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Digital Societies

# APAC IoT INNOVATION SUMMIT

Kuala Lumpur 24-26 Sept 2019



**#MOBILE360**

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Kuala Lumpur 24-26 Sept 2019

# Session 5: IoT Innovation & Ecosystem Collaboration

Kuala Lumpur 24-26 Sept 2019



**Andri Yadi**  
CEO  
DycodeX

**Session 5:**  
**SMARTernak: AIoT-powered Cattle-  
farm Assistant Platform**



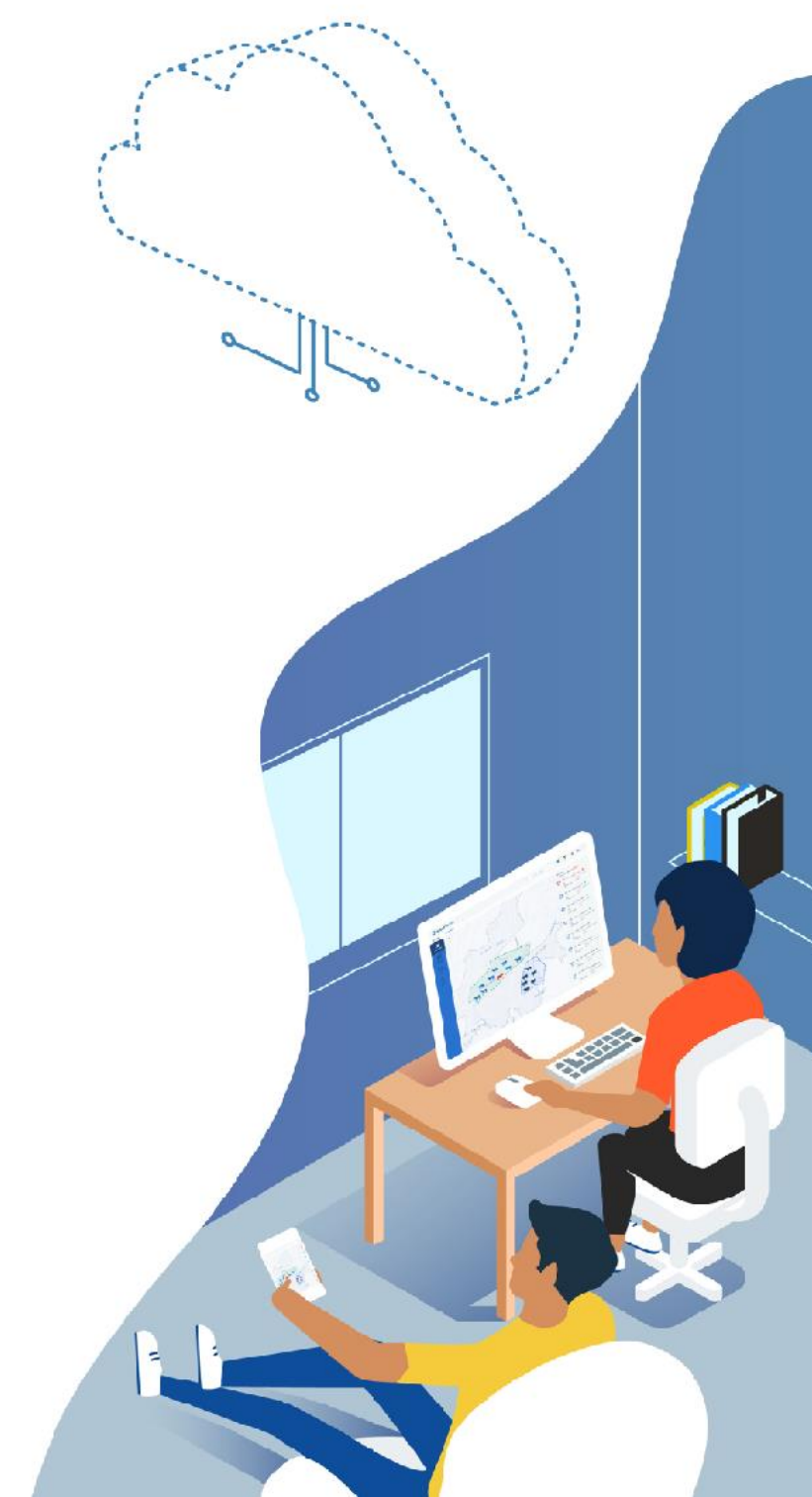


# E2E IoT solution for Cattle Farming



Andri Yadi  
CEO, DycodeX

GSMA APAC IoT Innovation Summit  
#Mobile360  
Kuala Lumpur - Sep 26, 2019







# About Me

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## Andri Yadi

Co-founder & CEO of Dycodex

Deputy Chairman, Indonesia IoT Association

[a@dycodex.com](mailto:a@dycodex.com) | <http://andriyadi.com>

A Physicist, Developer, Maker, Community Guy, Entrepreneur

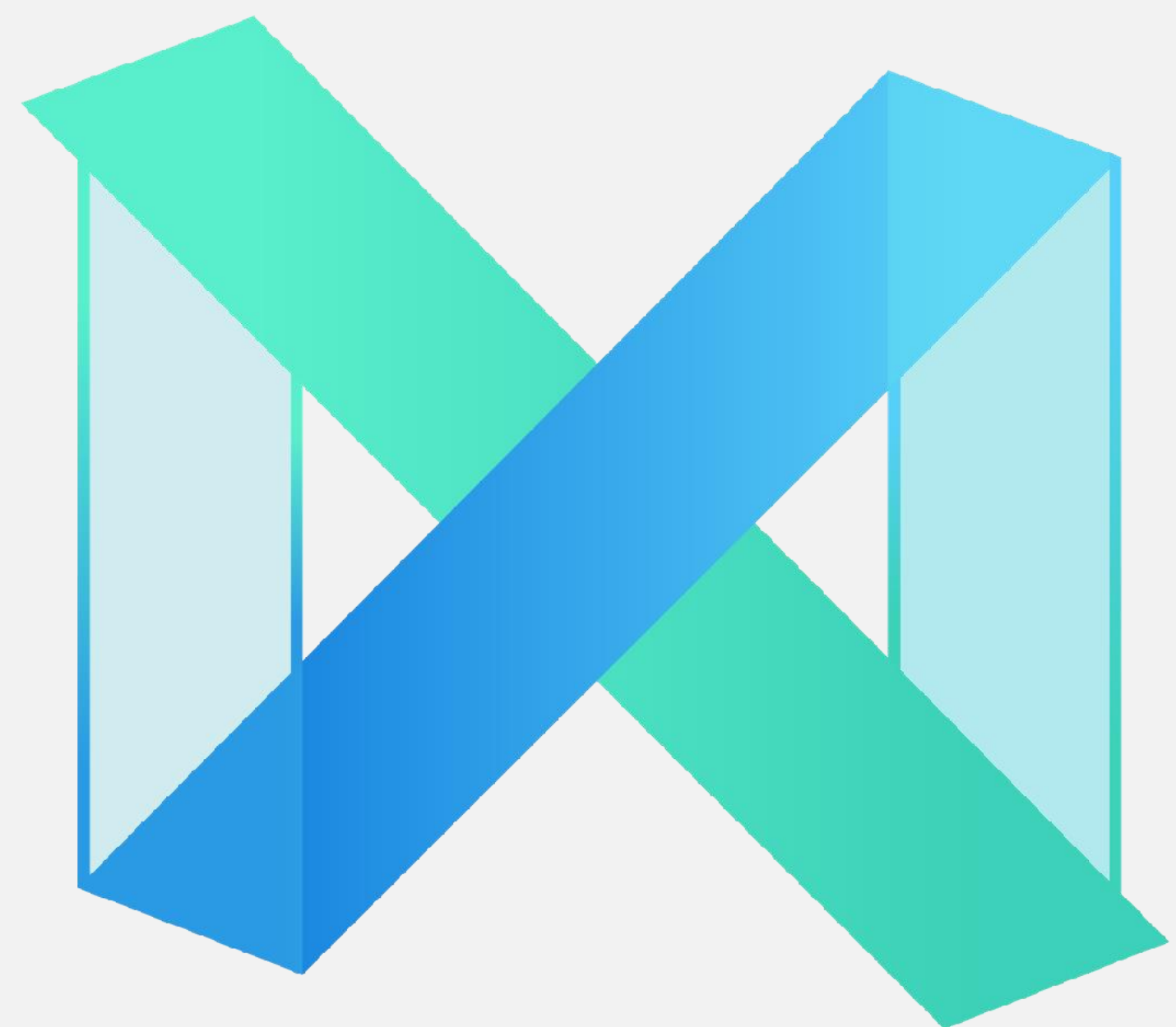
Microsoft Most Valuable Professional (MVP) of Azure for 12 years

Code for food & passion for 20 years

Break & make electronic stuffs for 22 years

Trying to change the world through entrepreneurship, 15 years now





**D Y C O D E X**

PT. Dycodex Teknologi Nusantara

# The Company

Our vision is to solve big problems with technology.

We're 4 years start-up, that is pioneering and leading in developing end-to-end home-grown Artificial Intelligence (AI) & Internet of Things (IoT)-based products & solutions in Indonesia, and enable maker movement along the way. Only a few of startups in the country capable of doing both AI & IoT, in-house!

As seen on

YAHOO!  
NEWS

Google

DailySocial<sup>id</sup>

e27

INFOKOMPUTER

TECHINASIA

CNN  
Indonesia

METRO TV

Bloomberg  
TV INDONESIA

BERITA SATU

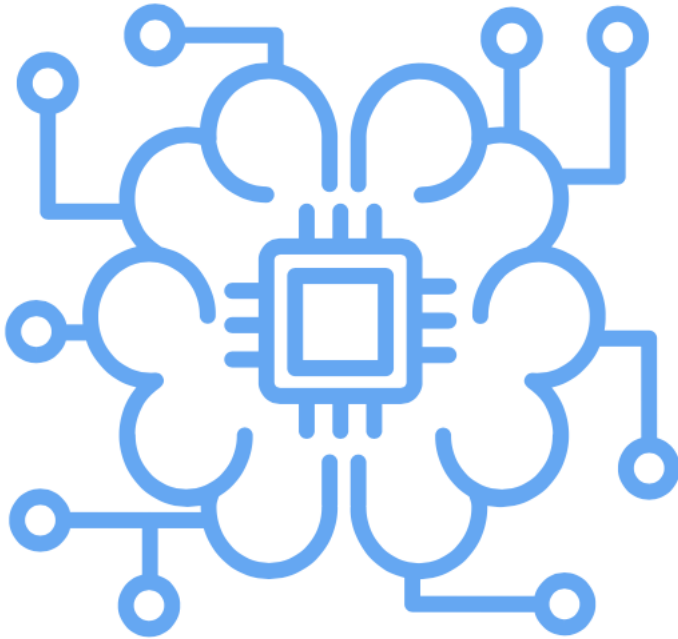
Pikiran Rakyat

SWA



# Approach

We approach our solutions to be powered by AI + IoT, end to end



IoT is about automated data collecting, storing, visualisation, and reacting, in massive scale

“Data Supplier”

AI is about making sense of the massive data, providing insights & recommendation, and predicting the future outcome

“Data Miner”

Combining AI + IoT (AIoT) enables a lot of opportunities!



So, in 2030...

**8.5 B**  
People

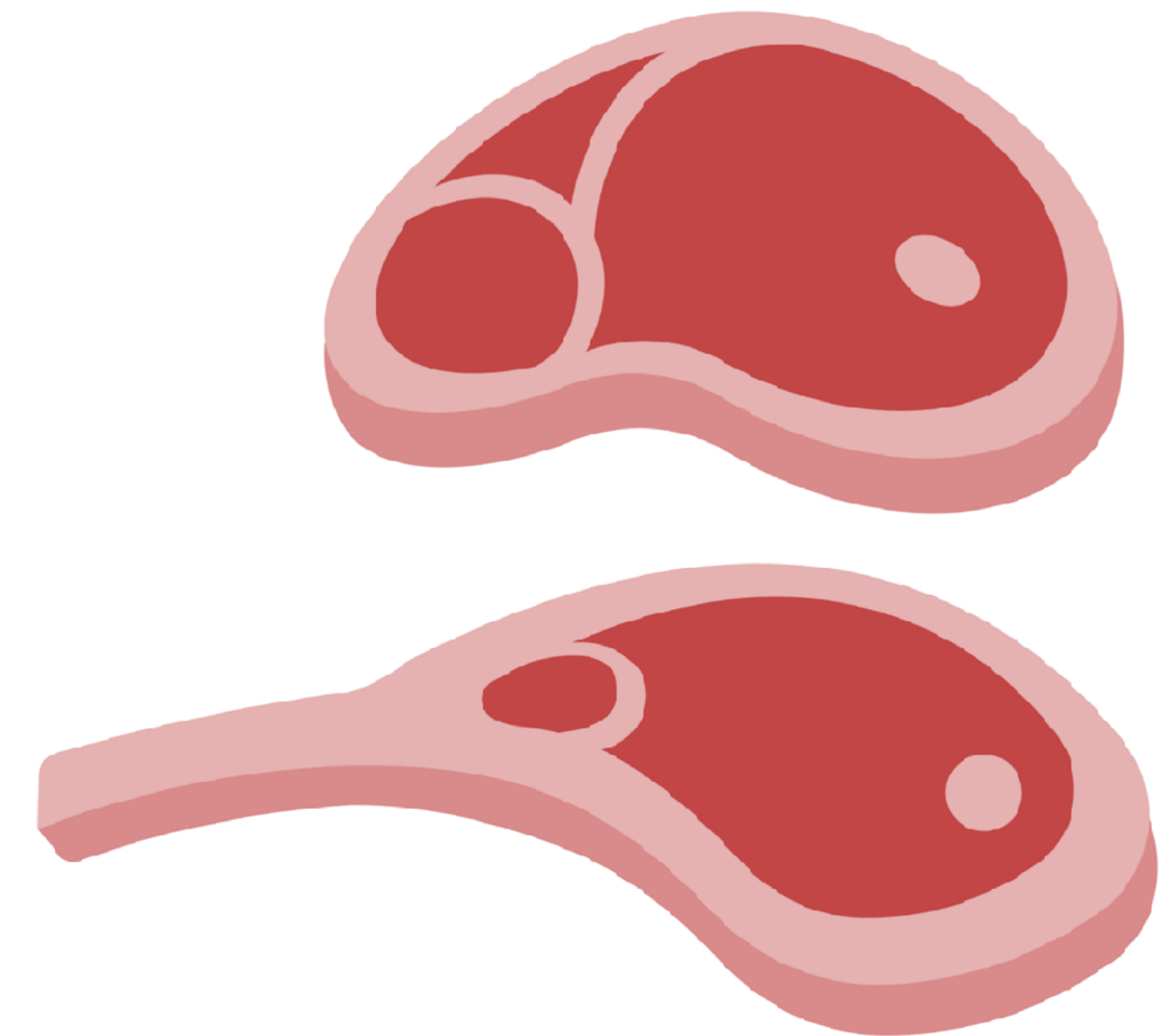
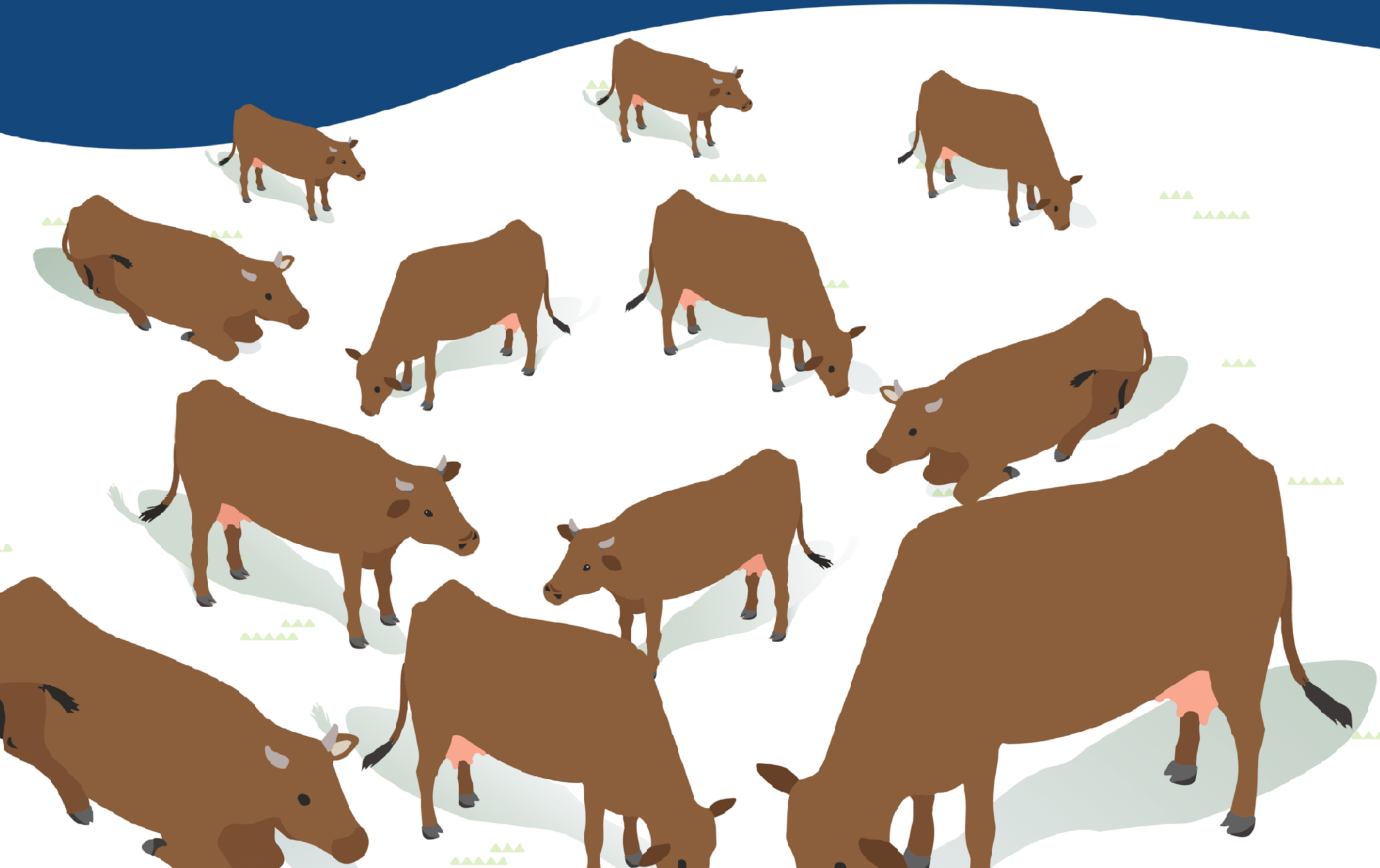
**1.8 B**  
cattle\*

**400 M Tones**

meat\*

**1.2 B Tones**

milk to produce



\*FAO





Food & Agriculture  
Organization

“Livestock sector is one of the fastest growing parts of the agricultural economy, contributing 40% of the global value of agricultural output and support the food security of 1.3 billion people”

”

“Indonesia will be self-sufficient in beef in the next 10 years”

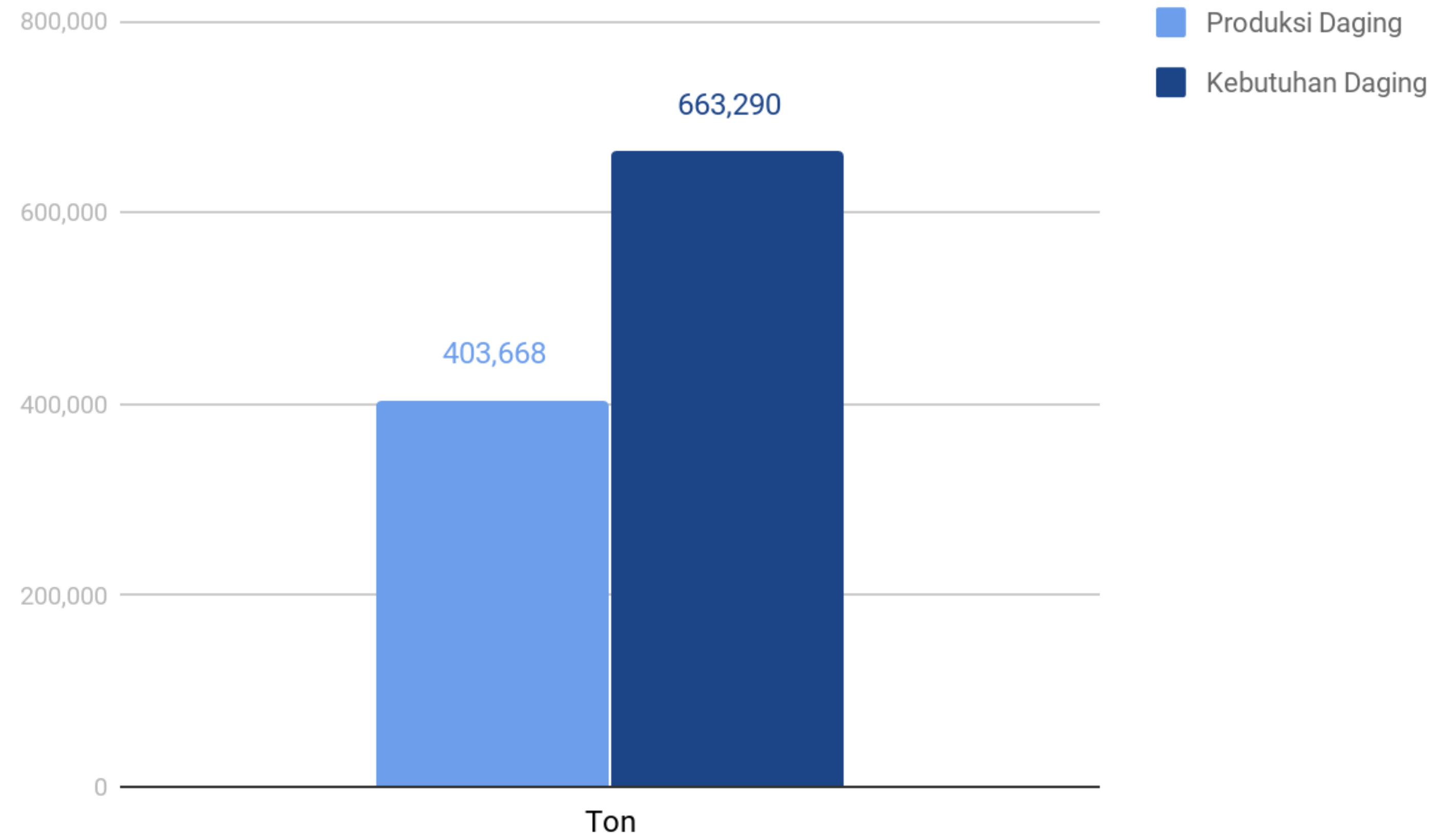


Ir. Joko Widodo,  
President of Indonesia



# Our Country's Challenge...

Indonesia's beef supply is still less than 60% out of demands



Source: "259.662 Tons Beef Demand Fulfilled by Import". CNBC Indonesia, Feb 27, 2019







# Cattle farming still has real world problems

“We have no reliable means to track feeding behaviour. Non-eating cows are often found dead after 2-3 days”

A personal farm, Subang - Indonesia  
Manages 400+ cows

”

## HERD COUNTING

“We often lose count when a herd of cows moves from one to another grazing area”

A corporate farm, Indonesia, manages **8000+** cows

## OPERATION EFFICIENCY

“We have to visit hundreds of cows every day, just to check whether they still move or not”

**Cattle Breeding Centre** - Ministry of Agriculture  
Manages **1400+** cows



# FUTURE FARMS

## small and smart

### SURVEY DRONES

Aerial drones survey the fields, mapping weeds, yield and soil variation. This enables precise application of inputs, mapping spread of pernicious weed blackgrass could increase wheat yields by 2-5%.

### FLEET OF AGRIBOTS

A herd of specialised agribots tend to crops, weeding, fertilising and harvesting. Robots capable of microdot application of fertiliser reduce fertiliser cost by 99.9%.



### FARMING DATA

The farm generates vast quantities of rich and varied data. This is stored in the cloud. Data can be used as digital evidence reducing time spent completing grant applications or carrying out farm inspections saving on average £5,500 per farm per year.

### TEXTING COWS

Sensors attached to livestock allowing monitoring of animal health and wellbeing. They can send texts to alert farmers when a cow goes into labour or develops infection increasing herd survival and increasing milk yields by 10%.

### SMART TRACTORS

GPS controlled steering and optimised route planning reduces soil erosion, saving fuel costs by 10%.

## Precision Livestock Farming (PLF)

Data-driven management of livestock by continuous automated real-time monitoring of production/reproduction, health and welfare of livestock and environmental impact.

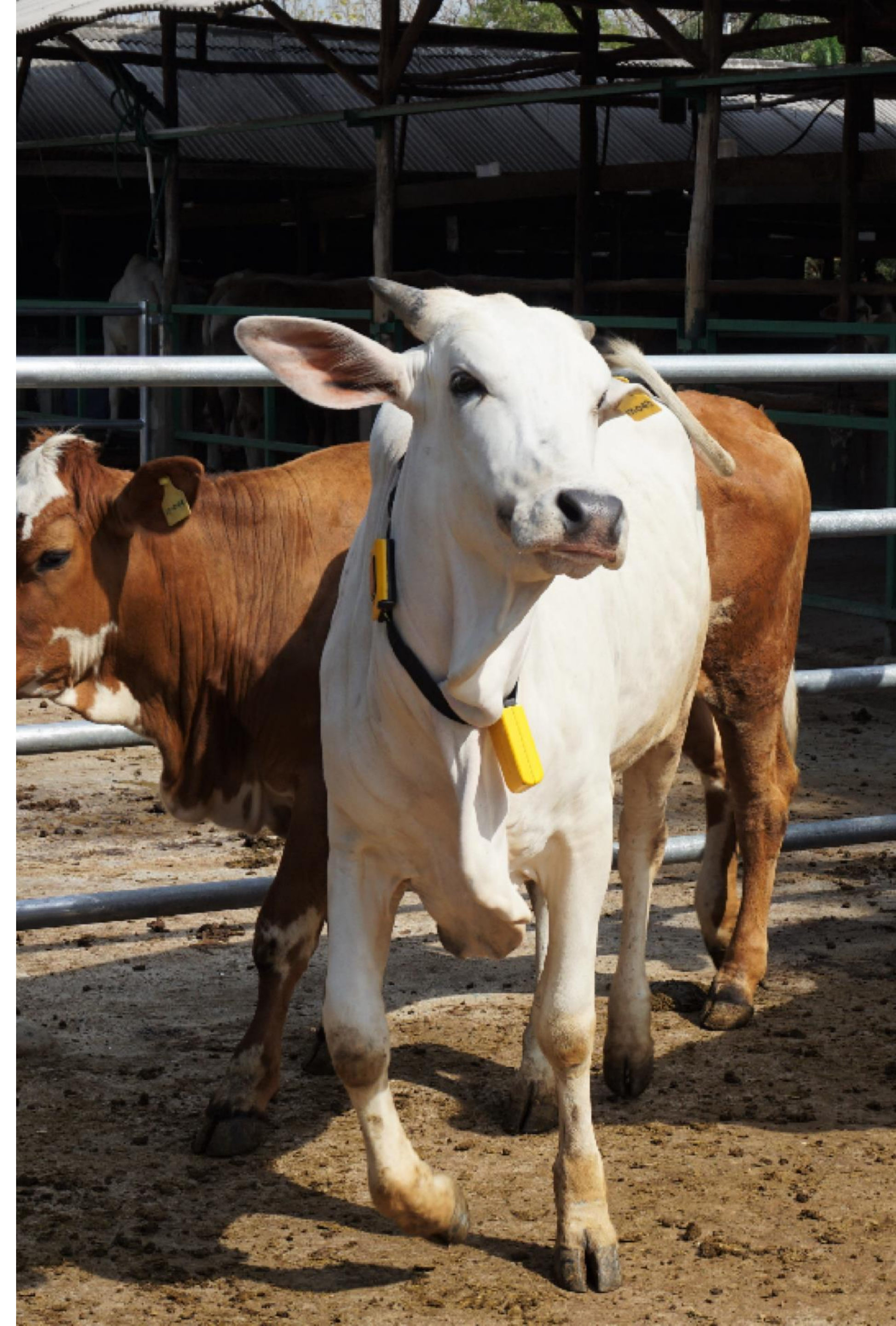


So, introducing...



**Internet of Things & Artificial Intelligence-powered  
Cattle-Farm Assistant Platform**

\* "Ternak" in SMARTernak means "cattle" in Bahasa Indonesia





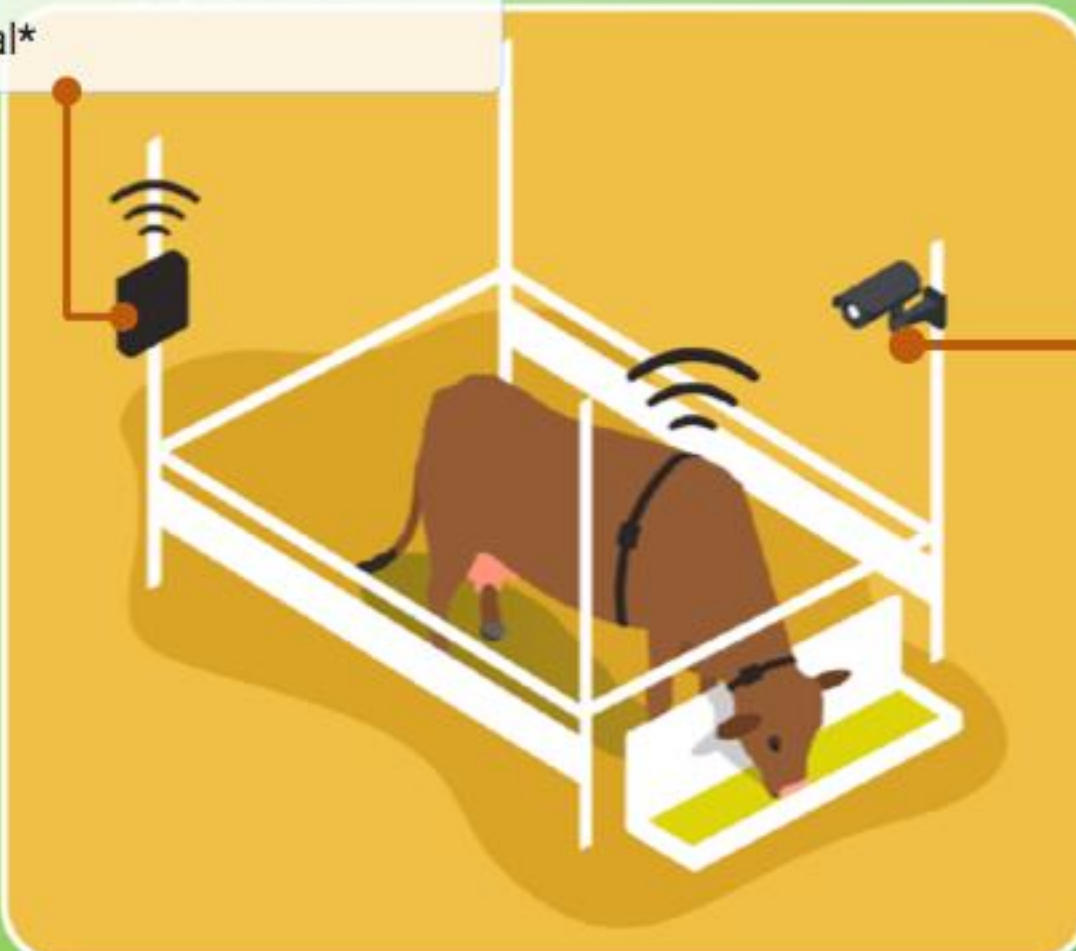
# SMARTernak: How It Works



**DRONE**  
Provide surveillance and help herding.  
*\*In development\**

## ENVIRONMENTAL SENSORS

Collection of sensors to monitor environment  
*\*optional\**



## SMART CAMERA

Monitor behaviour of 5 - 10 cattle, count herd, and estimate body weight using **AI-powered Machine Vision**.

*\*In development\**



## BASE STATION

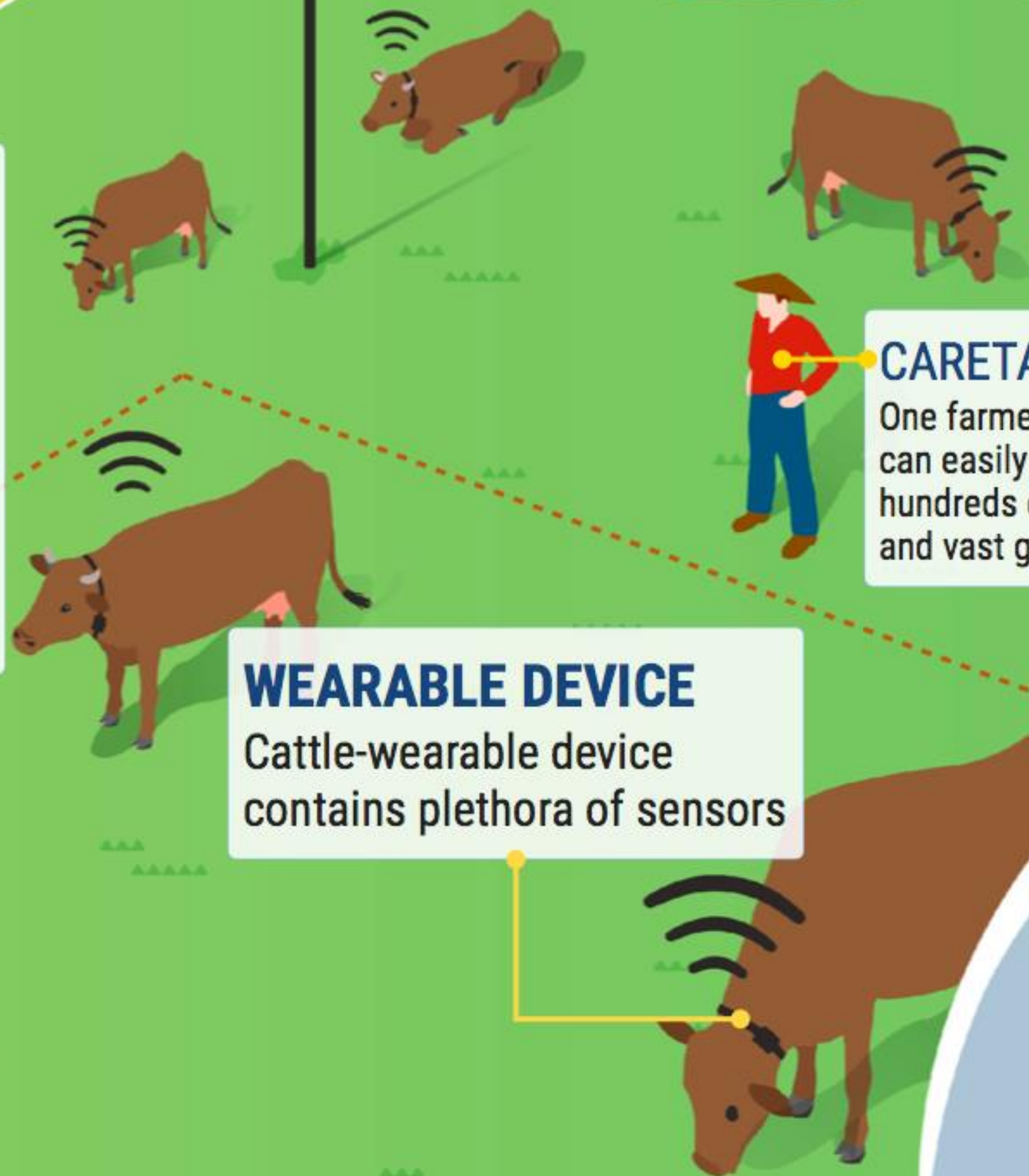
5-10 km coverage, to connect devices with Cloud.

*\* May leverage cellular infra (for NB-IoT connectivity)*



## CLOUD

Where the heavy-lifting happens.



## CARETAKER

One farmer/caretaker can easily handle hundreds of cattle, and vast grazing area

## WEARABLE DEVICE

Cattle-wearable device contains plethora of sensors

## VIRTUAL FENCE

Contain and move cattle without physical posts and wires.



## FARM MANAGER / OWNER / INVESTOR

Monitor the farm and manage operation comfortably from anywhere in the world



# Cattle-wearable Device



*SMARTernak is about platform.  
It's open to 3rd party devices.*



# Wearable Device Internals

Electronic board is 100% designed in-house, mass-produced in Indonesia, by 100% Indonesian

## Dual IoT Connectivity

Short Range: 1 km WiFi, Bluetooth v4.2, BLE Mesh-supported. High speed, e.g. for firmware update

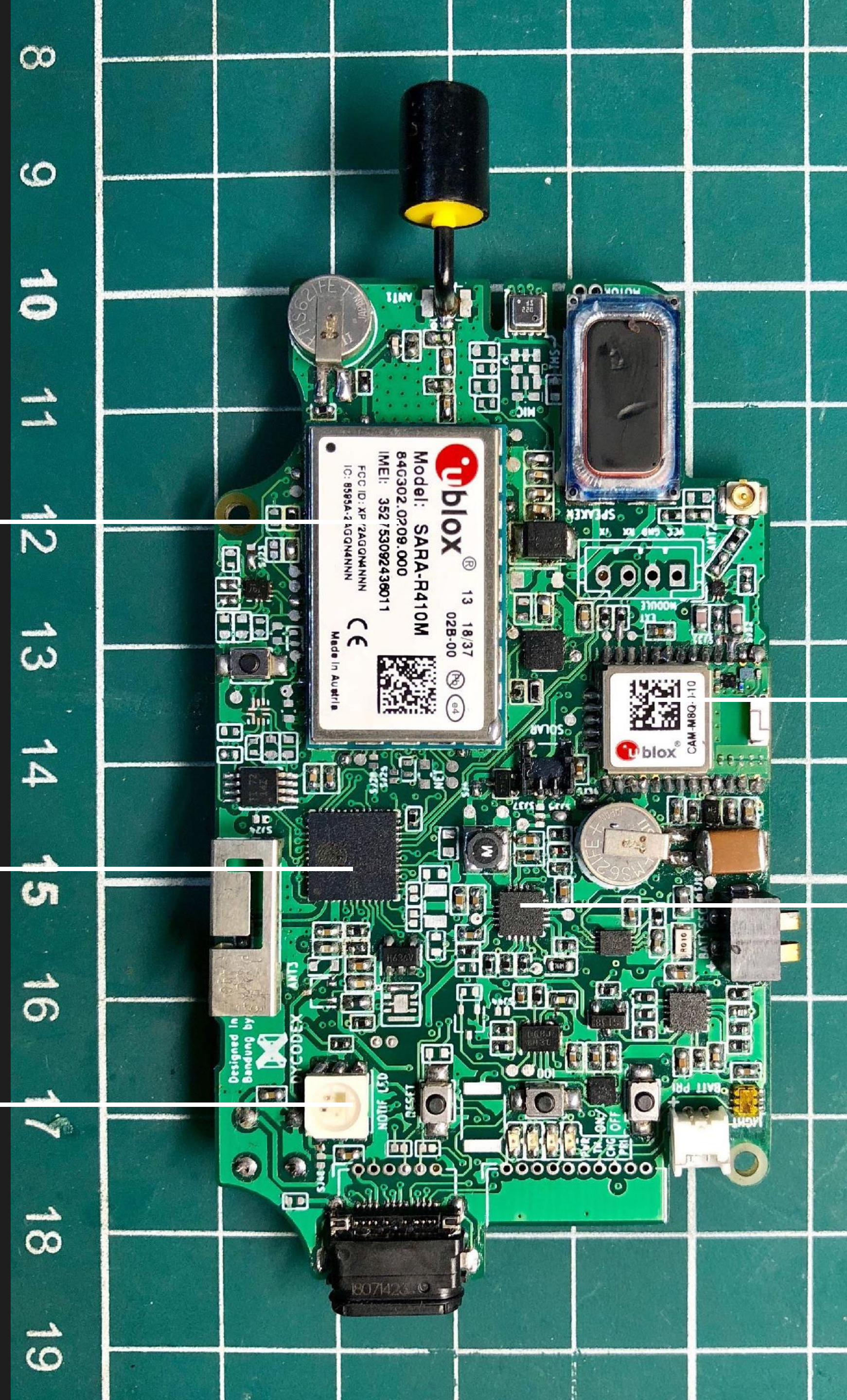
Long Range: NB-IoT, for low power yet long range coverage

## Powerhouse

Low Power, Dual Core Microcontroller with on-device Machine Learning inference

## Actuators

Audio Alert/Speaker  
LED



## Packed with Sensors

- GPS / GNSS
- Accelerometer, Gyroscope
- Body Temperature
- Ambient Temperature & Humidity
- Barometric Pressure
- Ambient Light
- MEMS Microphone
- Device Removal Detector

## Smart Energy Management

- Battery Monitoring
- Solar Energy Harvesting
- Smart Switching Between Main & Backup Battery
- Firmware-optimised power consumption



# Monitoring & Insights

Monitor cattle where-about & well-being

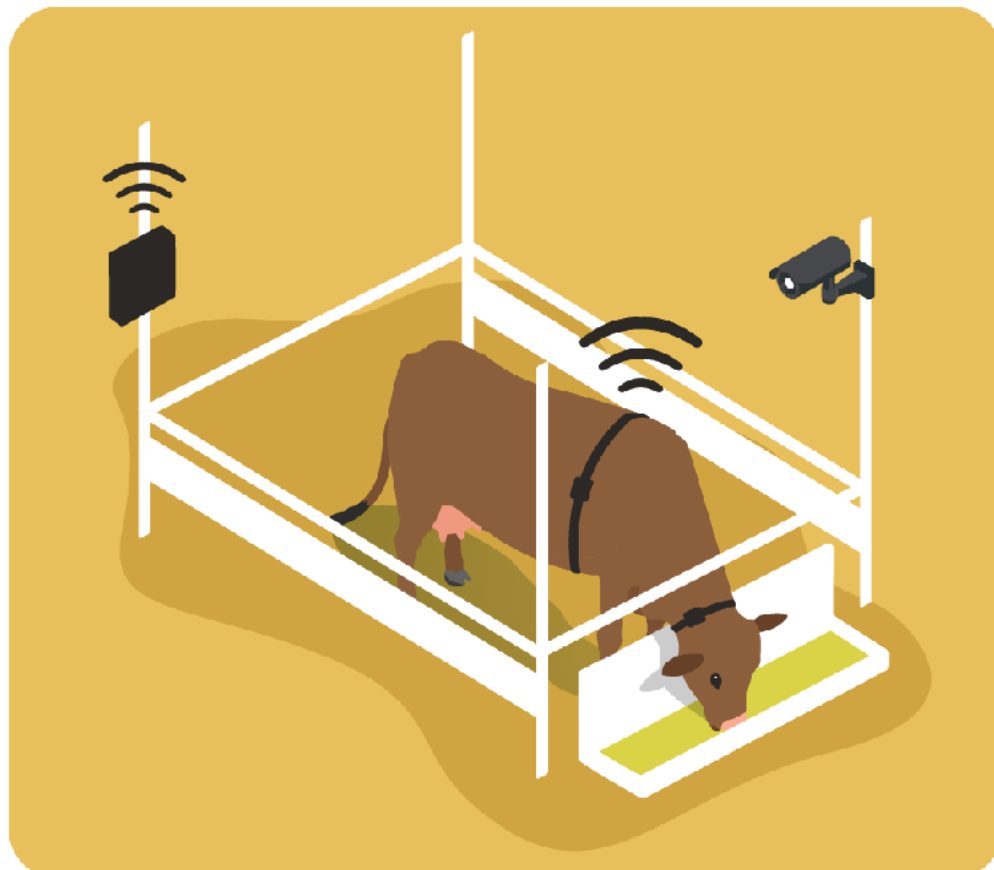
Provide insights - powered by AI  
farmer doesn't really care about (raw) data

## On-farm Smart Camera:

Monitor activity of 5 - 10 cattle -  
focus on group activity  
Count herd & movement  
Estimate weight\*

## Environmental Sensors:

Monitor ambient temperature,  
humidity, and air quality in barn



## Cattle-wearable device:

Precisely monitor each cattle for:

Location (latitude, longitude,  
movement speed, direction)

Body temperature

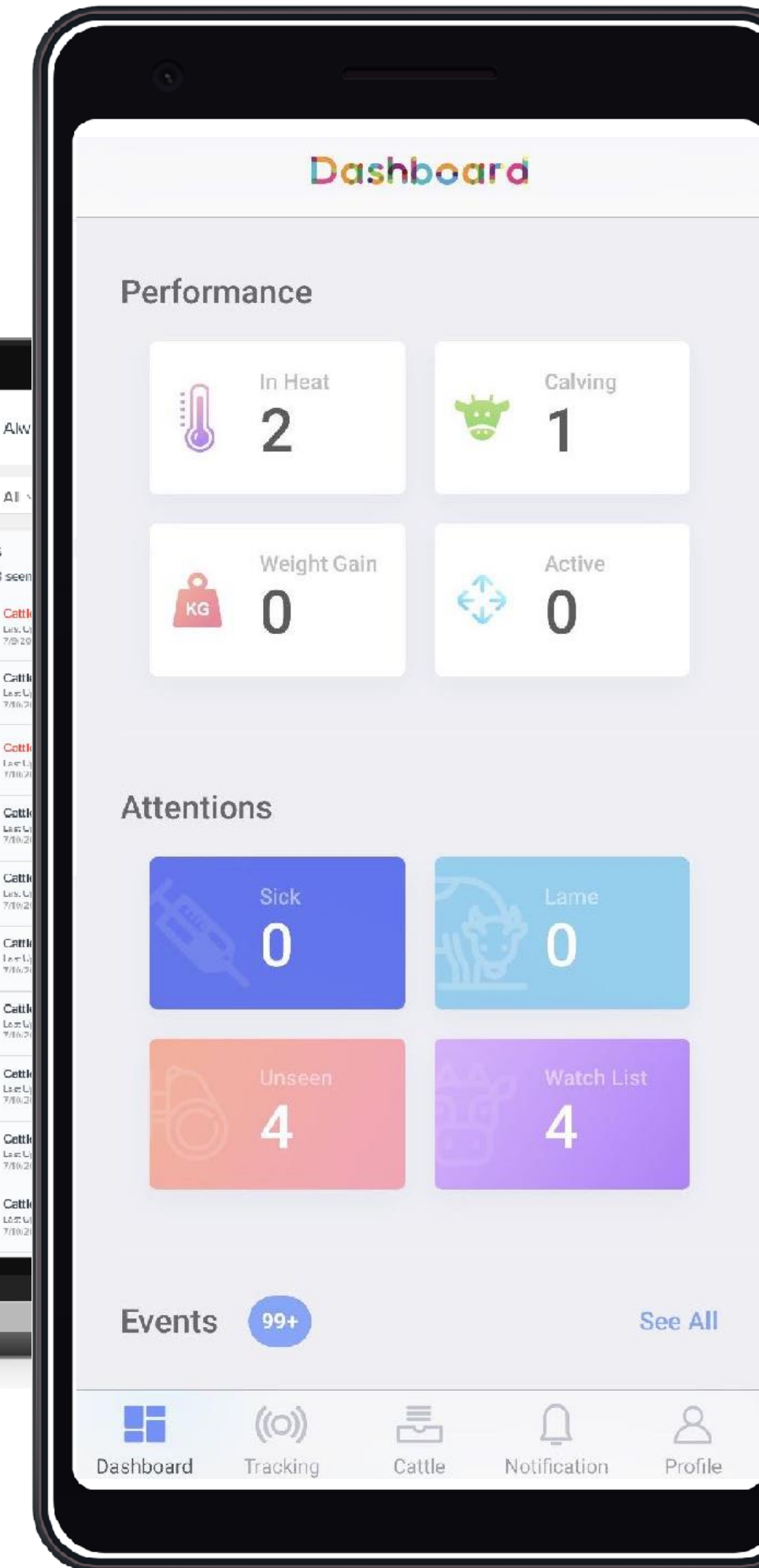
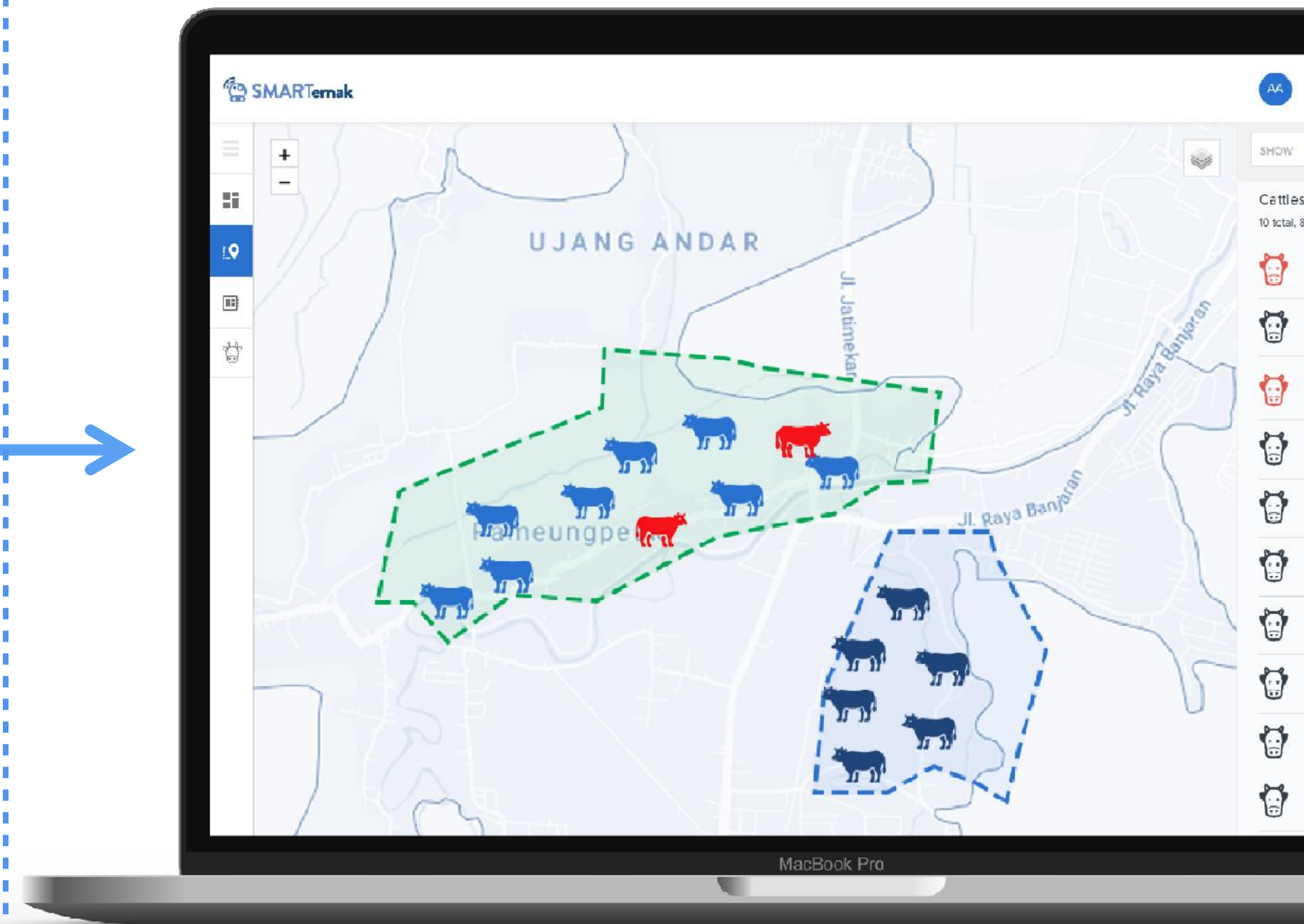
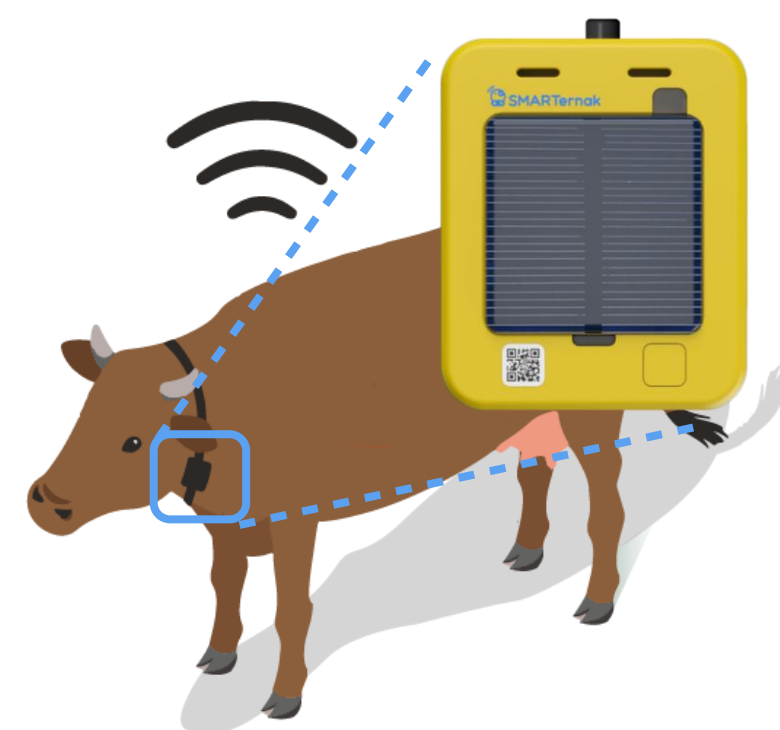
Ambient temperature &  
humidity

Ambient light & sound

Movement (linear  
acceleration, angular  
velocity, direction)

Device removal status

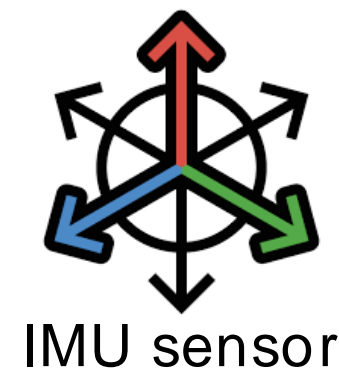
Battery voltage & capacity



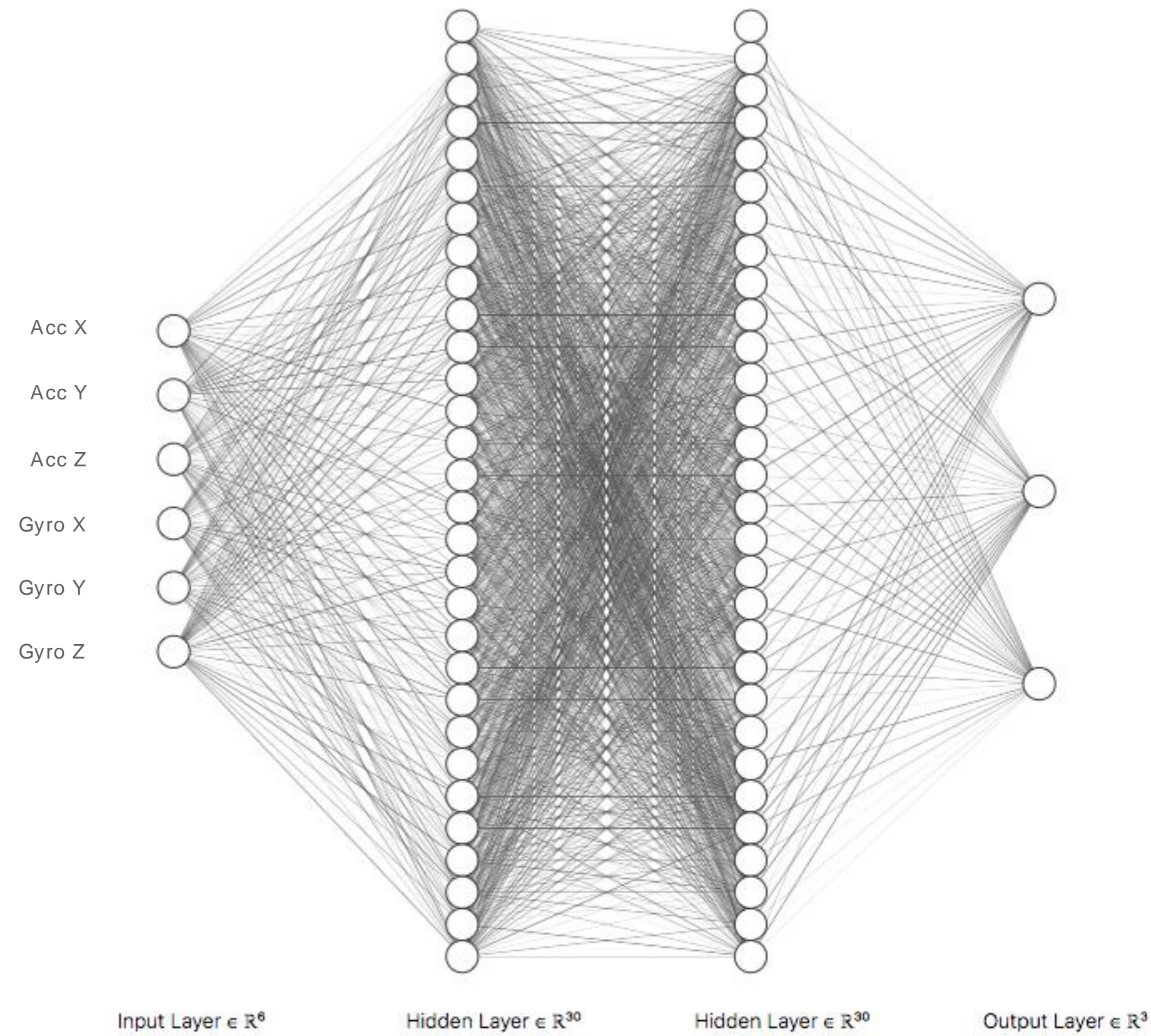


# Artificial Intelligence at The Edge

Learn & detect cattle behaviours to tailor actionable insights & recommendation based on sensor data with the help of on-device Artificial Intelligence



Motion captured by Inertial Measurement Unit (IMU) sensor inside cattle-wearable device



Deep Neural Network

**SMARTernak**

←

**Cattle 02**

Age 3 years 4, months, and 15 days  
Race Simmental  
Gender Male  
Weight 0 kg  
Last updated at 9/19/2019, 11:14:00 AM





**NAVIGATE**

**Device ID** smarternak\_a8610a3234227719  
**Device Name** smarternak\_a8610a3234227719  
**Battery Status** 94.17%, 4.14 Volt

**Predicted Activity**

lying

**Activity Stats**  
9/19/2019, 12:00:00 AM - 11:59:59 PM

Lying	Standing	Feeding	Idle
			
37	0	0	25

Predicted activity (standing, lying-down, feeding, and more)



# On-device Activity Prediction

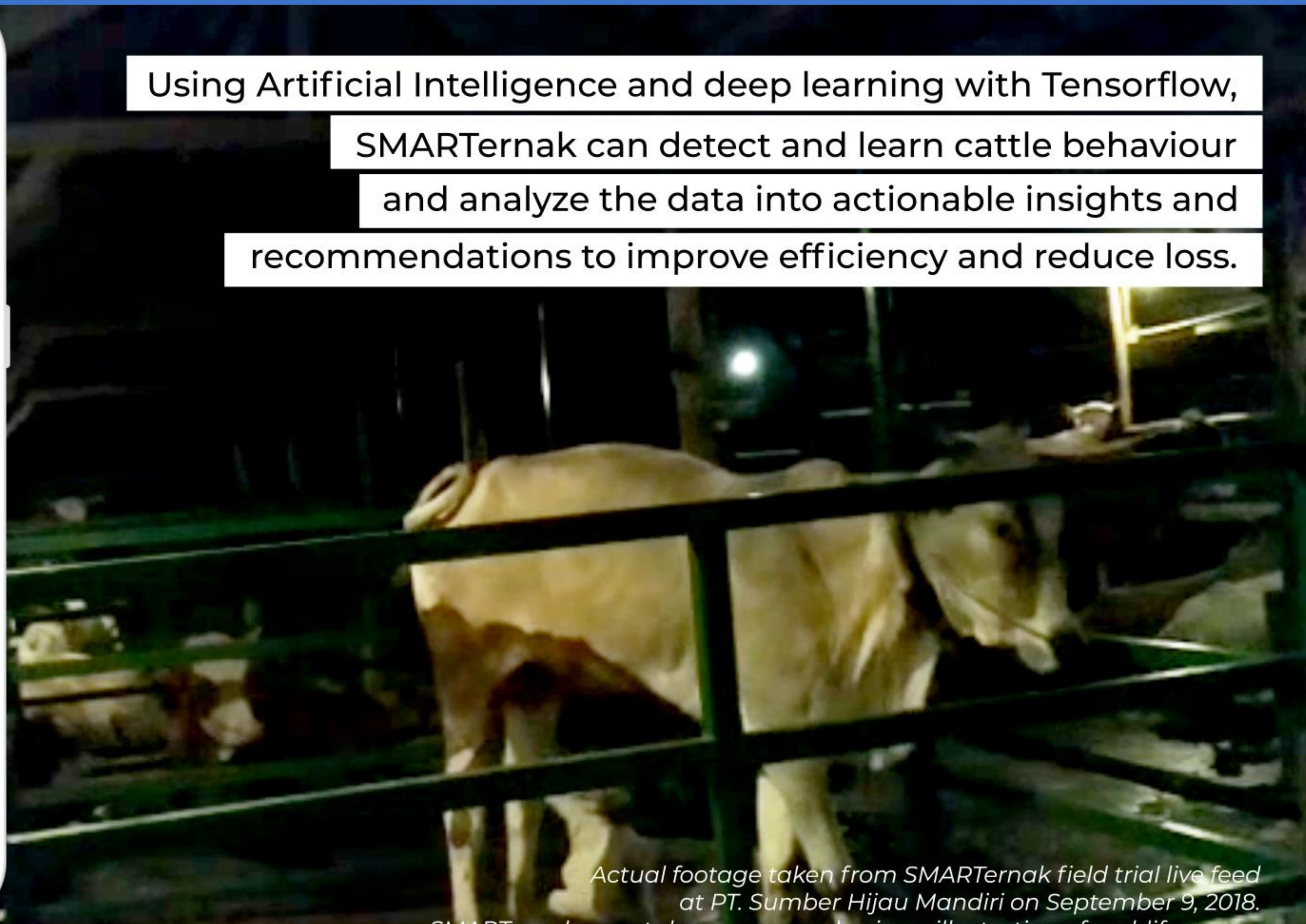
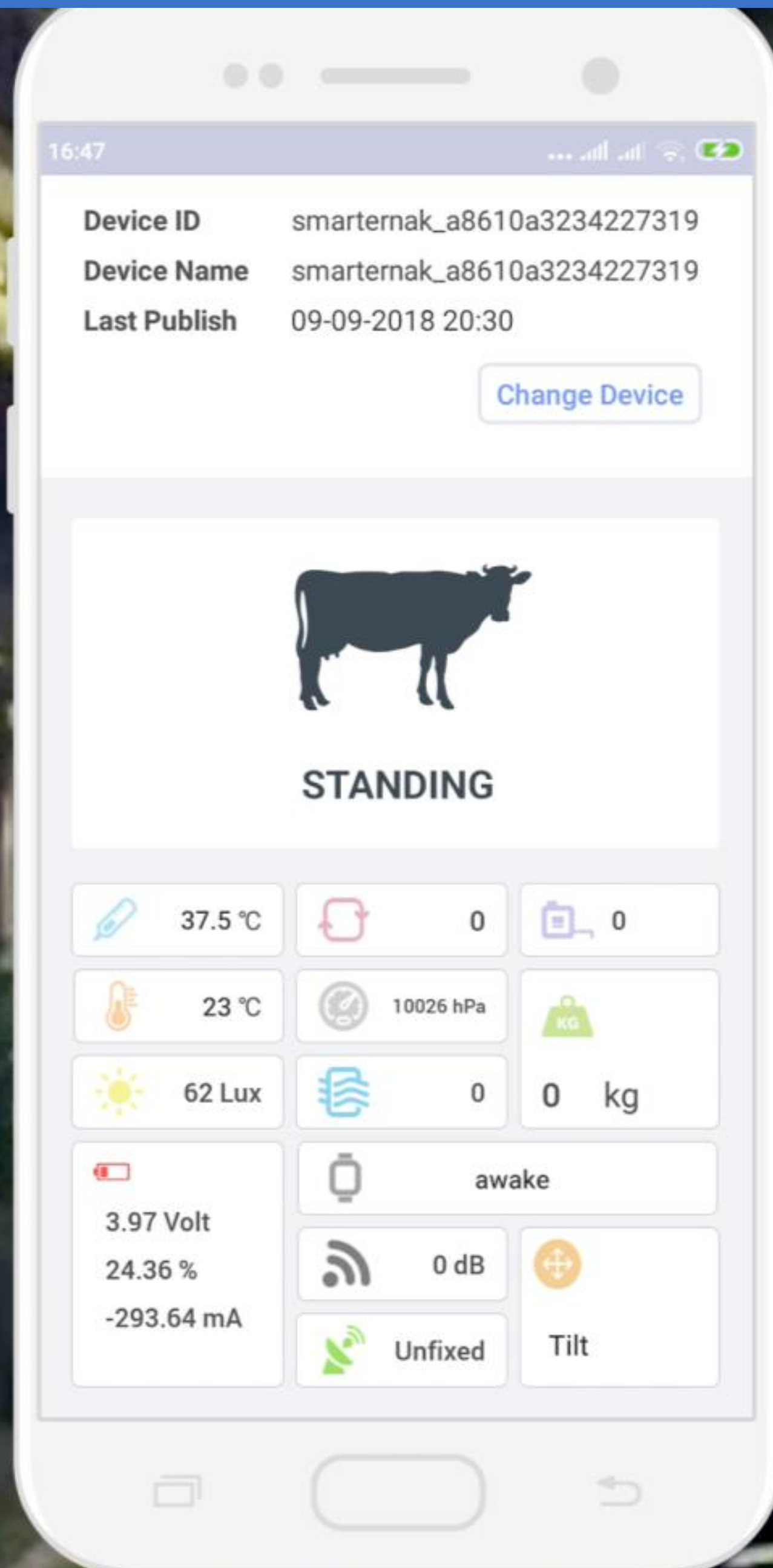
Demo Video: <http://bit.ly/smrtrnk-ai-1>

Using Artificial Intelligence and deep learning with Tensorflow,

SMARTernak can detect and learn cattle behaviour

and analyze the data into actionable insights and

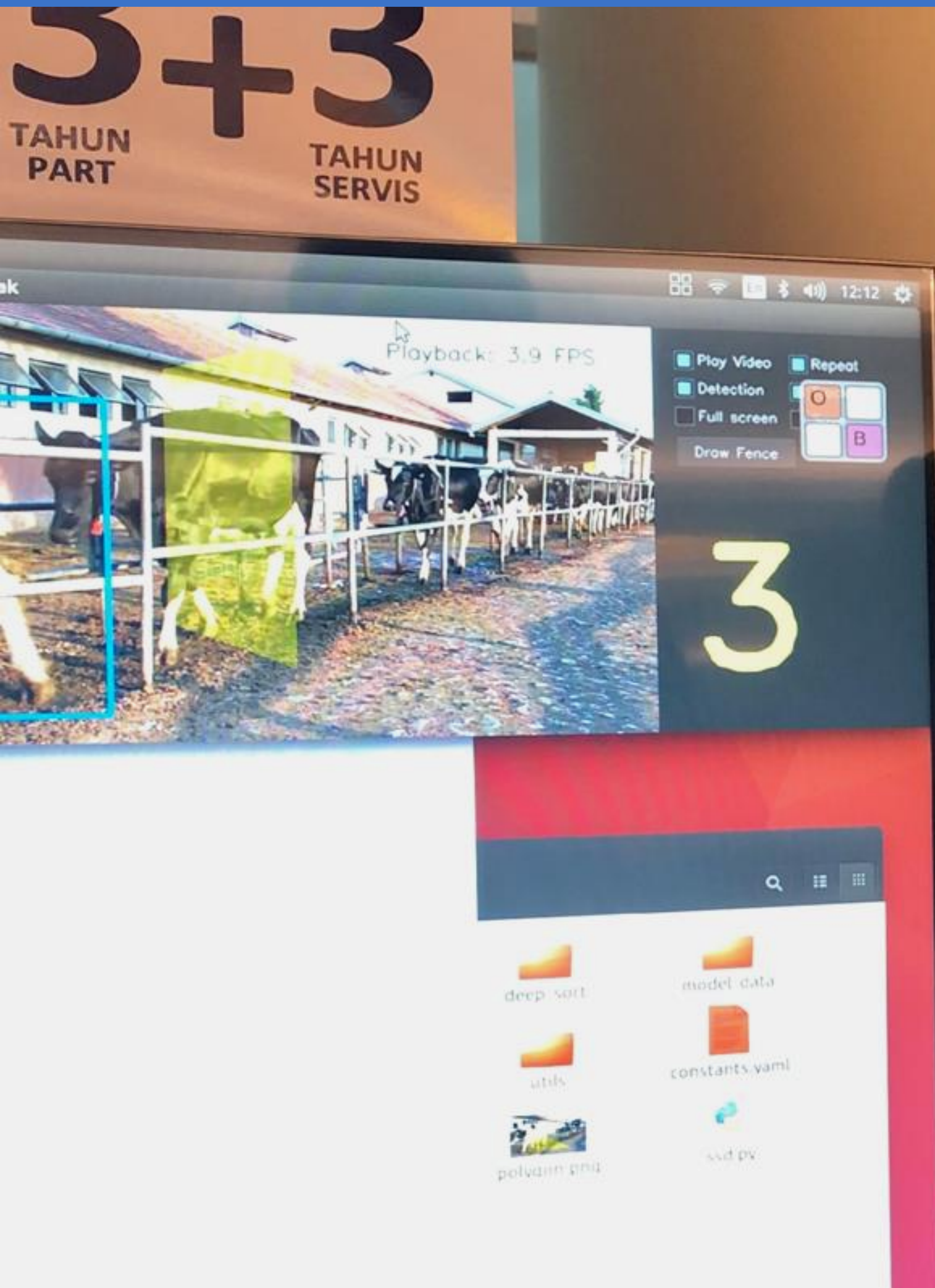
recommendations to improve efficiency and reduce loss.





# On-farm Smart Camera

*\*In development*



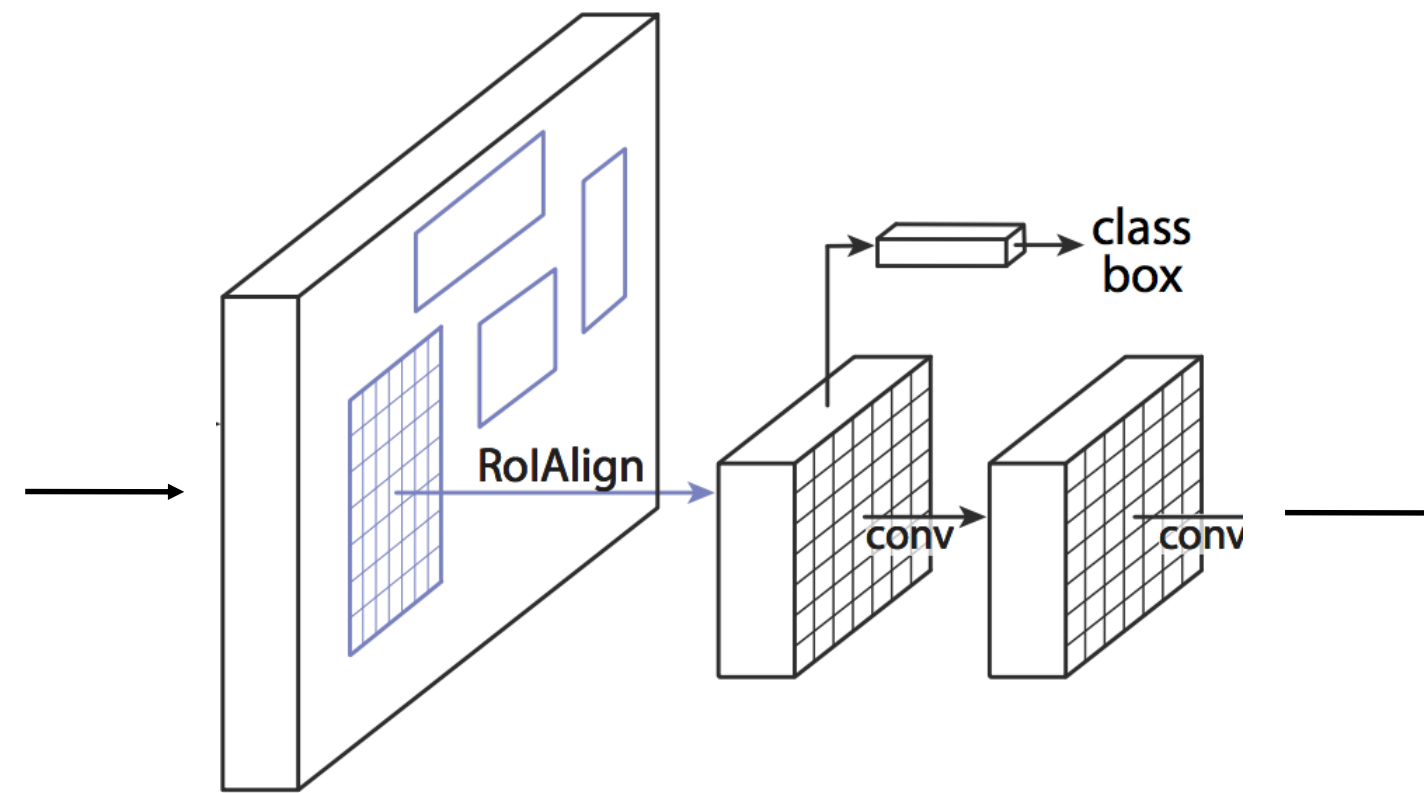


# On-farm Smart Camera

Cattle Counting & Behaviour Analysis using on-farm camera with the help of Machine Vision & on-device Artificial Intelligence



Image/video stream from camera



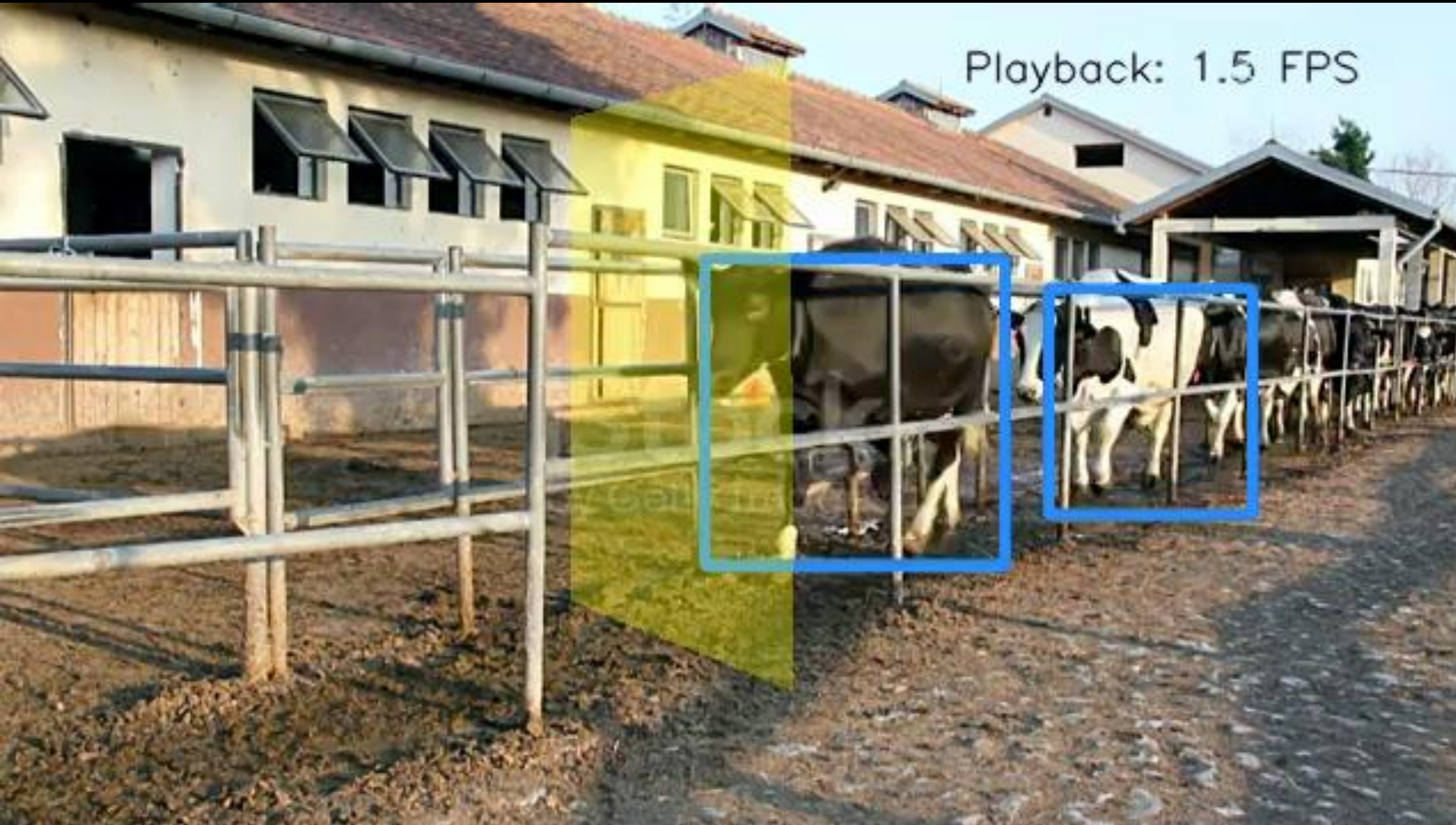
Deep Neural Network  
(Instance Segmentation)



Detected cows and predicted activity  
(standing, lying-down, feeding, ...)



# Smart Camera - Cattle Herd Counting



- Play Video
- Repeat
- Detection
- Tracking
- Full screen
- Save

Draw Fence



Demo Video: [https://youtu.be/Yk30\\_HImSK8](https://youtu.be/Yk30_HImSK8)



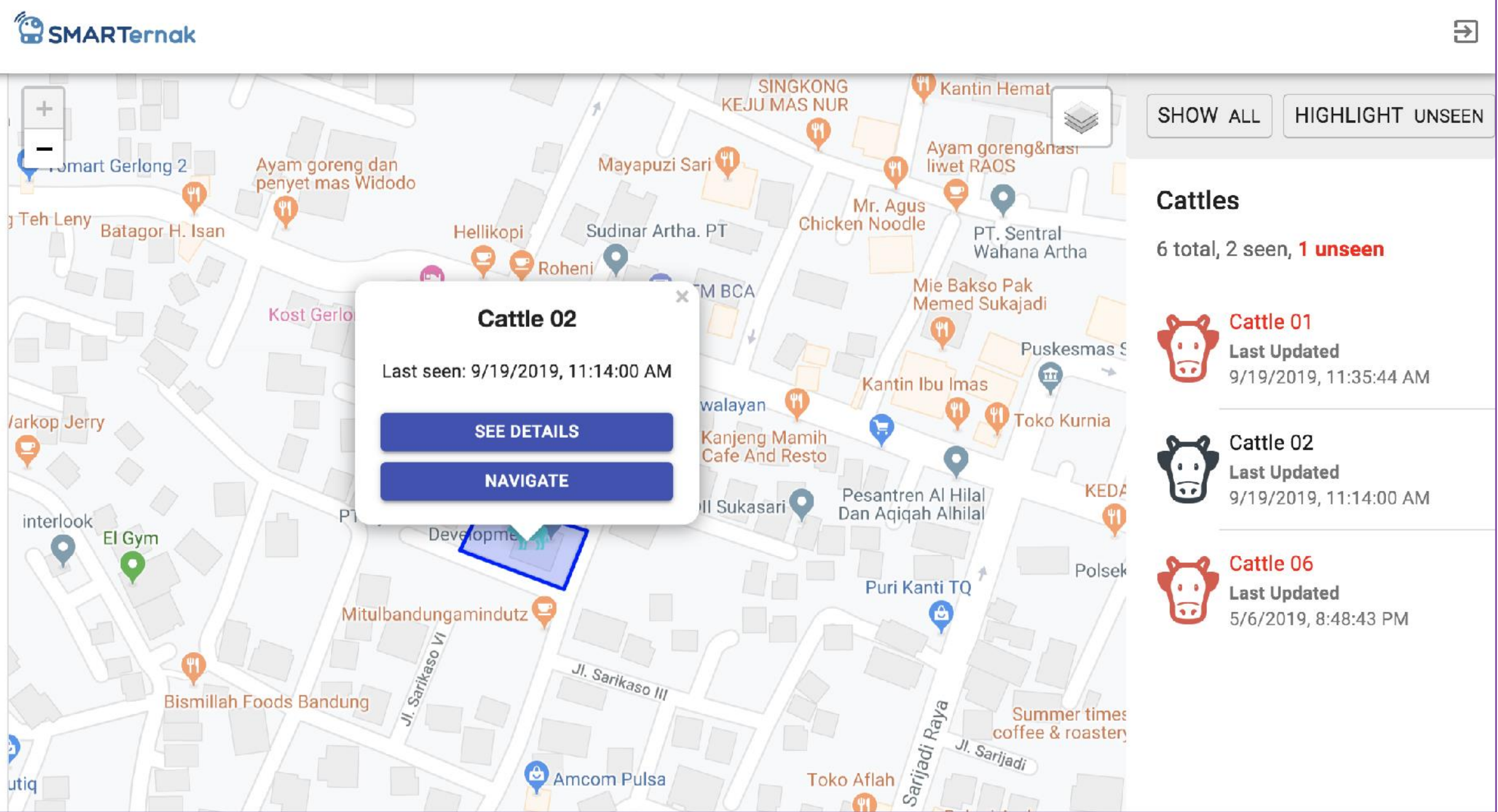
Smart Camera  
Cattle Activity  
Recognition -  
Demo

cow-lying 1.00



Demo Video: <https://www.youtube.com/watch?v=hbiJhS3GftU>





# CaWe Location Tracking

Precisely locate cattle position

No need to check cattle visually & physically, to increase productivity

Monitor the pattern and distribution of grazing activity

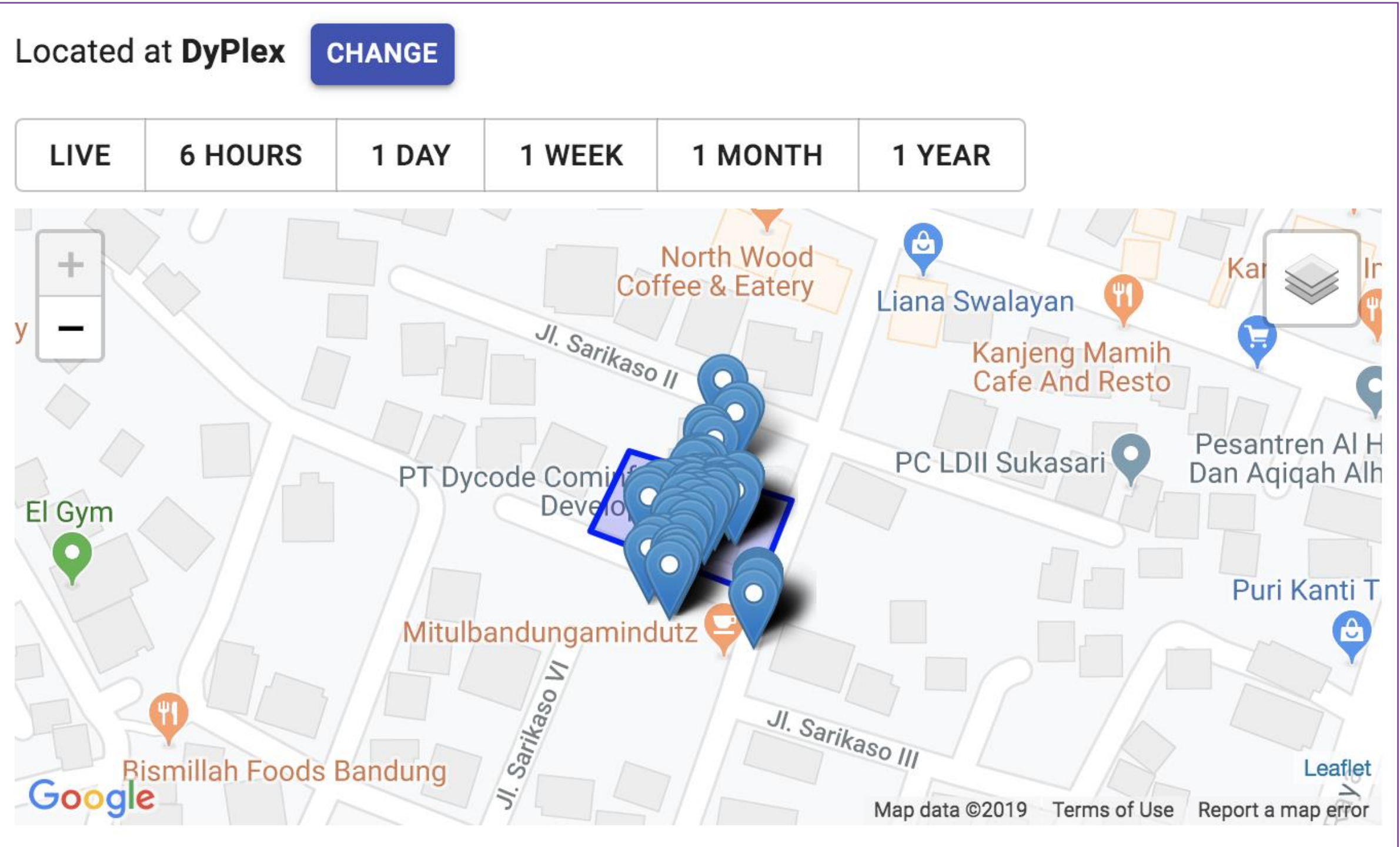
Virtual fencing:

Virtual and remote herding

Control grazing pattern, to give time for grass to grow, ensure sustain supply

Precise herd counting, no cattle left behind

Less physical (electrical) fence





# SMARTernak Solution - Variants & Features



## SMARTernak Ultimate



## SMARTernak Tracking

### for Extensive Farming

Free-ranging farming where mostly livestock grazes on large rangelands or pastures. Or, mixed crop-livestock farming: livestock grazes in the cropping area, such in integrated oil palm-ruminants system.



Track location & behaviour



Herd counting



Virtual fencing



## SMARTernak Health

### for Intensive Farming

Livestock is confined in shed or barn and eat feed, or semi-confined which some graze in limited/small area in particular season. Mostly focus on fattening, breeding, or producing dairy products.



Monitor & alert health issues



Estimate weight\*



Learn behaviour (feeding, standing, walking, etc)



Monitor environmental condition





**SMARTernak  
Real-World  
Implementation**

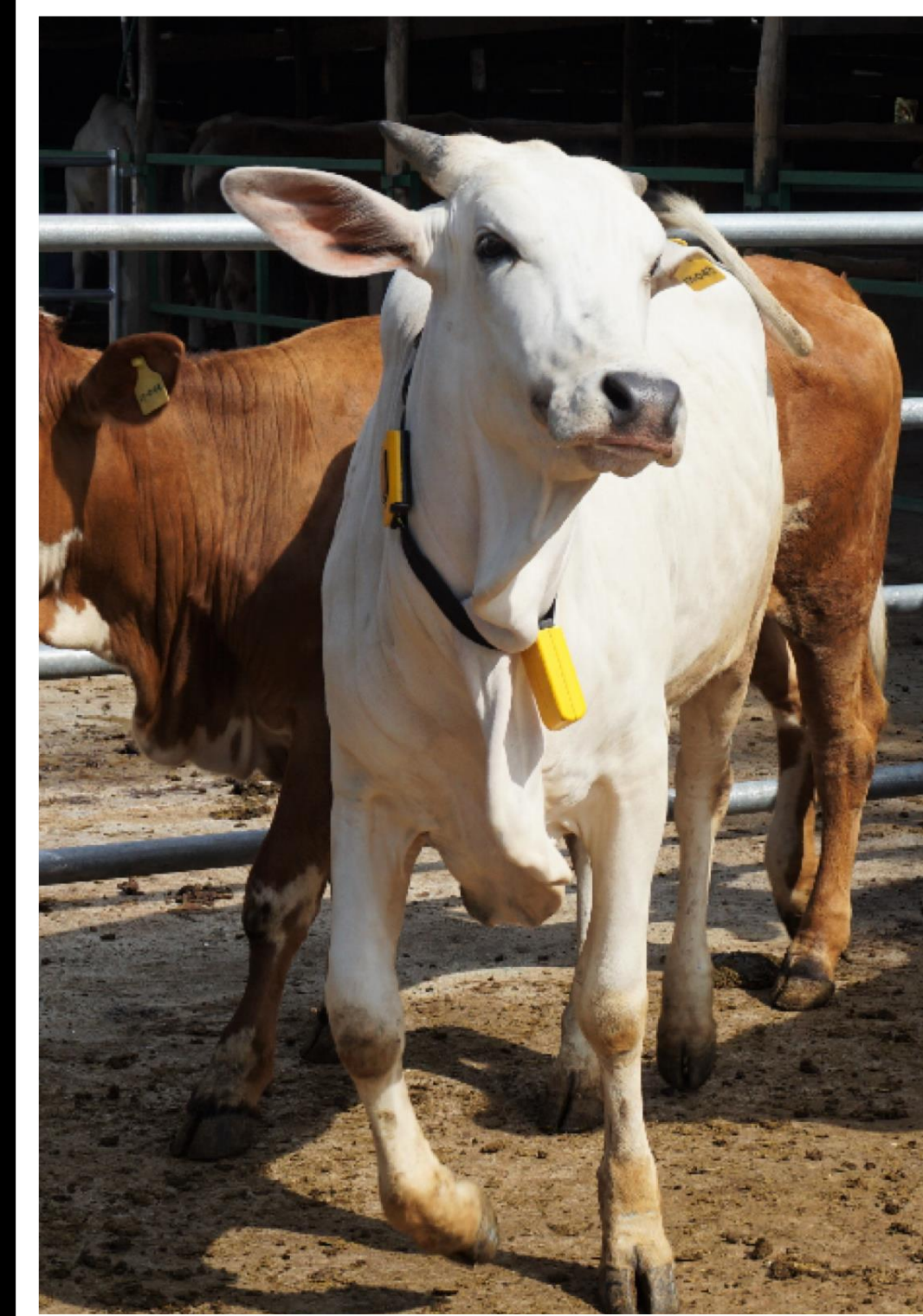




# PT. Sumber Hijau Mandiri

at Majelengka, West Java, Indonesia

in collaboration with **XL Axiata** for the 1<sup>st</sup> field trial of **NB-IoT** network

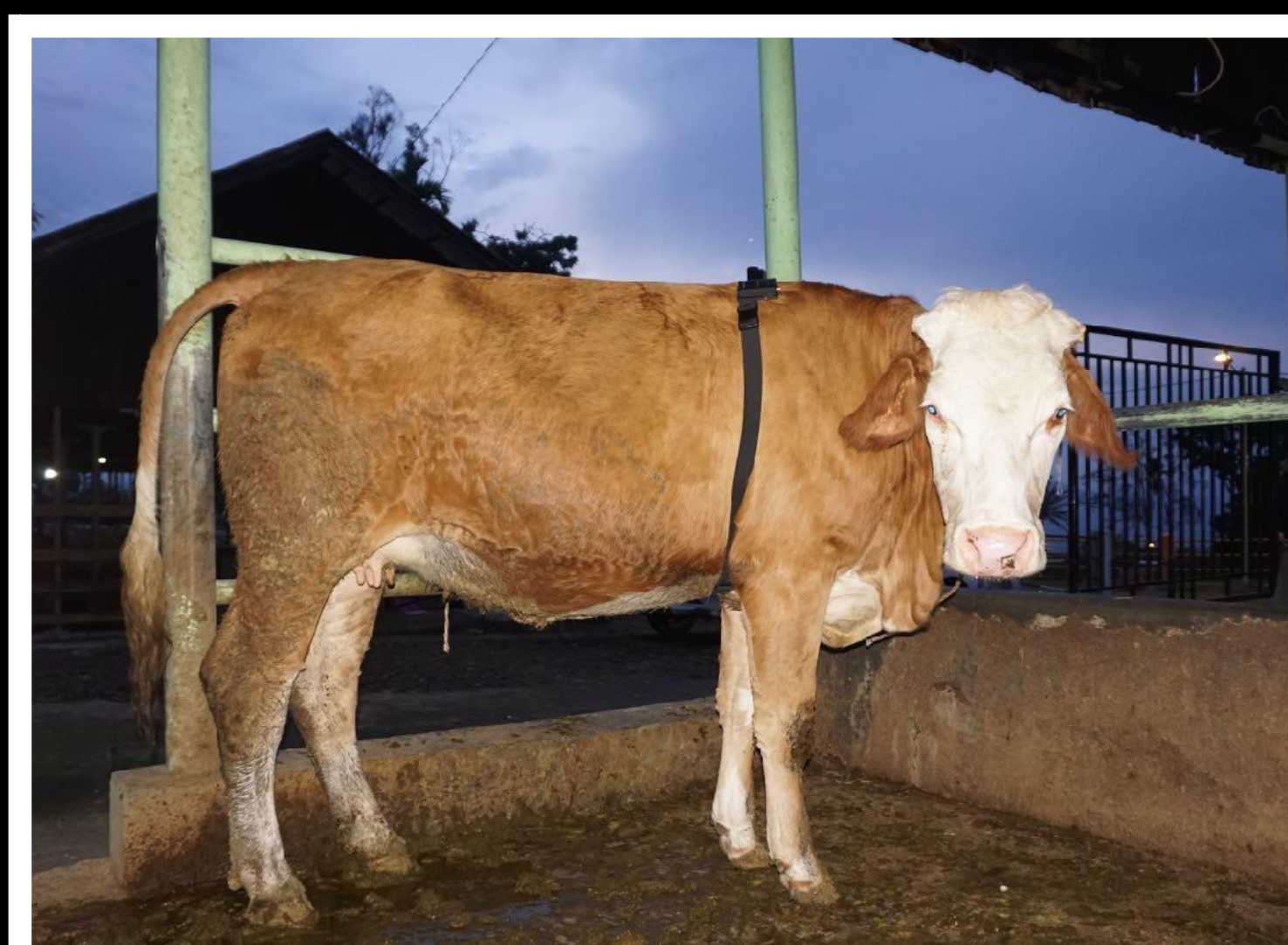
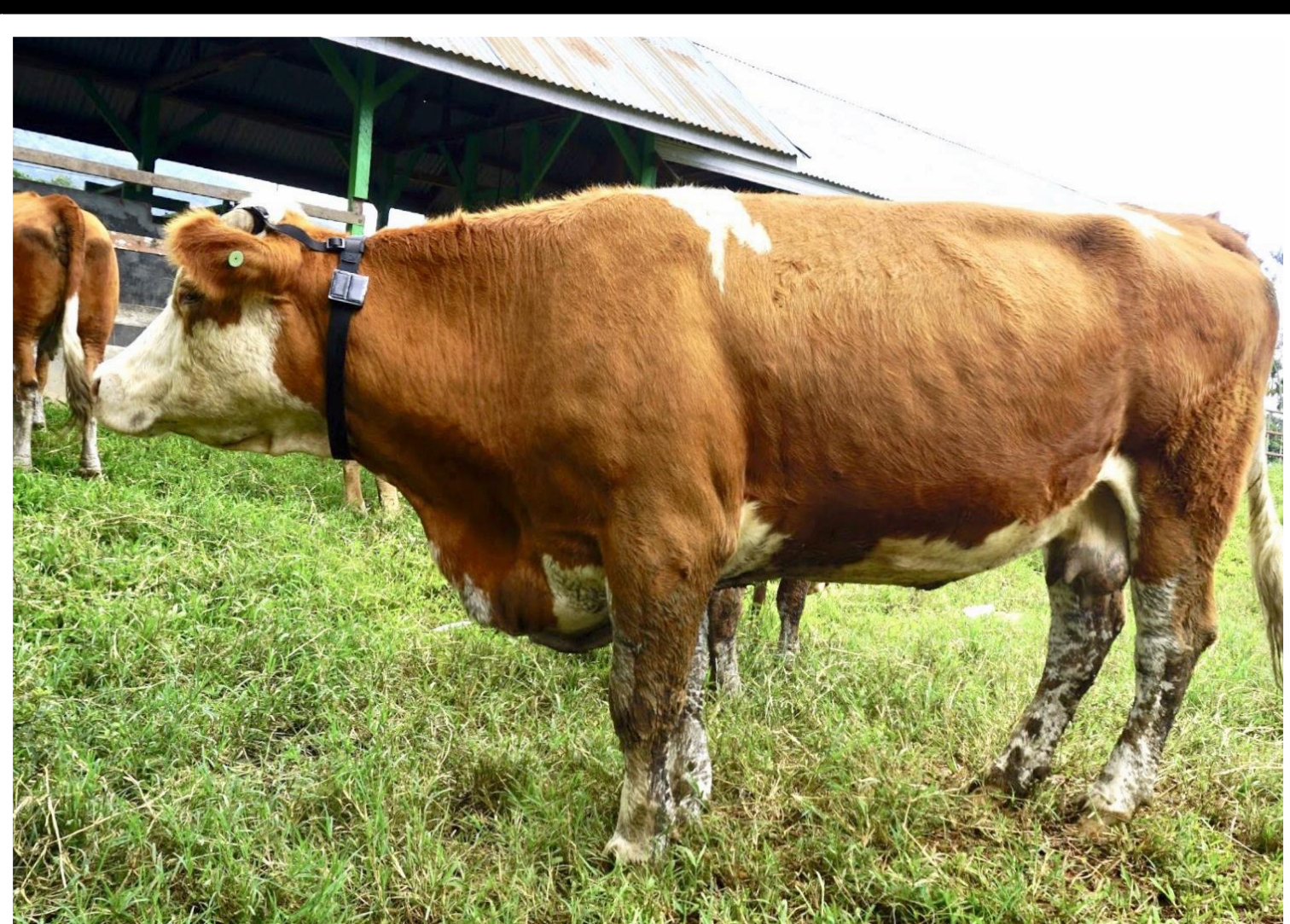




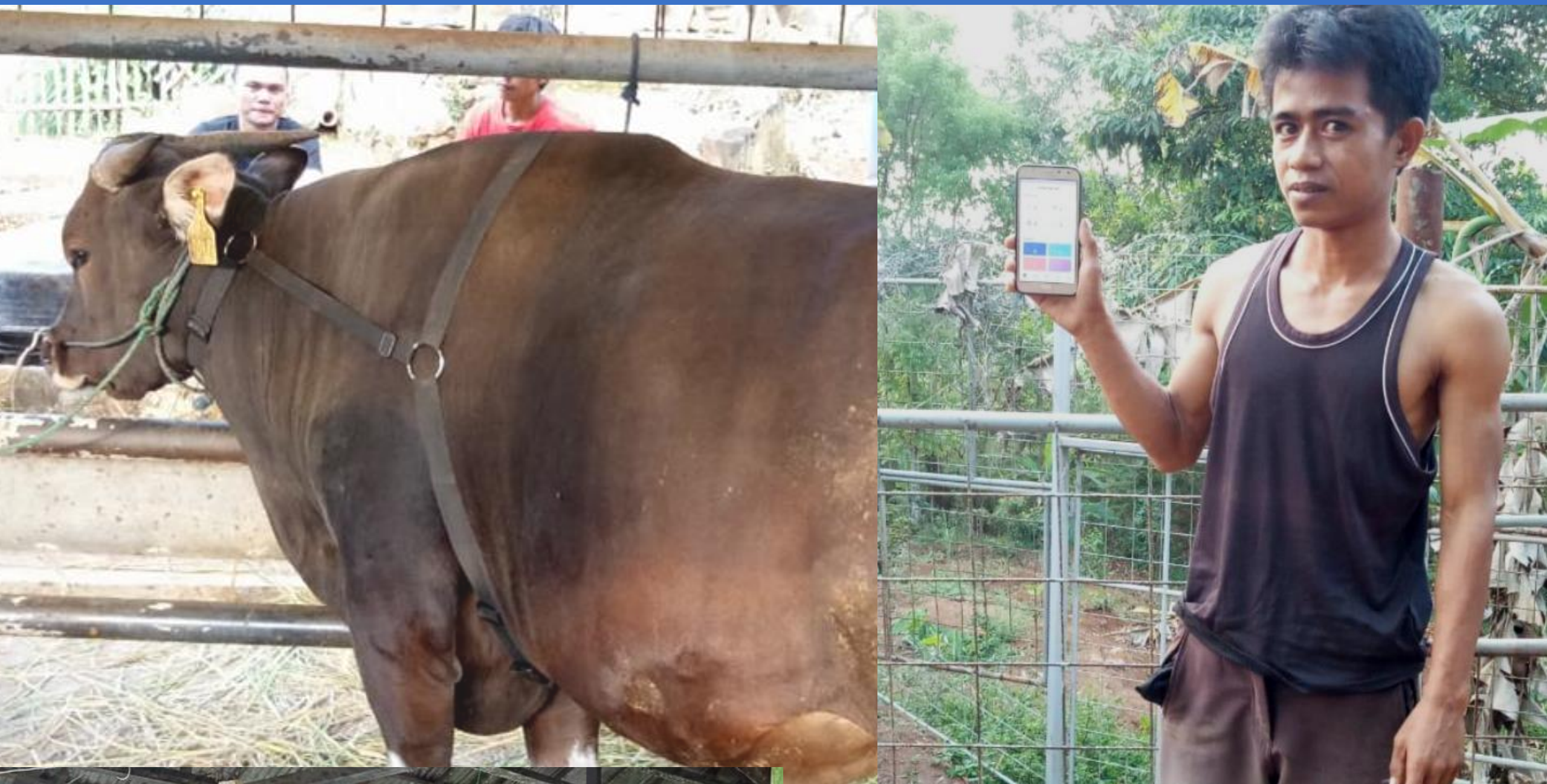
# Ministry of Agriculture's Cattle Breeding & Food Center

at Padang Mengatas, West Sumatera, Indonesia

in collaboration with Ministry of ICT (KEMENKOMINFO), supported by Ministry of Agriculture







Ministry of Agriculture's Breeding Facility - West Sumatera, Indonesia



## Don't just take our word for it

”

We can reduce the potential death of non-eating cows significantly, by the notification from the app.  
Now, I can sleep well.

**Rahmat**

Owner of RJ Farm, Subang, Indonesia

”

We manage 1400 cows with 100 staffs. By this platform, we can breed more cows and increase productivity, without adding more staffs.

**Dr. Harry Suhada**

Animal Breeding and Genetics Expert  
at Ministry of Agriculture, Indonesia





# Coverage by Metro TV in Ciawi, Bogor

Watch here: <http://video.metrotvnews.com/start/akWGwjLk-asli-lokal-kualitas-global-1>

START

13:07 WIB

BARA' ● HARI KE-13 PENCARIAN PENUMPANG LION AIR, 201 ORANG DIKERA





# Monetisation

## Device Sales

## + Subscription

### SMARTernak

Tracking or Health variant  
*Tracking or Health features,  
in one device*

\$99

and/or

### SMARTernak

Smart Camera  
*Monitor 5 cows at once*

\$399

\$5.9

per cow, per month

Includes:

Access to web dashboard and  
mobile apps, and all future updates  
Device warranty and support

OR

## Pay-as-you-go\*

We're pursuing this

\$11.9

per cow, per month

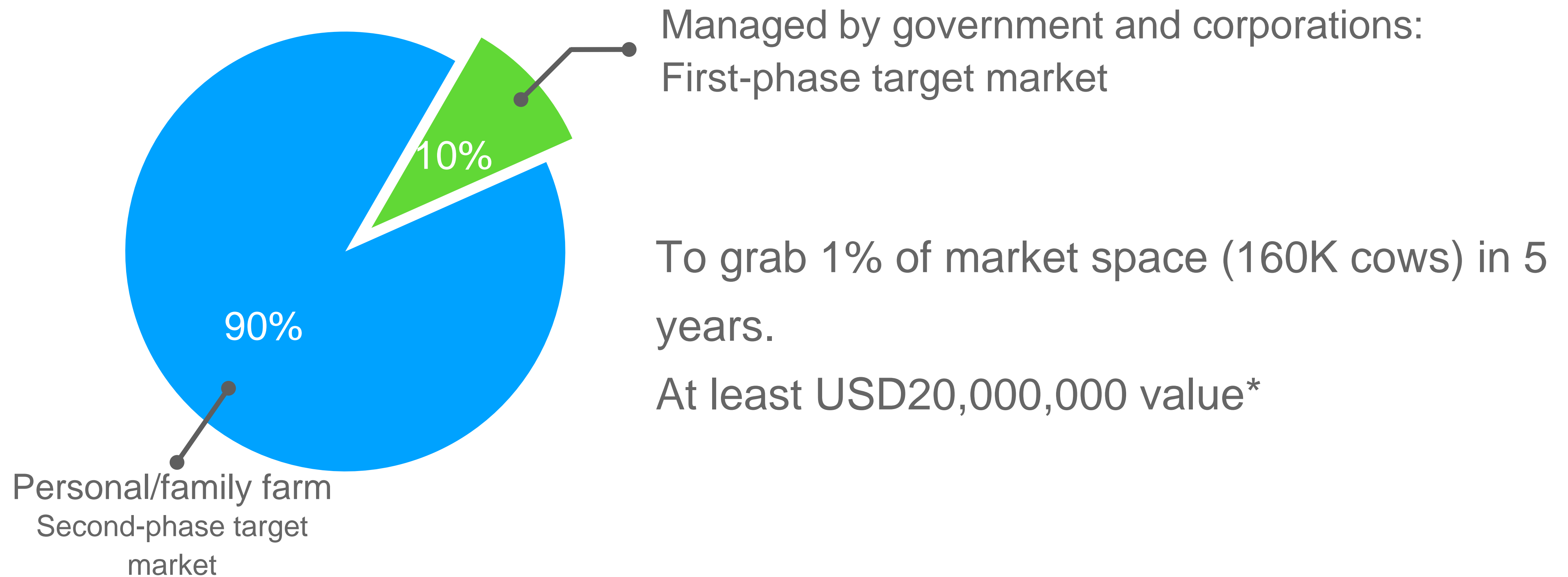
Includes everything  
No upfront cost

\*2 years minimum contract



# 16 million cows!

\*in Indonesia alone



\* Estimated value based on “pay-as-you-go” monetisation scheme





ridwankamil  • [Follow](#)



ridwankamil  IMPLEMENTASI "DESA DIGITAL" MENERIMA AWARD OF EXCELLENCE 2019 dari OpenGOV, institusi internasional di bidang inovasi pemerintahan. .

INOVASI ini adalah salah satu yang mengangkat 537 desa naik kelas dari desa berkembang menjadi status desa maju dalam waktu 10 bulan.

Award ini didedikasikan untuk semua pihak yang bekerja keras melalui kolaborasi Pentahelix.

MARI SEMANGAT, jika desa juara maka Insya Allah #JabarJuara.

3d



56,804 likes

3 DAYS AGO

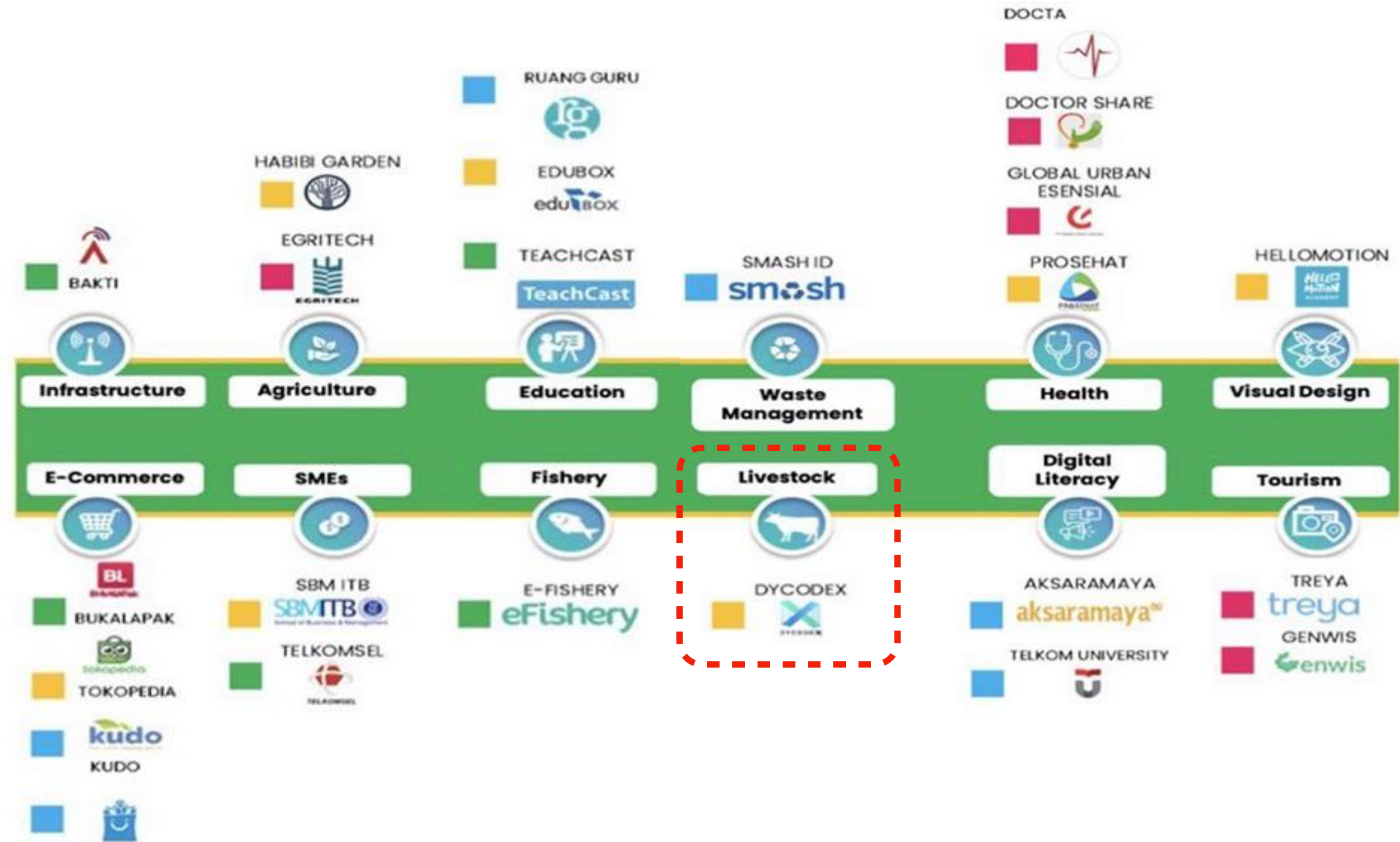
Log in to like or comment.



# Digital Village (Desa Digital)



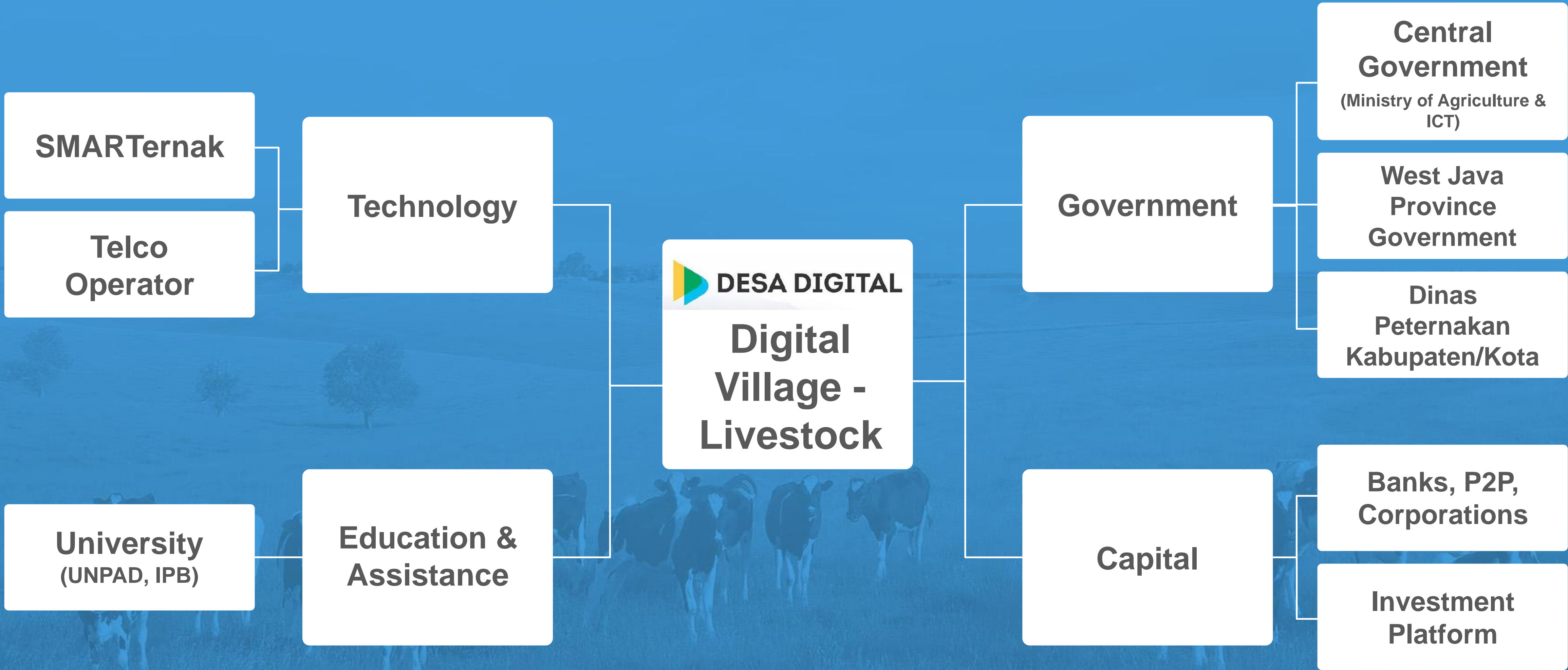
## Digital Village Partnerships





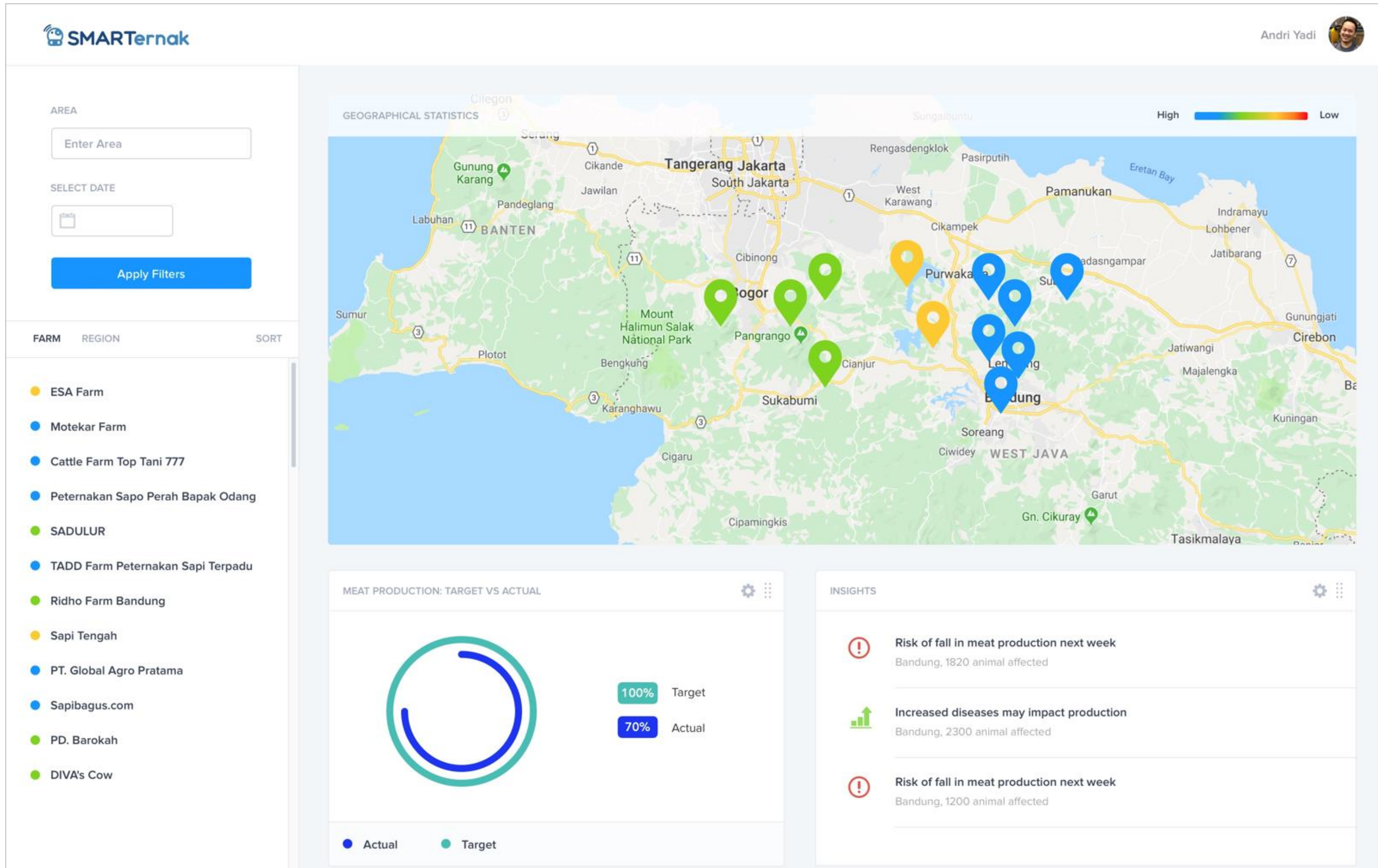
# Digital Village - Livestock Farming

In progress to work with **West Java Government** - Digital Service Division, for an initiative of “Digital Village - Livestock” to tap the cattle farming potentials in West Java, which is the **2nd largest** in Indonesia





# In the future...





 Long Range  
Low Power IoT  
Connectivity



Cattle Activity Recognition



Activity Trends

 **NB-IoT**  
with 2G Fallback




Sits firmly on cow's neck

 GPS & Compass



SMARTernak

 On-device  
Artificial  
Intelligence

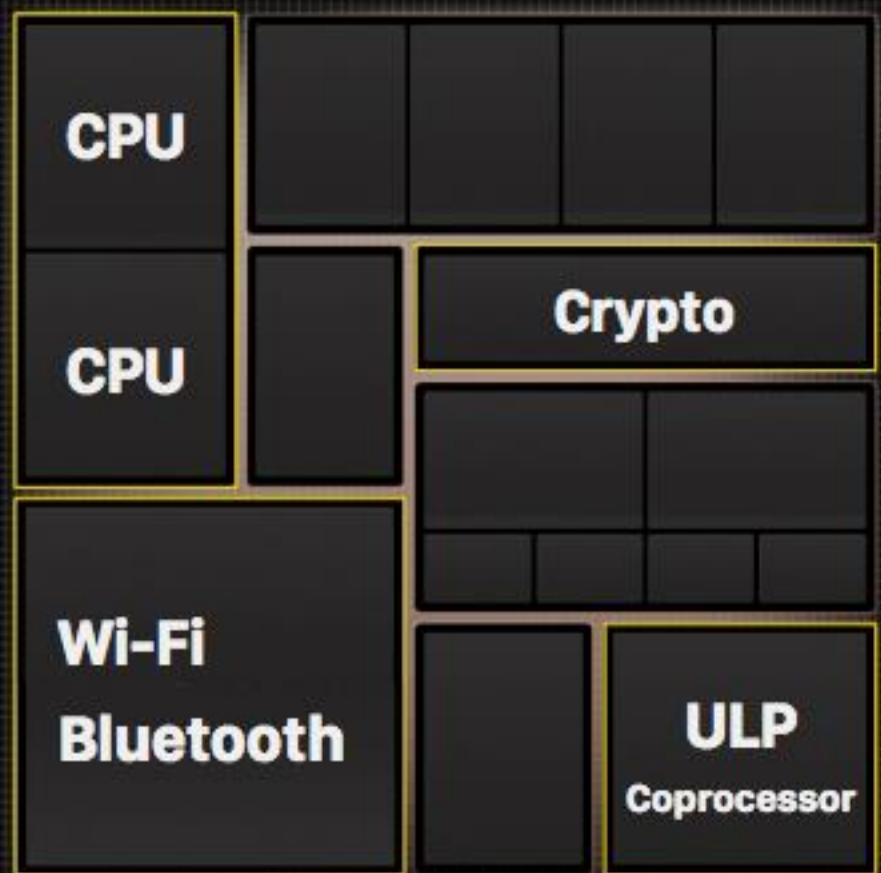
 Notify Cattle  
Health-related  
Issues



Virtual Fencing

 Device  
Removal  
Alert

**All-1/2-year Battery Life**  
and some more, with energy harvesting from solar



Sense Surrounding Environment



Smart Energy  
with Energy Harvesting

**Health Tracking Ultimate**  
3 variants for all farm types

Weight Progress Estimation\* 



# LET'S DO FIELD TRIAL

We understand that before the real large implementation, customers often need to try out the solution first.

Let's discuss.



DycodeX is much more than just  
SMARTernak and Agricultural space



# Products & Solutions Focus

## Home-grown AI & IoT-powered devices & platforms



**DytraX:**  
Asset Tracking Platform



**Smarterbike:**  
Bike Fleet Management  
(e.g: bike sharing)



**SMARTernak**  
Cattle-farm assistant



**AItrash**  
Smart Trash Management



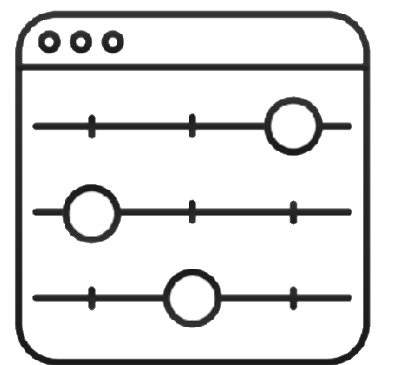
**PowtraX**  
Electricity metering



**Alora**  
Industrial Environmental  
Sensing



**Machinery Health  
Sensor**



**IoT Prototyping  
Platform for  
Education, Makers**

**Custom hardware  
design:**  
already helped 15  
companies/startups

**End-to-end AI + IoT  
development:**  
firmware, cloud, AI,  
web & mobile app

Asset tracking

Agriculture

Environment

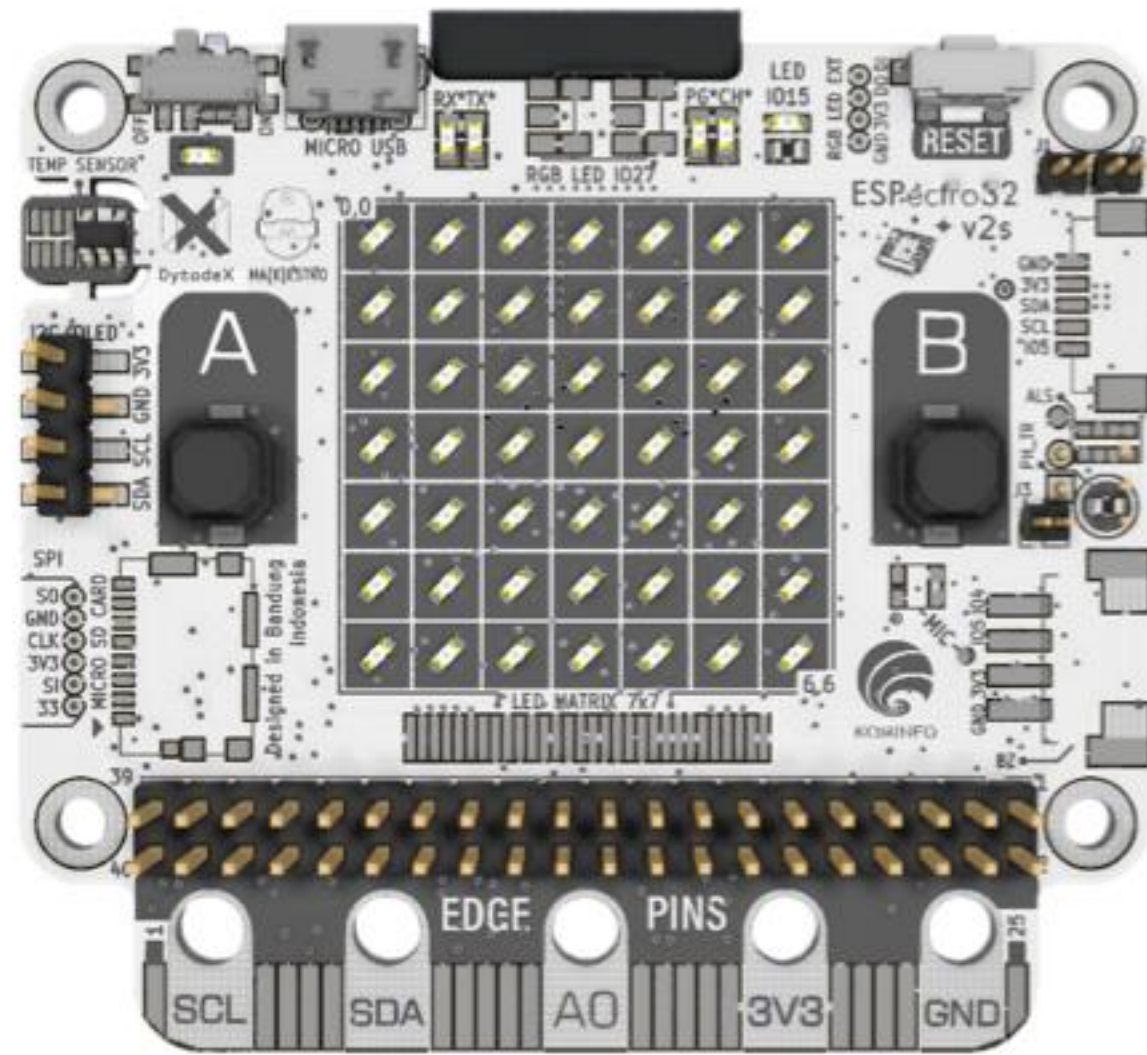
Energy

Industrial IoT

Design House



# IoT Prototyping Platform for Education & Makers



**ESPectro32**

## Backpacks



**NB-IoT + GPS/GNSS Kit**



**LoRa/LoRaWAN + GNSS Kit**



**Sensors & Actuators Kit  
(20+ Peripherals)**



**3G + GNSS + Sensors**

## IoT Prototyping Platform

Optimized for learning STEM, coding & electronics, also for fast prototyping.

Already sold 1000+

### Hardware:

**ESPectro32:** A development Board having highly capable, low-power dual-core Microcontroller, with built-in WiFi & Bluetooth connectivity

Extensible with Backpacks: NB-IoT/ Cellular, LoRa, Sensor Kits, Motor Driver, and more

### Software:

Arduino Software-compatible, supported by ready-to-use libraries

Learn to code with:

Visual drag-and-drop blocks\*

Swift Playground\*

IoT Cloud: to easily connect IoT devices



# Partners

Supported by  
3 Ministries of Republic of Indonesia



Local Partners:



Partnering with global brands for IoT R&D,  
component supply, mass production, and go  
to market



APAC Innovators





# DEMO DAY

Google

SMARTernak represented Indonesia - the  
only one - for  
Google Demo Day Asia 2018

Our awesome journey:  
<https://dycodex.com/milestone/>





**AND YES.. WE'RE RAISING FUND**

Let's discuss. Visit our booth for demo & profit!



# Key Takeaways

---

Through a combination of advanced sensor hardware technology and state-of-the-art machine-learning algorithms, SMARTernak is the next step in the advancement of cattle-farming for the future

**Big Opportunity**

**Team-Market Fit**

**Raising \$1.9M**

**1.8B Cattle in 2030**

\$50M in 5 years in Indonesia alone

Engineers, scientists, entrepreneurs, influential advisors, and partners

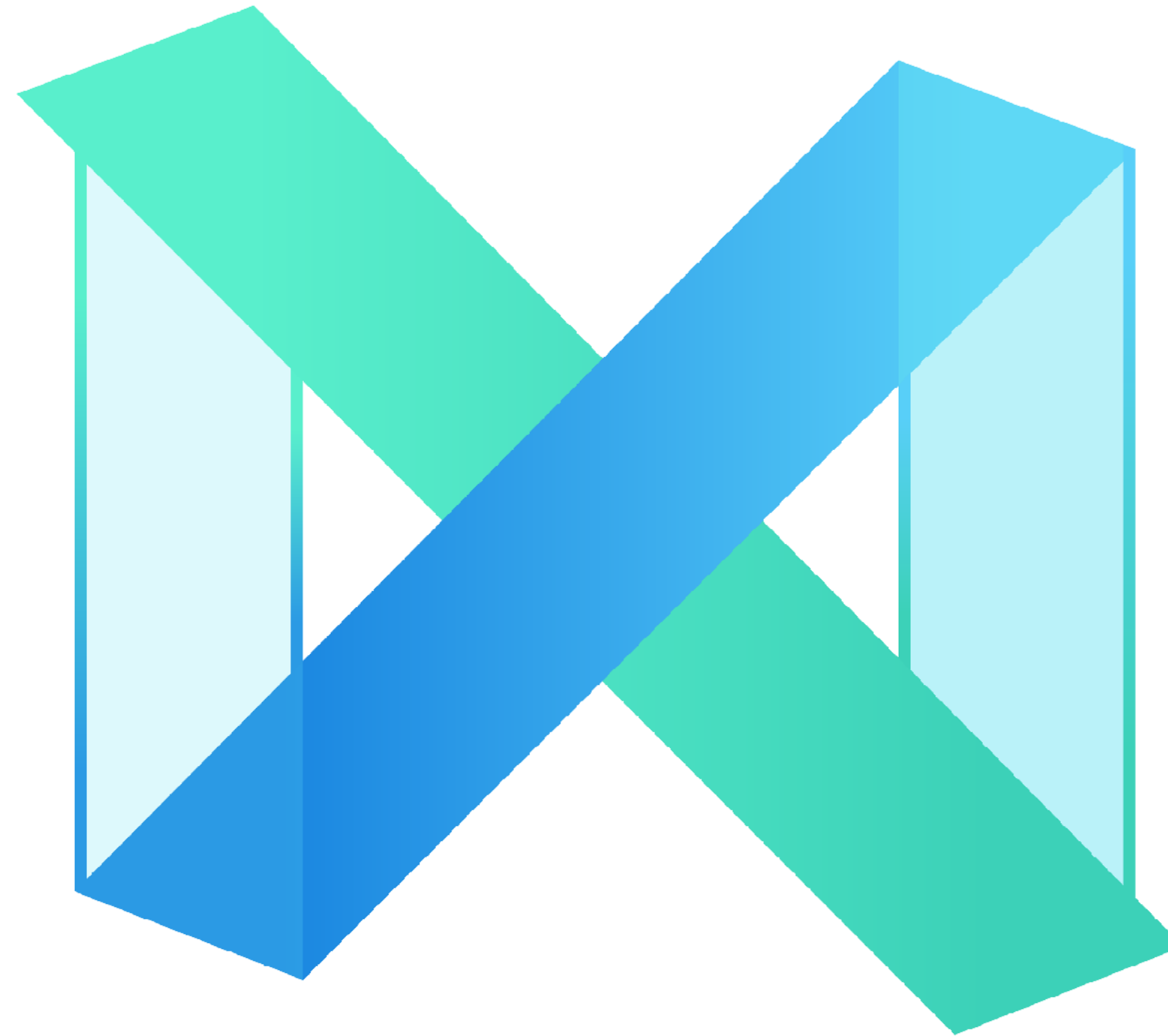
**3x Head Count**

Scale product, to dominate Indonesia market, initial expansion to other countries

**Join us to improve cattle-farming, with AI & IoT**



Keep in touch



DYCODEX

AI + IoT enabler

[hi@dycodex.com](mailto:hi@dycodex.com) | <https://dycodex.com>

Bandung, Indonesia