http://smtom.lecture.ub.ac.id/
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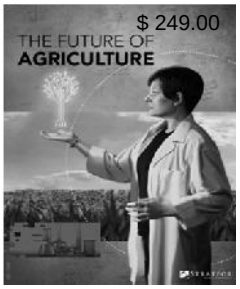
THE FUTURE AGRICULTURE

Mù Cang Chải is a rural district of Yên Bái Province, in the Northeast region of Vietnam.

http://sf.co.ua/15/03/wallpaper-1c2341.jpg



https://cdn.shopify.com/s/files/1/1174/8306/products/future-of-agriculture-cover_1024x1024.jpg?v=1464972939

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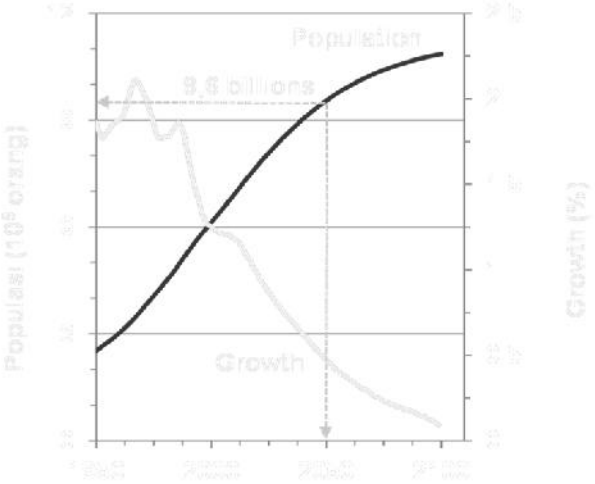
1. INTRODUCTION

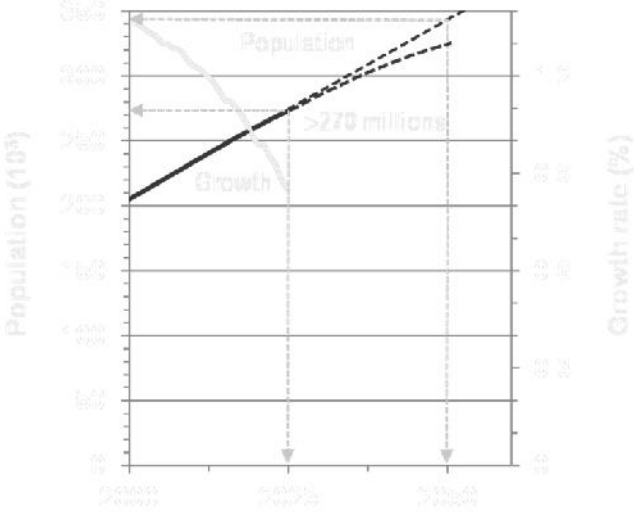
- PROBLEMS
  1. Population
  2. Limited Resources (Land, Water, Nutrition Etc.)
  3. Global Warming (Drought & Flood)
  4. Land Use Change
- TECHNOLGY DEVELOPMENT
  1. Biotechnology
  2. Information Technology
  3. Nanotechnology
- HEALTHY LIFE AWARENESS

1. POPULATION



Food production should be increased by 70% by 2050 to avoid mass malnutrition (FAO).

INDONESIA



Source: BAPPENAS

- The problems are
  1. Most of the land available to use for food is already being cultivated.
  2. The rest is atop mountains, covered by desert sands or in Antarctica
  3. The only potential farmland left is the world's remaining rain forests (*are we going destroy it?*). Some of it has been changed to oil palm plantation in Indonesia.
  4. Other resources for agriculture (water, fertilizers) are limited and should be used efficiently.
  5. Extreme weather events are on the rise, creating additional obstacles to productivity.

GLOBAL WARMING

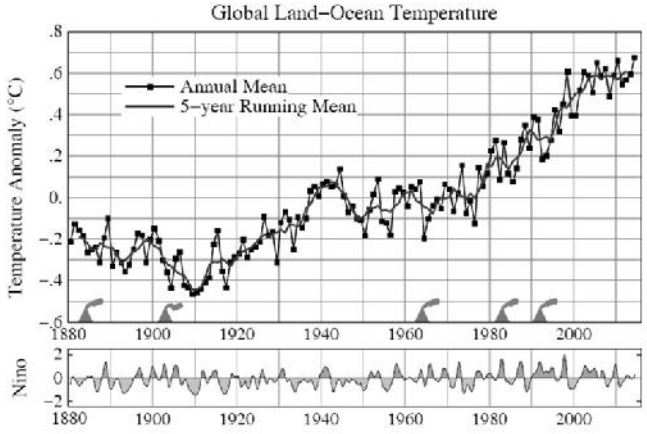
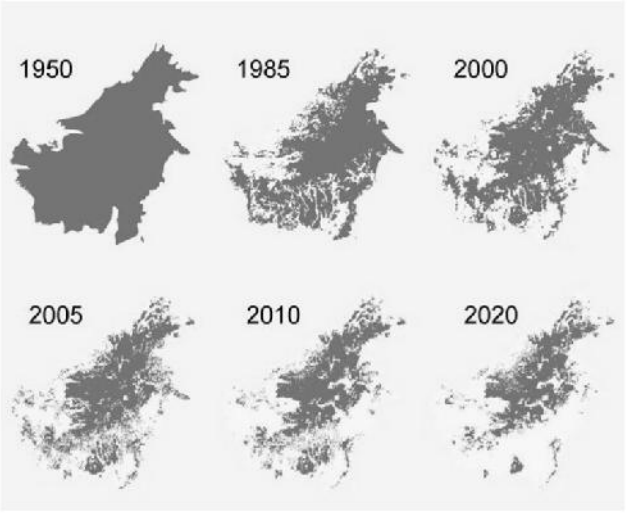


Fig. 1. Global surface temperatures relative to 1951-1980. ENSO index (12-month running mean) is based on sea surface temperature in Niño 3.4 area (5N-5S, 120-170W) in tropical Pacific[3] for 1951-1980 base period. Green triangles mark volcanic eruptions producing an extensive stratospheric aerosol layer.

http://csas.ei.columbia.edu/2015/01/16/global-temperature-in-2014-and-2015/

LAND USE CHANGE

Deforestation in Borneo, 1950-2020



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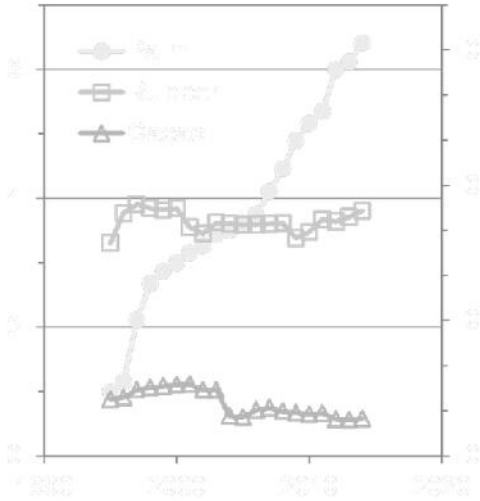
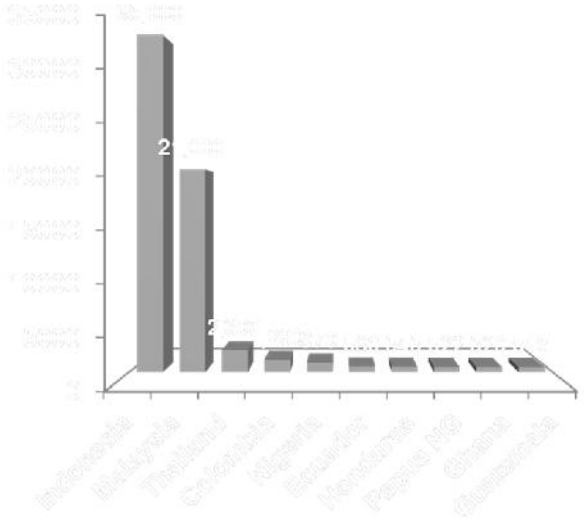


Source: Indonesia Statistics Bureau

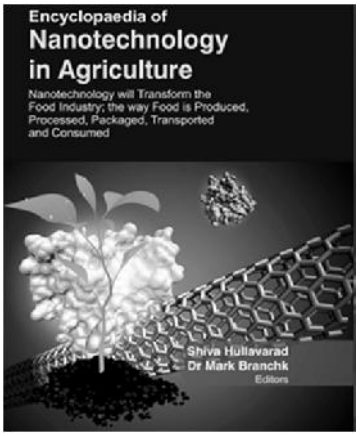
Oil Palm production (x1000 MT)



THE AGRICULTURE IN THE FUTURE

1. NANOTECHNOLOGY

The application of nanotechnology to the agricultural and food industries was first addressed by a United States Department of Agriculture roadmap published in September 2003



NAN

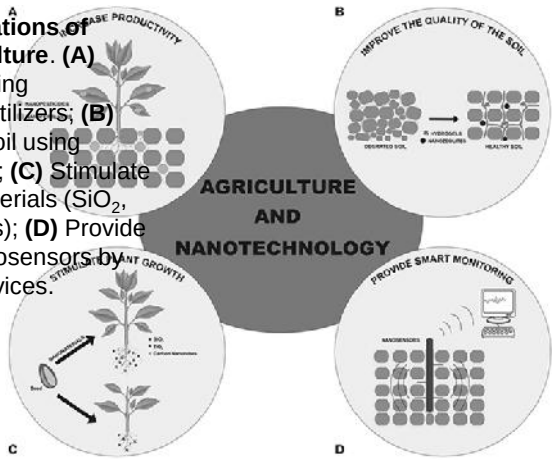
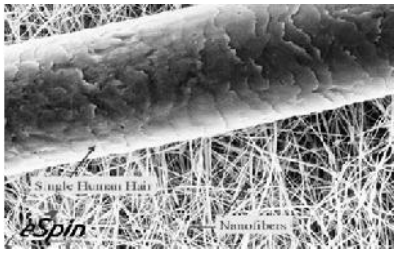


Figure 1. Potential applications of nanotechnology in agriculture. **(A)** Increase the productivity using nanopesticides and nanofertilizers; **(B)** Improve the quality of the soil using nanozeolites and hydrogels; **(C)** Stimulate plant growth using nanomaterials (SiO_2, TiO_2, and carbon nanotubes); **(D)** Provide smart monitoring using nanosensors by wireless communication devices.

What is Nanotechnology?

Nanotechnology is defined by as the science of understanding and control of matter at dimensions of roughly 1–100 nm (the US Environmental Protection Agency19)

This includes the manipulation or self-assembly of individual atoms, molecules or molecular clusters into structures to create materials and devices with new or vastly different properties

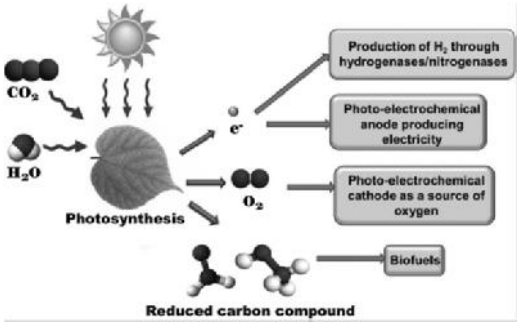


A Human Hair is about 100,000 µm wide

Nanotechnology in Biofuel

The reduced carbon compounds serves as a source of biofuel.

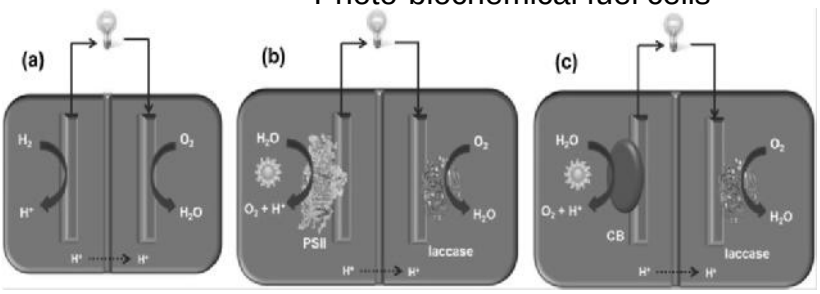
The electrons of the photosynthetic ETC are harvested for the production of



(i) electricity in the photo-bioelectrochemical cell
(ii) hydrogen with the help of enzymes (hydrogenases or nitrogenases)
(iii) oxygen in the photo-bioelectrochemical cathode

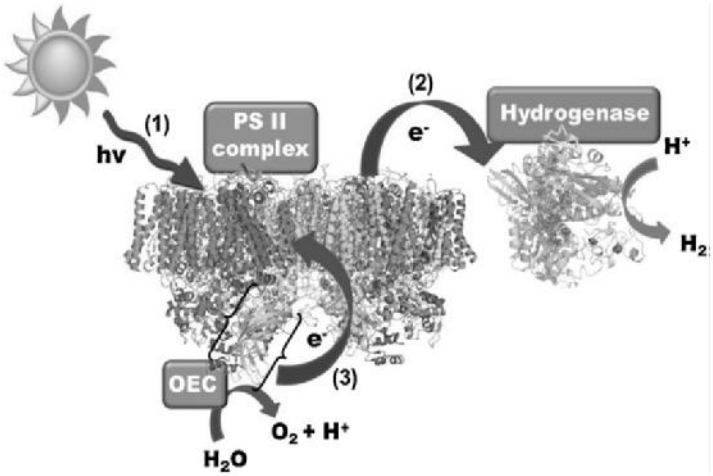
Conventional

Photo-biochemical fuel cells

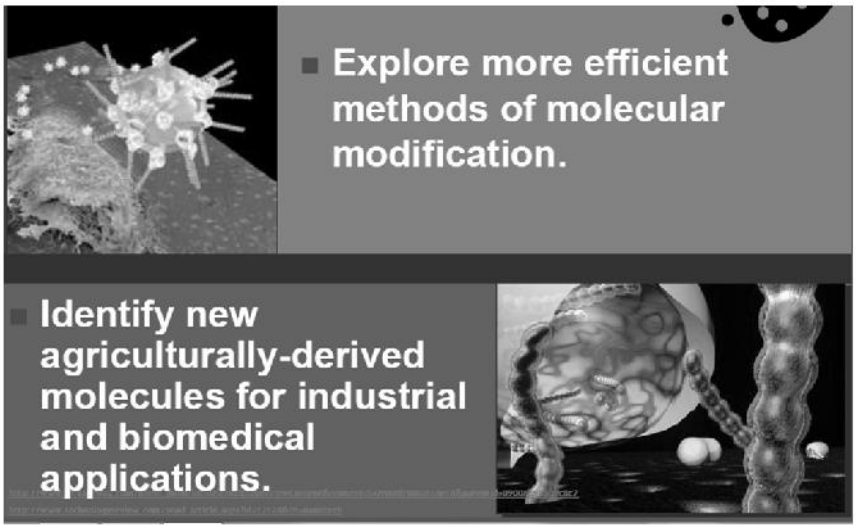


Models of fuel cells: (a) conventional hydrogen fuel cells with Pt as catalyst on both anode (+) and cathode (-), (b) and (c) are photo-biochemical fuel cells: (b) isolated PSII on the anode and (c) photosynthetic microorganisms (e.g. green algae or cyanobacteria/CB); both employ the enzymatic cathode for the reduction of oxygen to water via laccase.

HYDROGEN FUEL PRODUCTION



Schematic of hydrogen production by combining hydrogenases and photosystems

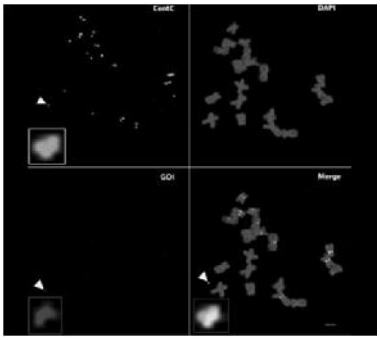


Research on anti-ageing products from soybean is underway at the Univ. Brawijaya

2. Agriculture Biotechnology

1919 The word "biotechnology" is first used by a Hungarian agricultural engineer.
2010 Researchers at the J. Craig Venter Institute create the first synthetic cell.
2015 Engineered mini-chromosomes have been produced in plants

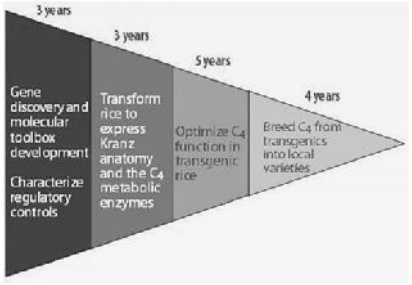
Mini-chromosome technology will be available (Syngenta and Chromatin) to deliver multiple stacked traits in a single corn hybrid faster and more efficiently than today's stacking technologies.



C4 Rice

The C_4 Rice project, leaded by Prof Jane Langdale, FRS as the principal investigator**,** began in 2006 at the International Rice Research Institute in the Philippines, funded by the Bill & Melinda Gates Foundation.

The research is on schedule, and engineering should begin in 2019, with the expectation that breeding of delicious, fiercely efficient C_4 rice could be complete by 2039.



Drought-resistance traits

The first corn hybrids that are drought resistant are available. Drought-resistant hybrids with genetically modified traits using biotechnology should appear in the middle of the decade.

The recent discovery of a genetic mutation at Purdue University that allows a plant to better endure drought without losing biomass may help increase WATER USE EFFICIENCY.

http://farmindustrynews.com/farm-equipment/20-technologies-changing-agriculture#slide-9-field_images-45641

3. Precision Agriculture

Smart Farming or Precision Agriculture is one of the hottest trend in agriculture.

Farmers have been able to improve crop yields and water utilization by the data generated from sensors on the field, farming equipment and using big data analytics,.

Portable Computers, Smartphones and Drones will be heavily involved in farm managements

In the future, agricultural machines will be able to communicate with each other and will be controlled via smartphone or tablet. Credit: Fraunhofer IESE

http://cdn.phys.org/newman/gfx/news/hires/2013/smartagricul.jpg

Precision Agriculture put emphasis on increasing efficiency, productivity and innovative approaches to future food security needs, coupled with appropriate attention to environmental needs and pressures for reducing carbon footprint.

'Smart', in the context of smart integrated farming, is a term that is now being applied to these evolving technological drivers.

Hyper precision

Precision agriculture technologies are becoming more robust and more precise ushering in an era of hyper precision.

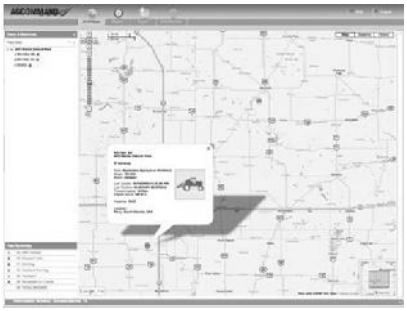
Drone technology

Drone technology will give the agriculture industry a high-technology makeover, with planning and strategy based on real-time data gathering and processing

1. **Soil and field analysis** (3-D maps for early soil analysis)
2. **Planting** (Startups have created drone-planting systems)
3. **Crop spraying** (Drones can scan the ground and spray the correct amount of liquid, modulating distance from the ground and spraying in real time for even coverage)
4. **Crop monitoring** (Drone can be used for time-series animations that can show the precise development of a crop and reveal production inefficiencies, enabling better crop management)
5. **Irrigation** (Drones with hyperspectral, multispectral, or thermal sensors can identify which parts of a field are dry or need improvements)
6. **Health assessment** (Drone-carried devices can identify which plants reflect different amounts of green light and NIR light)

1. 4G networks
Farmers frustrated by lack of access to higher-speed Internet services could find themselves in the Internet fast lane in the next couple of years, because of 4G (fourth generation) cellular communications networks.

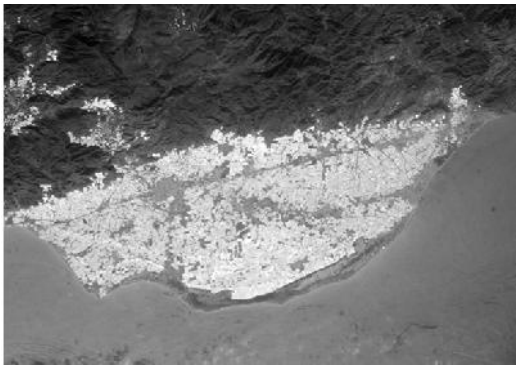
2. Telematics
Imagine pulling up on your mobile computer a map that shows where all your vehicles are operating and their fuel levels, how much product has been applied or how much crop harvested, and even if a piece of equipment is ready to break down.



4. GREEN HOUSE AGRICULTURE

The Tabernas desert (southern Spain), is the driest place in Europe before 1963

Tabernas's massive greenhouse clusters have been touted as an economic miracle.



http://earthobservatory.nasa.gov/IOTD/view.php?id=4508

Spain built greenhouses throughout much of the country's arid landscape and is now the place where more than half of Europe's fresh vegetables and fruits are grown, one of Europe's major exporters of produce. John Prior/Alamy

5. VERTICAL FARMS

Vertical 'Pinkhouses:' The Future Of Urban Farming?

A set of vertical farms designed for use in China.

Image: Vincent Callebaut Architects.

http://www.citymetric.com/skylines/why-we-should-be-farming-skyscrapers-1029

IN DOOR VERTICAL FARMS

The future of agriculture is an indoor vertical farm half the size of a Wal-Mart

FarmedHere is the largest indoor vertical farm in North America.

Everything that's happening can be controlled in an indoor farm that can use up to 95% less water than traditional methods."

The crops are grown indoors, where they're always monitored and kept away from harmful bacteria.

http://www.businessinsider.com/indoor-vertical-farm-is-the-future-of-agriculture-2015-10?IR=T&r=US&IR=T

In door Vertical farms are called sometimes "Pinkhouses," as they're are lit blue and red: Those are the spectrums of visible light best absorbed by plants. Thus pinkhouses generate high efficiency.

The pinkhouses use the mix of blue and red LED lamps which are super energy efficient in general, and can be tuned to specific wavelengths.

In the wild, plants use at most 8% of the absorbed light, while in pinkhouses, the plants can use as much as 15%

http://66.media.tumblr.com/9c98a11117c8356ac642d05d110843a6/tumblr_o5hf9mSX3s1r5ywtt_r1_og_1280.jpg

CE AGRICULTURE (CEA)

- **Controlled Environment Agriculture** (CEA) is agriculture systems which efficiently utilize modern technology for crop management.
- CEA technology provides an excellent platform for the introduction of nanotechnology to agriculture.
  - Nanotechnological devices for CEA that provide "scouting" capabilities could tremendously improve the grower's ability to determine the best time to harvest the crop, the vitality of crop, and food security issues, such as microbial or chemical contamination.
  - CEA is an advanced and intensive form of hydroponically based agriculture. Plants are grown within a controlled environment so that agricultural practices can be optimized.
  - The computerized system monitors and regulates localized environments such as fields of crops and irrigated water.

CONCLUSION

- The Future Agriculture will develop to be
  HIGH-TECH AGRICULTURE INDUSTRIES
- This, however, should be supported by the right Agriculture Education Systems that include, among others,
  1. Highly qualified human resource
  2. Excellent Laboratories
  3. Excellent Multimedia lecture rooms
  4. Excellent lecture materials and delivery
- Sumberdaya pendidikan (SDM, Lab. dll) juga perlu ditingkatkan dari segi quantitas dan qualitas


THANK YOU
Спасибо
謝謝
شكراً