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Jakarta, December 21, 2011

Number	: Un.01/F8/PP.08/3495/2011
Attachments	: TOR
Ref	: **Invitation to DAAD Alumnae Workshop**

Dear,

Dr. Sudarsono Soedomo

We are pleased to invite you to become **a speaker** in the

The DAAD Alumnae Workshop on Climate Change Economy

The workshop is organized by The Faculty of Economics and Business of Syarif Hidayatullah State Islamic University (UIN) Jakarta in cooperation with Deutscher Akademischer Austausch Dienst (DAAD) on February 14-16, 2012 in Seruni II Hotel (1 km before Taman Safari), Cisarua Bogor.

The aim of the workshop is to explore ideas among DAAD alumnae as well as Indonesian academicians on how people as well as government could prepare for economic challenges resulted from climate changes. These ideas then will be formulated into a policy recommendation for the Indonesian government, and will be developed further as strategic action plans

We expect you to deliver your point of view on the issue of ***"Climate change and environment, agriculture and forestry /bioscience"*** on Wednesday February 15, 2012 at 09.30-10.00.

Further, we highly appreciate you to provide a paper related to the issue based on your expertise, and email it to zaenalsdn@yahoo.com or sugih-wr@uinjkt.ac.id no later than January 30, 2012

For more details, please see attachments. We look forward to hearing from you soon

Kind Regards,

Dean Faculty of Economic and Business,

Prof. DR. Abdul Hamid, MS

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Climate Change, Economy, and Forest Resources*

Sudarsono Soedomo†

1 Introduction

Human settlement is usually started out by clearing forest or other natural vegetation. We know that forest and vegetation in general store carbon in their body. Dead wood and vegetation parts sooner or later will be decomposed and as the result CO_2 will be released to the atmosphere. Next step that human needs to be done is to create economic activities. Since the invention of steam engine, the use of fossil fuel has been increasing until today. Initially, wood was used to produce steam generating the engine. Wood was then replaced by coal, which is less voluminous. Today we realize that burning coal increases CO_2 in the air. Next progress was the invention of "more efficient" engine that consumes petroleum, one of fossil fuels. As coal, the use of petroleum also increases CO_2 in the air.

Economies in this planet are still dependent on the fossil fuels that are believed to contribute to the global warming leading to Climate Change. The environment has changed and start fighting back to economic progress created by human being. What happens next is that economic progress and environmental conservation are frequently viewed as a trade-off. My position is that economic progress and environmental conservation could and should go together. Environmental conservation is useless and will fail when it is not able to provide social welfare. Conversely, making economic progress by destroying the environment will destroy the economy itself. All economies operate in the environment and use materials from mother nature. Neglecting the environment in economic development simply means suicide.

In this paper I will discuss a bit about the possibility of a new climate that we will face (section 2), the world economy and economic development of Indonesia in relation to climate change (section 3), and section 4 discusses the position of agriculture and forestry in the face of climate change. Finally, section 5 is a very short closing remark.

2 New Climate

What is the path of the change with and without mitigation? What will new climate look like? Without knowing the path and the new steady state, it is impossible to predict the impacts. Beyond the rise of global surface air temperature is uncertainty.

*Presented in DAAD Alumni conference, Bogor, February 14-16th, 2012.

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Effects of the change on the hydrological cycle, regional specification of change, and, finally, impacts of the projected changes on biological, physical, and economic systems are uncertain (Rosenzweig, 1989).

Agricultural production processes are strongly dependent on natural climate. Technology, such as greenhouses, is to some degree able to disconnect the relationship between agriculture and natural climate, but the production costs will be astonishingly high. Manufactures and services are less or indirectly affected by climate condition. Impacts on agriculture in general will unavoidably pass on to the economy as a whole (Adams, 1989; Reilly et al., 2007). Certainly, there is another important issue, which is many people will be displaced since their homeland situated on low coastal areas is inundated under sea water.

Elements of climate that have important effect on agriculture productivity are precipitation and temperature. These two elements of climate are commonly used as indicators of a climate change (Adams, 1989; Southworth et al., 2000; Hitz and Smith, 2004; Huntingford et al., 2005; Lobell et al., 2006). Two characteristics of precipitation that affect agriculture most are the depth and the distribution along the year. These two characteristics determine water availability for plant growth, especially in non-irrigated regions. Biomass of forest that can be supported by an ecosystem is also determined by the depth of precipitation.

Air temperature, being an important element of agriculture productivity, is assumed to be relatively stable due to strong influence of ocean surrounding Indonesian Islands. Mean temperature will slightly change, but there is no one who is willing or brave enough to predict explicitly by how much the mean annual temperature over Indonesia will change. Most likely, in general the change will be less than 3°C(Sipayung, 2007). If this is the case, then the impact of the temperature change on agriculture will be minor, and probably nothing on forest (Hitz and Smith, 2004). A change in precipitation can be captured by its depth and distribution along the year under new climate condition. The depth may increase or decrease, while the distribution may be more concentrated (shorter) or more evenly distributed (longer) in a year. Based on the possibilities of the change in precipitation, we can assess possible effect on agriculture operation (Tab. 1).

3 Economy

At the global level, in general economic efficiencies have been increasing over time as indicated by declining CO_2 produced per dollar of income (Fig. 1). Economies of South Africa, China, and India are the least efficient ones. Economies of most developed countries surprisingly are much cleaner than the ones of developing countries. We can have many reasons for the phenomenon, but one of those reasons is the most developed countries move their dirty industries to developing countries.

The world economies also show that the Kuznets' Curve apparently holds. Using cross-section data of 2008 and employing very simple statistical analysis (see critics by Müller-Fürstenberger and Wagner, 2007) result in a concave relationship between per capita CO_2 as dependent variable and per capita income expressed in US$ as indepen-

Tab. 1: Scenarios of new rainfall pattern

Rainfall Depth	Distribution: Shorter	Constant	Longer
Higher	Shorter growing season, higher risk of flooding	Flower fertilization might be influenced badly leading to lower productivity	Longer growing season leading to higher productivity
Constant	Shorter growing season, higher risk of flooding and drought	There is no impact	Longer growing season
Lower	Shorter growing season, higher risk of drought	Lack of water, higher drought risk	Longer growing season, higher drought risk

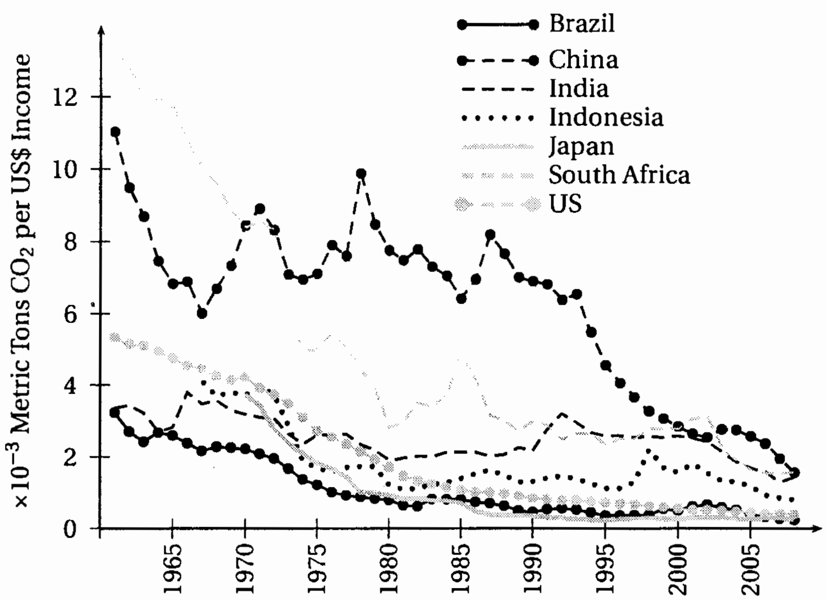

Fig. 1: Efficiencies of Economies

dent variable (Fig. 2). Both coefficients of linear and quadratic terms are significant at 1% significant level. The maximum emission will be achieved at the annual income level of 89,250 US$ before the emission starts declining. Average annual income per capita of world population in 2008 was 13,934.37 US$. There is a huge gap between where are today and what level of annual income per capita needed to achieve the turning point. Does it mean that a huge amount of CO_2 will be emitted before the turning point is passed through? It is certainly too scary. Luckily, however, different indicator of environmental quality has different level of the turning point. Forest change, for example, needs much lower level of the turning point (Mather et al., 1999). For the last ten years, Java Island has been experiencing an expansion of small scale private forest leading to an increase in forest standing stock. If deforestation is temporary, then why do we so worry about deforestation? If forest is truly valuable for the safety of our planet, then why hesitancy to pay forest services is still persistent?

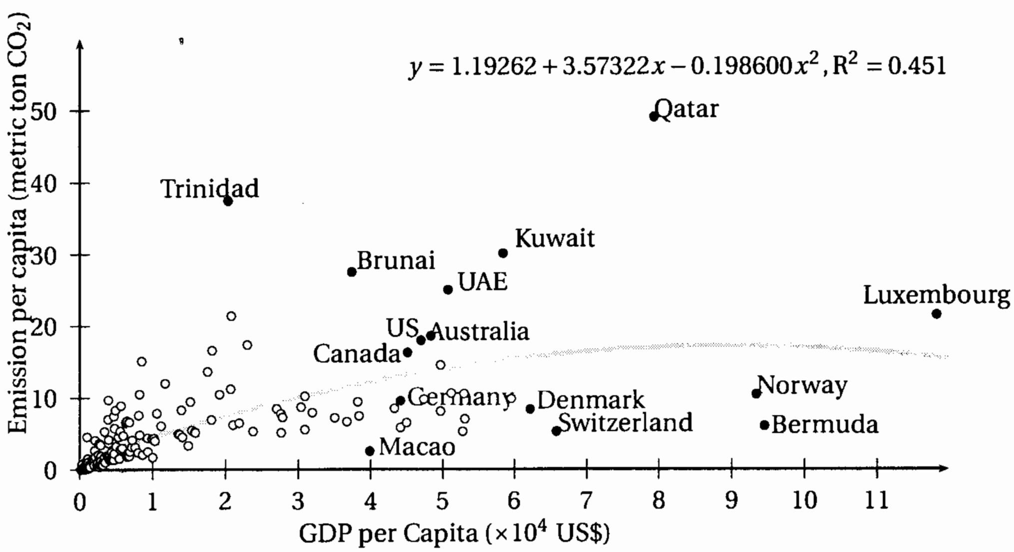

Fig. 2: Relationship between emission and income per capita of 2008, in 2008 US$

Now, for national level, let us take a look the economy of Indonesia, particularly its fiscal policy. So far, the importance of forest is still limited in a seminar room. In reality, burning fossil fuel is much more important so that the government needs to support it by providing subsidy. Although it can not be compared directly, the figures in Tab. 2 say a lot about real attitude of the society represented by the government. State budget allocated to subsidy for fuel that add CO_2 in the air is much larger than the one allocated to activities or sectors that potentially support CO_2 reduction from the air. In 2006, the fuel subsidy was 64.2 trillions rupiah, while the budget for environmental protection was only 2.7 trillions rupiah.

Environmental protection budget rose to 10.1 trillions rupiah in 2011, but at the same time fuel subsidy jumped to 129.7 trillions rupiah. In addition, two government institutions that are frequently associated with environmental protection, namely Ministry of Forestry and Ministry of the Environment, received annual budget, in total, of 1.8 trillions rupiah in 2006 and 7.0 trillions rupiah in 2011.

Since fuel subsidy has been given for several decades, it seems that Indonesian people have bëen addicted to gasoline. Because of the subsidy, fuel consumption has

Tab. 2: Pro (+) and contra (-) forces of CO_2 emission (trillions rupiah)

		Year						
Description		2006	2007	2008	2009	2010	2011	2012
Fuel subsidy	+	64.2	83.8	139.1	45.0	82.4	129.7	123.6
Environmental protection	-	2.7	5.0	5.3	10.7	6.6	10.1	10.6
Ministry of Forestry	-	1.5	1.8	3.2	2.1	3.3	5.9	6.1
Ministry for the Environment	-	0.3	0.4	0.4	0.4	0.4	1.0	0.9

Source: Ministry of Finance

been done less rationally and development of alternative source of energy, mainly biofuel, has no enough incentive. Without full rationality, it is hard to build a competitive economy. As the international fuel price and domestic fuel consumption increase persistently, the state budget can no longer be provided without compromising other important projects, such as infrastructures.

Gasoline is not only regular economic commodity but also political one. Every time the government intends, seriously or not, to raise gasoline price, political debates evolve. Actually, only the people living in the cities can enjoy subsidized price of gasoline, but the people who live in remote areas, where there is no enough road, have to pay much higher price of gasoline. It could be twice higher or even more than what the people living in the cities do. As long as metropolitan people are happy, people in the remote areas can be neglected.

4 Agriculture and Forestry

For agriculture, I will focus only on food crops since their vital role as a livelihood of so many people and national security on one side. On the other side food crops, more specifically annual ones, are relatively more sensitive to any change in weather.

4.1 Food Crops

Let us begin with environmental requirement for several crops that produce food. Most food crops grow optimally at temperature range of 20°C-30°C (Tab. 3). Even rice and mung bean can survive and is still productive at temperature of 36°C- 38°C, as long as water is adequately available. Mean monthly temperature of most regions in Indonesia is around 25°C-26°C. It is very unlikely that any change in temperature will put Indonesia outside the favorable temperature range.

Direct effect of temperature change might be insignificant, but its indirect effect could be quite destructive. We need to be vigilant against the outbreak of pests and plant diseases. Several types of insects and plant diseases are very sensitive to weather changes. Under certain conditions, some types of insects and plant diseases can proliferate uncontrollably.

Tab. 3: Environmental requirements of several food crops (Winch, 2006)

Crop	Altitude (m asl)	Growing period (days)	Day length (Short/Long)	Rainfall (mm/year)	Temperature (°C)
Rice	0-1000	90-120	Mostly short	>900	22-38
Maize	0-3000	90-120	Short	600-900	21-30
Shorgum	0-2300	70-220	Mostly short	350-800	17-30
Groundnut		90-160	Neutral	300-1200	15-30
Mung bean	0-1800	65-120	Mostly short	650-900	20-36
Soy bean	0-600	80-175	Short	400-1600	10-32
Cassava	0-1000	180-360		1000-2000	20-30
Sweet potato	0-2500	90-240	Short	750-1000	10-32

The positive impact of increasing levels of CO_2 in the air on agricultural production is not impossible. We know plants need CO_2 and water to produce sugar which is then converted into starch. Some studies indicate that CO_2 enrichment in the air can increase crop productivity (Slingo et al., 2005), especially in temperate regions. In tropical regions, however, the impact tends to be negative (Tubiello et al., 2007). It is, generally, accepted that the availability of water for agriculture will be a key issue for crop production in the coming decades. Higher CO_2 levels improve the water usage efficiency of most crops. Plant transpiration is reduced under higher CO_2 and the crop loses less water..

The impact of climate change is believed not the same for all places. There are places that have a positive impact, but there are also places that have a negative impact. Furthermore, agricultural production will also undergo changes and adjustments. Based on this belief, climate change will not seriously disrupt world agricultural markets (Tobey et al., 1992). Interregional adjustments in production and consumption will take place that reduce the severity of the impact.

There are so many uncertainties in climate change and its effect on agriculture productivity. Hence, as a precautionary measure, it would be wise if we diversify our sources of food. Dependence on rice needs to be reduced gradually. Moreover we know that to produce the rice we need large amounts of water. Other sources of carbohydrate need to be explored more seriously. Diversification of food sources is still useful even though there is no climate change impacts on production of food crops.

4.2 Forest

Two most important discourses concerning forest and forestry are deforestation and forest degradation. Deforestation and forest degradation make forest the largest source of emission. As indicated at Tab. 4, forests contain a huge amount of co2 that is ready to be released to the air when the forests are burned. It makes Indonesia the third largest emitters in the world. The following argument is easy to predict, namely avoiding deforestation and forest degradation is a major way to save our planet. As a logical consequence, international pressure, sometimes with the lure of financial assistance or incentive such as carbon market, on Indonesia to conserve the forest is very strong.

Tab. 4: Biome-average tropical forest biomass carbon stock estimates (t C/ha)(Gibbs et al., 2007)

	Sources			
Forest type	(H and D)[a]	(B and A)[b]	(G and B)[c]	IPCC (2006)
All forest	-	151	-	-
Tropical equatorial forest	250	-	164	180-225
Tropical seasonal forest	150	-	142	105-169
Tropical dry forest	-	-	120	78-96

[a] Houghton (1990) and DeFries et al (2002)
[b] Brown (1997) and Achard et al (2004)
[c] Gibbs and Brown (2007a,2007b)

It is quite easy to say "stop deforestation and forest degradation." The question is how? Another question is that is it necessary? The first question is perhaps rather easy to answer, but the second question might be surprising and create counter question. Let me start addressing the first question without intention to really answer it. All I would like to do here is just to share what really has been going on.

There are thirty million hectares of state forest area without the presence of managers in the field. In addition to manpower shortages, the government also is facing a limited budget as indicated by Tab 2. It makes the actual ruler of the forest area become unclear. In fact, if there are government officials who are present in the field, then this does not mean that the problem can be overcome because many government officials are also problematic. Roman author, Juvenal, was suggesting that wives cannot be trusted, and keeping them under guard is not a solution–because the guards cannot be trusted either (Hurwicz, 2008).

If deforestation and forest degradation can be prevented entirely, the decision to use the forest solely as a place to store carbon is a waste of resources. Productivity of humid tropical forests is much higher than the productivity of any other ecosystem (Tab. 5). Moreover, the carbon market so far is just noise rather than real facts, because of various procedural obstacles that remain unsolved, such as difficulty in monitoring (Tassone et al., 2004), high transaction costs (van Noordwijk et al., 2008), and many risks (Galik and Jackson, 2009). Meanwhile, the climate and soil in Indonesia is very suitable to support forest growth. Compared with the growth of forests in temperate regions, the growth of forests in Indonesia is much faster. In addition, revenues from the sale of carbon credits do not make a great contribution toward a project's implementation costs so that carbon trading has so far not been a great incentive to implementing projects on a large scale (Fehse, 2008). Therefore, the proper function of forests in Indonesia is to absorb carbon from the air, not to store carbon.

If the carbon storage function of forests would be appreciated, then this function should only be an additional service, while its main function is to absorb carbon. Carbon storage can be placed in the form of dead wood. As long as the wood does not decompose, the CO_2 stored in the wood will not be released into the atmosphere. Countries

Tab. 5: Net Primary Productivity (NPP) of Various Biomes (Grace, 2005)

Biome	Net Primary Productivity (ton C/ha/yr)
Tropical forests	12.50
Temperate forests	7.75
Boreal forests	1.90
Artic tundra	0.90
Mediterranean shrublands	5.00
Crops	3.05
Ice	0.00

that have a high level of CO_2 emissions rate per capita may compensate for environmental damage made through storing carbon in dead wood preserved, which is purchased from wood producing countries such as Indonesia. What I am suggesting here is business as usual with regular markets except that the timber traded is not intended to regular wood consumption but rather to accumulate "carbon credit." Allow me to name this second approach with a radical approach, as a challenge to the conventional approach - the forest is to store carbon that should not be disturbed.

In order to more easily visualize what is being discussed, I will use Fig. 1 as a tool. Fig. 1 can describe two different things. First, it reflects the development of a particular forest stands with increasing age, say from zero to T years. At first, stand growth is slow, then faster, and finally slows down again. At the age T, forest stands are ready to be harvested. At the age T, the volume of forest stands is V (T). The rate of carbon uptake is directly proportional to the rate of growth of the forest stand. When age of the stand has exceeded T years, then the rate of carbon sequestration is practically close to zero. At this point, the function of forest stand is more as carbon storage. Second, Fig. 1 can reflect several different forest stands with the same size but having different ages. This is what is known as a normal forest structure. For the second case, the total volume of forest stands, ranging from age zero to age T, is $\sum_{a=0}^{T} V(a)$. After the T-old forest stands are harvested, then the volume of the remaining forest stands are $R = \sum_{a=0}^{T-1} V(a)$.

To compare which approach that can absorb more CO_2, then it is sufficient if we are able to show which approach will accumulate more timber, in the forest as well as in the storage place. If we let a normal forest grow forever so that all forest stands achieve their maximum volume, then the total volume will be $\int_0^{\infty} V(a)da \approx TV(\infty)$. Meanwhile, if the normal forest is harvested regularly and harvested timber is stored as "carbon credits," then the total volume of timber that can store carbon at time t is $R(t) + S(t)$, where $S(t)$ is the accumulated dead wood.

Now, we must calculate the volume of dead wood that will accumulate as a carbon pool. It is assumed that the volume of wood utilized is 60% of V(T), which in other words 40% of V(T) will be left in the field and immediately decomposes to release CO_2 (Ingerson, 2009). With the annual decomposition rate of δ percent of the existing timber

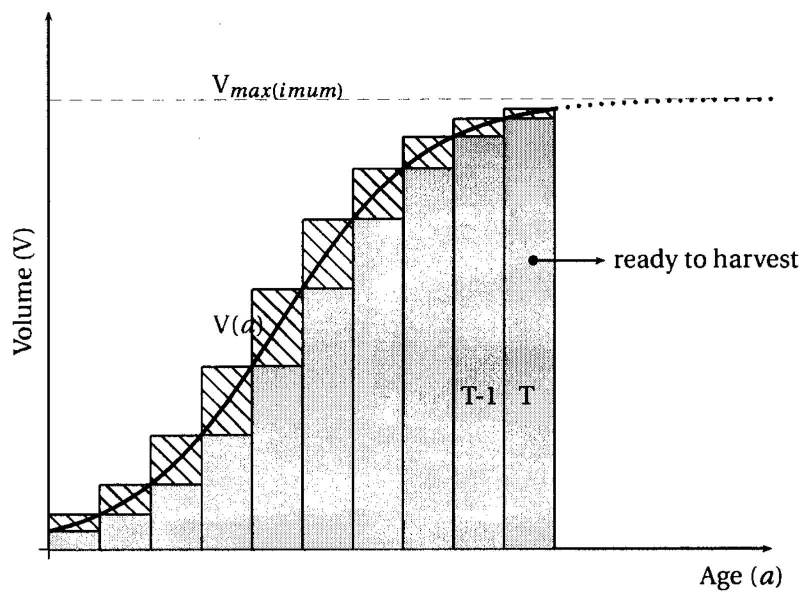

Fig. 3: Growth of Forest Biomass

volume, the volume of wood that will be accumulated up to time t is equal to

$$S(t) = \frac{0.6V(T)e^{-\delta t}(\delta - 1 + e^{\delta t})}{\delta} \tag{1}$$

When time goes to infinity then stock of timber accumulated is equal to $S(\infty)$:

$$S(\infty) = \lim_{t\to\infty} \frac{0.6V(T)e^{-\delta t}(\delta - 1 + e^{\delta t})}{\delta} = \frac{0.6V(T)}{\delta} \tag{2}$$

This is the steady state stock of wood that are stacked to store carbon. Accumulation trajectory of dead wood for carbon storage can be seen in Fig. (4).

Given the steady state, the remaining stock of forest stands is also constant ($R(t) = R$) then the next task is to compare between $TV(\infty)$ and $R + \frac{0.6V(T)}{\delta}$. The results of this comparison is dependent on the decay rate of wood, ie the smaller the value of δ, the higher the chance that the $TV(\infty)$ is smaller than $R + \frac{0.6V(T)}{\delta}$. To avoid the use of chemicals that can pollute the environment, I propose either north pole or south pole or both as a place to store wood. With a very low temperature, the wood will last longer so it is not easy to release CO_2 into the air. The decomposition rate of wood at the poles can be as low as 0.001 per year (Brovkin et al., 2012). By using the decomposition rates of 0.001 per year then it is almost certain that $TV(\infty) < R + 600V(T)$. It means that the radical approach that I propose is more effective than the conventional approach in terms of absorbing and storing carbon. If we think that wood is so bulky, then converting wood into charcoal, or even synthetic diamond, may be considered.

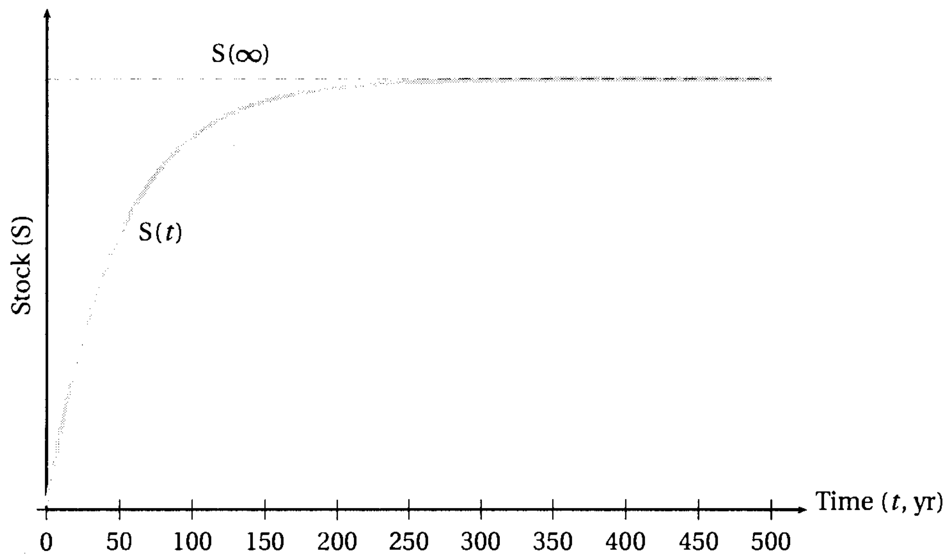

Fig. 4: Stock of timber volume to store carbon

Who needs wood most to store carbon? Let us take a look several major CO_2 emitting economies measured in CO_2 emission per capita, such as Australia, Canada, Germany, Japan, US, and UK. In order to offset 10 percent of their CO_2 emission, a huge biomass of wood will be needed (Tab. 6), assuming that the same technology of production is employed. For example, the US requires 300 millions ton of wood annually, Russian Federation 90-94 millions ton, and Germany 43 millions ton. Are they really willing to do it? This is such a big question mark! In total, all those seven economies require 585 millions ton of wood a year. If all those woods are purchased from Indonesia, then Indonesia has to provide at least 46 millions ha of productive plantation forest.

Tab. 6: Wood biomass required to offset 10 percent of emission per capita

	Emission (tCO_2/capita)			Wood biomass required (ton)		
Country	2006	2007	2008	2006	2007	2008
Australia	18.2	18.1	18.6	20,630,319	20,559,264	21,791,279
Canada	16.8	16.5	16.3	29,910,070	29,654,195	29,692,487
Germany	9.9	9.6	9.6	44,370,197	42,931,036	43,099,390
Japan	9.6	9.8	9.5	66,508,564	68,246,203	65,301,685
Russian Fed.	11.7	11.7	12.0	91,714,752	90,496,514	93,995,684
UK	9.0	8.7	8.5	29,717,387	28,829,855	28,570,714
US	18.5	18.5	17.9	301,784,140	305,510,487	298,474,362

Last but not least, are we really serious in dealing with climate change, that is caused by CO_2 emission in particular? Let us analyze what we could have done if fuel subsidies were used to replant forests. Analysis covers years of 2006 to 2008 only and the results are presented in Tab. 7.

Tab. 7: Fuel subsidy and its implication

Item		Year 2006	2007	2008
Fuel subsidy	billions rupiah	64,212.1	83,792.3	139,106.7
Fuel amount	kiloliter	14,269,355.6	18,620,511.1	30,912,600.0
CO_2 emission	ton	33,171,010.2	43,285,848.6	71,860,440.2
Plantation forest[a]	ha	3,210,605.0	4,189,615.0	6,955,335.0
CO_2 captured[b]	ton	147,152,729.2	339,176,750.0	805,115,666.7
	ton/capita	0.52	1.33	3.26

[a] Reforestation cost is Rp 20,000,000,- per ha
[b] NPP is 12.5 tC per ha per year up to age of 10 years

As it can be seen, the money spent for fuel subsidy could have developed 3.2 millions ha of forest in 2006, 4.2 millions ha in 2007, and 7.0 millions ha in 2008. Using the net primary productivity data, the amount of CO_2 absorbed by the forests would be 0.52 ton per capita in 2006, 1.33 ton per capita in 2007, and 3.26 ton per capita in 2008. During the same period, CO_2 emission of Indonesia was 1.47 ton per capita in 2006, 1.59 ton per capita in 2007, and 1.73 ton per capita in 2008. Actually, if we were serious enough, then altering the position of Indonesia from the emitter to the absorber of CO_2 is not too difficult.

5 Closing remark

Climate change is global problem, so we need global idea to address it. Are we serious, joking around, or just making noises?

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