22.5%	110 26.9%	118 28.9%	51 12.5%	38 9.3%
Aspect 6: the surveillance on health during the haze					
6.1 Observe abnormalities of the family, and go to consult a doctor or public health center.	192 46.9%	140 34.2%	59 14.4%	13 3.2%	5 1.2%
6.2 Listen to the news and information from the government closely.	207 50.6%	132 32.3%	47 11.5%	19 4.6%	4 1.0%

Table III show the analysis practicing on health protection measure of the respondents during the haze.

The recommendation on health protection	practicing		The reason does not practice health protection measure	
	yes	no		
1. Personal protection. (both indoor and outdoor)				
1.1 Avoid doing activities outdoor, including exercise and strenuous activity	236 57.7%	173 42.3%	Necessary to work outdoor	142 81.1%
			Like outdoor activities	19 10.9%
			Ignore	14 8.0%
1.2 Use mask or wet cloth cover the nose and mouth	226 55.3%	183 44.7%	Breathing is not easy	77 45.8%
			Nuisance	25 14.9%
			Can't find the material for making the mask	16 9.5%
			Ignore	50 29.8%
1.3 Use hygiene mask (green mask)	333 81.4	76 18.6%	Breathing is not easy	30 39.5%
			Nuisance	17 22.4%
			Mask is expensive	5 6.6%
			Ignore	24 31.6%
1.4 Change the mask or wet cloth every 4 hours	127 31.1%	282 68.9%	Not easy to change	140 75.7%
			Don't have time	30 16.2%
			Ignore	15 8.1%
1.5 Drink clean water or saline gargling	348 85.1%	61 14.9%	Don't have time	11 20.0%
			Inconvenient	16 29.1%
			Ignore	28 50.9%
1.6 Do not smoking	394	15		13

The recommendation on health protection	practicing		The reason does not practice health protection measure	
	yes	no		
	96.3%	3.7%	Addicted to smoking	86.7%
			Ignore	2
				13.3%
1.7 Avoid using rain water	365 89.2%	44 0.8%	No water supply	6
				22.2%
			Ignore	16
				59.3%
			Have only one water uses in household	5
				18.5%
1.8 Observe abnormalities of the family. If I have to consult a doctor or go to a public health center.	375 91.7%	34 8.3%	Have no time to go health center	5
				16.1%
			Inconvenient transportation	4
				12.9%
			Ignore	22
				71.0%
1.9 Listen to the news and information from the government closely.	393 96.1%	16 3.9%	No television, radio, etc	1
				6.3%
			Don’t understand about information	9
				56.3%
			Ignore	6
				37.5%
As the practice, when does you begin to protect yourself	Starting the haze period			297
				72.6%
	Getting health effects			71
				17.4%
	Announcement from the			34
				8.3%
	Others			7
				1.7%
2. Indoor protection				
2.1 Installation air filter in the house	88 21.5%	321 78.5%	The air filter is expensive	152
				49.7%
			Have no space for install the air filter	34
				11.1%
			Ignore	120
				39.2%
2.2 Close the doors and windows to prevent dust accumulate in houses	364 89.0%	45 11.0%	Breathing is not easy	24
				57.1%
			Ignore	18
				42.9%
2.3 Making wet curtain trap the dust before enter to the house	144 35.2%	265 64.8%	Have the air filter	12
				5.7%

The recommendation on health protection	practicing		The reason does not practice health protection measure	
	yes	no		
			Have no time	53
				25.1%
			Have no equipment to do the curtain	25
				11.8%
			Ignore	121
				57.3%
2.4 Mop more frequently to prevent dust spread, and reduce the accumulation of dust in the house	354 86.6%	55 13.4%	Have no time	15
				32.6%
			Inconvenient	17
				37.0%
			Ignore	14
				30.4%
2.5 Planted tree and shrub around the house	325 79.5%	84 20.5%	No space for tree planting	57
				71.3%
			Obscuring the scenery around the house	4
				5.0%
			Ignore	19
				23.8%
3. Reduction of open burning				
3.1 Avoid burning agricultural waste	395 96.6%	14 3.4%	Habit	6
				50.0%
			Need to burning	5
				41.7%
			Have no other method	0
				0.0%
			Ignore	1
				8.3%
3.2 Avoid burning forest to get out of	404 98.8%	5 1.2%	Habit	2
				40.0%
			Need to burning for forest food	2
				40.0%
			Ignore	1
				10.0%
3.3 Avoid burning garbage in the household / community	398 97.3%	11 2.7%	Habit	3
				33.3%
			Have no other method	5
				55.6%
			Ignore	1
				11.1%