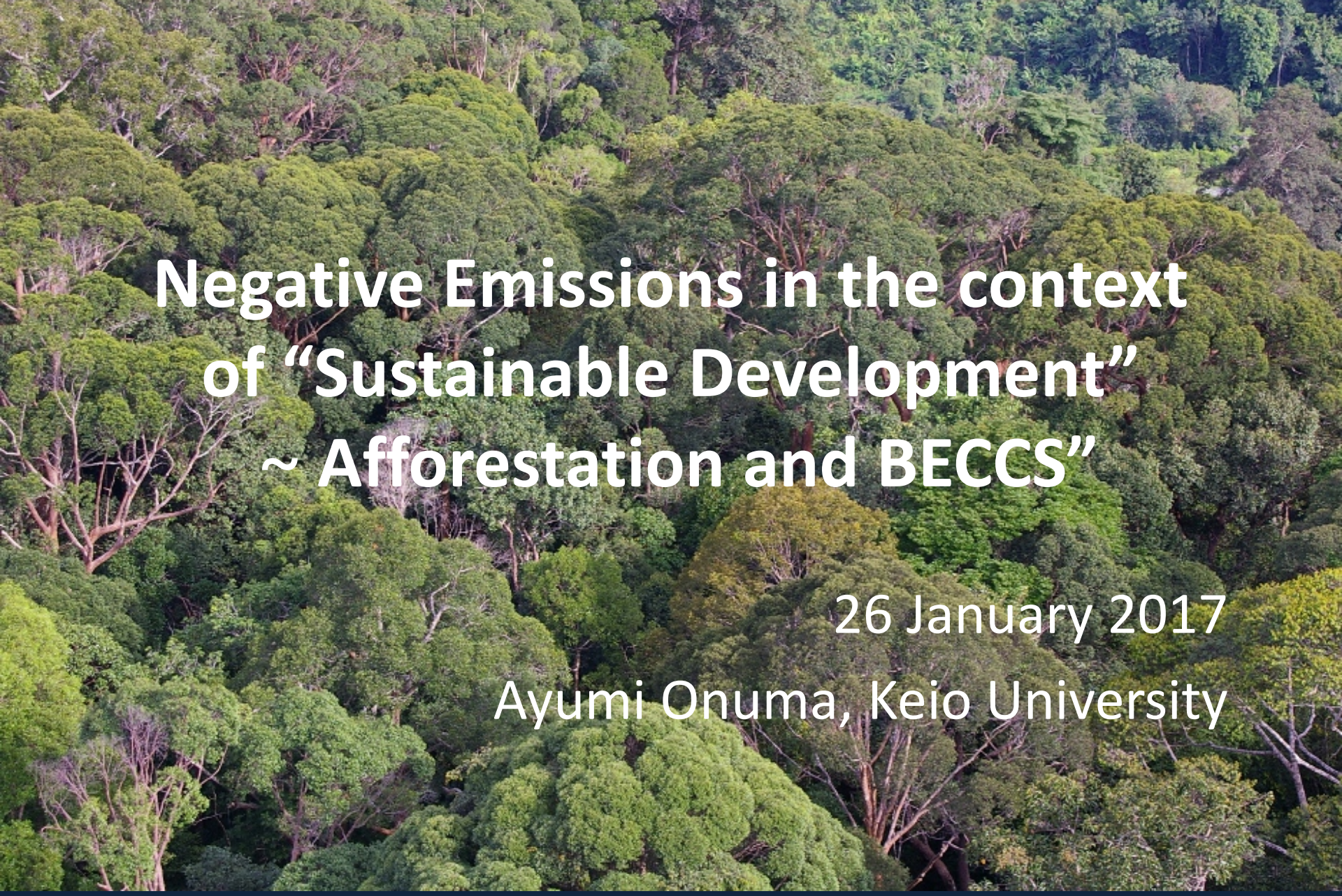

Negative Emissions in the context of "Sustainable Development" ~ Afforestation and BECCS"

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Negative Emissions ～Afforestation and BECCS

- IPCC AR5 showed proportion between accumulate emissions and rising global average temperature
  - necessary for deployment of negative emissions under 2℃ target
  - total emissions : up to 1010GtCO2(=275GtC)since 2012
  - emissions in 2012: 35.6GtCO2(=9.7GtC)
- carbon sink and storage with afforestation and BECCS
  - Feasibility of low cost

Co-benefit of Afforestation and BECCS

- Afforestation
  - expansion of forest generate co-beneft through the ecosystem services
    - biodiversity
    - stabilization of local climate and water
- BECCS
  - promote renewable energy
  - Development in least developing countries

Forest and carbon

- Forest storage 625GtC with biomass and deadwood
- 1ha of forest storage average 162tC

  -equivalent amount of firing 0.25Mℓ gasoline

・Afforestation absorb carbon

Potential of carbon reduction with afforestation depends on type of vegetation and scale of area

BECCS and carbon

- Estimation of BECCS potential: 100EJ in 2050
- Carbon emission reduction in the air and energy generation

- timber biomass
- sugar beet, sugar cane
- wheat, corn
- rapeseed
- waste , algae

A Rough Calculation

- Afforestation storage 3.3tC/ha in a year for five decade
- 1GtC/yr of carbon stock require 300Mil hectares of afforestation
  - equivalent of area of India
- BECCS also requires a large scale of land use
  - land use change of existing farmland
  - conversion of ecosystem with low carbon stock e.g. glass filed
  - abandoned farmland

①biodiversity

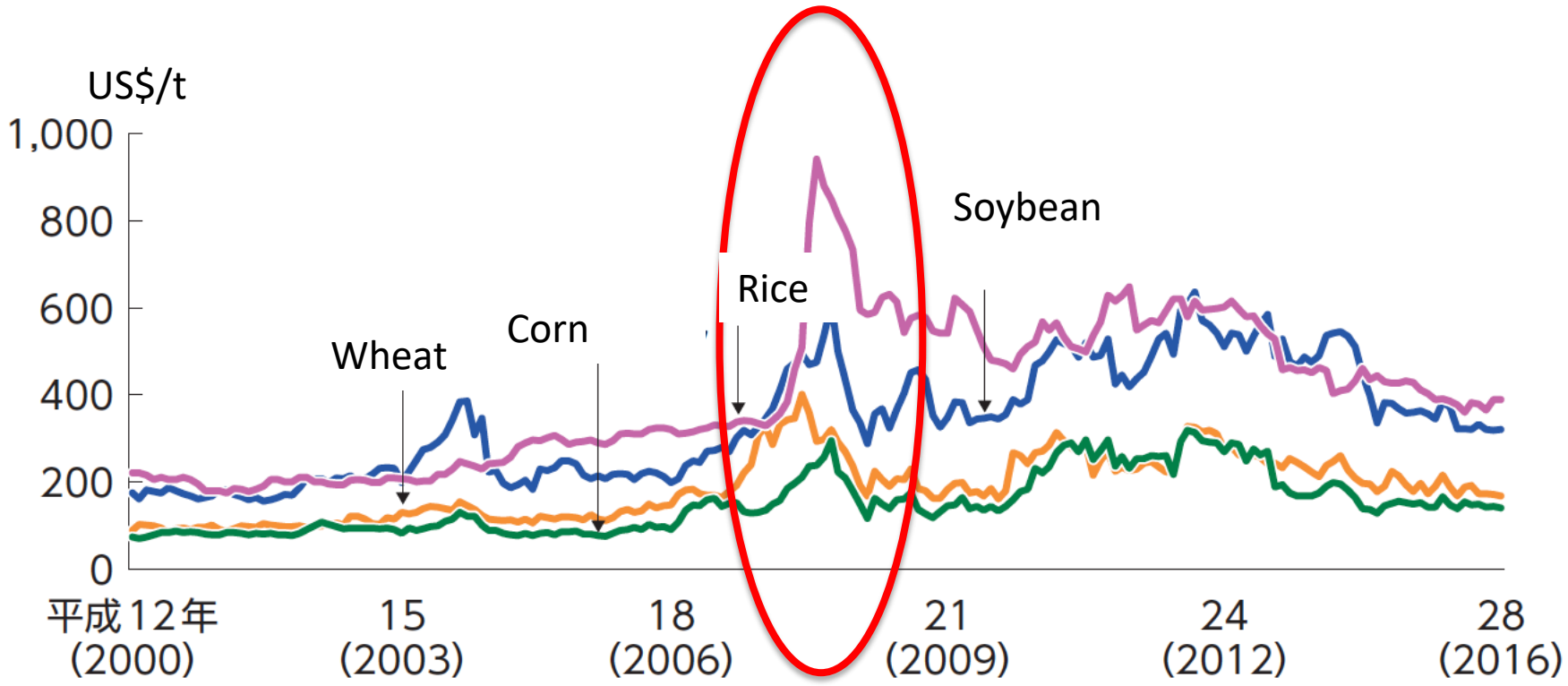
- Type selection of vegetation ～（fast growing monoculture)
  - eucalypts, acacia, poplar
  - low biodiversity
  - decrease of ecosystem services
- land use – conversion of ecosystem
  - reduction of biodiversity such as glass field
- pollution from increase of fertilizer

②food production ～land use

- Possibility of food price increasing
  1. trade off between land use change such as cropland and food production
  2. cost increase due to limitation of fertilizer
- Dramatically crop price increase due to demand increase of bio fuel in 2008

- The rapid crop price rise in 2008 is due to the use of crops from food to
- It is essentially equivalent to a land use conversion from food to bio fuel production.

International crop prices



Source: MAFF

③food production ～fertilizer

- Increase limitation of fertilizer
  - –nutrition (phosphorus, nitrogen, potassium)
- phosphorus are limited and deplorable resources

Phosphate rocks are eccentrically located in China, US, Morocco, Jordan, and South Africa (90%)

Estimation of Peak Phosphorus in 2030

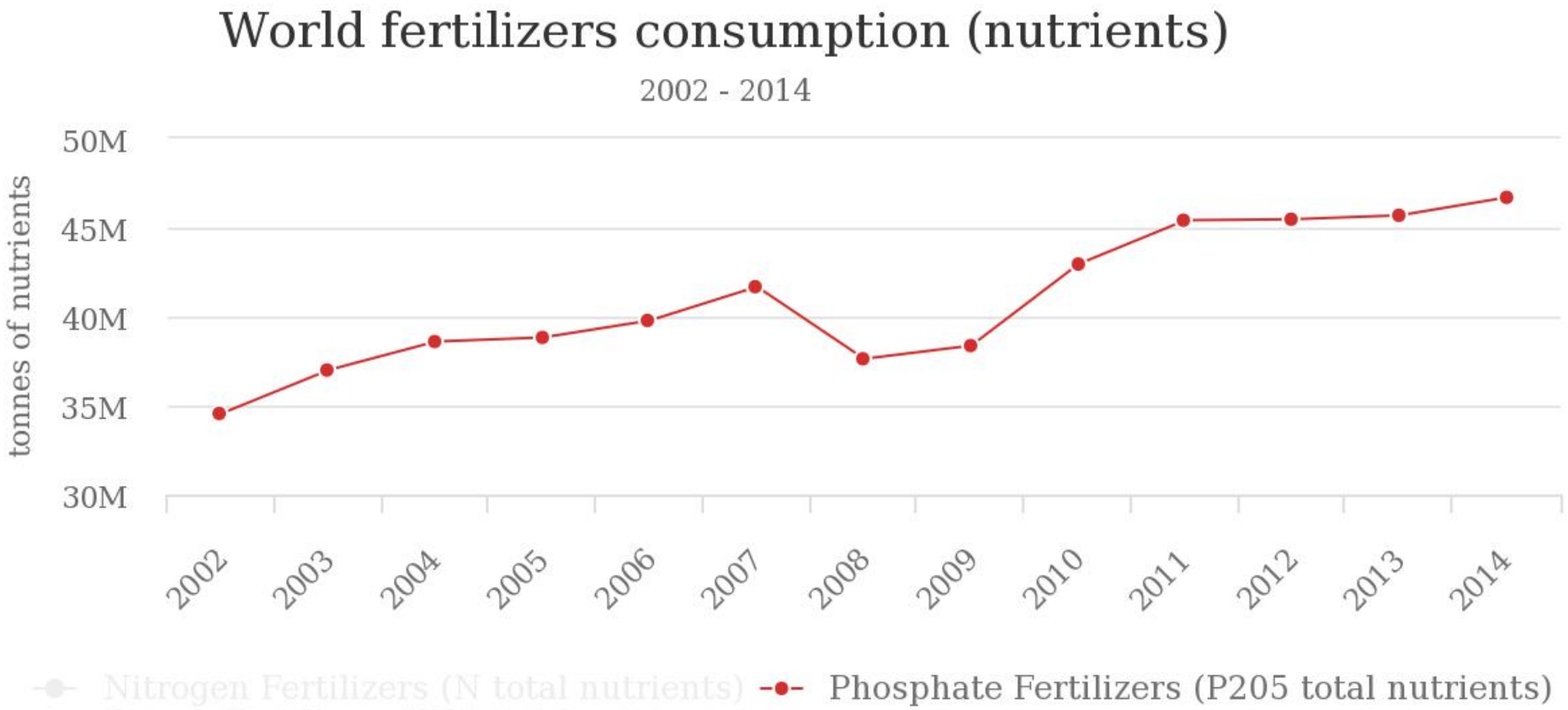
- After Peak Phosphorus production decrease
- demand increase of afforestation and BECCS leads to price increase of Phosphorus?

⇒food price increase

BOP must be heavily damaged

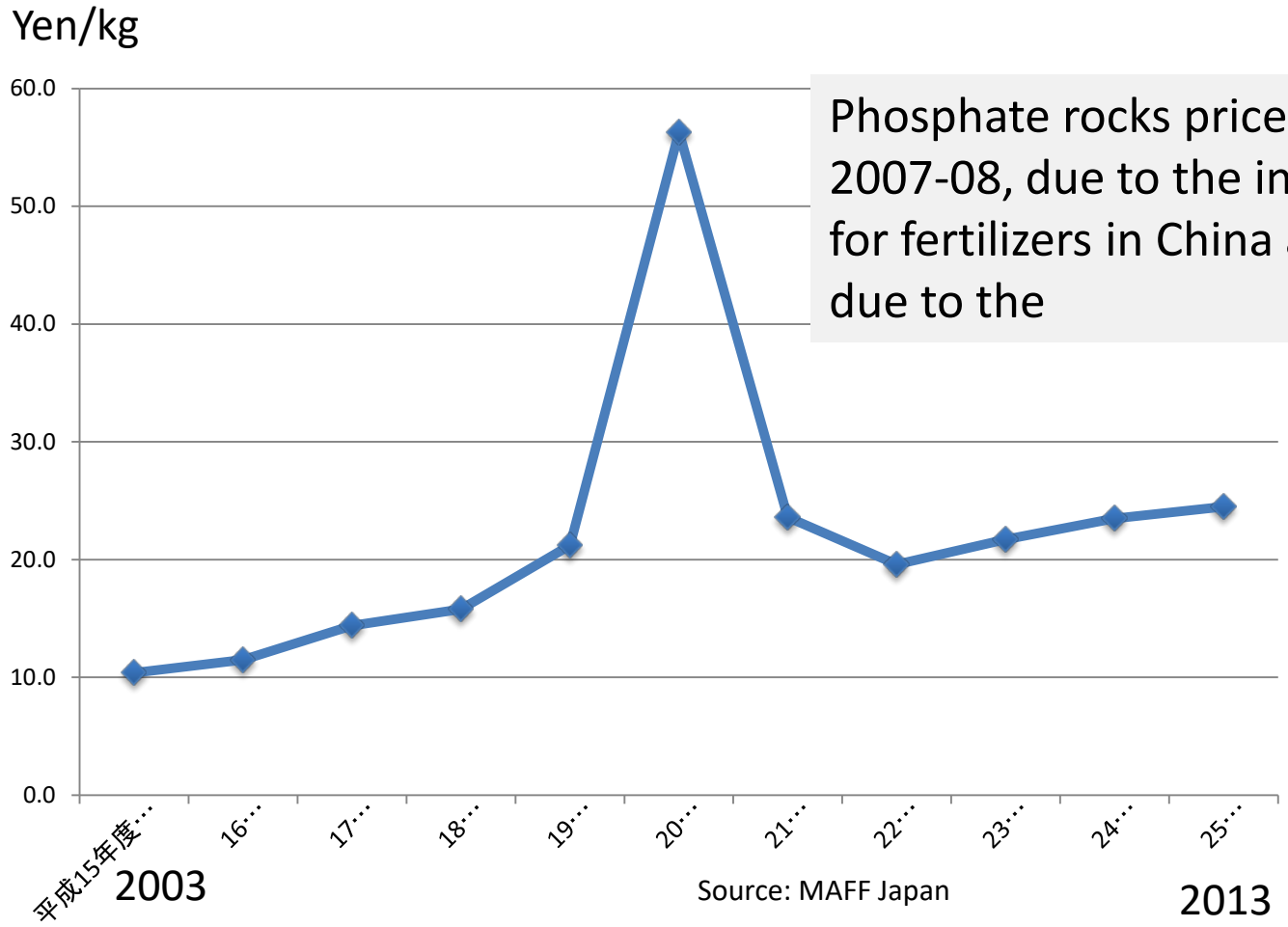
World consumption of phosphate fertilizers

30% increase within 2002-14



Source: FAOSTAT (Jan 21, 2017)

Import prices of phosphate rocks in Japan



Source: MAFF Japan

Phosphate rocks price skyrocketed in 2007-08, due to the increasing demand for fertilizers in China and India, and also due to the

Is sustainable development feasible?

- Reduction of biodiversity
  - monoculture, conversion of ecosystem, pollution of fertilizer
- Reduction of standard of living in BOP
  - trade off with food production, price increase of fertilizer

BECCS and Afforestation could harm "Sustainable Development"

Some measures to challenges

- establishing a frame of defecation of credit created by environmentally friendly manner.
  - achievement of premium price rather than additional cost →control with incentive
- technological promotion on capturing Phosphorus