

# **Artificial Intelligence in Agriculture & Fishery**

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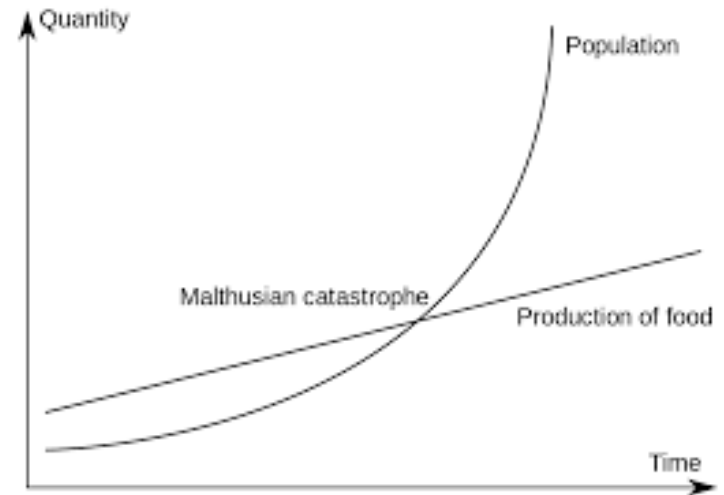
**Jogyakarta**

**2019**



# Agenda

- Malthusian catastrophe
- Industrial Revolution
- Food, Energy and Water Nexus
- 8 ways AI can help save the planet
- Smart IoT = AI + IoT
- AI in Agriculture



**The amount of CO<sub>2</sub> in the atmosphere  
has become so large that ...**

<https://www.msn.com/en-us/video/n/theres-so-much-co2-in-the-atmosphere-that-planting-trees-can-no-longer-save-us/vp-BBOWAIY>



*"Everything else can wait, but not agriculture."*

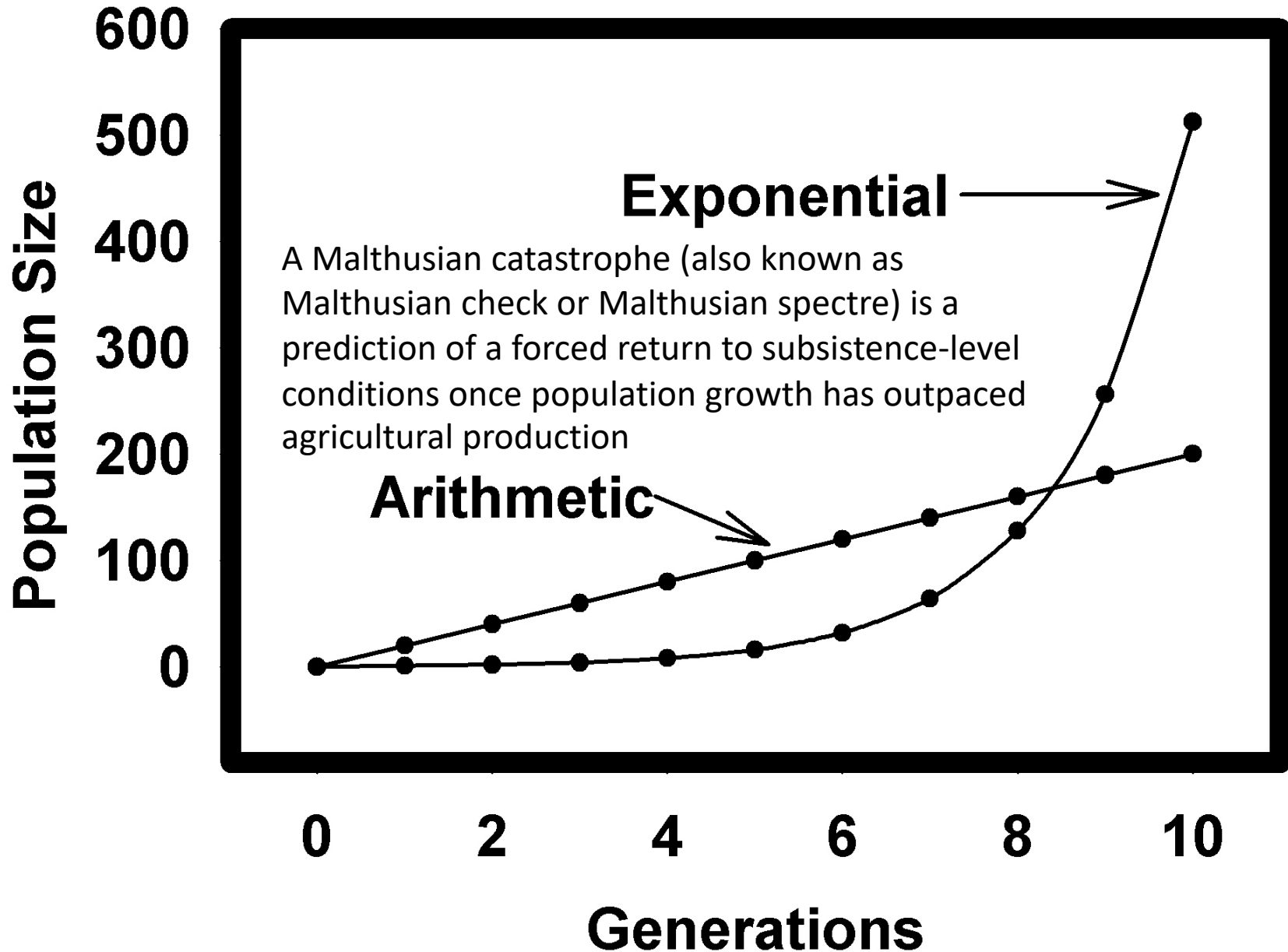
*Jawaharlal Nehru*

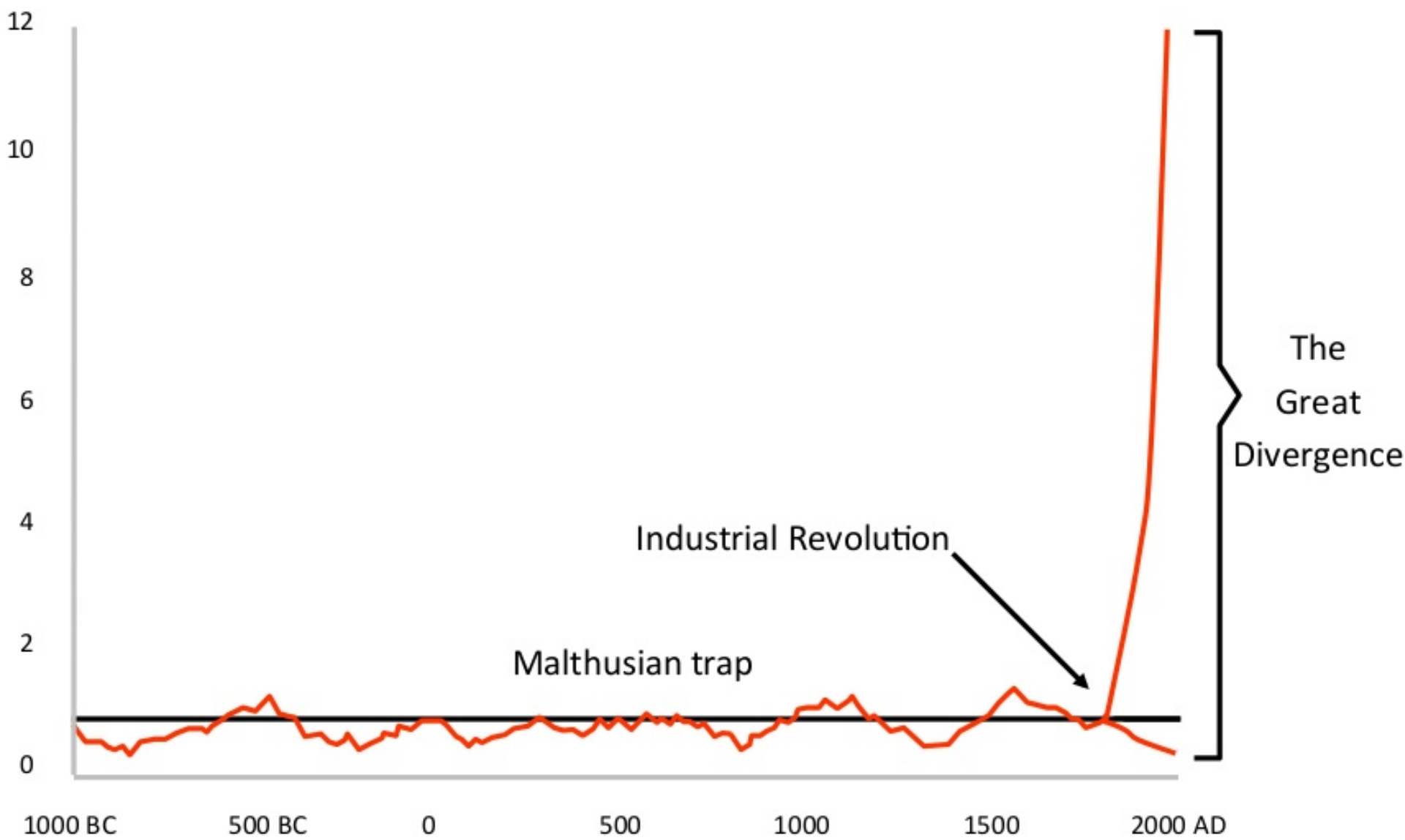


Food and Agriculture Organization  
of the United Nations



# Comparison of Exponential and Arithmetic Growth







# Causes of the Industrial Revolution

## **AGRICULTURAL REVOLUTION**

- Dutch build dikes
- British discover ways to produce more food, and invent seed drill

### **BETTER FOOD PRODUCTION**



## **POPULATION EXPLOSION**

- People eat better
- Women give birth to healthier babies
- Better medical care slows death rate

### **MORE DEMANDS FOR GOODS**



## **ENERGY REVOLUTION**

Water wheels power new machines  
Coal used to fuel steam engine

### **FASTER PRODUCTION OF GOODS**



## **INDUSTRIAL REVOLUTION**

# INDUSTRIAL REVOLUTION



The industrial revolution begins. Mechanization of manufacturing with the introduction of steam and water power

**1st**  
Revolution



Mass production assembly lines using electrical power

**2nd**  
Revolution



Automated production using electronics, programmable logic controllers (PLC), IT systems and robotics

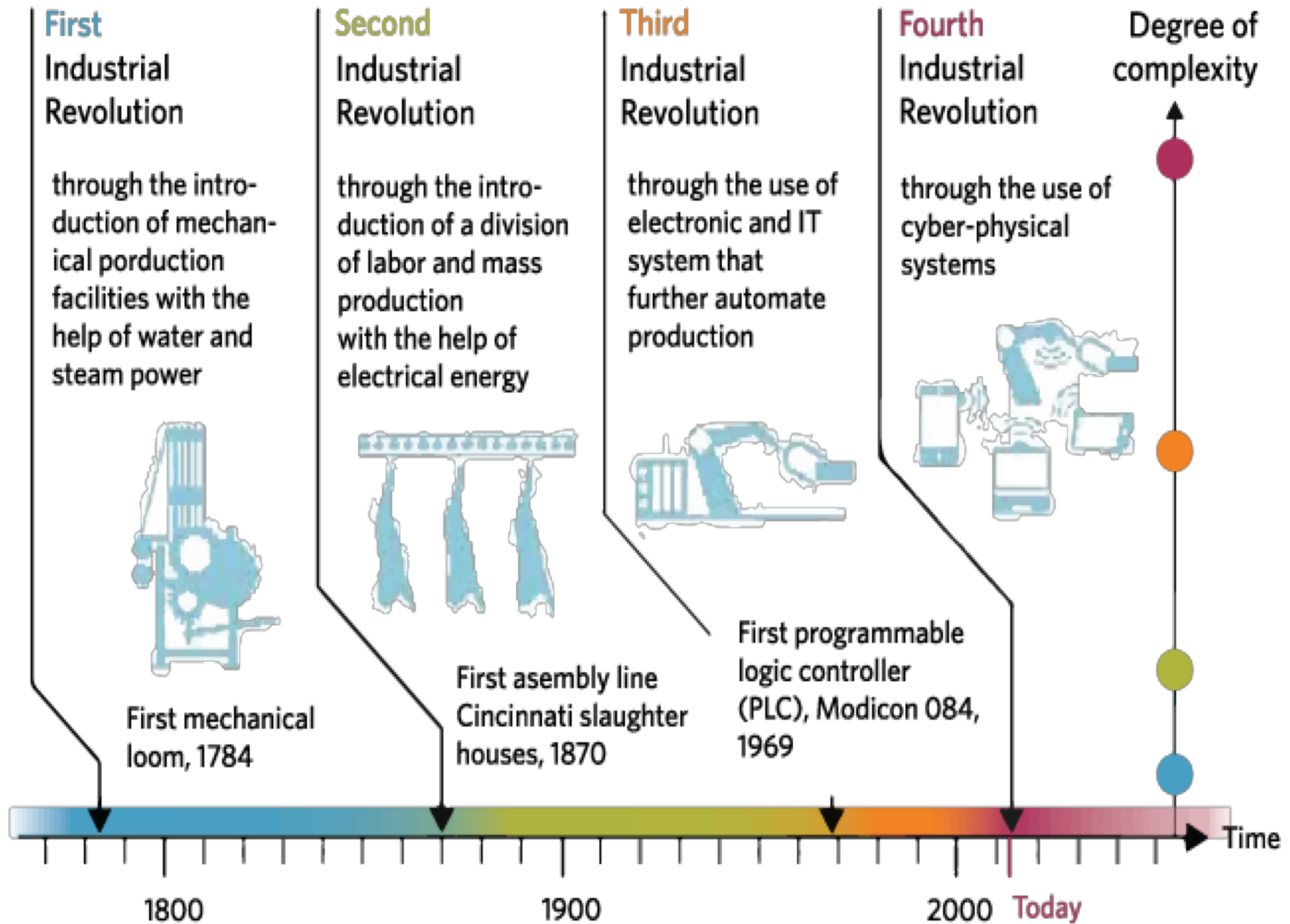
**3rd**  
Revolution



Autonomous decision making of cyber physical systems using machine learning through cloud technology

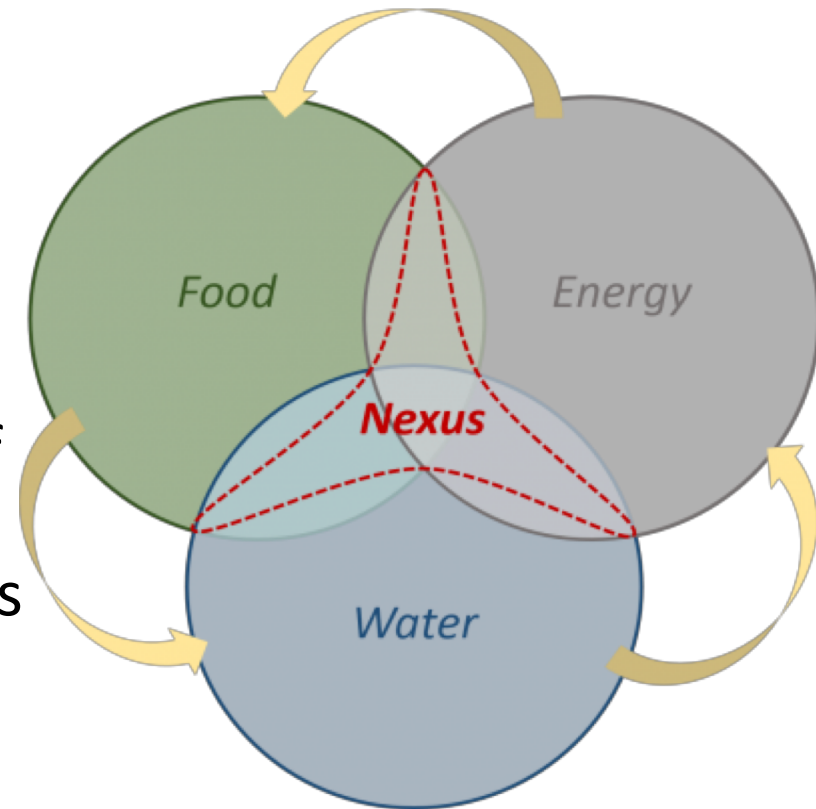
**4th**  
Revolution



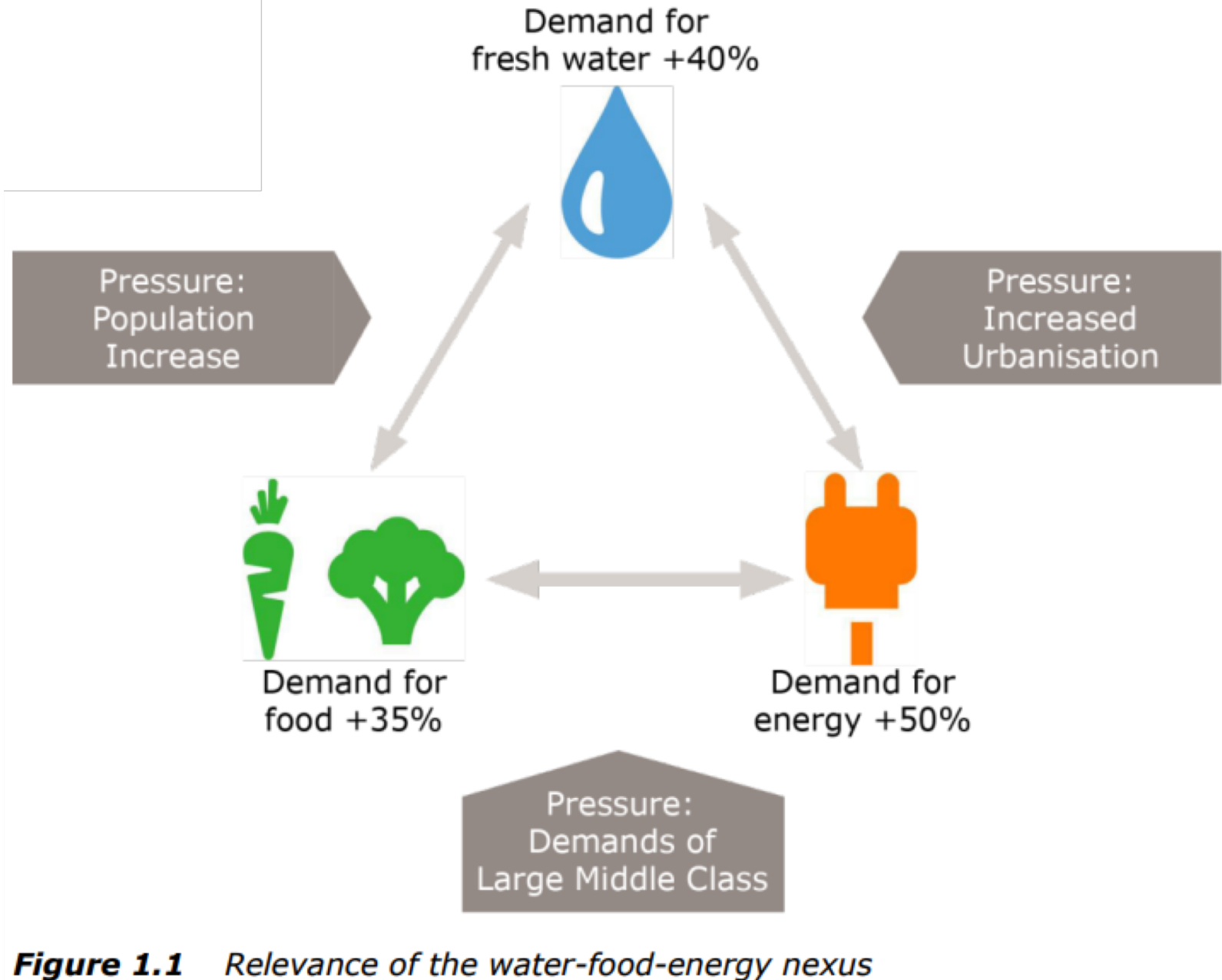


# Food, Energy and Water Nexus

- The FEW nexus is the intersection of food, energy, and water, three interdependent components that, together, are the lifeblood of the Earth. By 2025, there will be nine billion people on Earth. Unless we are able to thoroughly understand the connection between all three, global efforts to meet the needs of people on Earth will fail.
- In this sense, the FEW nexus affects everybody, from government, to industry, to academia, to citizens across the globe.







**Figure 1.1** *Relevance of the water-food-energy nexus*

Reinhard, Stijn, Jan Verhagen, Wouter Wolters and Ruerd Ruben, 2017. Water-food-energy nexus; A quick scan. Wageningen, Wageningen Economic Research, Report 2017-096.

**Global  
governance failures**

**Economic disparity**

**Food security**

Food crisis – Social unrest

**Water security**

Chronic shortages – drag on growth  
Water crisis – Social unrest

**Energy security**

Chronic shortages – drag on growth  
Energy crisis, economic damage,  
Social unrest

Water intensity of  
food production

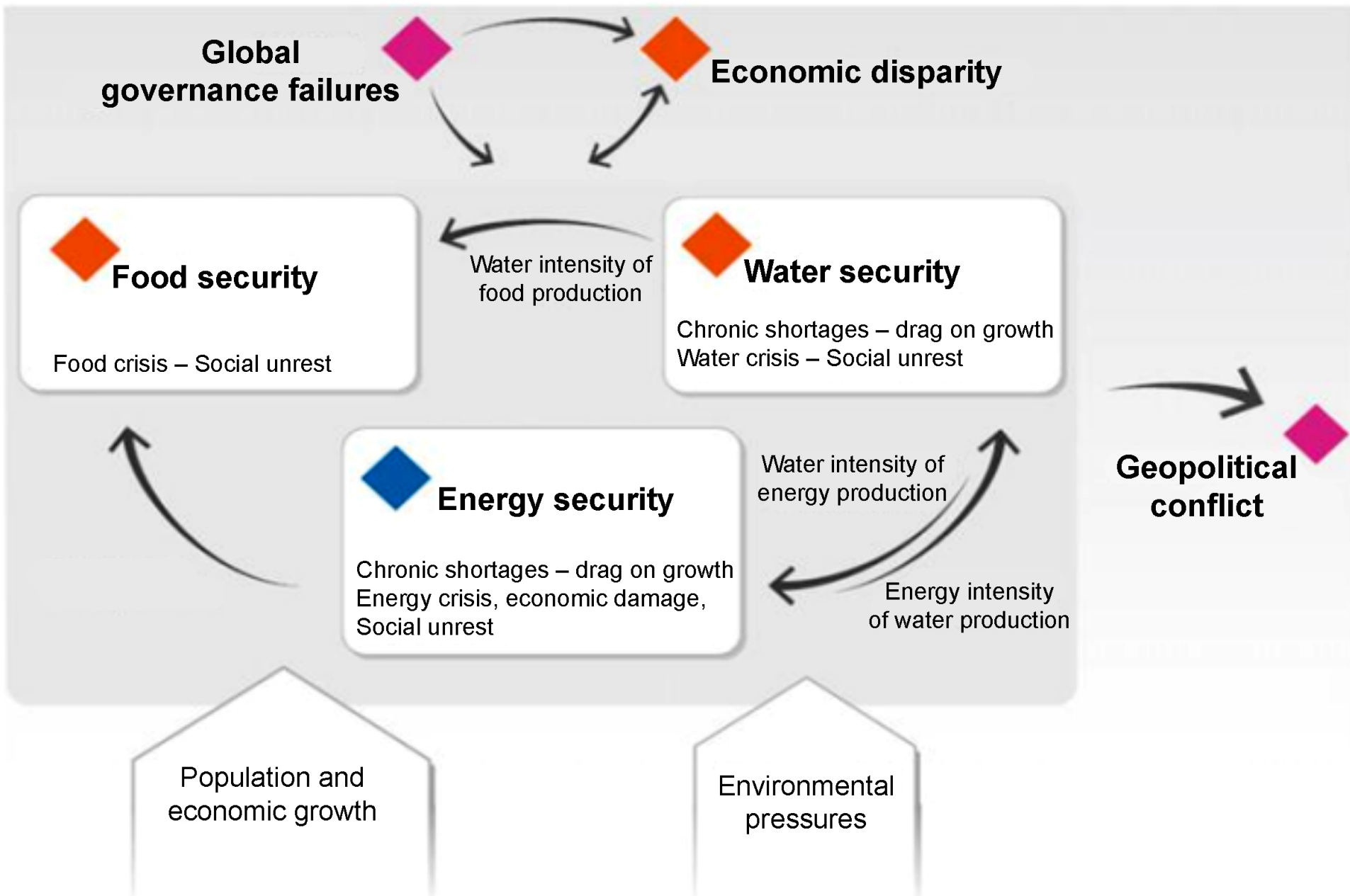
Water intensity of  
energy production

Energy intensity  
of water production

**Geopolitical  
conflict**

Population and  
economic growth

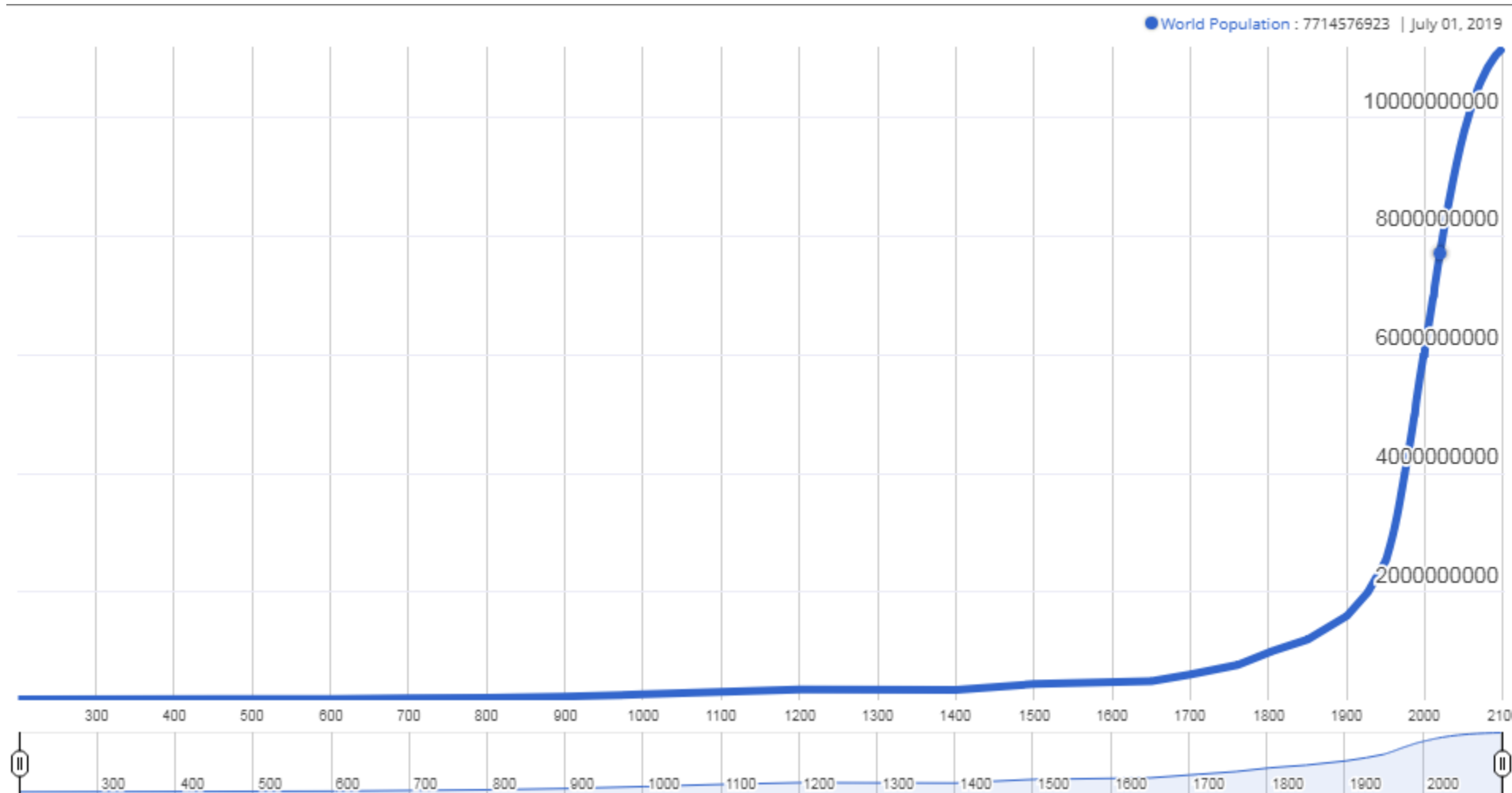
Environmental  
pressures





# World population July 1, 2019

## 7.714.576.923

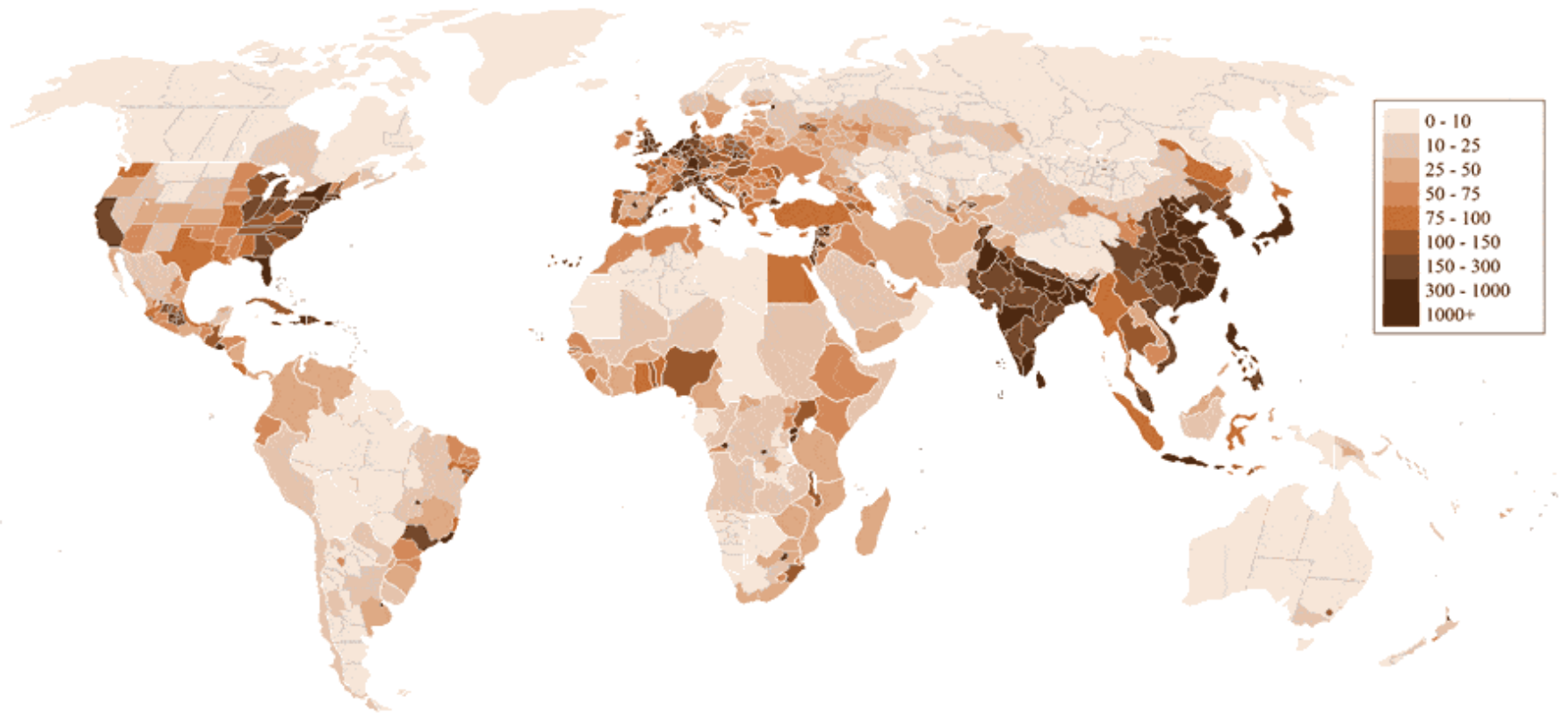


<http://www.worldometers.info/world-population/>

# World Population Density (people/km<sup>2</sup>)

[back to t](#)

Population density map of the world showing not only countries but also many subdivisions (regions, states, provinces). See also: [World Map](#)




<http://www.worldometers.info/world-population/>

# Temperature rises across Iran, Ahvaz hits record high

July 29, 2018



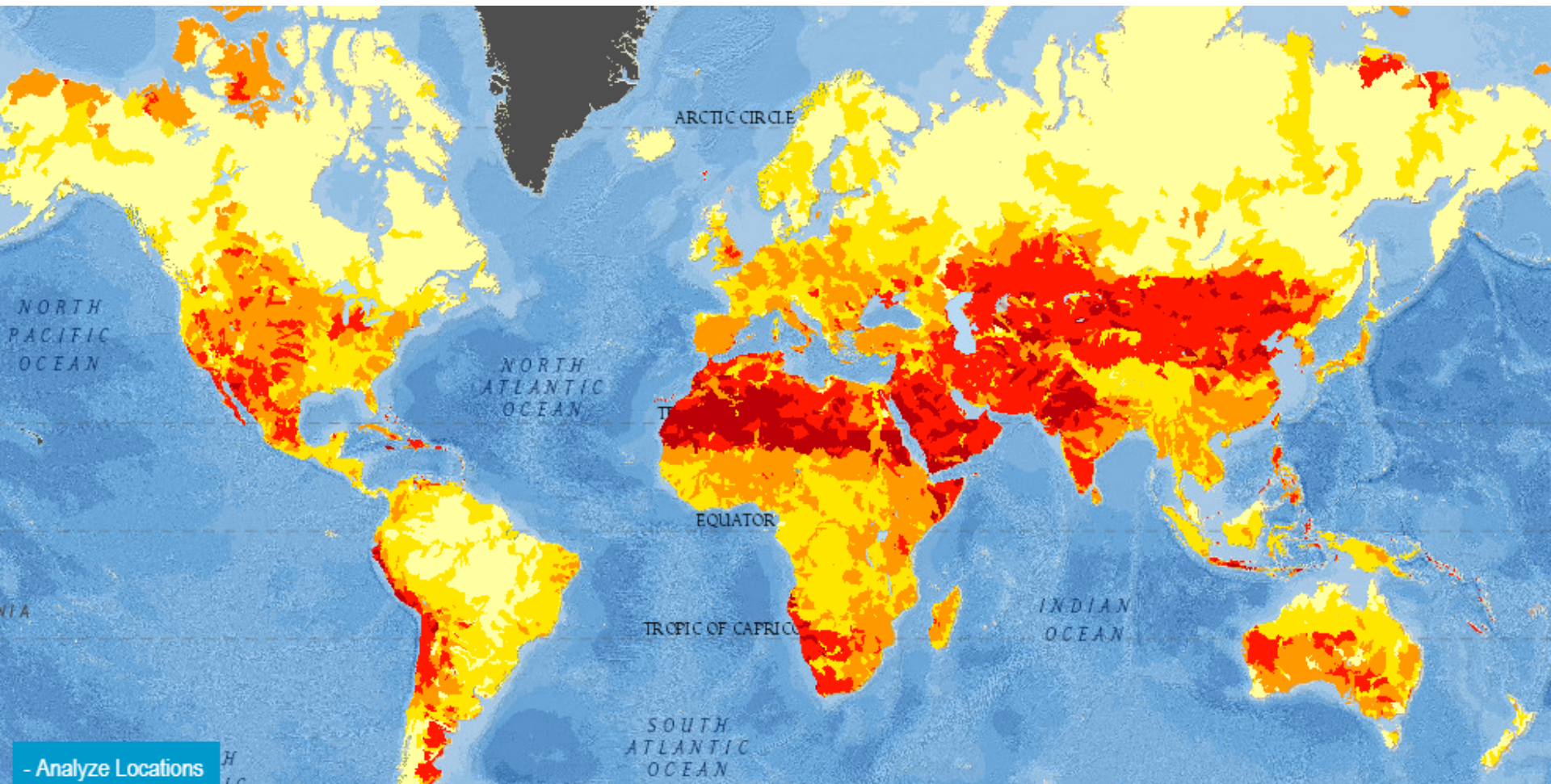




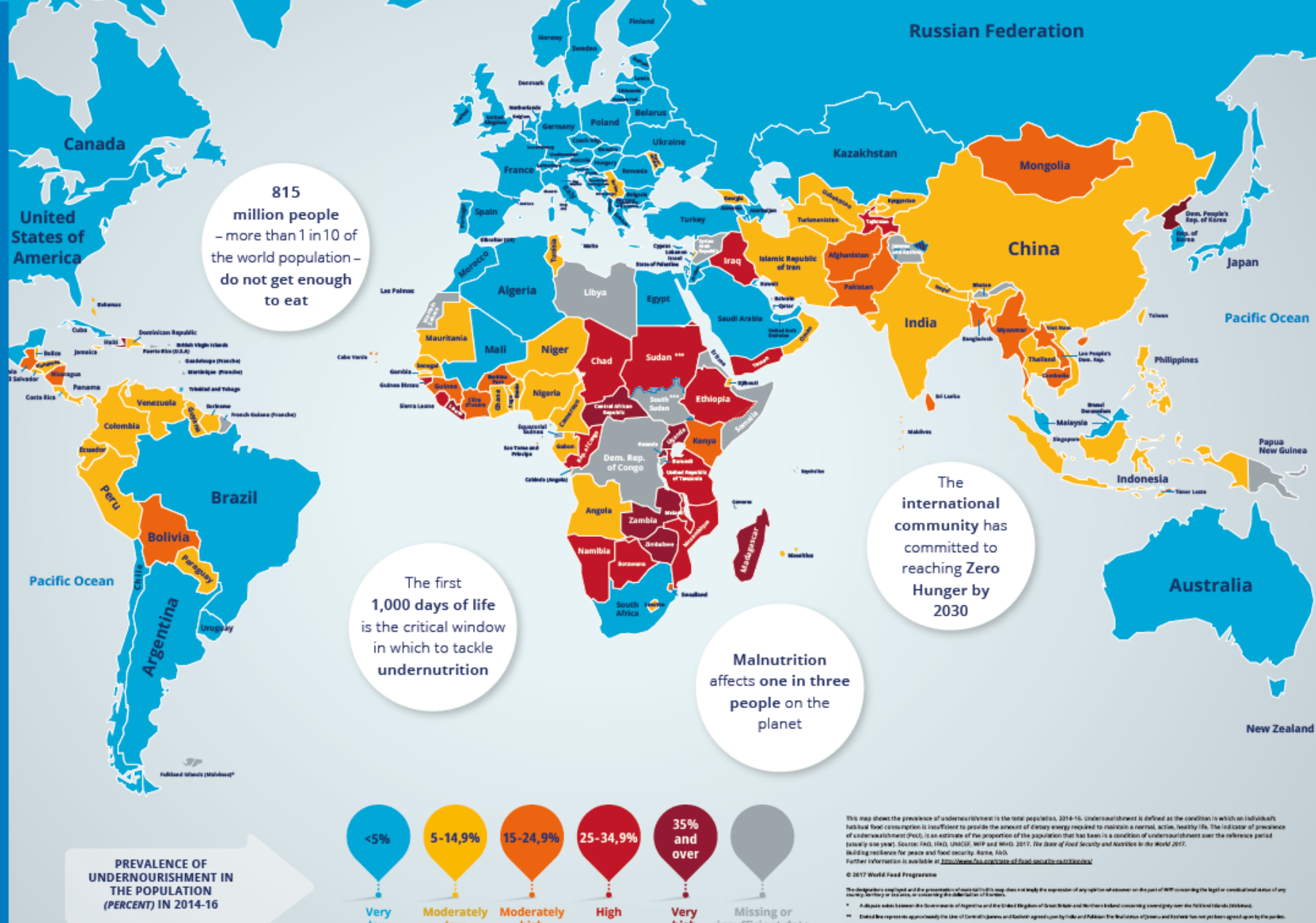
*"If the wars of this century  
were fought over oil,  
the wars of the next century  
will be fought over water."*

*- World Bank Vice President Ismail Serageldin*

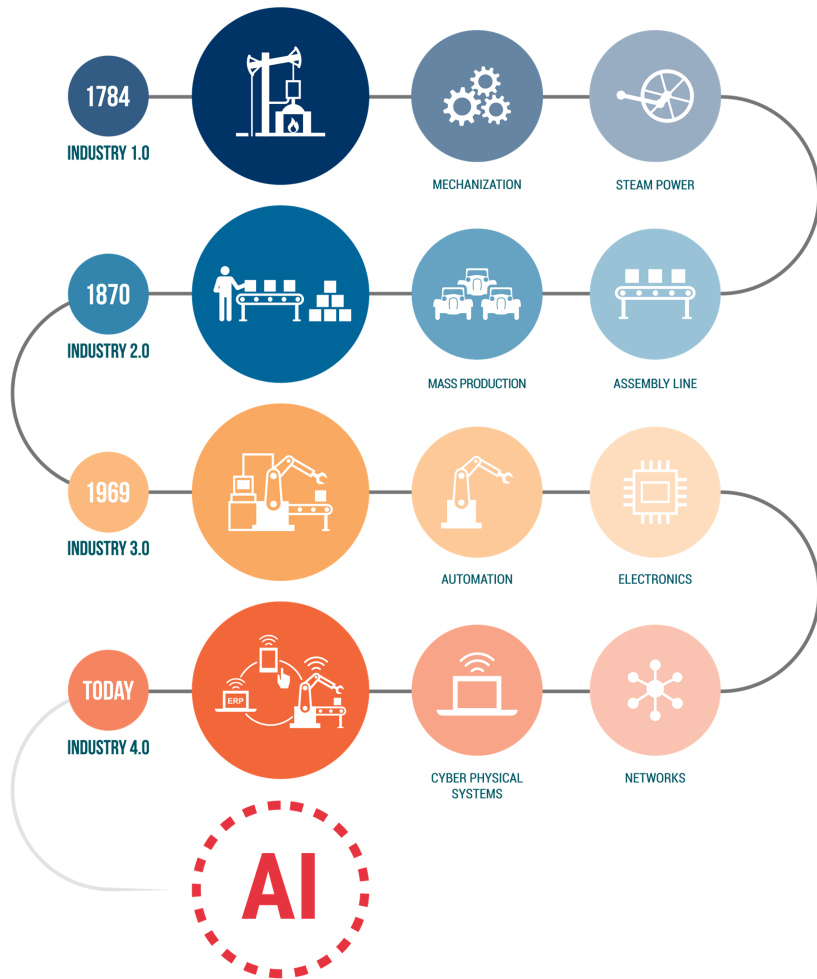
# AQUEDUCT Water Risk Atlas



<https://www.wri.org/applications/maps/aqueduct-atlas/#x=-164.79&y=4.71&s=ws!20!28!c&t=waterrisk&w=def&g=0&i=BWS-16!WSV-4!SV-2!HFO-4!DRO-4!STOR-8!GW-8!WRI-4!ECOS-2!MC-4!WCG-8!ECOV-2!&tr=ind-1!prj-1&l=2&b=terrain&m=group>



# To tackle world hunger



# AT THE CUSP OF THE 5<sup>TH</sup> INDUSTRIAL REVOLUTION

Recent rapid adoption and application of artificial intelligence algorithms — triggered by access to big data and better hardware-processing capabilities — are changing the face of blue and white collar jobs.



# 8 ways AI can help save the planet



## *Climate change*

- Clean power
- Smart transport options
- Sustainable production and consumption
- Sustainable land-use
- Smart cities and homes



## *Biodiversity and conservation*

- Habitat protection and restoration
- Sustainable trade
- Pollution control
- Invasive species and disease control
- Realising natural capital



## *Healthy Oceans*

- Fishing sustainably
- Preventing pollution
- Protecting habitats
- Protecting species
- Impacts from climate change (including acidification)



## *Water security*

- Water supply
- Catchment control
- Water efficiency
- Adequate sanitation
- Drought planning



## *Clean air*

- Filtering and capture
- Monitoring and prevention
- Early warning
- Clean fuels
- Real-time, integrated, adaptive urban management

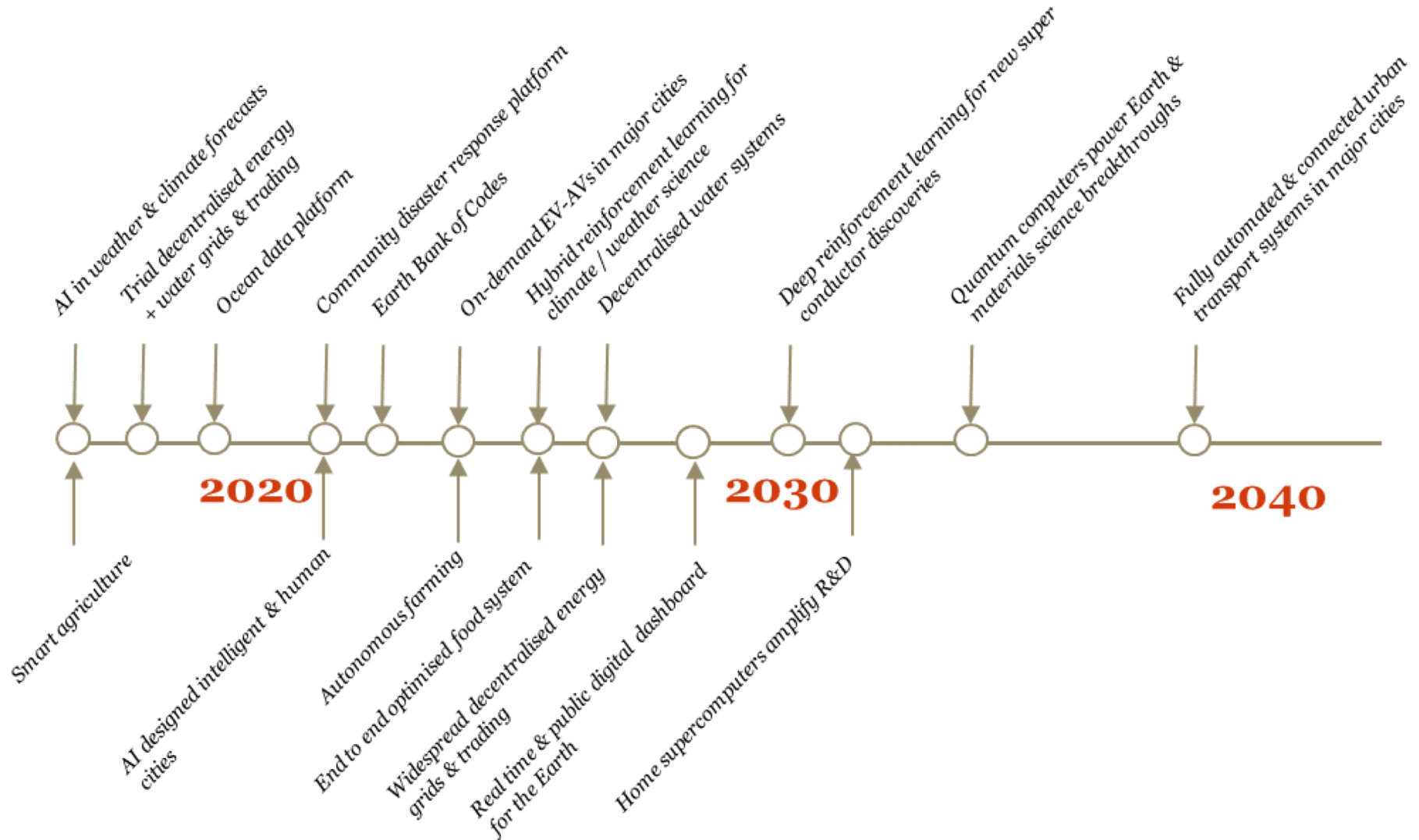


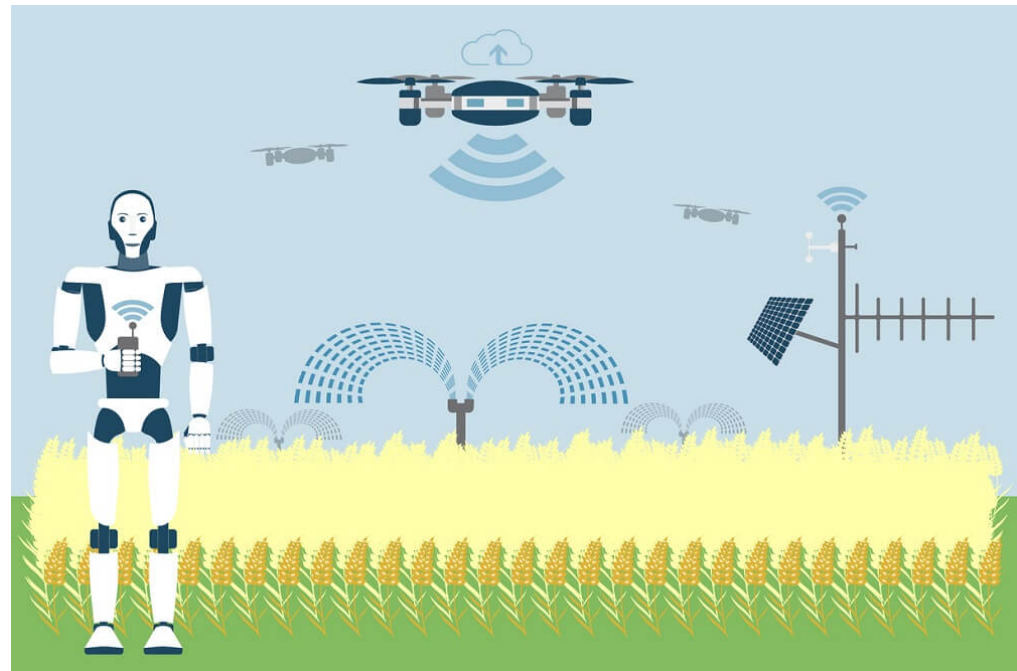
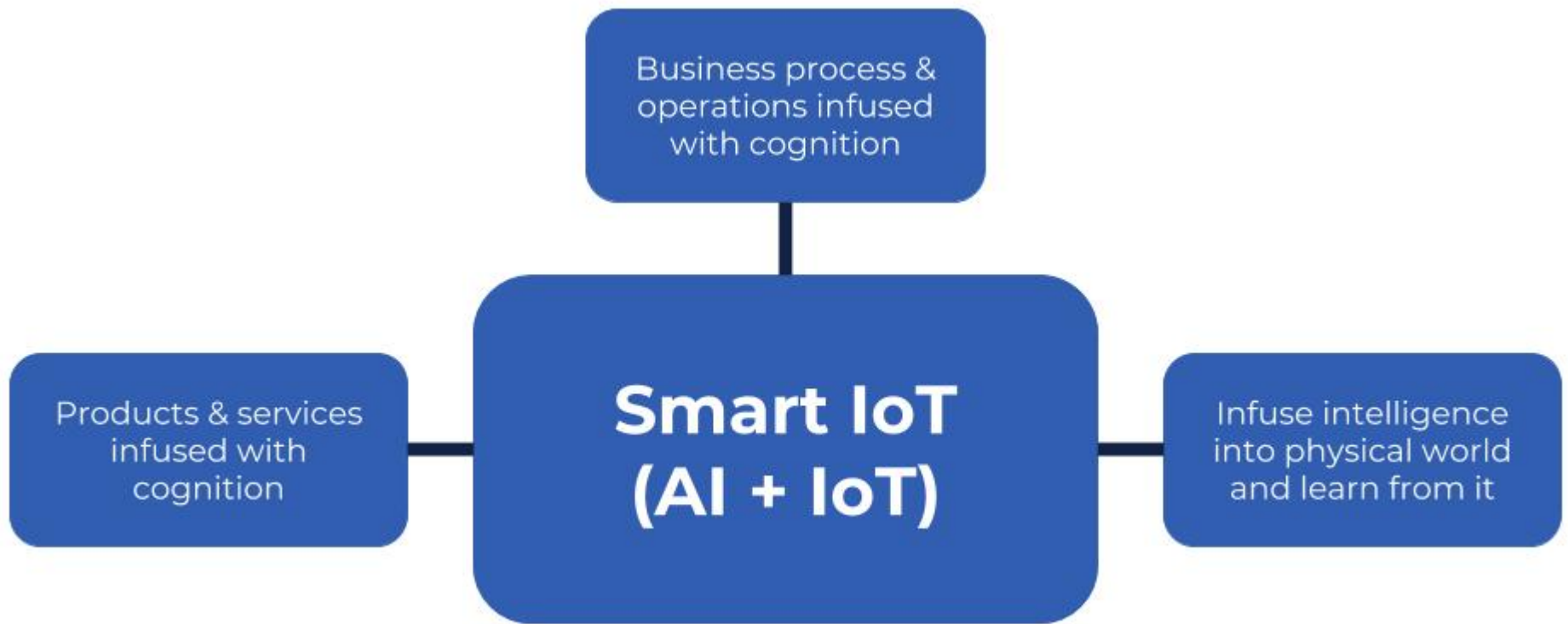
## *Weather and disaster resilience*

- Prediction and forecasting
- Early warning systems;
- Resilient infrastructure
- Financial instruments
- Resilience planning

# AI for the Earth game-changers: indicative timeline

Image: PwC





# TECHNOLOGY IS RE-SHAPING THE WORLD



## Internet of Things

*Everything that can be connected, will be connected!*



## Mobile

*Information anywhere, anytime!*



## Cloud

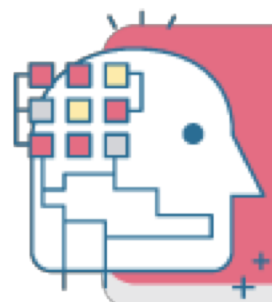
*Infinite power of computation in your pocket!*



## Big Data

*Insights about every aspect of our lives!*





**AI:** Data-based learning

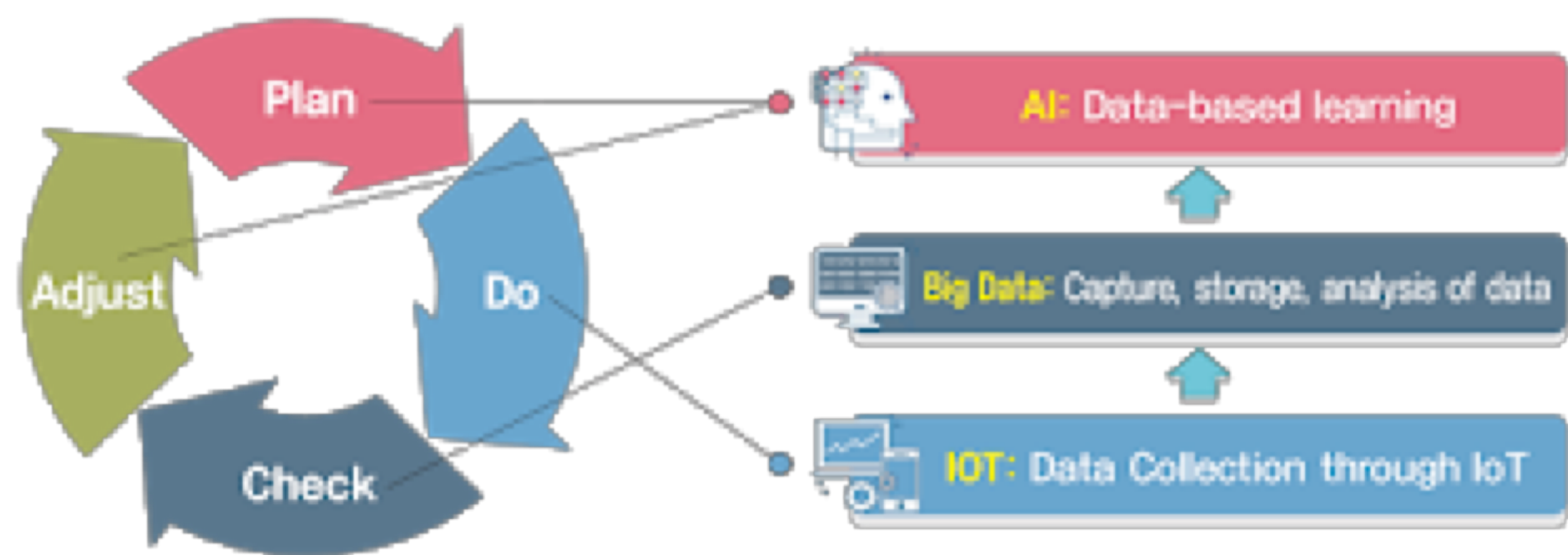


**Big Data:** Capture, storage, analysis of data

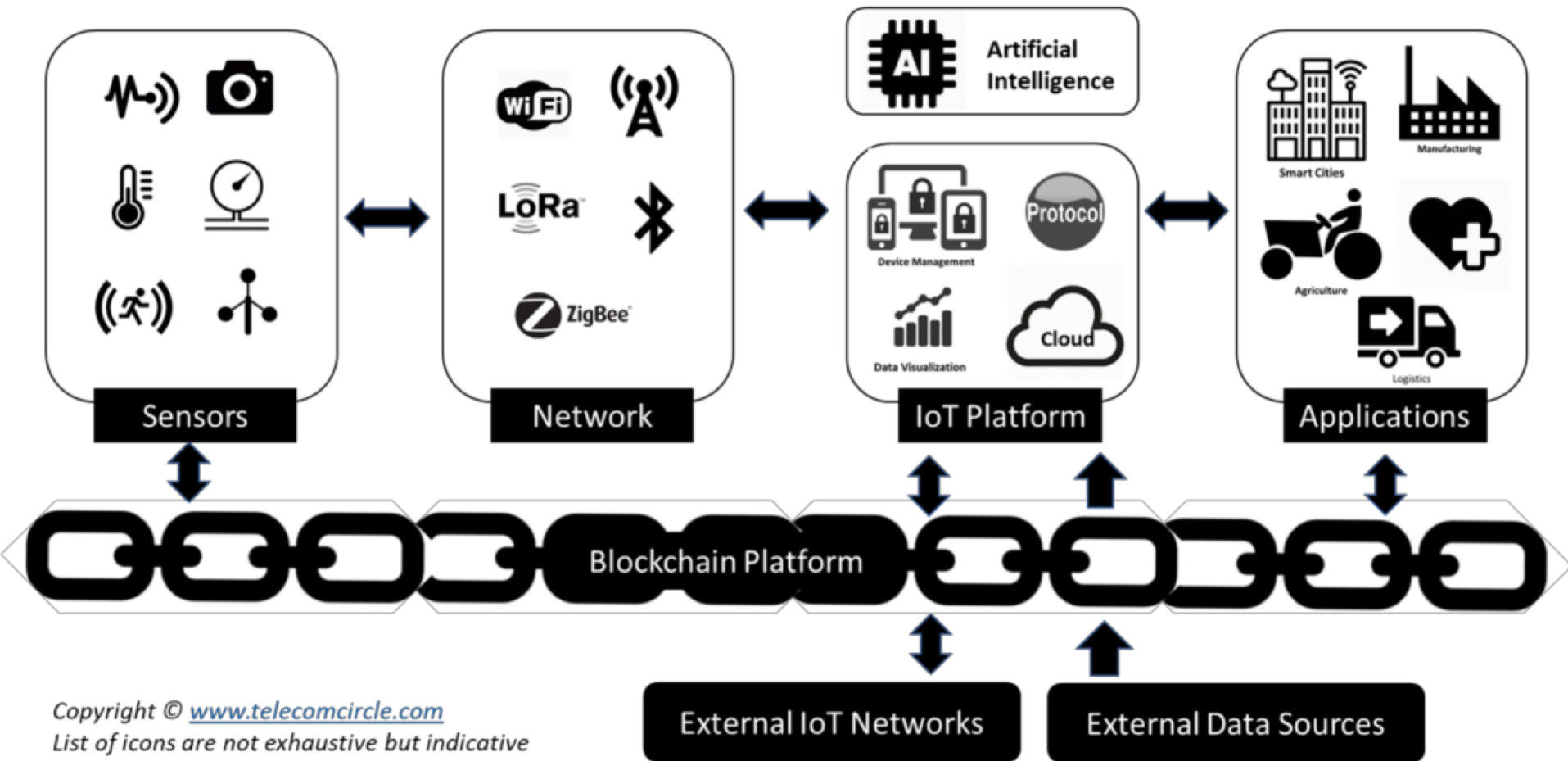


**IOT:** Data Collection through IoT

## Continuous Improvement

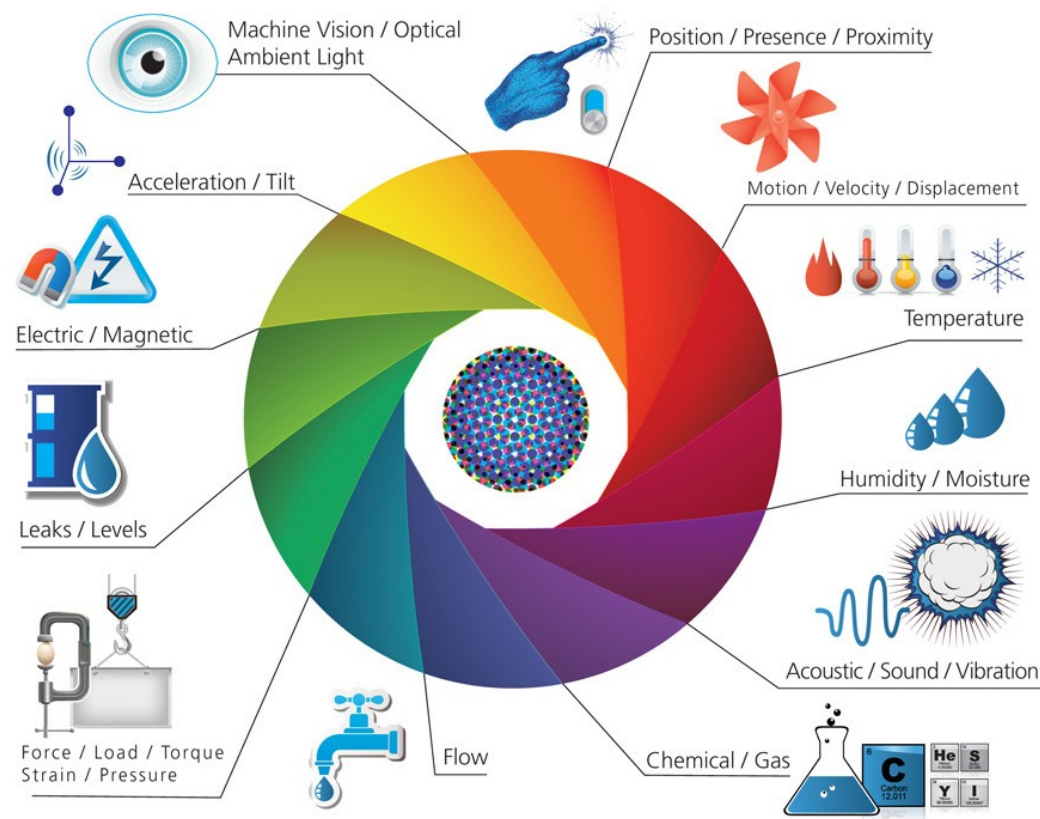


## IoT, Blockchain and Artificial Intelligence in Action



# Sensors For All Conditions

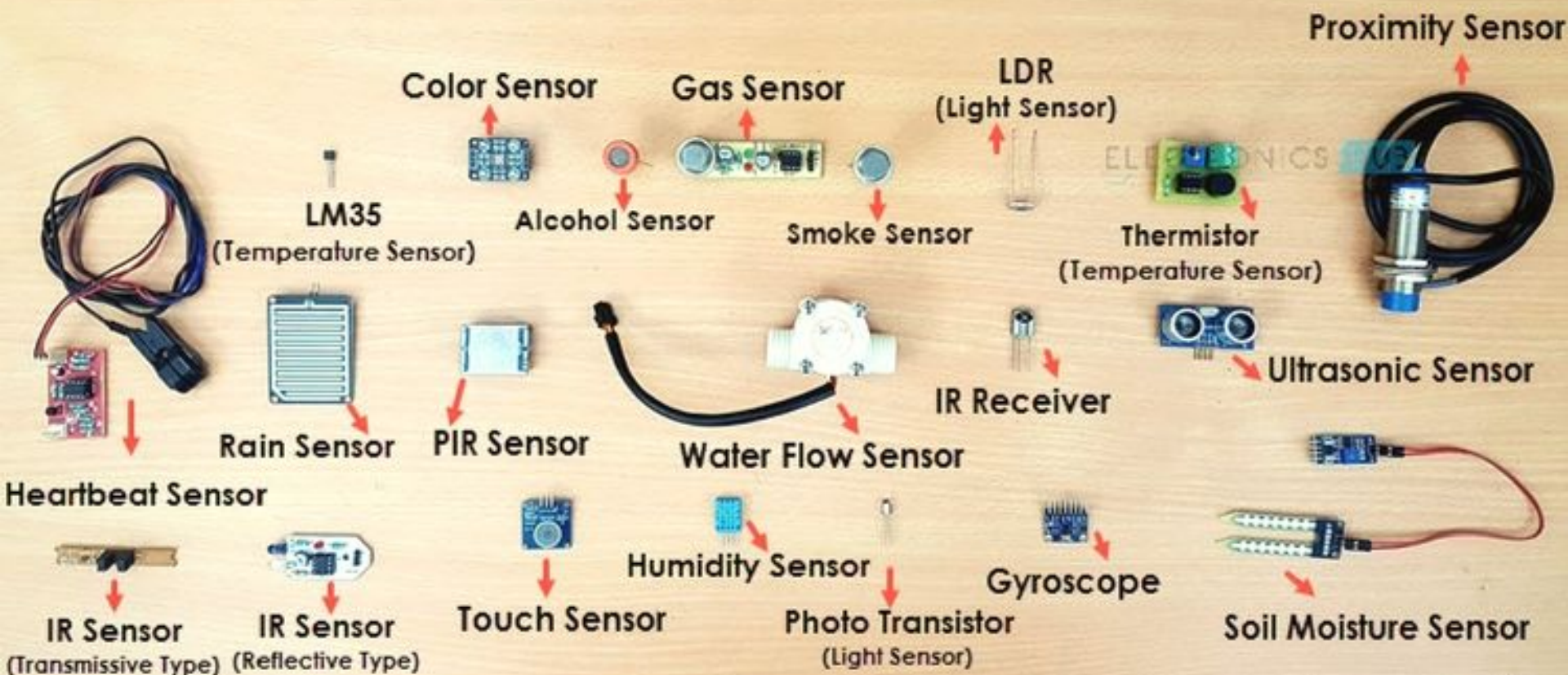
- Digital Temperature
- Digital Humidity
- Heat Index (Feels Like)
- Dew Point
- Main / UPS Power
- Power Current (Amps)
- Active Power & Temperature
- Flood / Water Cable
- Flood / Water Spot
- Flood Protection Kit
- Smoke / Fire
- Motion
- Room / Door Entry
- Air Flow
- Analog Sensors
- Relay Switches
- Network Cameras
- Light Towers & More



• <https://avtech.com/Products/Sensors/>



# DIFFERENT TYPES OF SENSORS





MQ-2  
Smoke Gas



MQ-3  
Alcohol



MQ-4  
Methane gas



MQ-5  
Methane Natural Gas



MQ-6  
LPG Gas



MQ-7  
Carbon monoxide gas



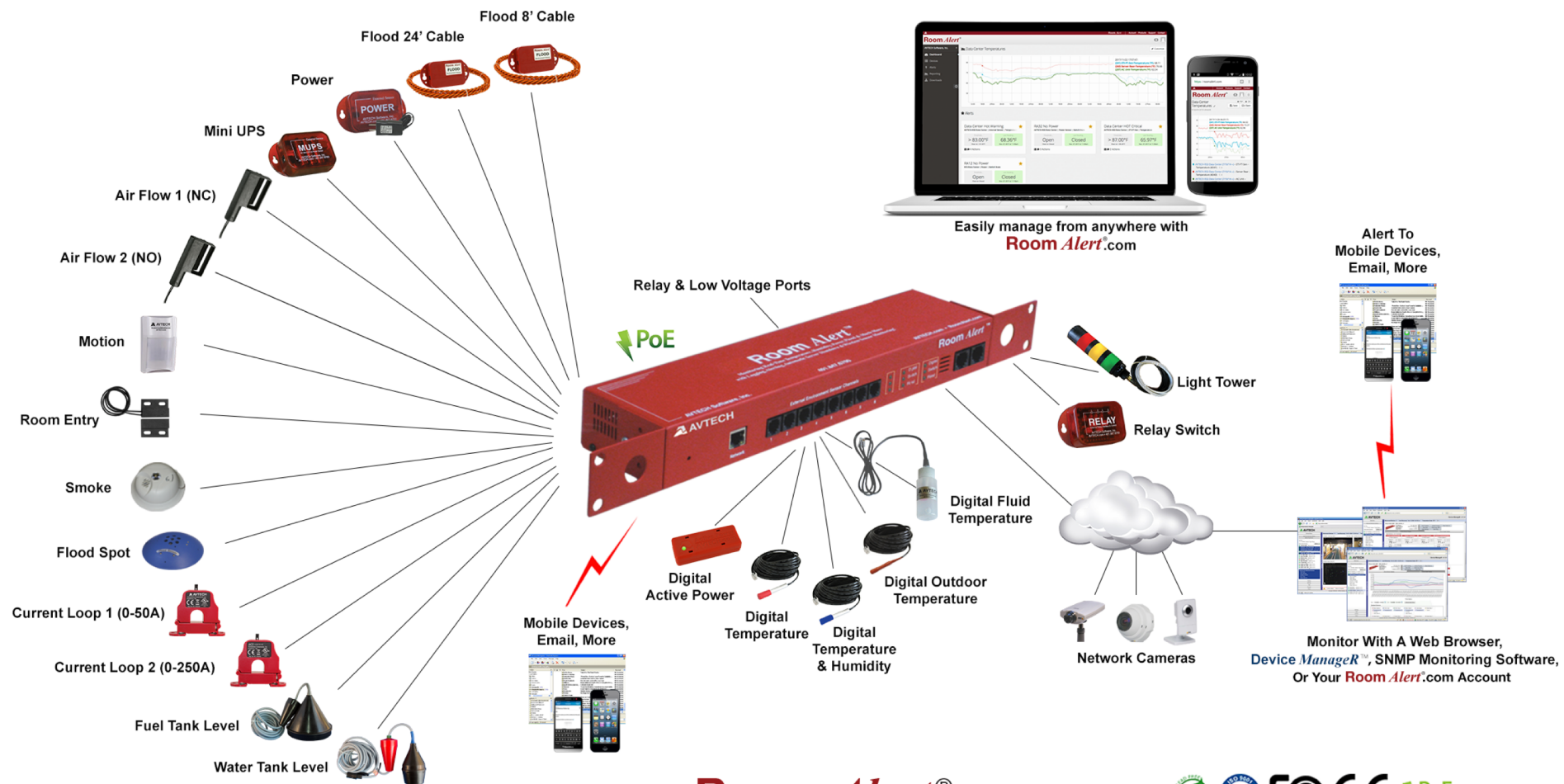
MQ-8  
Hydrogen



MQ-9  
Combustible gas



MQ-135  
Air Quality



**Room Alert**®





# Smart Water

Monitoring water quality & safety

Real-time water control & management

Monitoring drinking water quality

Healthy, pollution-free, ecosystems for wildlife

Chemical leakage detection

Public health & risk monitoring

Sewage monitoring





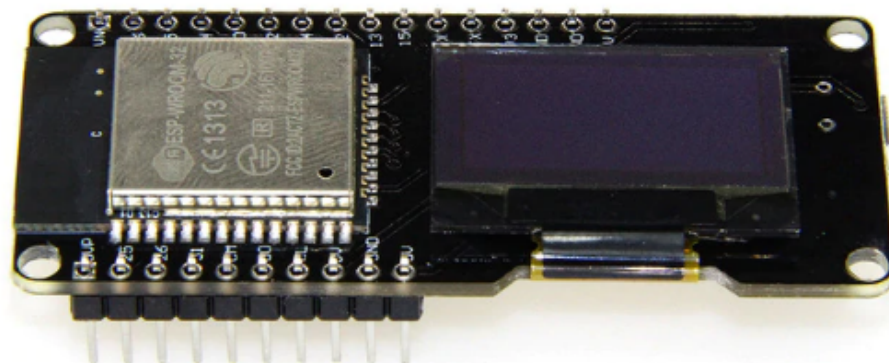
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Open: 2 year(s)

99.2% Positive feedback ▾

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ESP-32S ESP8266 &OLED

★★★★★ 4.9 (220 votes) | 548 orders

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Price: ~~US \$8.90~~ / piece

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Color:



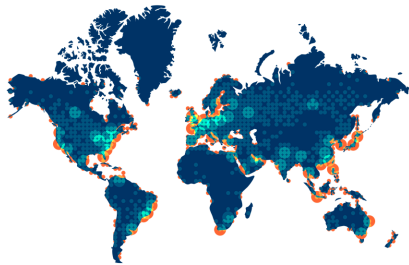
Shipping: **US \$3.42 to Indonesia via AliExpress Standard Shipping** ▾

Estimated Delivery Time: 20-35 days ?

Quantity:  piece (85 pieces available)

# 5 USE CASES OF AI + ROBOTICS IN AGRICULTURE

## ANALYZING SATELLITE IMAGES



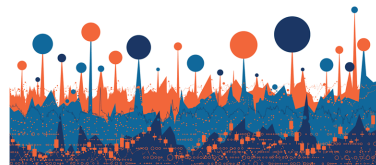
## IN-FIELD MONITORING



## ASSESSING CROP/SOIL HEALTH



## PREDICTIVE ANALYTICS



CBINSIGHTS



## AGRICULTURAL ROBOTS





## PEST CONTROL

Image-recognition technology identifies and treats various types of bugs and vermin.

AI algorithms determine which breeds and conditions will produce the highest yields

## BOOST CROP YIELD



## SEASONAL FORECASTING

AI systems create probabilistic models for seasonal forecasting.

AI enhances IoT devices transforming farm management systems.

## ENHANCE IOT DEVICE DATA



## BETTER CROP SELECTION

AI helps determine crop choices for farm's needs.

Chatbots answer farmer's questions, provide advice and recommendations on specific farm problems

## CHATBOTS FOR FARMERS

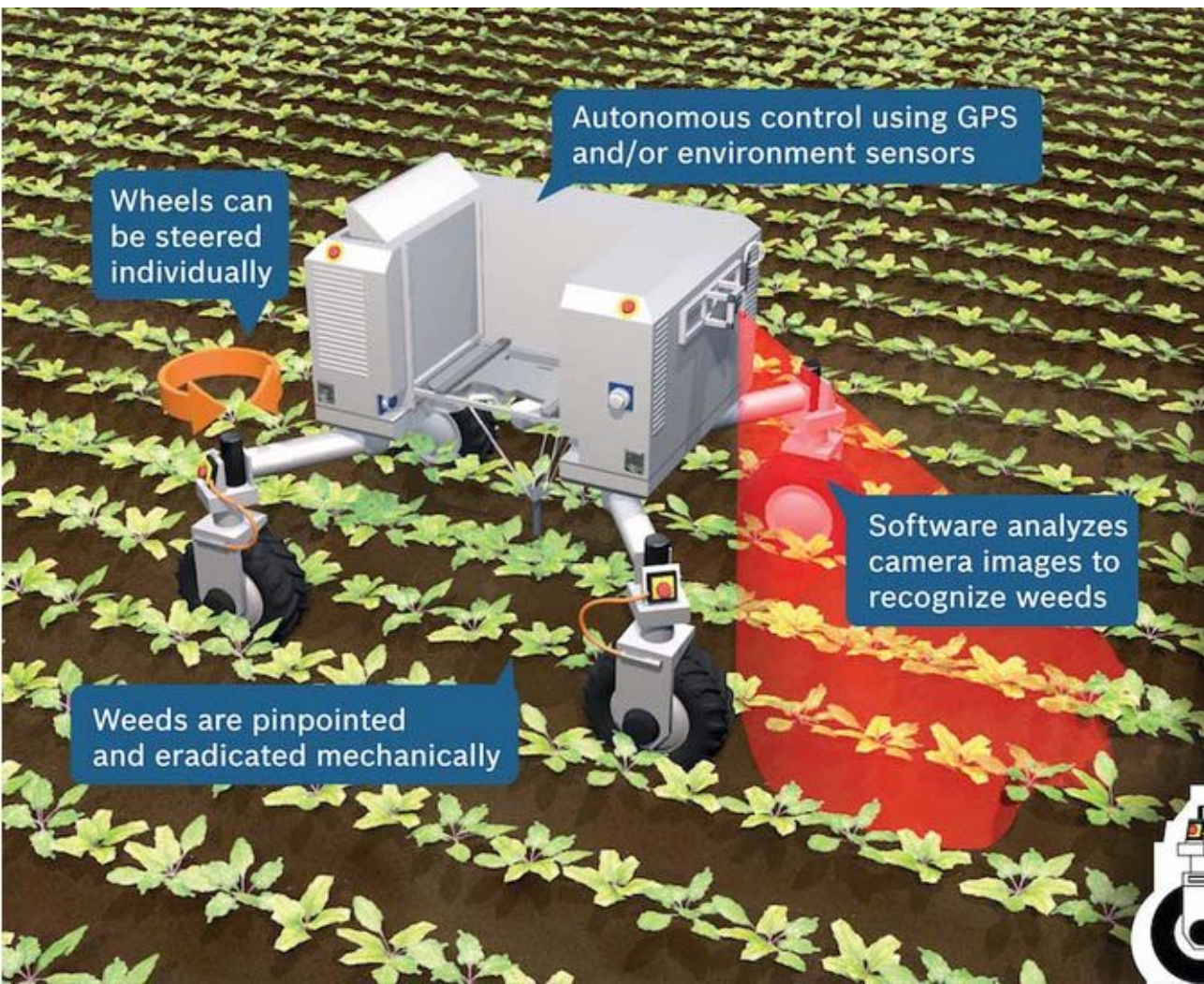


## AGRICULTURAL ROBOTS

Agricultural robots harvest crops faster than human laborers.



# Autonomous Weed-Killing Robot Could be the Future of Farming



Other tools can be fitted for different applications



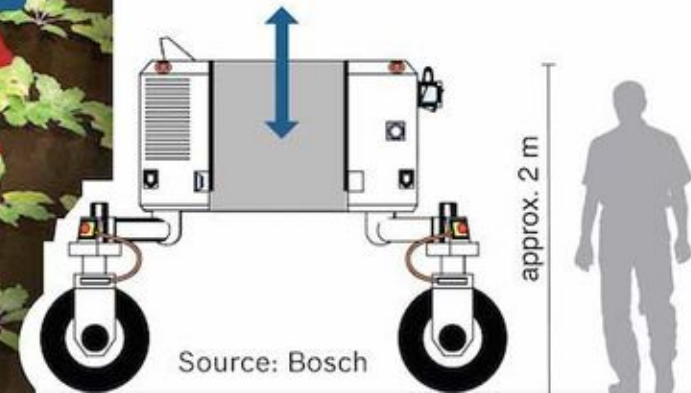
**Measuring soil density**

Soil can be examined to a depth of 80 cm



**Field trials**

Automatic plant analysis





**1** NO POVERTY



**2** ZERO HUNGER



**3** GOOD HEALTH AND WELL-BEING



**4** QUALITY EDUCATION



**5** GENDER EQUALITY



**6** CLEAN WATER AND SANITATION



**7** AFFORDABLE AND CLEAN ENERGY



**8** DECENT WORK AND ECONOMIC GROWTH



**9** INDUSTRY, INNOVATION AND INFRASTRUCTURE



**10** REDUCED INEQUALITIES



**11** SUSTAINABLE CITIES AND COMMUNITIES



# THE GLOBAL GOALS

For Sustainable Development

**12** RESPONSIBLE CONSUMPTION AND PRODUCTION



**13** CLIMATE ACTION



**14** LIFE BELOW WATER



**15** LIFE ON LAND



**16** PEACE AND JUSTICE STRONG INSTITUTIONS



**17** PARTNERSHIPS FOR THE GOALS





## GOAL 12 RESPONSIBLE CONSUMPTION AND PRODUCTION

Ensure sustainable  
consumption and production  
patterns.



An estimated

**1.3 billion tons of**

**FOOD**

are wasted every year worldwide.  
In Indonesia, an estimated  
13,079,000 metric tons of food  
are wasted every year.



Indonesia produced  
3.2 million tons of plastic  
waste in 2010, with  
around 1.29 million tons  
ending up in the ocean.



If people worldwide  
switched to energy efficient

**LIGHTBULBS**

the world would save

**US\$120 billion**  
annually.



More than

**1 billion people**

still do not have access to  
clean water.



In 2013,  
53% of Indonesians used  
improved sources of  
drinking water. However,  
13% of Indonesians still do  
not have access to  
improved water sources.

Should the global population reach

**9.6 billion**

by the year  
2050

the equivalent of almost



**3 PLANETS**

could be required to provide the natural  
resources needed to sustain current lifestyles.



The Indonesian population has been  
growing in the past years and has  
reached 255 million people in 2015.  
In 2032, the Indonesian population  
will have reached 300 million.  
Young people represent nearly 26%  
of Indonesia's population.

# Our future is at sea: Jokowi



Ayomi Amindoni

The Jakarta Post

Jakarta | Wed, June 15, 2016 | 04:40 pm

Like



Maritime axis -- President Joko "Jokowi" Widodo leads a Cabinet meeting at the Presidential Office in Jakarta. He said the government would set up a maritime development policy, in line with his goal for Indonesia to become the world's maritime axis. (Courtesy of the Presidential Office/-)

<http://www.thejakartapost.com/news/2016/06/15/our-future-is-at-sea-jokowi.html>





**KKP RI** ✓

@kkpgoid

Kementerian Kelautan & Perikanan RI  
Ministry of Marine Affairs & Fisheries  
(MMAF) of Republic of Indonesia  
FB:Kementerian Kelautan & Perikanan RI  
IG:@kkpgoid

📍 Indonesia

🌐 kkp.go.id

📅 Joined May 2014



Dua koma tujuh lima trilyun rupiah

• 3 Oct 2016



# EKSPLOITASI MASIF, POPULASI IKAN KRITIS

Kementerian Kelautan dan Perikanan memperkirakan sumber daya ikan akan habis jika eksploitasi penangkapan dibiarkan berlangsung secara berlebihan. Di sejumlah wilayah potensial, populasi beberapa jenis ikan terancam kritis. Pembatasan dan pengendalian izin penangkapan diperlukan agar stok ikan dapat berkesinambungan.

## STATUS TINGKAT EKSPLOITASI

Berlebih —  
 Penuh —  
 Sedang —

**Pelagis Besar:** Jenis ikan utama Tuna, Cakalang dan Tongkol

**Udang:** Jenis Udang utama Udang Jerbung dan Udang Dogol

**Pelagis Kecil:** Jenis ikan utama Kembung, Baniyot, Layang

**Demersal:** Jenis ikan utama Peleka, Kurisi, Kuniran, Layur dan Kekakapan

SELAT MALAKA	
DEMERSAL	UDANG
IKAN KARANG	LOBSTER
PELAGIS KECIL	KEPITING
CUMI-CUMI	RAJUNGAN
PELAGIS BESAR	

SAMUDRA HINDIA	
DEMERSAL	UDANG
IKAN KARANG	LOBSTER
PELAGIS KECIL	KEPITING
CUMI-CUMI	RAJUNGAN
PELAGIS BESAR	



LAUT SULAWESI	
DEMERSAL	UDANG
IKAN KARANG	LOBSTER
PELAGIS KECIL	KEPITING
CUMI-CUMI	RAJUNGAN
PELAGIS BESAR	

SAMUDERA PASIFIK	
DEMERSAL	UDANG
IKAN KARANG	LOBSTER
PELAGIS KECIL	KEPITING
CUMI-CUMI	RAJUNGAN
PELAGIS BESAR	

LAUT ARAFURU	
DEMERSAL	UDANG
IKAN KARANG	LOBSTER
PELAGIS KECIL	KEPITING
CUMI-CUMI	RAJUNGAN
PELAGIS BESAR	

LAUT CINA SELATAN	
DEMERSAL	UDANG
IKAN KARANG	LOBSTER
PELAGIS KECIL	KEPITING
CUMI-CUMI	RAJUNGAN
PELAGIS BESAR	

LAUT JAWA	
DEMERSAL	UDANG
IKAN KARANG	LOBSTER
PELAGIS KECIL	KEPITING
CUMI-CUMI	RAJUNGAN
PELAGIS BESAR	

SAMUDRA HINDIA	
DEMERSAL	UDANG
IKAN KARANG	LOBSTER
PELAGIS KECIL	KEPITING
CUMI-CUMI	RAJUNGAN
PELAGIS BESAR	

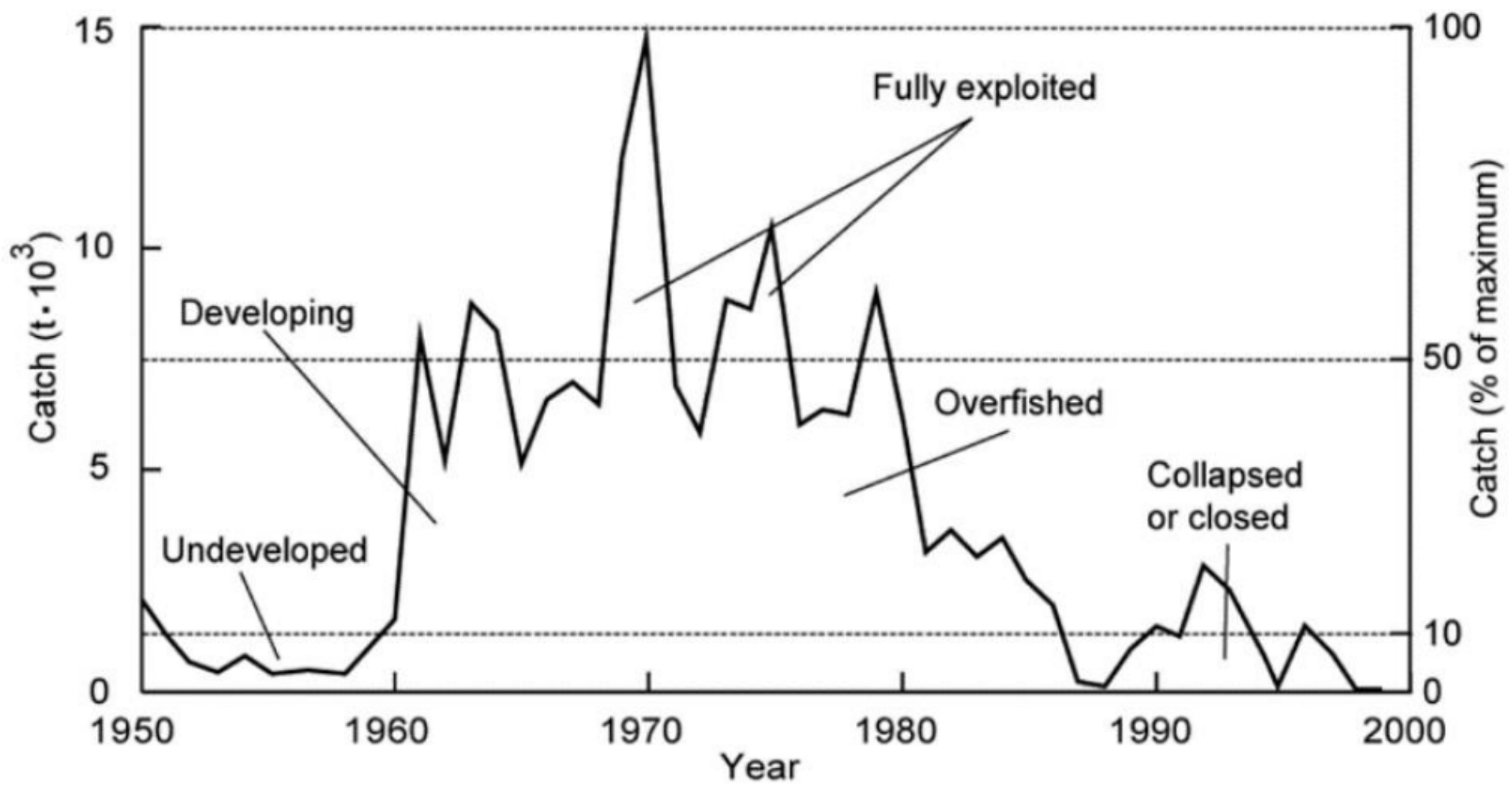
SELAT MAKASAR	
DEMERSAL	UDANG
IKAN KARANG	LOBSTER
PELAGIS KECIL	KEPITING
CUMI-CUMI	RAJUNGAN
PELAGIS BESAR	

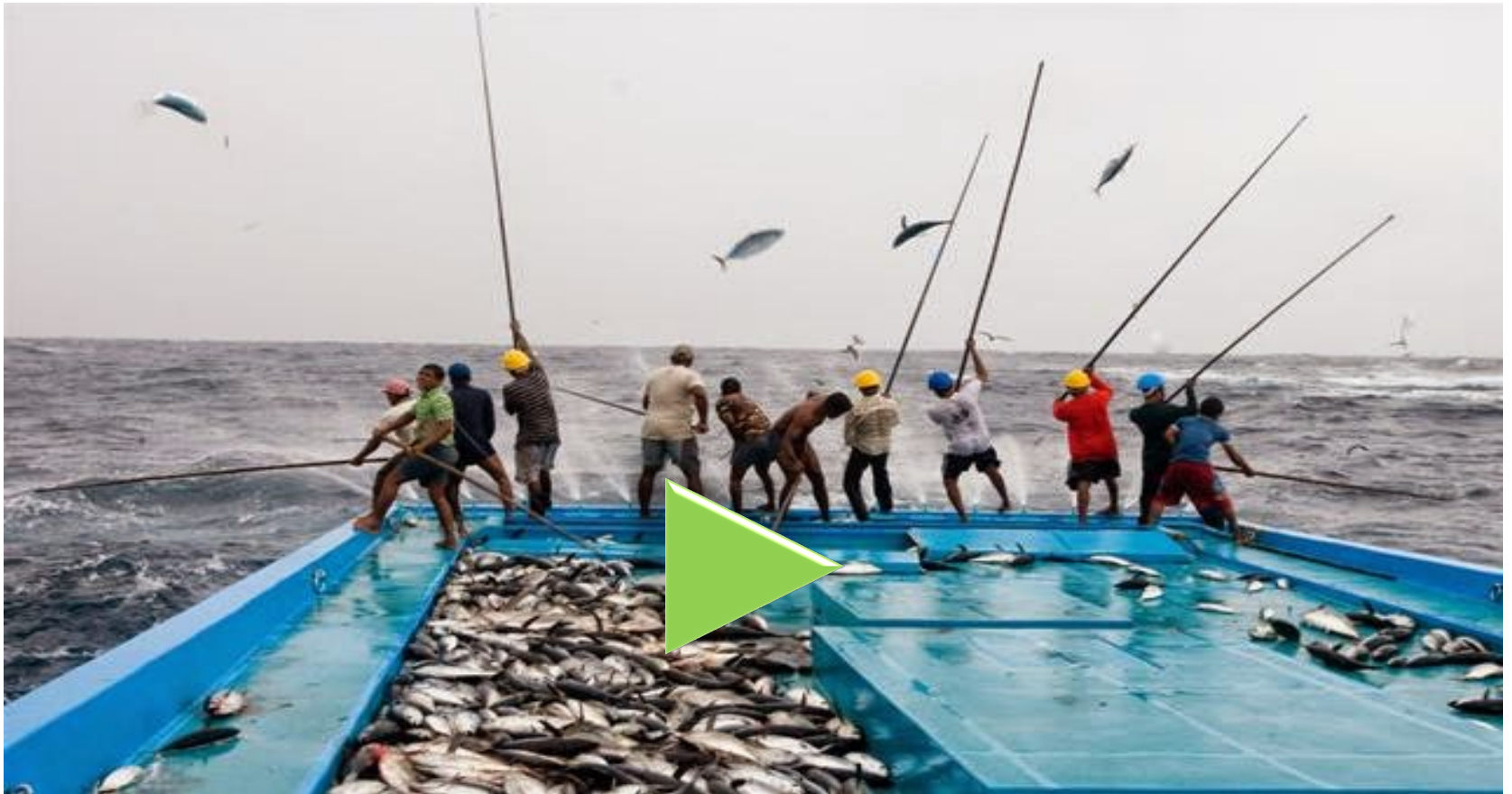
LAUT BANDA	
DEMERSAL	UDANG
IKAN KARANG	LOBSTER
PELAGIS KECIL	KEPITING
CUMI-CUMI	RAJUNGAN
PELAGIS BESAR	

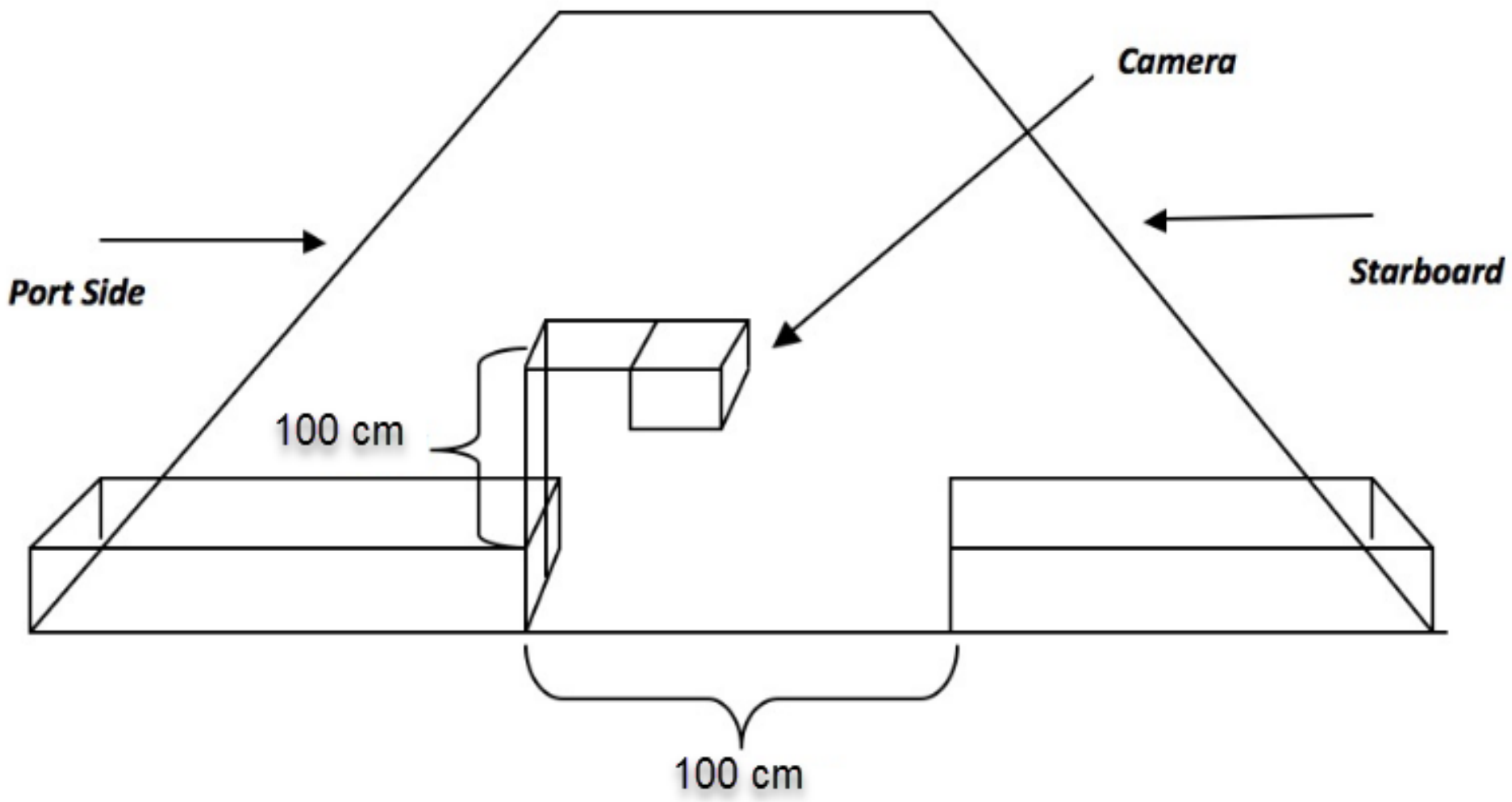
  

TELUK TOMINI	
DEMERSAL	UDANG
IKAN KARANG	LOBSTER
PELAGIS KECIL	KEPITING
CUMI-CUMI	RAJUNGAN
PELAGIS BESAR	



# Huhate – Pole and Line







# Skipjack Tuna Life History Traits (Fromentin & Fonteneau, 2001)

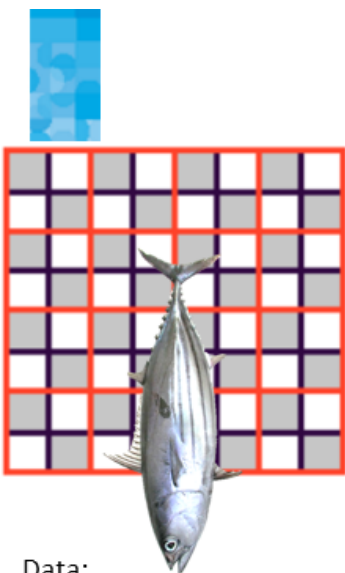
Life history traits of the 10 selected tunas and tuna-like species<sup>a</sup>

Names	Acronym	Main latitudinal range	Spawning duration (month/year)	Length at maturity (cm)	Weight at maturity (kg)	Age at maturity (year)	Maximum length (cm)	Maximum weight (kg)	Maximum age (year)	Juvenile growth (%L yr <sup>-1</sup> )	Minimal SST (°C)	References
Skipjack	SKJ	Tropical	12	45	1.7	1.5	75	23	4.5	40	20	Antoine et al. (1982), Bard et al. (1983), Cayré (1981), Cayré and Diouf (1981), Cayré and Farrugio (1986), Cayré and Lalœ

Spawning duration (month/year)	Length at maturity (cm)	Weight at maturity (kg)	Age at maturity (year)	Maximum length (cm)	Maximum weight (kg)	Maximum age (year)
12	45	1.7	1.5	75	23	4.5

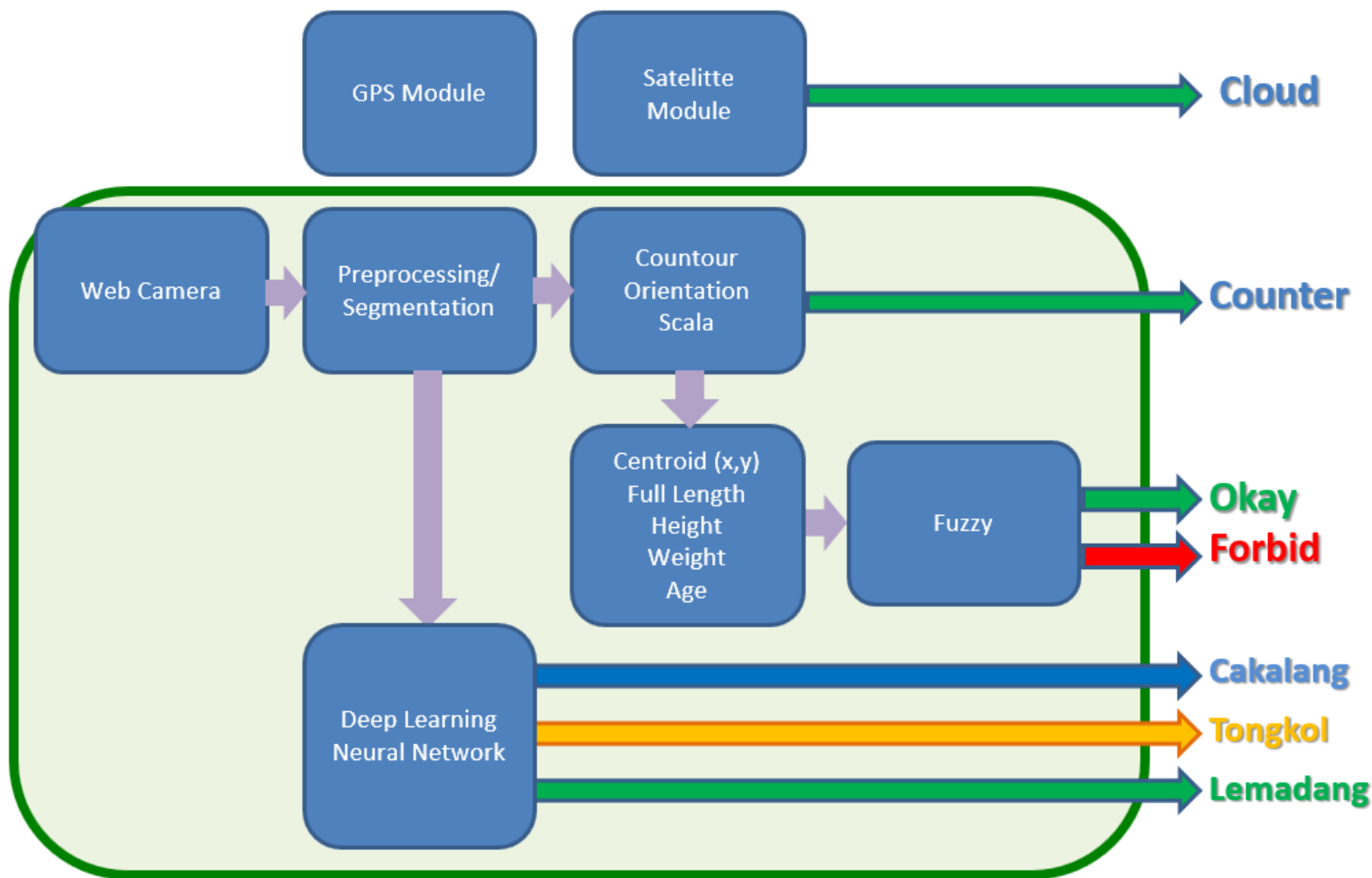
Skipjack tuna (*Katsuwonus pelamis*) is a pelagic, high productivity species with a maximum age below 4.5 years (Fromentin & Fonteneau, 2001).

Fromentin J-M, Fonteneau A. (2001). Fishing effects and life history traits: a case study comparing tropical versus temperate tunas. Fisheries Research 53:133–150 DOI 10.1016/S0165-7836(00)00299-X.



Data:

- dd/mm/yyyy
- hh:mm
- GPS Location
- Counter
- Image
- Full Length
- Height
- Weight
- Cakalang/Tongkol/  
Lemadang/ Yellow Fin



# A Fish Classification on Images using Transfer Learning and Matlab

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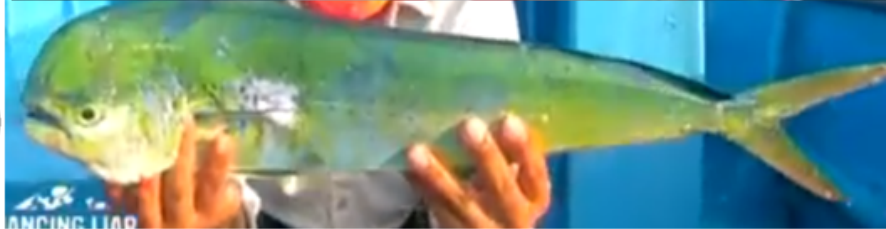
1. **Katsuwonus Pelamis (Cakalang)**



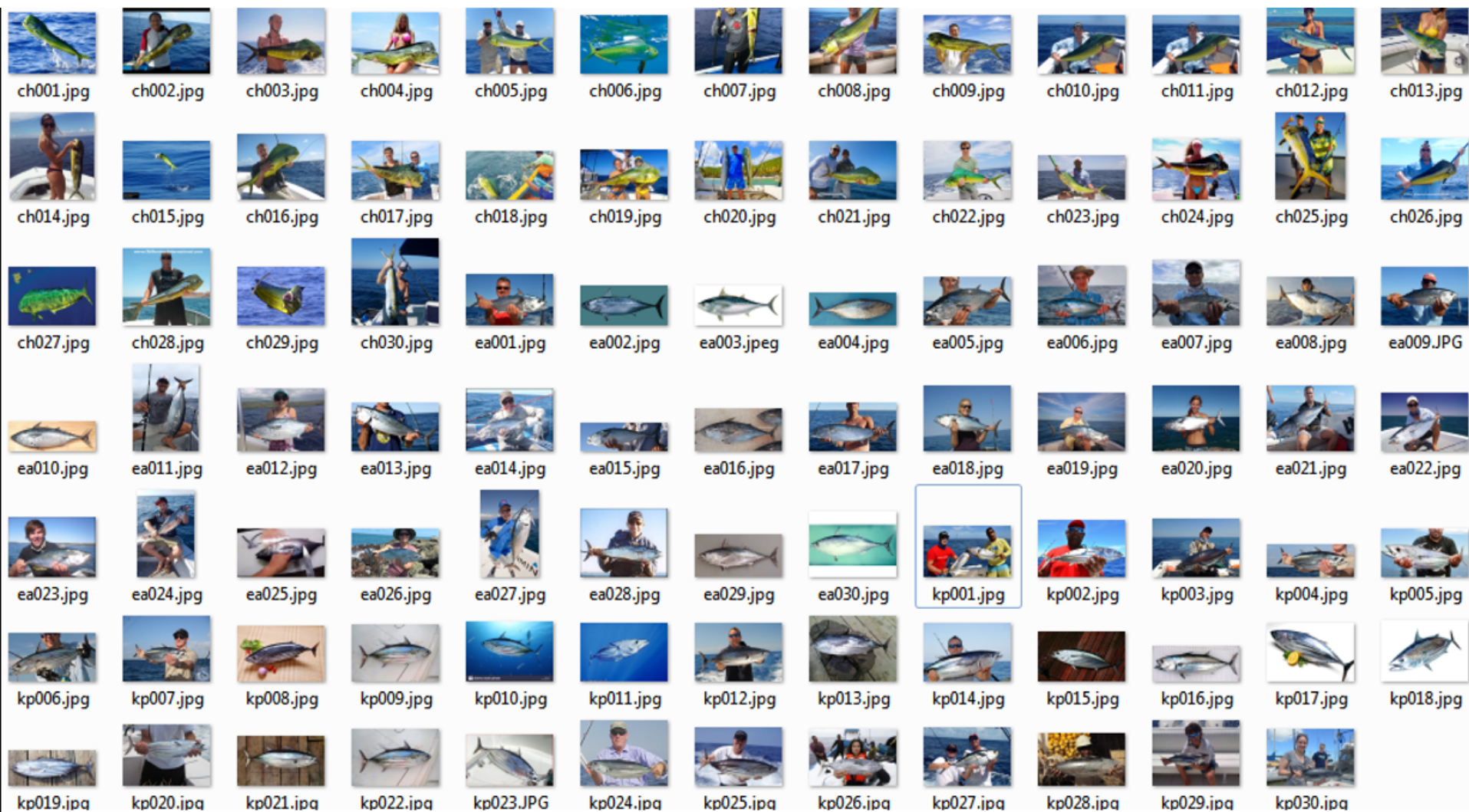
2. **Euthynnus Affinis (Tongkol)**



3. **Coryphaena Hippurus (Lemadang)**







# Computer Vision Tasks

**Classification**



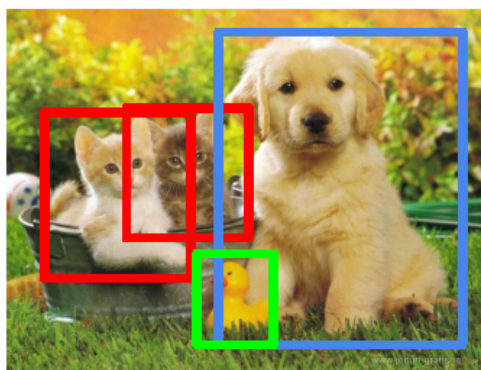
CAT

**Classification  
+ Localization**



CAT

**Object Detection**



CAT, DOG, DUCK

**Instance  
Segmentation**



CAT, DOG, DUCK

Single object

Multiple objects

- Research Location: Bitung (Near Manado)
- Time: April 2019
- Data set: video of cakalang, tongkol and lemadang fish at fisherman boat
- Preprocessing
  - Normalization
  - Instance Segmentation
  - Find Centroid
  - Full length and Height
  - Length → Age
  - Length → Weight





# Smart remote telemetry unit (RTU) and Satellite Modem









Reset

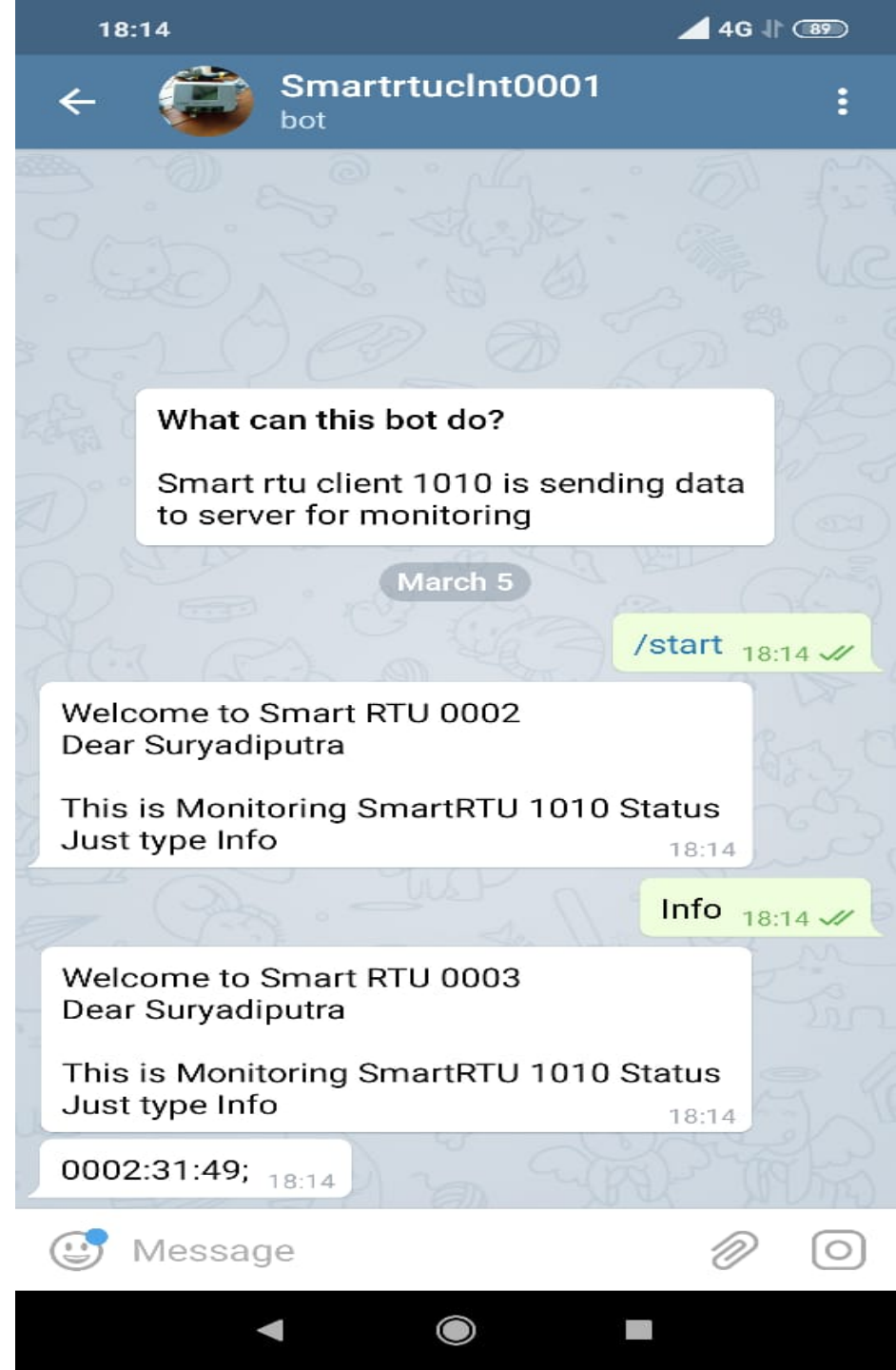
Temp  
29 C  
Humid  
55 %

IP : 192.168.43.180 0002

Smart-RTU 1010 eth

# smartrtucInt0001

- ID
- Temp
- Humidity









Facebook interface showing the **IoT Indonesia** public group page. The page header includes the group name, a search bar, and navigation links (Home, Create, etc.). The left sidebar lists group features: About, Discussion (selected), Chats, Announcements, Members, Events, Videos, Photos, Files, Group insights, and Moderate group.



The main content area displays a graphic titled **IoT Indonesia** featuring a map of Southeast Asia with blue lines connecting various locations to a central cloud icon. A red circle highlights the Indonesian archipelago on the map.

Below the graphic are interaction buttons: **Joined** (dropdown), **Notifications** (checked), **Share**, and **More** (three dots).

The bottom navigation bar includes options to **Write post**, **Add photo/video**, **Live Video**, and **More**. On the right, there is a section for **POPULAR TOPICS IN POSTS** with a **Manage** link.

<https://www.facebook.com/groups/IoTIndonesia>

 The Indonesian Artificial Intelligence R&D Center 

 Suryadiputra Home Create     

The Indonesian Artificial Intelligence R&D Center

Public group

About

**Discussion**

Chats

Members

Events

Videos

Photos

Files


Group insights

Moderate group



The Indonesian ARTIFICIAL INTELLIGENCE R&D Center

Joined ▾ ☒ Notifications  Share ... More

 Write post  Add photo/video  Live Video ... More

POPULAR TOPICS IN POSTS [Manage](#) x

<https://www.facebook.com/groups/TIAIRDC/>

# Discussion

