Current Review: Japanese Status and Challenges on Deliberate Uses of Biotechnology in Environments

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Topics

• Deliberate Uses of Biotechnology in Environments and Socio-Economic Impacts and Benefits
• Public Perception on Biotechnology
• Policy and Recommendations from Stakeholders
Deliberate Uses of Biotechnology in Environments and Socio-Economic Impacts and Benefits

- Bioremediation (Recovery, Reduction, Recycling)
- Biomass (energy, industrial materials)
- LMO-FFPs
- Pharming
- Environmental degradation alleviation due to climate change
Bioremediation in Japan
(Compilation from JBA-NEDO 2002-2006)

• **Microbial remediation:**
  Many research cases in contained conditions such as mercury and TCE
  Testing such on Wastewater Treatment Verification-Test Plant
  including Excess Sludge Reduction and Phosphorus Recovery
  (Arakawa et al. 2005)
  Three cases on soil remediation industrial applications under Japanese regulatory guidelines
  No significant efficacy and cost compared with physical soil replacement

• **Phytoremediation**
  Many experimental studies
  Low efficiency and high costs in heavy metal collection
  But proactive uses in greening city buildings aiming at clean airs
  Transgenic testing is way to go with burden of regulations
Aquatic bioaugmentation on *Ralstonia eutropha* KT-1 on TCE: short life
Socio-economic value?

- Public awareness also included from the beginning on the testing
- Public acceptance of technology observed
- Short life of the bacterial function does not pay off the TCE control yet
- Yet to go with transgenic microorganisms on cost performance and efficiency plus regulations?
Biomass

- Biofuels based on processing plants with altered capacity: Biodiesel used in local industries

Suncarefuels, LTD.: Tsukuba local venture supplying bio-diesel from sunflowers to local buses: pilot plant modules (1KL / day) for technology transfer to local communities

Local governments encourage expansions
LMOs-FFP (GM crops) in Japan

• The biggest LMOs-FFP importer in the world
• All food approved also approved on environmental dissemination, however, no comparative advantage in cropping them in Japan
• Non-FFP transgenic flowers (Rose, carnation) are well marketed in Japan so far.
Pharming

• Anti-pollen allergen rice being examined for commercialization but way to go for regulatory processes

• Costly confined system more promoted due to the lengthy regulatory processes and public perception on the field research of transgenic pharma-plants

• But many R&D taken places
Environmental degradation alleviation due to climate change

• Transgenic trees with field trials: abiotic stress tolerances (Eucalypts and poplars)
Drought & Salt Tolerances in Seedling with *codA*

- 2 M Na Cl 400 ml every other day for one month
- Three months old

L: Non-transgenic
R: Transgenic

Two weeks without water

Three months old
No water for 2 weeks
E. camaldulensis with mangrine
600 mM NaCl two months
Two years and four months old GM trees: over 7 meter high, July, 2010. *E. Globulus codA*

*Doubles biomass production*
Public Perception on Biotechnology

• Generally biotech accepted with the support of GOJ policy on the priority as industrially important areas

• Pharmaceutical products recognized and accepted such as insulin and erythropoietin

• GILSP applications on GMMs over 1000 cases

• However, LMOs-FFP not well recognized
Debates

- Genetic engineering and products thereof are hazardous and should be eliminated
- Religion, creed and individual thoughts are the highest priority, S&T less value or no value
- No option
- Deny participation

- Scientific risk assessment and management furnished and proven to be safe
- Balanced benefit for societies with potential risk
- Leave options for choice
- Allow participatory approach
Background activities Independent book projects as the results


Cases taken from Japan

- Low public perception by majority of surveys
- Strong NGO activities on anti-GM crops
- Contradiction between the Government policy & regulation and local prefecture / city governments
Simplification of risk assessment process on LMOs for R&D under controlled environments

- International competitiveness on R&D
- Promotion of protection and use of IPR on biotechnology
- Accelerate decision making for industrial applications
- However, Industrial applications shall go through careful evaluation
Backgrounds

Summaries and Suggestions

Figure 1. The regulatory framework, a triangular network including government organizations, researchers, and the public, is important for the development of living modified organisms (LMOs). (Chen et al. Plant Biotechnology, 23. 2006)
Policy and Recommendations from Stakeholders
Six Pillars on Biotech R & D and ELSI

- Proprietary R & D With biotech for industrial application
- Consultation for Legal Aspects: Policy & Regulations
- Capacity building supports
- Environmental Safety Research: Standardization & Applications
- ELSI Research & Risk Communication methodology
- Public awareness & science literacy
Status and Pitfalls on Plant biotech R&D in Japan

• Strategic approach in understanding plant genes
• Biosafety on genetic engineering and facilitating the field base risk assessment
• Strategic approach in analyzing plant gene functions
• Public acceptance on transgenic plants
Overall conclusion

Biosafety framework for LMOs

Government organizations:
Building up regulation;
Supporting information

Science communication
(participatory approach to science, Bio-café)

Scientist or researchers:
Science dialogue exchange

NPO, NGO, and public:
Public engagement on science;
Science literacy

ELSI and PEST issues

Practice suggestions by stakeholders

Effective science communication

Make the biosafety regulatory framework balanced and harmonized
GOJ Policy and Support Implementation on Env. Biotech.

- Biotechnology as a key technology for industry
- Environmental protection and sustainability are national priority
- Yet more ELSI points to be considered for continuity of R&D and also applications