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Forest Farm for Haze Free

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Abstract

Haze issue has been getting more serious in recent one decade in Chiang Mai, Northern Thailand. It was a little bit difficult to identify what is the cause of the problem and why it has been becoming a serious issue due to the lack of official data reported in public. The authors obtained and found the data officially reported how many hectares of forest were burnt for recent three years from 2014 to 2016 and which district has the biggest number of hot spots in Chiang Mai province area especially for Mae Jaem district consisting of seven (7) divided sub-districts. To our surprise, nearly 70% of the total number of hotspots were from national forests, not regional community or agricultural sector such as cultivated farmland after harvesting crops. Despite severely prohibited, it has been said in general, the forest and mountain were burnt for farmers to get an additional income from mushroom cultivation, therefore it has been thought that the haze issue has been caused by those mushroom farmers. According to the data obtained approximately 235,000 hectares has been incinerated in recent three years. But now it is already too late and what to do toward the future is a new challenge. Forest farm or Agro-forestry is one of the solutions, but a careful afforestation plan must be organized and shown before taking action.

In this paper, one model for estimating how much energy and carbon dioxide have been wasted and discharged respectively from forest burning is shown from the viewpoint of warning not to do it again toward the future.

Keywords: Haze issue, Energy & resource waste, CO2 production, Northern Thailand

1 Introduction

Almost one decade before in early 2000, the haze issue has been gradually closed up seriously as we have now. Some of the voluntary group named Chiang Mai International Friends consisting of almost 20 or so foreign people living in Chiang Mai got together and discussed and submitted the proposal to local government how it should be solved, however no active progress for this issue could be shown and found unfortunately. Since those days, it has been becoming a poetry now. People say that the season for Haze has come even this year, but it looks there is no topic on concrete countermeasures. The authors have been looking for what is the main reason or cause of the issue why it happens for a long time. It has been said that the haze issue has been caused by the forest burning by mushroom farmers to get an additional income from its cultivation after burning. It was however a mysterious and difficult to accept this explanation due to no official data report, however the real data was recently found to show what is the main cause of the issue about the Mae Jaem district in Chiang Mai as shown in Table. 1 to Table. 3, in which they show the number of hot spots for seven sub-district, how many area (ha) were burnt from what reason and which kind of land area for recent three years from 2014 to 2016.

Table 1 Hotspots point of Mae Jaem 2014

Table 1 Hotspots point of Mae Jaem Chiang Mai between 1st January – 31th May 2014

70 %

Province	District	Sub district	AREA						
			Forest conservation	National forest	ALR	Community & etc	Agricultural	Beside Highway	Total
Chiang Mai	Mae Jaem	Mae sug	-	109	9	2	-	8	128
		Mae Najoor	1	121	7	1	-	1	131
		Ban Taub	60	23	-	-	2	-	85
		Klong Kaeg	9	23	12	1	-	2	48
		Pang Hin Fon	-	33	1	9	-	-	43
		Chang Keorg	-	8	1	1	1	2	13
		Tha Pha	-	6	7	-	-	-	13
Total Mae Jaem			70	323	37	14	4	13	461

Table 2 Hotspots point of Mae Jaem 2015

Table 2 Hotspots point of Mae Jaem Chiang Mai between 1st January – 31th May 2015

Province	District	Sub district	AREA						
			Forest conservation	Nationa forest (76.1%)	ALR	Community & etc	Agricultural	Beside Highway	Total
Chiang Mai	Mae Jaem	Mae sug	-	162	8	1	-	2	173
		Mae Najoor	-	94	12	1	-	-	107
		Ban Taub	49	26	-	-	-	-	75
		Klong Kaeg	10	14	12	-	-	1	37
		Pang Hin Fon	-	31	-	-	1	-	32
		Chang Keorg	1	9	-	-	2	-	12
		Tha Pha	1	2	4	1	-	-	8
Total Mae Jaem			61	338	36	3	3	3	444

Table 3 Hotspots point of Mae Jaem 2016

Table 3 Hotspots point of Mae Jaem Chiang Mai between 1st January – 31th May 2016

Province	District	Sub district	AREA						
			Forest conservation	Nationa forest (64.6 %)	ALR	Community & etc	Agricultural	Beside Highway	Total
Chiang Mai	Mae Jaem	Mae sug	-	70	10	1	1	9	97
		Mae Najoor	6	77	13	2	3	3	104
		Ban Taub	49	21	1	-	-	2	73
		Klong Kaeg	3	10	4	1	3	1	22
		Pang Hin Fon	3	51	-	3	2	1	60
		Chang Keorg	1	7	3	1	-	1	13
		Tha Pha	1	6	7	-	1	-	15
Total Mae Jaem			63	248	38	8	10	17	384

Table 4 Burnt area and hotspots in 2014

Table of burn area divided into sub district in 2014

District	Burn area(RAI)	Point of hotspots
Tha Pha	173,268	48
Chang Keorg	136,991	85
Pang Hin Fon	111,725	128
Klong Kaeg	90,593	131
Ban Taub	45,884	13
Mae Najoor	42,136	13
Mae sug	15,519	43
Total	616,116	461

Table 5 Burnt area and hotspots in 2015

Table of burn area divided into sub district in 2015

District	Burn area(RAI)	Point of hotspots
Tha Pha	130,553	37
Chang Keorg	127,540	75
Pang Hin Fon	117,336	173
Klong Kaeg	101,360	107
Ban Taub	42,495	12
Mae Najoor	32,540	8
Mae sug	11,975	32
Total	563,799	444

Table 6 Burnt area and hotspots in 2016

Table of burn area divided into sub district in 2016

District	Burn area(RAI)	Point of hotspots
Tha Pha	81,850	23
Chang Keorg	43,853	72
Pang Hin Fon	35,774	97
Klong Kaeg	26,663	104
Ban Taub	20,192	13
Mae Najoor	17,347	15
Mae sug	6,681	60
Total	232,360	384

2 Forest burning

It is already known that the forest shouldn't be burnt unnecessarily without any special purpose. In general, many of the forest fires are caused by human intentional actions, but most others are natural ones in general which is well known as wildfire in some special area or geographical zone due to different climatic condition from the other areas. Slash & burn is one of the most popular ways of developing new farmland for cultivating crops for food and other important material production needed for human activity and their daily life. One time in the past the slash & burn farming has been named sustainable agriculture due to a small scale migrant farming, however along with the social needs of production not only food but also bio-fuel, a vast cultivation area is newly required, and deforestation has been carried out on a large scale. In order to promote economic development, agricultural land development of large enterprises not looking at the environment causes a vast area of forest incineration, which also causes a tremendous inconvenience to neighboring countries in some area. In northern part of Thailand haze issue is one of the most serious matters to solve due to the reason of bad effect on human health needless to say. however in addition it gives more serious effect on tourism, which is one of the most important business industry for these areas. As already shown in the above data, the real main cause of the problem was found finally in detail. It was guessed that a main cause of the forest burning was caused by mushroom farmers, however it was wrong as far as concerned with the data shown above. It was finally found that it was mainly caused by the national forest burning. It looks almost no use and too late to ask who did it?, why they did it? Was it done legally or illegally? It is however the fact to see that a huge amount of area of national forest was burnt. One of the most important things is not to do it again. It looks a little bit difficult to know why it happened and why they did it. Probably it can be guessed that those people knew it shouldn't be done, however they might not notice how much energy and resources were consumed wastefully and how much CO2 was discharged

unnecessarily from its burning. Warning is necessary for the people not to burn it, however it is also important to let them how it is useless and harmful for human health in addition to the other miscellaneous disadvantages. Warning to the people should be equipped with more precise description how much energy and resources may be wasted and how much CO2 may be discharged additionally and unnecessarily if the forest is burnt. Needless to say the strict regulation and law for punishment and compensation should be legislated in parallel with warning and education related to environment preservation and conservation including training program, however even in this program the basic important data should be shown to keep in mind simply and clearly. The model for estimating energy loss and CO2 discharged from forest burning is shown for better understanding.

3 Modeling of Energy & Resource loss and CO2 discharge

By burning the forest, trees as the natural resources are burnt completely and a lot of heat enery is also consumed wastefully. In addition the unnecessary huge amount of CO2 is produced. If those trees are not burnt, they can be used usefully for many purposes as energy, material and sometimes in case as food without jeopardizing environment with CO2 production. Here shows one of the models to estimate how much energy is consumed and tress resources are lost in addition to CO2 production how much it is discharged from burning of them. The main purpose of this model building is to let the related people to know easier how seriously and importantly the forest burning gives a big influence to environment. In this case the tree is energy resource, therefore for better understanding the energy should be expressed as the equivalent amount of it how much tree (wood) should be needed to obtain the equal amount of energy in case one liter of kerosene is burnt. Of course gasoline or diesel fuel can be used instead of kerosene needless to say as far as it is more understandable commonly.

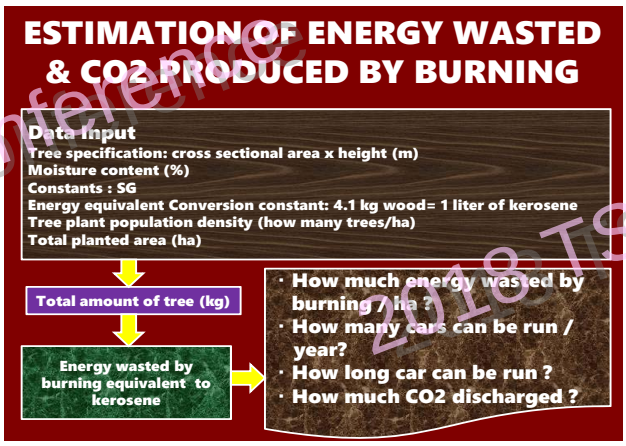

Fig. 1 Estimation flow for energy & CO2 calculation how much they are produced from burning

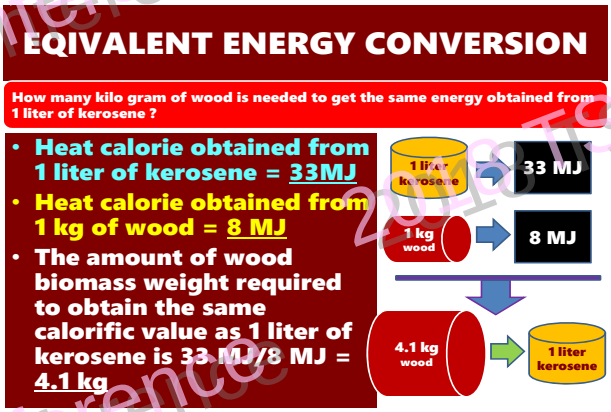

Fig. 2 Equivalent energy conversion how much energy is needed from tree burning to get equivalent energy obtained from one liter of kerosene burning

Fig. 1 shows the schematic chart view of the calculation flow. Prior to start the calculation many constants / conversion coefficients should be known for various energy resources and CO2 production (petroleum and tree in this case).

3.1 Equivalent energy conversion (Fig. 2)

It is necessary for better comparison and understanding to know how many kilo gram of wood (tree) is needed to get the same amount of energy obtained from 1 liter of kerosene first. It can be done as follows. Heat calorie obtained from 1 liter of kerosene is equal to 33MJ. and heat calorie obtained from 1 kg of wood (tree) is 8 MJ, therefore the amount of wood biomass weight required to obtain the same calorific value as 1 liter of kerosene is as 33 MJ/8 MJ = 4.1 kg

3.2 3.2 Data Input

Objective tree specification should be assumed by cross sectional area of tree (3.14 x radius (m) x radius (m) x height (m), Moisture content (%) of tree, Specific Gravity of tree, Energy equivalent Conversion constant: 4.1 kg of wood tree produces equal amount of energy to the one produced from one liter of kerosene and Tree plant population density

(how many trees / ha). Branches and leaves to be burnt should be considered separately

Total planted area (ha) (unit should be converted from rai to hectare in case such as 6 rai = 1 ha

3.3 Total amount of tree weight

This can be calculated based on the tree planting population density expressed by the number of trees / (ha) multiplied by total area of tree planted (ha). Fig. 4 shows the schematic view of tree specification assumed for estimating energy and tree resources how much energy and total amount of tree weight considering specific gravity, moisture content, tree population density / (ha) etc.

3.4 Energy wasted by burning equivalent to kerosene

Knowing the total amount number of trees (kg), the total energy to be obtained from burning can be calculated from the relationship that 4.1 kg of wood tree burning produces 33MJ of energy obtained from one liter of kerosene.

3.5 Optional results

By use of the model, the following results can be obtained. Which result should be chosen depends on the options of the individuals, however one of the ways is to print out all results and make the best choice from them to explain depending on case by case. Here the case of car was picked up for better example of comparison to understand the energy waste and CO2 production. Mileage data for individual car is also considered too.

1) How much energy was wasted by burning / ha?

2) How many cars can be run / year using those energy wasted?

3) How long one car can be run by those energy wasted?

4) How much CO2 was (or will) discharged / ha or targeted forest burning?

For the estimation how much CO2 is produced from one unit amount of energy resources, the conversion constants are needed for corresponding fuels as shown in Fig. 3

CO_2 Discharge for various kinds of fuel

Various kinds of fuel	Carbon equivalent discharge coefficient	Unit heating value	CO2 discharge / Unit amount of fuel (kg or l)
Raw coal	0.0245 tC/GJ	28.9 GJ/t	2.596 kg-CO2/kg
Steam coal	0.0247 tC/GJ	26.6 GJ/t	2.409 kg-CO2/kg
Crude oil	0.0187 tC/GJ	38.2 GJ/t	2.619 kg-CO2/l
Gasoline	0.0183 tC/GJ	34.6 GJ/t	2.322 kg-CO2/l
Jet fuel	0.0183 tC/GJ	36.7 GJ/t	2.463 kg-CO2/l
Kerosene	0.0185 tC/GJ	35.7 GJ/t	2.489 kg-CO2/l
Light oil	0.0187 tC/GJ	38.2 GJ/t	2.619 kg-CO2/l
A type heavy oil	0.0189 tC/GJ	39.1 GJ/t	2.710 kg-CO2/l
LNG	0.0135 tC/GJ	54.5 GJ/t	2.698 kg-CO2/kg

Fig. 3 CO2 discharge for various kinds of fuel

Fig. 4 Tree specification for calculation

Here shows one of the roughly estimated example how much energy was wasted by burning in Mae Jaem area based on some assumption.

1) Heat calorie obtained from 1 liter of kerosene = 33MJ. Since the heat calorie obtained from 1 kg of wood biomass is 8 MJ, the amount of woody biomass weight required to obtain the same calorific value as 1 liter of kerosene is 33 MJ ÷ 8 MJ = 4.1 kg

2) Tree specification is assumed as follows. Radius of tree: 0.2 m, Height: 15 m, Specific gravity of wood: 0.4~ 0.7, however it is set as 1.0 considering the moisture content for conventional growing tree. Volume of tree: it must be assumed as the product = height times cross section area of tree trunk expressed by (π x radius2)

3) Weight of one tree = 15 (m) x 3,14 x (0.2 m x 0.2 m) = 1.884 (kg) where S.G =1.0

4) Total weight of trees / ha = 1.884 (kg) x 3000 = 5,652 (kg) where tree planting population is 3,000 / ha. Area unit conversion: 1 ha = 6 rai

5) Burnt out area in Mae Jaem = 616,116 (rai) = 102.686 (ha)

6) Kerosine equivalent energy consumption= (102,686 x 5,652)/4.1 = 141,556,408 (liter)

7) Assuming that one car's mileage is 8 (km) / (liter), and calculate how much distance a car can be driven. Dividing the above value of 141,556,408 (liter) by 8 (km/liter) gives 17,694,551 km. If it is divided by 40,000 km (equal to the distance to go around once the planet of earth), it gives 4,423,637.75 times the planet of earth.

8) How many people can drive a car using above mentioned petroleum per year? Assuming that the distance traveled by one person is 20,000 (km / year), then 17,694,551 km is divided by 20,000 km, = 884.72755 people will be able to drive for one year. Also, if traveling 15000 km / year, it will be 1,179.63673 people

4 Conclusion

The followings are the conclusion derived from this paper.

1) Main cause of the haze issue was found that it was caused by the national forest burning in Mae Jaem district, in Chiang Mai province.

2) Almost 60 to 70% of the total number of hotspots are counted as from national forest, therefore more strict management and control of national forest are needed not to repeat it again by legislation of law and regulation in addition to fine payment for compensation and punishment. In addition more opportunity should be provided for education and training to teach how importantly the environment shouldn't be jeopardized from the viewpoints of wasting energy and resources in addition to unnecessary CO2 production including the warning not to burn any more.

3) To stop burning and not to let the people do it again, one model is introduced to show how much energy and resources are wasted by forest burning from the viewpoint of showing some simple INDEX for energy and resource waste by burning for easy and better understanding, Even for CO2 production it can be possible to show how much it can be produced from burning.

4) The energy wasted by burning branch and leaves attached to the main tree is not considered and taken account for calculation. Some simple concept application might be convenient for more simplified way of calculation such as the weight ratio of main trunk tree to the others of branch and leaves etc.

5) Simplified numerical INDEX expressed by unit area for example may be effectively used for the related people to keep in mind not to burn reminding how much energy and resources may be wasted unnecessarily.

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