The Impacts of Charcoal Burning at Khok Soong Subdistrict Municipality, Phon Thong District, Roi Et Province, Thailand

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ABSTRACT

Fuels are essential for the production of various energy, especially as heat in cooking. Generally, the fires used in cooking come from a variety of things, such as electricity, gas, and even firewood. However, rural people often had the opportunity to use only firewood for cooking fuel. Therefore, this research aimed (1) to study the problem of the charcoal burning business, 2) analyze the effects of the charcoal burning business, and 3) propose suggestions and solutions to the effects of the charcoal burning business. This research was studied in Khok Sung Sub-District Municipality, Phon Thong District, Roi Et Province, Thailand by using a combination of research tools including questionnaires for 216 persons and in-depth interviews for 15 persons. Data analysis by content analysis method, along with descriptive statistical analysis. The research results found that:

1. The 3 main problems of the charcoal burning business are as follows: (1) Odor: Burning charcoal will produce a bad smell that is hard to control. (2) Smoke: Combustion There will be smoke produced from burning all day and night. And (3) Dust: Burning charcoal will produce dust that is formed from ashes and soot that disperse into the air, where dust may fly along clothing, the poor body can affect the respiratory system.

2. Impacts from the charcoal burning business were found to have 3 issues: (1) The most affected by odor were 85 (41.3%), Impact of soot smoke, 83 (40.3%), and dust effects of 41 persons (19.9%), respectively. (2) Moderate health effects were found to have the highest mean irritant, respiratory effects (mean 1.88), effects on sick/cold/cough/sneezing (mean 1.79), impact on the rash was minimal (mean value 1.50) respectively. (3) For the treatment of illness, it was found that the number of self-medicated patients was 54 (45.4%), who bought oral medication for 34 people (28.6%), and the number of visits to doctors was 29 (24.4%) respectively.

3. the solutions to resolve impacts from the charcoal burning business as follows: 1) the boundary should be set far from the original source, 2) The coal-burning business operator should be away from the community for a distance of 1 kilometer or more, 3) Should promote alternative occupations for entrepreneurs of charcoal burning business, 4) The number of charcoal operators should not be too large, 5) Should issue regulations to control or register entrepreneurs on a year-to-year manner, 6) An impact assessment committee should be established, ad 7) It should strictly implement the zoning policy and apply it to all operators equally.

Keywords

Charcoal Burning Business; Impacts ; Solution

Article Received: 10 August 2020, Revised: 25 October 2020, Accepted: 18 November 2020

Introduction

The GLOBAL ISSUE has had many impacts on the global society, and one of the factors is GLOBAL WARMING, which is a major contributor to the rapidly changing global temperature, global warming is the main cause of the increase in greenhouse gas emissions from human activities such as wood-burning, coal burning, fuel, and various human-made and artificial chemicals. All of these are the main reasons for the rise of greenhouse gas phenomena, and concentrations in the Earth's atmosphere so that the sun's rays that are supposed to be reflected back in the right amount are returned to the greenhouse gas. These mirrors contain, thus causing the global temperature to gradually rise accordingly. The most noticeable phenomena are soil conditions, wind, sky, strange weather, more severe natural disasters, floods, earthquakes, violent wind storms, unusually hot weather that people die, including new disease epidemics and increasing numbers of disease vectors (Panitanan Suwanbolnukul. 2020).

Khok Sung Sub-district Municipality, Phon Thong District, Roi Et Province, Thailand is another interesting case study about GLOBAL WARMING. Due to some areas of Khok Sung Sub-district Municipality, some groups of people work in burning charcoal which causes pollution problems and creates global warming. This can be analyzed from complaints and calls for government agencies to help resolve problems, especially the charcoal industry, for example, the letter from Phon Thong District Office No.0617/995 dated April 21, 2011, pointed out the effects of charcoal burning that caused many nuisances such as smoke and the foul smell of smoke, including the occurrence of respiratory disease, etc.

It is therefore imperative that the Khok Sung Sub-District Municipality, the owner of the area, has to find a solution to resolve the disputes between the business operators and the affected villagers, therefore organizing a community forum and exchanging opinions between entrepreneurs and residents. The homes of the affected people led to the 4 common agreements, which are; 1) To have the charcoal burning business operator form a group in the form of a committee to enter into a mutual agreement or create a common procedure and report to the mayor continuously. 2) In the period from February to April of every year, reduce the burning of charcoal to reduce the amount of smoke, since, in this period the air is still without wind, causing the smoke to disturb the villagers, it may be another complaint. 3) Operators who have not entered the stationary zone quickly move to the stationary zone, if unable to enter the stationary zone, the burn location should be moved 500 meters from the community as well, with the group committee's consideration to proceed. And 4) Solving common problems within and outside society at all levels is strong, both socially, economically, and politically, able to face a fast and complex global society. Therefore, In this situation, it can no longer be solely for solving problems through the government structure, observed from the above four agreements unable to resolve the problems that arise because they still appear Various complaints on a regular basis.

From the above problems, Khok Sung Sub-District Municipality, therefore, requested cooperation with Roi-Et Rajabhat University as a central organization with academic potential to help conduct research on "Study of the impact of the charcoal burning business" to further use the data obtained from the research in solving the problems of the Khok Sung community.

Research objectives

This research aimed to (1) Explore the problem of the charcoal burning business, 2) Analyze the effects of the charcoal burning business, and 3) Provide solutions to the effects of the charcoal burning business. This research was held in the area of Khok Sung Sub-district Municipality, Phon Thong District, Roi Et Province, Thailand.

Research Methodology

The sample groups used in this research are as follows: 1) The group of charcoal burning business in Khok Sung Sub-District Municipality was obtained by specifying the sample size at 50%, thus, received a sample of 10 people. 2) People in areas affected by the charcoal burning business are obtained by determining the size of the sample population of the thousands. Using a sample of 15 percent (Boonchom Sri-Sa-ard, 2010: 41), the sample was representative of 206 households.

The research instruments were (1) Interview form used to interview entrepreneurs of charcoal burning business regarding general information of the interviewee, area layout and residential area, production information, problems from charcoal burning business, and other suggestions. (2) A questionnaire used to inquire opinions of people affected by the charcoal burning business in Khok Sung Subdistrict Municipality.

Data Analysis: The quantitative data was used with descriptive statistics were Frequency, Percentage, Mean, and Standard deviation. The qualitative data is based on Content Analysis.

Research Results

1. Problems from the charcoal burning business

The production process and production time of the charcoal tribe stove, classified by 8

entrepreneurs, appear the general data analysis as shown in Table 1.

Table 1: Production Stages and Lead Time

Operator name	Process and production lead time					Output quantity (sack)
	Raw material collection (day)	furnace Construction (day)	Burning charcoal (day)	Total duration (day)	Times of Most smoke (day)	
1. Mrs. A.	5	5	15	20	5	80
2. Mrs. B.	2	2	10	14	3	30
3. Mrs. C.	8	1	8	17	5	30
4. Mrs. D.	3	1	14	18	5	37
5. Mr. J	3	1	15	19	7	40
6. Mr. K	2	1	10	13	4	40
7. Mrs. A.	1	1	15	17	5	40
8. Mr. L	4	2	10	16	3	40
Average	**4**	**2**	**12**	**17**	**5**	**42**

From Table 1, it was found that charcoal burning entrepreneurs used the process and time for producing charcoal/stoves on average totaling 17 days, when considered on an individual basis, it was found that the firing process took the most time, on average, 12 days, followed by the gathering of raw materials takes an average of 4 days, the construction of a tribal stove takes an average of 2 days, an average of 5 days of smoke, and the average quantity of charcoal produced 42 sacks/time/stove. However, the problems from the charcoal burning business are as follows.

1.1. The smell problem was found that the charcoal burning process produces a burning smell, the smell of fumes may also float in the direction of the blown wind which is difficult to control, making it a problem for nearby residents or downwind, causing a nuisance, there is a pungent smell and a burning nose, tncluding affecting the respiratory system of the people in the area.

Picture 1: Characteristics of charcoal and ashes after burning coals
Source: Seksan Sonwa, Kongkiat Sookasem and Somjai Pumipuntu (2011)

1.2 The problem of soot found that the combustion will have smoke from burning all day and night, especially during the strong wind will cause the soot that formed may float to cling to the clothes and belongings of the villagers putting outside the house

1.3 Dust problems show that the burning of charcoal will cause dust, which is caused by the ashes and soot that is dispersed into the air, where the dust may fly into clothing The body and when inhaled in large quantities can have health effects such as respiratory problems.

Picture 2: Problems of the charcoal burning business
Source: Seksan Sonwa, Kongkiat Sookasem and Somjai Pumipuntu (2011)

2. The effect of the charcoal burning business

Inquiring about 206 representatives of the people in the affected areas, it was found that the majority of respondents. Were 113 females (54.9 percent), Age 31-40 years, 60 people (29.1%), Unspecified the number of household members of 81 people (39.3%), There are 1-3 male household members, 103 (50.0%), 1-3 female (53.4%), Refused to identify where they lived in the community: 137 (66.5 percent), Duration of stay at the current residence more than 1 year or more Number 193 people (93.7 percent), And the distance from home to the nearest charcoal burning establishment is more than 1,000 meters (42.2%). However, the effect of the charcoal burning business as follows:

Characteristics of the affected effects are as shown in Table 2 - 5.

Table 2: **Amount and percentage of respondents classified by impact**

Effecting	Amount (people)	Percentage
1. To be affected		
Not affected	87	42.2
Affected	119	57.8
2. Type of impact		
smell	85	41.3
Soot	83	40.3
Dust	41	19.9
Other	3	1.5

From Table 2, it was found that most respondents were affected by the charcoal burning business of 119 (57.8%), the most affected by odor was 85 (41.3%), followed by the smoke effect of 83 people (40.3%), and dust impacts of 41 people (percent 19.9) respectively.

Table 3 Amount, percentage, and severity of health effects

The severity of the effects received	Severity			Average	S.D.	Level
	High	Moderate	Low			
	Amount (%)	Amount (%)	Amount (%)			
1. Irritation/respiratory system	19 (16.0)	67 (56.3)	33 (27.7)	1.88	0.65	Moderate

2. Burning eyes	12 (10.1)	60 (50.4)	47 (39.5)	1.71	0.64	Moderate
3. Itchy rash	7 (5.9)	46 (38.7)	66 (55.4)	1.50	0.61	Moderate
4. Sick/cold/cough/sneezing	15 (12.6)	64 (53.8)	40 (33.6)	1.79	0.65	Moderate
Total	**13 (10.9)**	**59 (49.6)**	**47 (39.5)**	**1.72**		**Moderate**

From Table 3: it was found that the severity of health effects was moderate (mean 1.72), irritation or respiratory irritation was highest (mean 1.88), followed by illness/cold/cough/sneezing (mean 1.79), and the least rash (mean 1.50), respectively.

Table 4: Amount, percentage of affected by treatment pattern

Treatment pattern	Amount (person)	Percentage
1. Self healing	54	45.4
2. Buy oral medicine	34	28.6
3. See a doctor	29	24.4
4. Chronic illness	2	1.6

From Table 4, it was found that the self-healing treatment was 54 (45.4%), followed by those who bought medicine for themselves, 34 people (28.6 percent), and treatment by visiting doctors of 29 people (% 24.4) respectively.

Issue 2 The period of time affected by 206 people as follows:

Table 5 Amount and percentage of respondents impacted by time, frequency, and month of impact.

Time interval/frequency Affected	**Amount (person)**	**Percentage**
1. Affected period		
morning	5	4.2
afternoon	8	6.7
night	99	83.2
All 24 hours	7	5.9
2. The frequency of being affected		
1-2 day	22	18.5
3-4 day	58	48.7
5-6 day	17	14.3
Very day	22	18.5
3. The month that was most affected		
November (No. 1)	39	32.8
December (No. 2)	39	32.8
January (No. 3)	37	31.1
Other months	4	3.3

From Table 5, it was found that It is most affected during the night. 99 people (83.2 percent), affected three to four days a week of 58 people (48.7 percent), and during the months that were affected, 1st and 2nd place were During November and December, respectively, there were 39 people (% 32.8) respectively.

3. Solutions to resolve the effects of the charcoal burning business

3.1 Information on the management of impacts is presented in details in Table 6 - 7.

Table 6: Amount and percentage of respondents classified by impact management issue.

Management issues	Amount (persons)	percentage
1. Know the solutions to the complaints of the Khok Sung Subdistrict Municipality.		
Know	144	69.9
Unknow	62	30.1
2. Determination of the area of the charcoal burning business of Khok Sung Municipality		
appropriate	116	56.3
Non- appropriate	90	43.7
3. Amount of operators burning charcoal of the sub-district municipality		
appropriate	86	41.7
Non- appropriate	120	58.3

From Table 6, it was found that the complaints were solved by 144 persons (69.9%), the determination of the charcoal burning business boundary is suitable for 116 people (56.3%), and the number of operators burning unsuitable charcoal is 120 people (58.3 percent), respectively.

Table 7 Amount, Percentage, Mean, Standard Deviation And the level of satisfaction in solving the problems

Assessment list	Satisfaction			Average	S.D.	Level
	Highest-High	Moderate	Low-Lowest			
	Amount (%)	Amount (%)	Amount (%)			
การแก้ไขปัญหาเรื่องร้องเรียนของเทศบาลตำบลโคกสูง	37 (17.9)	97 (47.1)	72 (35.0)	2.75	0.94	ปานกลาง

From Table 7, the respondents were at a moderate level (mean 2.75) satisfaction in solving the problems of the Khok Subdistrict Municipality.

However, the suggestions and solutions for the impact of the charcoal burning business are as follows: (1) the boundary should be set far from the original site because the original boundary is still too close to the community for the safety of villagers' health. (2) The charcoal burning business operator should be at a distance of 1 kilometer or more. (3) should promote new occupations for entrepreneurs in the charcoal burning business Since it affects many aspects. (4) The number of charcoal operators should not be too large and the distance from the community should be established. (5) Should issue rules for controlling or registering entrepreneurs in the form of year to year or create appropriate business conditions by specifying conditions not to affect the community. (6) An impact assessment committee should be established. Before the license for business operation. And (7) should strictly implement the zoning policy and apply it equally to all operators.

Discussion

This research found some interesting points to discuss the results as follows.

1. The smell problem was found that in the burning process, it will produce a burning smell caused by the charcoal burning process, which the smell will float in the direction of the blowing wind, causing problems for people living nearby. Nearby or under the wind or even with the operator itself, causing the nuisance of an unpleasant burning smell, causing a stinging and stinging nose, as well as long-term effects on the respiratory system. it corresponded to Pranee Punthumasinchai (1995) The main pollutants and their effects from air pollutants are classified into nine categories. The odor is a type of air pollution caused by the degradation of organic matter to produce hydrogen sulfide gas. (H2S) or caused by chemicals or components used in the manufacturing process, and consistent with the research of Thanarat Jitcharnvichai (2019) study the LOW-TEMPERATURE POTTERY MADE FROM LIGNITE FLY ASH AND THALEKAEW CLAY IN PHITSANULOK PROVINCE found that the results showed that the most average finesse range of both raw materials (lignite fly ash and Thalekaew clay) was 251μ-2 mm. The chemical composition analysis of the lignite fly ash and Thalekaew clay indicated that the percentage of silica oxide was 35.50% and 62%, alumina oxide 18.80% and 18.20%. It was found that the percentage of calcium oxide was 17.30% and zinc oxide 12.90% in lignite fly ash. The results also showed that the first ingredient (mixture with 5 % of lignite fly ash) was the best ingredient of all the atmosphere. In the oxidation atmosphere, it was found that the highest strength was 244.79 kg/cm2; the highest density was 2.04 g/cm3, and water absorption was 12.60 %. In the reduction atmosphere, the results showed that the highest strength was 244.03 kg/cm2; the highest density was 1.95 g/cm3, and water absorption was 5.47 % with a light red color of 6/8 2.5YR all of the atmosphere. Therefore, the two atmospheres were chosen to manufacture the products because the properties of the ingredients were equivalent to the properties of earthenware.

2. The soot problem It was found that during the combustion process there will be smoke from the combustion of fuel all the time of the day and night, causing stinging and affecting the respiratory system, if inhaled in large quantities, it can cause blackouts and long-term adverse health effects. Consistent with the research of Wanchat Napasri, Tawatchai Sandchompoo, and Kanungsuk NanthachomphoIt was found that burning waste, leaves and grass, setting up fires to repel mosquitoes, and burning charcoal would cause many air pollution problems such as smoke, fire, ash, dust, which affects health problems and illnesses “Respiratory system"

3. In terms of dust issues, it is found that the burning of charcoal causes dust particles which are generated from the ashes and soot that are dispersed into the air, including the charcoal dust generated by the charcoal produced. These dust particles track human clothing and bodies and cause dirt, which, if inhaled, can cause respiratory problems, directly affecting their health. It was consistent with the research of Walaiporn Pramchoo (2009) the Effects of Wood Smoke Exposure on the Pulmonary Function Among Charcoal Production Workers in Surat Thani Province found that respiratory symptoms from smoke inhalation, including the study group, had 84% of cough, had 82 percent of phlegm, chest tightness until breathlessness 42%, breathing is stuck 38%, nose irritation 80%, having a stuffy nose - runny nose 26 percent.

4. The severity of each side effect was found to be moderate overall, including respiratory irritation, illness/cold/cough/sneezing, and stinging. It can be seen that although the overall severity of the severity is moderate, the effects that directly affect the health of those affected by air pollution will continue to accumulate forever, which is consistent with the research of Wanchat Napasri, Tawatchai Sandchompoo, and Kanungsuk Nanthachompho (2007) It was found that 80% of the population were engaged in agriculture and some of them were hill tribes, who faced problems of arable land, deforestation, and forest fires. And the people in urban communities also have lifestyles that cause air pollution, such as burning garbage, burning leaves and grass, setting fire to repelling mosquitoes, and burning charcoal causing air pollution problems, haze fire, ashes, and dust can affect health problems, sicknesses, and respiratory disease. And consistent with the research of Treekitti Triboot (2015) found that the measured

CO emissions ranged from 521-710 ppm, were at this level resulted in nausea, vomiting, severe dizziness, an abnormally rapid heartbeat, and an arrhythmia until unconsciousness and death if taken in this amount for more than 3 hours. And The concentrations of NOx emissions ranged from 2.1 to 4.6 ppm, resulting in stinging and irritation of the respiratory tract.

5. The affected period was found that most of the effects occurred during the highest night time, with the affected duration of 3-4 days per week, and the month that was most affected was November and December respectively, it was consistent with the research of Weratep Geeratithadaniyom (2004) studied the air quality conditions in Nakhon Ratchasima, Nakhon Ratchasima Province by monitoring 10 major air toxins in the atmosphere were Sulfur dioxide (SO2), Nitrogen oxide (NO) gas, Gas nitrogen dioxide (NO2), Nitric Oxide (NO3), Ozone gas (O3), Carbon monoxide (CO) gas, Total hydrocarbons (HC), Methane gas (CH4), Non-methane hydrocarbon (Non-CH4), and fine dust 10 micrometers (pm-10). which install a mobile air quality monitoring station in the area of Nakhon Ratchasima Municipality. The number of 2 locations for a continuous period of 13 days. The research results were found that for each hour, the average concentration of small dust particles was quite high, especially during the nighttime at the Thao Suranaree Monument. In addition to small dust, it also contained relatively high levels of carbon monoxide and ozone with the highest 1-hour average. Therefore, these can be harmful to the respiratory system if given for a long time.

6. Suggestions and solutions are as follows: (1) set the boundary distance from the community, (2) Organize the charcoal burning business zone, (3) Promote a new career substitute, (4) limit the number of charcoal burning operators, (5) Issuing regulations to control, (6) establishing a control committee, and (7) Strictly follow the policy. In accordance with the organization that has been successful in this management is Tha Som Subdistrict Administrative Organization has established a law for regulating activities that are hazardous to health in the category of charcoal burning in 2018 (Government gazette. 2020) (1) It is prohibited to burn charcoal in forest areas under the law on forestry and public benefit areas. (2) The establishment must be located away from religious establishments, hospitals, educational establishments, nurseries, nursing homes for the elderly or the nursing home or the disabled, or any other place requiring special protection of public health, which must: It is not within the range that may affect public health or must establish an effective public health impact prevention system, taking into account the nature and type of the establishment. (3) Must be at least 500 meters away from public roads, such distances may be determined in accordance with the resolution of agreement in the area. (4) Must be at least 300 meters from natural and public water sources, except for the operator's own water supply. (5) In case of being located in an area with slopes, operators must have measures to prevent leaching of ash sediment outside of their own area, such as an embankment, ditch around the area, etc. (6) In case of located near or adjacent to forest areas, operators must set up fire prevention lines around the charcoal burning area, including taking care and preventing their own charcoal burning activities to cause the fire to the nearby forest. (7) Operators can operate up to 2 burners per household. (8) The charcoal kiln is not more than 2 meters wide, 3 meters long, 1.80 meters high, the operators can collect up to 10 burners in the same area, the determination of any additional places, the set of distances, and the defining systems to be in accordance with the Public Health Act or other relevant laws.

Policy recommendations

The results of the research generated a body of knowledge to manage the impact of the charcoal burning business for Khok Sung Municipality through the participation of people involved in the form of expressing opinions and proposing guidelines. Solving problems together, including the body of knowledge about the government administration model in determining the solution for the charcoal burning by using the research model as a thinking base for solving the problem which will lead to the connection of knowledge to the guidelines for practice well. Therefore, policy recommendations to improve the service in accordance with the needs of the recipient, as follows: (1). There should be support

for the modern production technology with the least pollution or the knowledge of the management of other forms of the least polluted kiln to the operators in the area. (2) Should install facilities such as water and electric systems for the charcoal operators to facilitate the control of the furnace and the management that causes the least pollution. (3) the new business zone should be set far from the original line because the old line is still close to the community and still affects the community, preferably 1-2 Km up distance from the community. (4) Should promote new occupations for entrepreneurs in charcoal burning business as the traditional charcoal burning business has many negative impacts. (5) The number of operators who burn the charcoal should not be excessive. (6) Should establish regulations, control or register entrepreneurs year by year, or create appropriate business conditions that do not affect the community. (7) An Impact Assessment Committee should be set up prior to any license to operate and continually monitor and evaluate. And (8) Should operate strictly in accordance with the policies and apply them to all operators equally.

Suggestions for the next research

Research should be conducted on adding added value to the community economy and may be adapted from a combination of research methods to participatory research in bringing local resources to develop into a creative economy model, etc.

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