

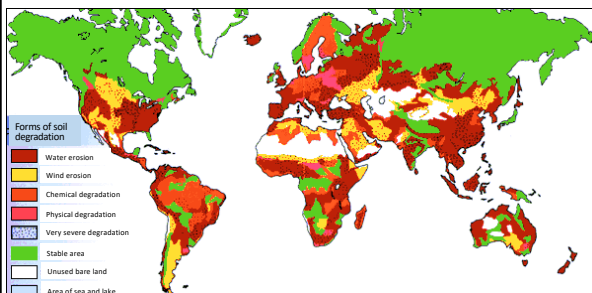
# Soil crisis

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## What is soil crisis ?

- Functions of plant production inherent to soil are lost due to the improper management by human.
- Due to the input of harmful and polluted material, functions of soils are damaged and harmful crops are produced.
- Soil becomes unsuitable for crop production.

## Soil degradation caused by human.



## Disappearing agricultural land.

- Using the farm land for other purposes.
  - Soil erosion
  - Soil pollution
  - Desertification, salinization
- Erroneous land management by human.

## Desertification

### Definition of desertification

- "Decline or destruction of the ability of land to produce biological resources, which finally leads to the state like a desert."
- "Phenomena such as the production of grasses become impossible in graze land, or the irrigated lands are abandoned due to salinization or waterlogging."

## Causes of desertification

- Excess cultivation
- Excess grazing
- Excess forest clearing
- Improper irrigation

### Slash and burn agriculture

- 200 million people make a living on slash and burn agriculture in 3 million square kilometers of land in the world.
- It is equivalent to 21 % of the total agricultural land in the world.



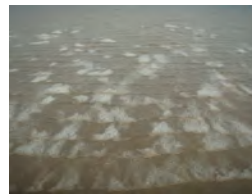
Slash and burn field in  
Leyte, Philippines



No. 65,  
Shifting cultivation in  
W-Sarawak, Malaysia

### Problems due to the development of tropical forest in Sarawak, Malaysia

Turbid sea



Sea shore near the airport of  
Mukah, Sarawak.



### Development of tropical forest in Sarawak, Malaysia

University campus constructed  
in the wetland forest.



Large oil palm plantation



### Wetland forest in Sarawak

Red turbid river



Undeveloped forest and  
meandering river



### Development of oil palm plantation in Sarawak

Logged trees cut out from the wetland forest



Soils dug out from the drainage canal



### Oil palm plantation

Orderly lined palm trees



Seeds of oil palm



Forest fire in Sumatra island in 1997.



Forest fire in Sumatra island in 1997. The sun looked like the moon in the daytime.



Burned wetland forest in Naratiwa, Thailand.



Landslide in southern Leyte, Philippines 2003. 12. 20

## Slash and burn agriculture

- The most important subsistence agriculture, which 2-4 hundred million people are engaging.
- At present, it is mainly conducted in the tropics, but the initial form of agriculture was slash and burn also in Europe, whole America, and Asia including Japan.

## Problems of slash and burn agriculture in present state (1).

- Proper population for slash and burn agriculture is 8 people in 1 square kilometer.
- However, now, 2 hundred million people are living on slash and burn in 3 million square kilometers land.
- Proper population for the slash and burn is calculated to be 2400 people, and 3 million are in too much excess.

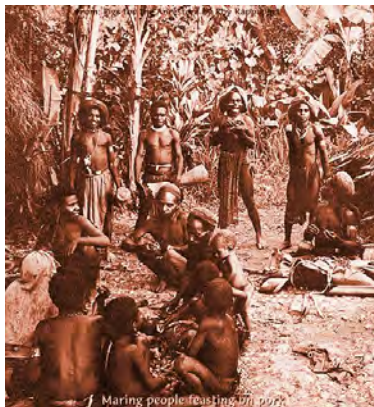
## Problems of slash and burn agriculture in present state (2).

- Cash crops are grown in wide area (coffee, sugar, cotton, groundnuts). (
  - Ignoring the necessary fallow period.
  - In too large area, in mono culture, and in continuous culture
  - Occupying the superior lands.
  - Poor farmers are expelled to the lands in inferior conditions.

## Should the traditional slash and burn agriculture be blamed?

- The slash and burn life of Tsembaga tribe in New Guinea.
- Folklore research by Rappaport.

Festival of Tsembaga tribe before the fighting.



Ritual ceremony of Tsembaga tribe before fighting



### Tsembaga tribe in New Guinea

- 204 people are living in the area (8.3km<sup>2</sup>) of tropical lowland – mountain forest (altitude 670 – 1,525 m) .
- 405ha (4km<sup>2</sup>) of land are used for slash and burn, and actually 36 -40 ha are used for growing the crops.
- Consequently, 90 % of the land are bush fallow.

### Technology of slash and burn by Tsembaga people.

- Only secondary forest is cleared. (Primary forest is seldomly cut.)
- Make a border fence to the field area.
- They do not plow, but drill holes on the soil with a rod, and tubers and stems of various crops are planted.
- 36 kinds of crops are cultivated.
- They raise pigs, and pigs are slaughtered every 10 years in the feast.
- Upland fields are used only for two years and left for the fallow field thereafter.

### Cultivated crops

- Staple foods: Taro, sweet potato, yam, cassava
- Banana, beans, corns, sugar cane, cucumber, pumpkin, and many other leaf vegetables are grown.
- Very complex cropping system adopting mixed culture.
- Because each crop has different height and different root depth, land and space can be used effectively by the proper combination of different crops.

### Energy balance of slash and burn agriculture: the labor input.

- Forest clearing and land preparation:  $363 \times 10^3$  kcal/ha
- Crop planting and field management:  $559 \times 10^3$  kcal/ha
- Harvesting work:  $465 \times 10^3$  kcal/ha
- Total:  $1387 \times 10^3$  kcal/ha

= total of 603 people x days /ha

Equivalent to 3 days labor for 204 people / ha.

For 40 ha of the field, 204 people need to work only 120 days annually.

(Assuming 2,300 kcal /day is required for the adult.)

### Energy balance of slash and burn agriculture: food production.

- From the field:  $22770 \times 10^3$  kcal/ha
- Foods collected/hunted:  $1387 \times 10^3$  kcal/ha
- Total:  $24157 \times 10^3$  kcal/ha

Assuming 2,300 kcal /day is required for the adult,  
 $24157 \div 2.3 = 10503$

= equivalent to 10503 people x day /ha  
 = the food for 28.8 people /ha annually.

### Energy balance of slash and burn agriculture: food consumption.

- Consumption by people:  $15195 \times 10^3$  kcal/ha  
 6,600 people x day, (32 days for 204 people/ha)
- Consumption by pigs:  $8962 \times 10^3$  kcal/ha

= From the 40 ha of slash and burn field, the food supporting 204 people for  $32 \times 40 = 1280$  days can be harvested.

### Energy balance of slash and burn agriculture: final balance sheet.

- By the 102 days labor annually, food necessary for 1280 days (3.5 years) can be harvested. In addition, pigs are raised. Numbers of pigs vary from 40 to 160 in 10 years cycle.
- Efficiency of energy balance:  $1280 \div 102 = 12.5$ . It is extremely high.

### In order to carry out the slash and burn life by Tsembaga people,

- 40 ha / 204 people = 0.2 ha / person
- 15~20 times of fallow period is necessary:
- 3-4 ha of forest / person are necessary.
- For the 200 million slash and burn people in the world, 600 – 800 million ha of forest are necessary. = 30 – 40 % of the total tropical forest in the world.
- Total area of forest in the world: 4.3 billion ha.
- Total area of tropical forest in the world: 2.0 billion ha.

### Slash and burn agriculture in Sarawak, Malaysia

- Native people have scientific knowledge on the kinds of plants and the quality of soils.
- Slush and burn agriculture by the native people does not deteriorate soils or causes destructive erosion.
- Reference
- **Natives of Sarawak: Survival in Borneo's Vanishing Forests" by E. Hong**
- Japanese translation: Housei Univ. Press (1989)

### Cultivation of various crops:

- Land Dayak tribe: Upland rice, cucumber, pumpkin, beans, corns, cassava
- Iban tribe: Upland rice, mustard, cucumber, pumpkin, loofah, melon, cassava, corn, pineapple, *Sauropus androgynus*
- Kenya tribe: Cones, cucumber, pumpkin, sweat potato, tapioca, sesame, egg plant, sugar cane, ginger, banana, tobacco, chili, betel

### Harvests from the fallow forest:

- 482 kinds of plants are utilized.
- As food, forage, medicine, construction material, dye material, fuel, poison, fence, insect repellent

### Self-sustenance of rice

- Required amount of rice in one year for a family of Iban people comprising 5.7 members:
- 1203 kg
- Yield / ha of upland rice / is around 1000 kg.
- Area of slash and burn field managed by one family is 3 ha.
- This area is enough for producing the required amount of rice.

## Slash and burn by Iban people

Data related to upland rice production	
Area of the field cultivated by 1 adult.	0.53 ha
Rice production / ha	1,325 kg
Labor days / ha	138-175 days / year
Consumed amount of rice by 1 adult.	211 kg
Produced amount of rice by 1 adult.	702 kg
Annual labor days for rice production by 1 adult	73-93 days
Consumed amount of rice by 1 family (5.7 members)	1,203 kg
Area of slash and burn field managed by 1 family (5.7 members)	3 ha

## Protection of primary forest

- Slash and burn is conducted by using the secondary forest.

## Soil conservation and maintenance of soil nutrients

- Crops suitable for each soil are grown.
- Soil fertility is judged from the natural vegetation.
- Incomplete forest clearing.
- Minimum tillage.
- No soil erosion and no soil loss occurs.

## Forest as a valuable resource of animals and plants

- Hunting, fishing, food collection
- Large part of food come from the forest.

## Traditional slash and burn agriculture is not destroying the forest.

- Timber (lumber) companies and large scale land development projects are more responsible for the loss and degradation of forest.

## Over-grazing

- Consumption of plants by domestic animals exceeds the growth of plants.
- Required area for the proper grazing:
  - Sheep: 2 ha / animal
  - Cow: 10 ha / animal

### Problem of over-grazing

- Because goats feed the whole part including the root of any plants, they are the main cause of the destruction of vegetation.
- Land surface becomes bare.
  - Causes wind erosion and water erosion.

### Excess forest clearing

- People depend mainly on firewood for their fuel in the developing countries and in the desert area.
- In Sahel area of Africa, one person consumes 1 ton of firewood annually.
- Water holding property and permeability in the forest soils are lost, and large amounts of soil flow out from the bared land.

### Technology to prevent desertification



Feeding trees by over-grazing.



Conservation and rehabilitation of the land by enclosing the land.

### Technology to prevent desertification



Saving the consumption of fire woods by improving the cooking oven.