Bumitama Gunajaya Agro

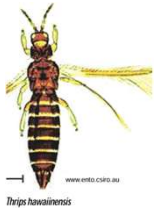
Aplikasi Polinasi Terbantu *Hatch&Carry* dan Polinasi Artifisial Terintegrasi dengan Bioacoustic Polli-Sensor

Project Leader :

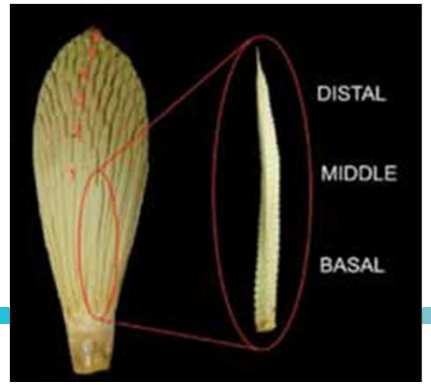
Indah Trisnawati Dwi T., M.Si., Ph.D

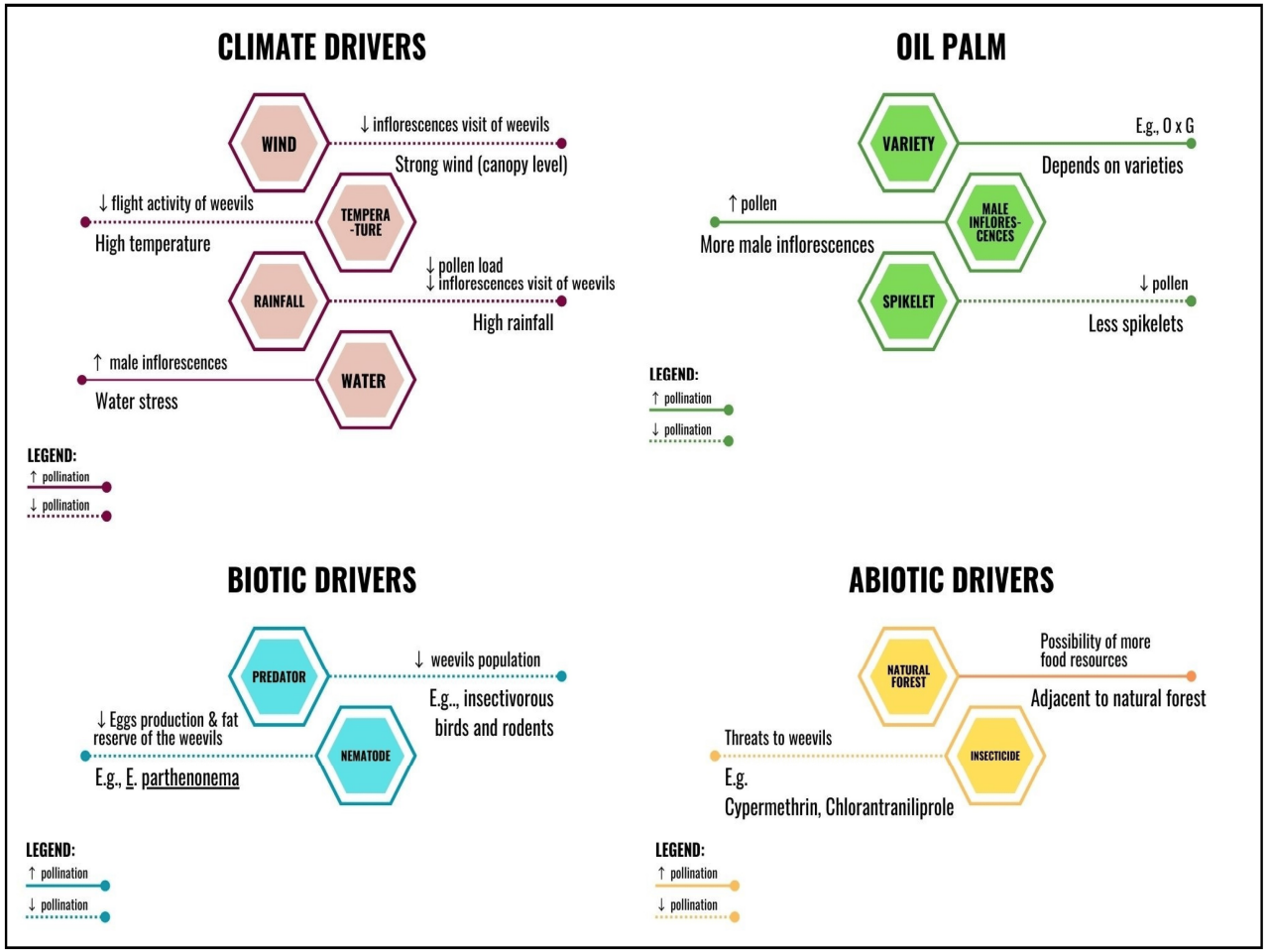
LATAR BELAKANG

- Signifikansi ekonomi & lingkungan dari perkebunan sawit & ketergantungannya pada penyerbukan serangga, maka ekologi polinasi sawit harus diperhitungkan.



- Hambatan polinasi :
  musim, karakter jenis bunga & aktivitas serangga pollinator (kumbang *Elaeidobius* spp. & serangga peloncat *Thrips hawaiiensis*)





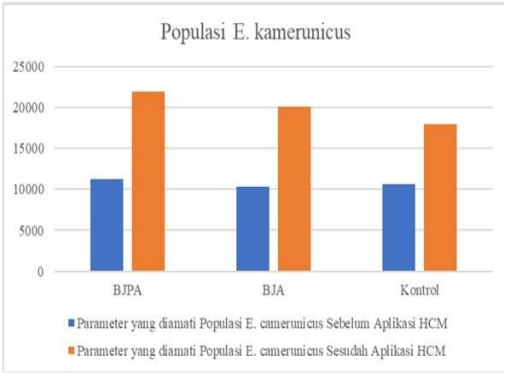
Polen bunga jantan mekar mengandung senyawa volatile organic (OVOC) beraroma kuat & berperan penting sebagai atraktan serangga

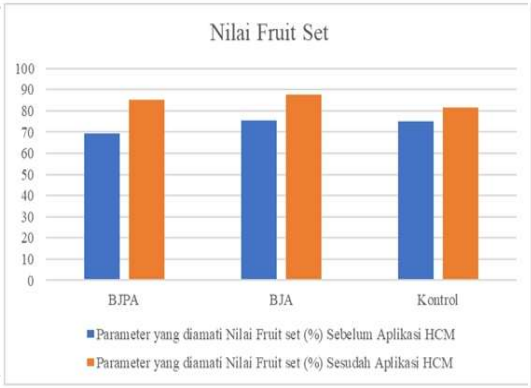
JUSTIFIKASI RISET

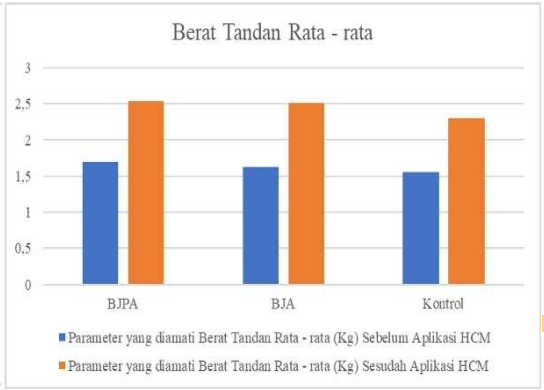
Assisted Pollination : Hatch & Carry Technique

Fruit set increased between 20.28% - 20.39% on 10 m to 200 m distances compared to 400 m from the box **(Prasetyo et al. 2014),** increased the weevil population & average bunch weight **(Pratama, 2024)**

Distance between palm samples and hatch and carry box (m)	Mean of fruit set value (%)		Mean of bunch weight (kg), four months after hatch and carry application
	During hatch and carry application	Four months after hatch and carry application	
10	67.29a	88.61a	7.11 ab
100	64.85a	87.38a	7.59a
200	65.29a	82.50a	6.44ab
300	69.91a	67.58b	6.16ab
400	67.77a	62.22b	5.21b
Assisted pollination	70.23a	84.50a	7.16ab
Mean	67.56	-	-





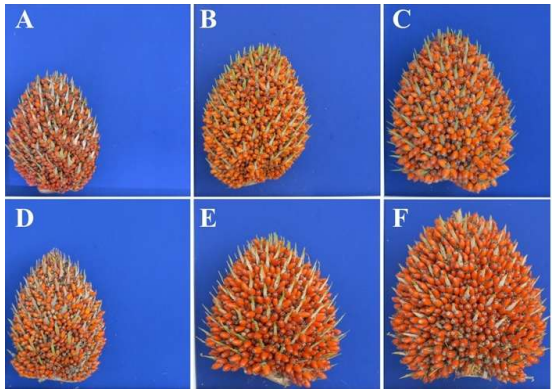


Artificial Pollination : NAA attractant application

The volatile compound NAA acts as an attractant to increase pollination effectiveness and the fruit set.

Flowering stage (%)	2-Nonynoic acid	Palmitic acid	1-dodecyne	Undecanoic acid	Estragole
25	0.807	23.785	-	2.683	24.840
50	1.057	52.213	-	3.677	44.050
75	-	76.337	2.615	-	129.095
100	-	98	11.751	-	313.805

Naphthalene acetic acid (NAA) is an economically viable method for increasing the productivity and profitability of the hybrid palmoil crop (**Romero et al. 2021**).
Free fatty acids (FFA), vitamin E, and carotene content were highly variable within all the treatments (**Ruiz-Alvarez et al. 2021**)



(C) 600 mg L−1 NAA applied three times. (D) A dose of 1200 mg L−1 NAA applied once. (E) A dose of 1200 mg L−1 NAA applied twice (Romero et al. 2021)

JUSTIFIKASI RISET

Monitoring the population & efficiency of pollination:

South African Journal of Botany 132 (2020) 171-179

Introduction of current pollination techniques and factors affecting pollination effectiveness by *Elaeidobius kamerunicus* in oil palm plantations on regional and global scale: A review

Mamehgol Yousefi[a,*], Azmin Shakrine Mohd Rafie[b,1], Samsuzana Abd Aziz[c,1], Syaril Azrad[d,1], Afifah binti ABD Razak[e,1]

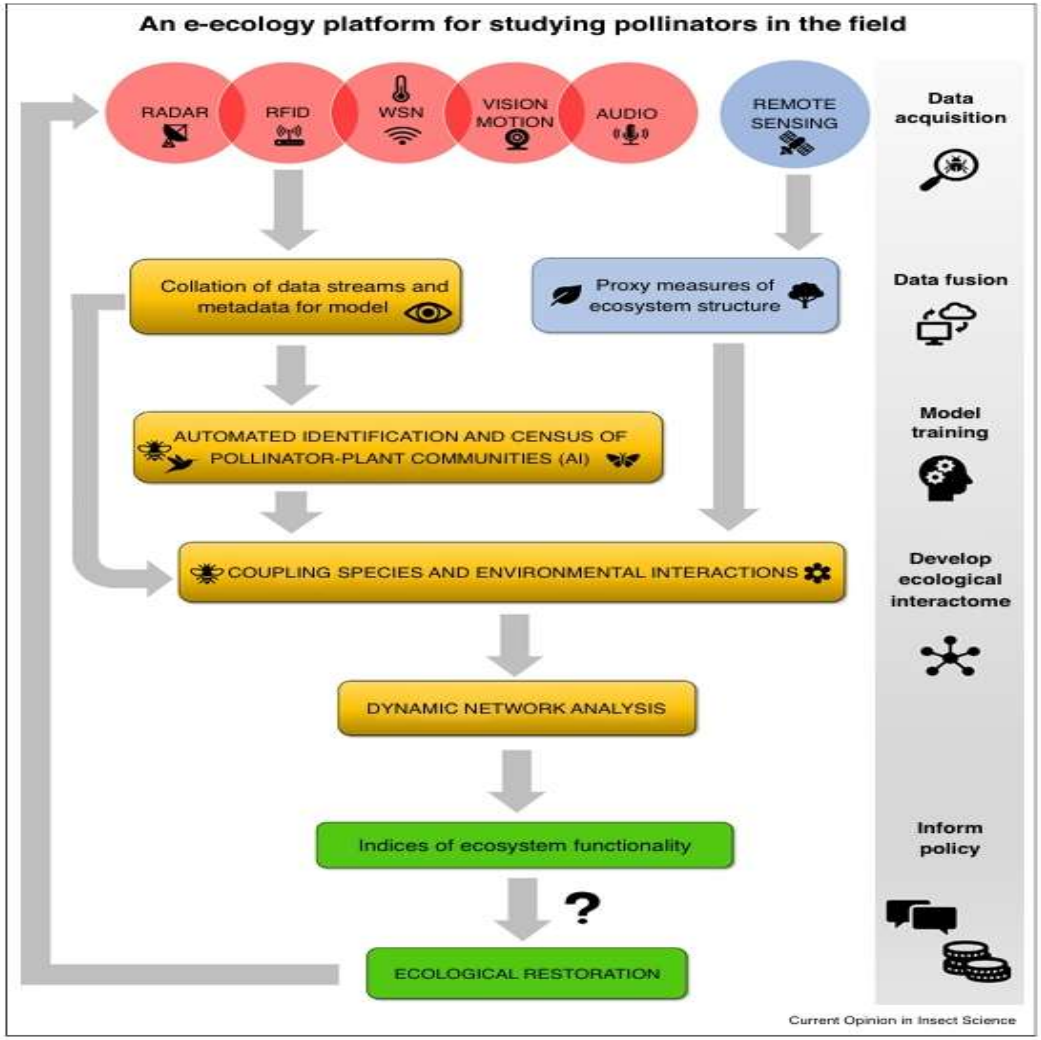
Researchers in Malaysia designed an intelligent pollination management solution, comprises of a robust **Wireless Sensor Network (WSN) system**. The application of sensors to monitor mother palms, a decision support system to operate data and accurately determine pollination cycle, and intelligent dashboard oil palm readiness for pollination **(Yousefi et al. 2020),** the system which simulates readiness of the oil palm flowers for pollination for decision making and support triggered via smart phones or other devices **(Kassim and Harun, 2015)**

Ecologists define e-ecology as the deployment of Internet of Things (IoT) technology to augment manual collection of ecological data in the field with the optional addition of Artificial intelligence (AI) **(Barlow & O'Neill, 2020);** sensors 'smart' hive monitoring, particularly as part of wireles ssensor networks (WSNs) that allow scalable monitoring of multiple hives over extended periods of time and send real-time data to a cloud server **(Jiang et al. 2016)**

Available online at www.sciencedirect.com
ScienceDirect
Current Opinion in Insect Science

Technological advances in field studies of pollinator ecology and the future of e-ecology

Sarah E Barlow[1] and Mark A O'Neill[2]



TUJUAN RISET

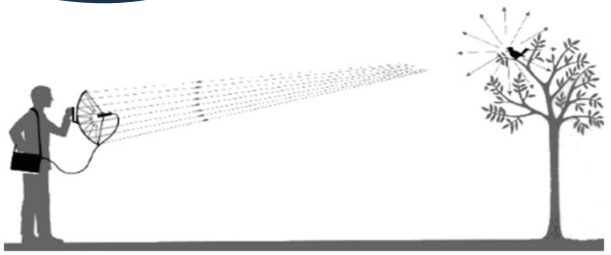
- Aplikasi **Teknik *Hatch & Carry*** untuk polinasi terbantu dalam demplot perkebunan.

- Aplikasi **asam naftalena asetat (NAA)** untuk polinasi artifisial sebagai atraktan pollinator dalam demplot perkebunan.
  - ➜ Senyawa volatile NAA berperan atraktan peningkatan efektivitas polinasi dan *fruitset*

- Monitoring **efektivitas polinasi** dengan frekuensi kunjungan serangga (*visiting pollinator*) dalam demplot perkebunan.
  - ➜ Frekuensi kunjungan polinator dimonitor melalui inovasi sensor bioakustik (**Bioacoustic Polli-sensor**)

BIG PICTURE RISET

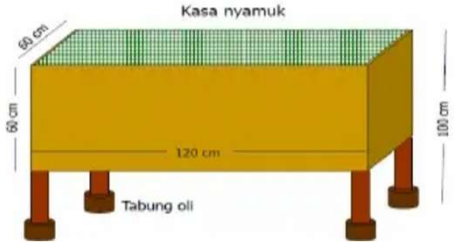
2025	2025	2026	2026-2027
Improvement of the pollination mechanism	Improvement of the pollination mechanism	Monitoring the efficiency of pollination	Final Research Output
Mechanical	**Chemical**	**Acoustic monitoring**	**Pre-commercialization**
Assisted pollination : **Teknik *Hatch & Carry***	*Artificial pollination* : **NAA application**	*Monitoring pollination process* : **Bioacoustic Polli-sensor**	*Integrated pollination system improvement & monitoring package* (**Pollinator-friendly**)

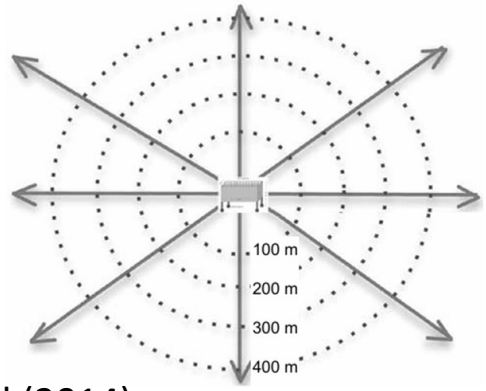


METODOLOGI RISET

Mechanical Assisted Pollination

Teknik Hatch & Carry





Prasetyo et al (2014)

2 tahap Teknik H & C :

1. Penetasan

Penetasan dalam kotak : larva & pupa kumbang *E. kamerunicus* yang ada pada bunga Jantan

2. Pelepasan kumbang ke lapangan

Sebelum dilepaskan, kumbang dalam kotak disemprot 1 g polen murni berviabilitas tinggi saat pagi hari

- Kotak *hatchery* 60 cm x 60 cm x 120 cm, ditutup kasa & dilengkapi atap pelindung (seng/rumbia).
- Berisi 6 tandan bunga jantan (4-5 setelah anthesis), mengandung larva stadia akhir dan kepompong
- Peletakan kotak : kotak *hatch & carry* dipasang di lokasi, 1 kotak/25 Ha.
- Analisis **nilai *fruitset*** dari kelapa sawit **pada 5 jarak berbeda** dari setiap kotak, yaitu berjarak 10 m, 100 m, 200 m, 300 m, dan 400 m dari kotak, sampel 5 *fruit bunch*/pohon yang dipilih

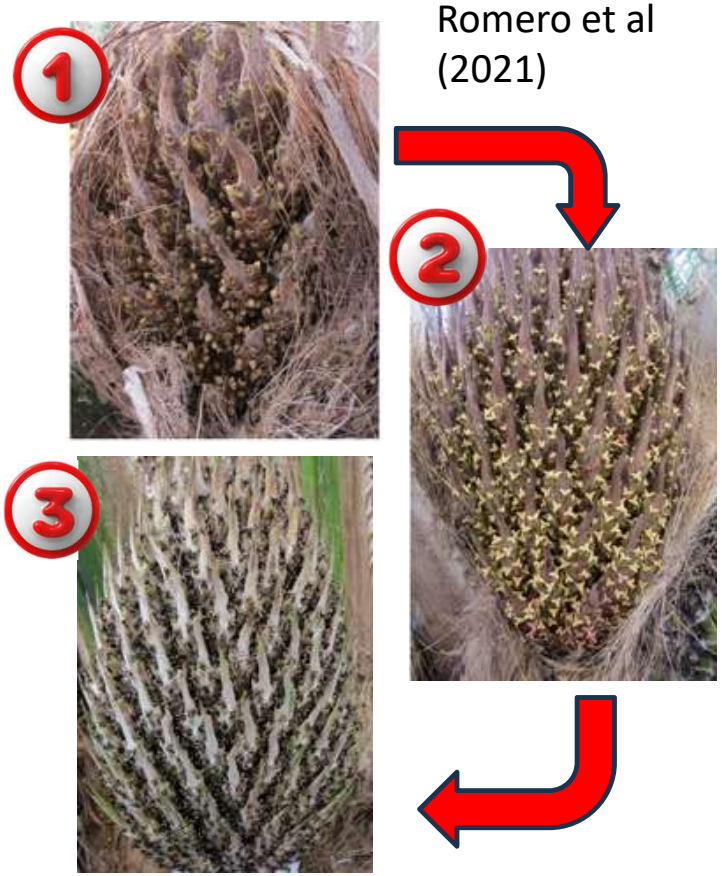
METODOLOGI RISET

Chemiical Artificial Pollination

Naphthalene Acetic Acid (NAA) application

Acuan Tahap Perkembangan Bunga : standart BBCH (***Biologische Bundensartalt Bundessortenamt und Chemische Industrie***)

Romero et al (2021)



3 Tahap Perlakuan NAA pada Bunga Betina :

1. ***Pre-anthesis* III (603)**
   Bunga belum mekar, *rachis*/tangkai bunga membuka lebih kuat.
2. ***Anthesis* (607)**
   Bunga mekar, >70% *tepal*/kelopak & mahkota bunga terbuka, tepal berwarna krem.
3. ***Post-anthesis* (609)**
   Fase transisi bunga betina menjadi tandan, terjadi penyerbukan bunga betina, terjadi perubahan warna ungu pada *stigma* bunga (7 hari setelah anthesis).

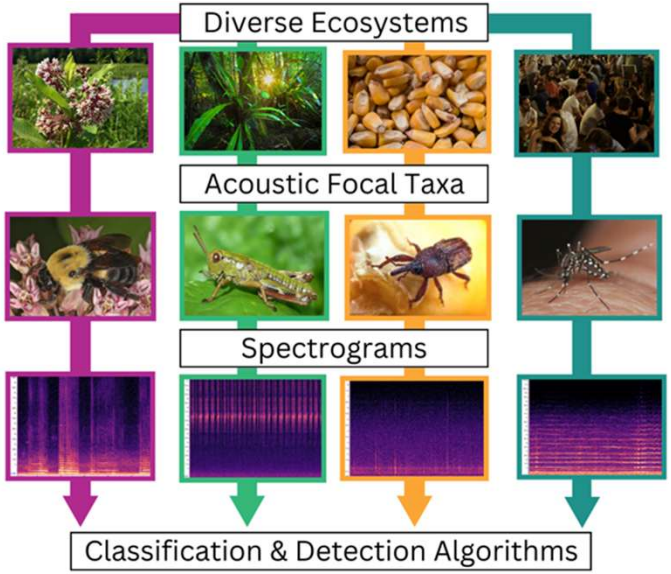
Aplikasi pada 20 pohon (replikasi), kepadatan ± 115 pohon/ Ha.

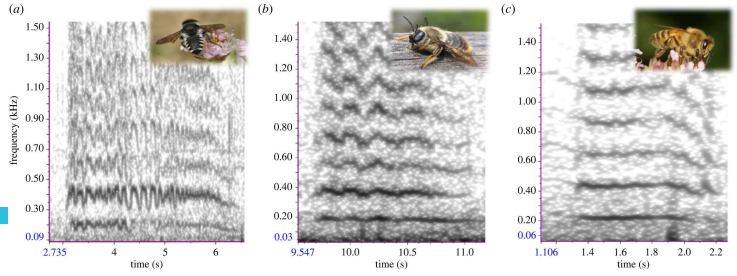
Perlakuan terdiri dari campuran NAA dengan 0,25% Adjuvan penetrant, 0,2% surfaktan non-ionik Tween 80, dan 2,5% etanol. Total dosis 200 mL disemprotkan per bunga majemuk.

METODOLOGI RISET

Bio-Acoustic monitoring : buzzing (flight sound)

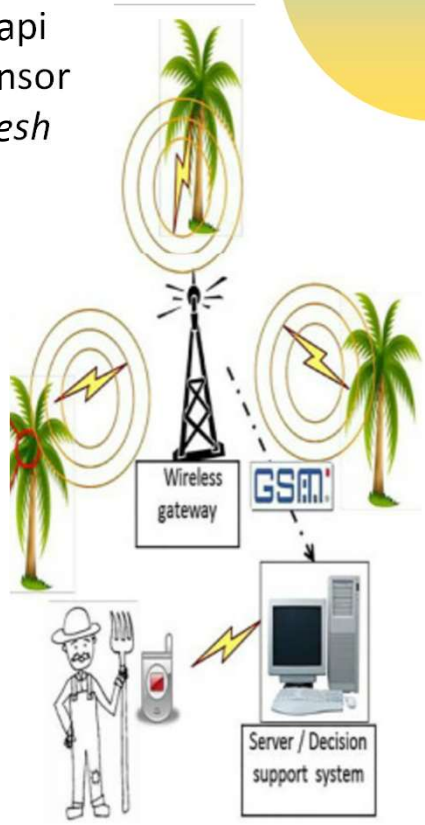
Bioacoustic Polli-Sensor





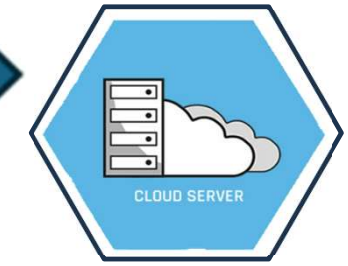
Pohon yang dilengkapi dengan unit Polli-sensor sebagai "*wireless mesh networks*"

Polli-Sensor gateway



Data transmission

Management software



GANTT CHART RISET

No	Kegiatan	Bulan Ke-											
		1	2	3	4	5	6	7	8	9	10	11	12
1	Rapat koordinasi dan persiapan												
2	Monitoring dan Evaluasi persiapan												
3	Perencanaan dan aplikasi Teknik *Hatch & Carry* - Pembuatan & penempatan kotak di demplot - Penetasan dalam kotak - Pelepasan kumbang ke lapangan + pengamatan *fruitset*												
4	Perencanaan dan aplikasi Attraktan NAA - Penyemprotan NAA pada bunga betina : *Pre-anthesis III*, *Anthesis, Post-anthesis* - Pengamatan *fruitbunch & fruitset*												
5	Perencanaan & monitoring dengan Bioacoustic - Instalasi unit Polli-Sensor pada tanaman - Harvest dan Pengelolaan Data : Polli-Sensor gateway, transmisi data, manajemen software												
6	- Analisa data *fruitset & fruitbunch*												
	- Analisis dan Kompilasi Data dari Acoustic Spectogram												
	- Identifikasi flight sound serangga polinator												
7	Penyusunan laporan akhir project												

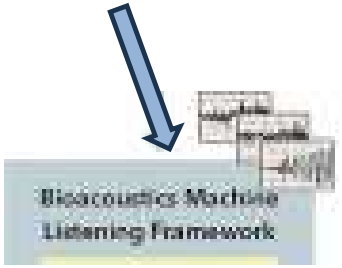
LUARAN RISET

1 Produk

Komposisi atraktan NAA, unit *Hatch & Carry*

2 Prototype

Unit Bioacoustic "Polli-Sensor"

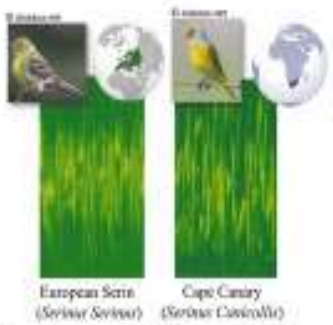


3 Paket Sistem "*Polinator-friendly*"

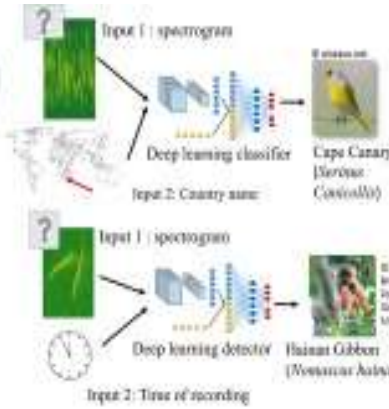
Paket sistem peningkatan & monitoring pollinator : polinasi terbantu + polinasi artifisial + bioacoustic sensor

Monitoring wildlife with acoustic recorders produces large volumes of data that can require a lot of human effort to analyse

Deep learning has transformed acoustic classification and detection, but achieving high accuracy and low false positive rates remains a significant challenge



Spectrograms (visual representation of acoustic recording) can appear similar, however, we can use **metadata** such as geographical location to tell them apart



Our findings show that by incorporating **metadata** can improve the performance of deep learning classifiers, with a range of potential applications ecology

RENCANA ANGGARAN RISET

RINCIAN	SAT	QTY	HARGA	TOTAL
1. Honororarium				**31.111.250**
Project Leader	Rp.	1	15.635.000	15.635.000
Project Member	Rp.	3	5,158,750	15,476,250
2. Biaya Bahan				**245.816.000**
Teknik Hatch & Carry	paket	1	54.216.000	54.216.000
Aplikasi Attraktan NAA	paket	1	61.000.000	61.000.000
Pembuatan prototype Bioacoustic Polli-Sensor	paket	1	130.600.000	130.600.000
3. Lain-lain				**81.570.000**
Transportasi, akomodasi, pengangkutan sampel & alat	paket	1	35.785.000	35.785.000
Jasa (Programer : API ; Desktop)	paket	1	45.785.000	45.785.000
TOTAL				**358.497.250**

STRUKTUR TIM RISET

Indah Trisnawati D.T., M.Si., Ph.D
Team Leader

Mukhammad Muryono, M.Si., Ph.D

Prof. I.D.A.A. Warmadewanthi, M.T., Ph.D

Dr. Dhany Arifianto, S.T., M.Eng.

DAMPAK RISET (NON FINANCIAL & FINANCIAL)

Non-Financial

- Mendukung usaha PT BGA berinovasi dalam teknik terintegrasi praktek agrikultur yang berkelanjutan.
- Mendukung PT BAG dalam mengurangi ketergantungan pada penyerbuk alami untuk produksi.
- Meningkatkan kehati dan kesehatan lingkungan / ekosistem dalam perkebunan sawit,.
- Memberikan wawasan baru tentang dinamika penyerbukan dan interaksi serangga-tumbuhan kelapa sawit
- Mendukung target SDG's
  (SDGs 12) Responsible consumption and production
  (SDGs 15) Life on land

Financial

- Meningkatkan kuantitas dan kualitas hasil tandan buah dan fruit set.
- Memperbaiki dan meningkatkan keberlanjutan perekonomian perkebunan sawit, hingga 15.04% - 21.05% fruit set, amount of oil dari 8.6 ke 11.1 ton CPO/ha (naik 29%)
- Menyediakan monitoring secara real-time untuk keputusan manajemen yang efektif.
- Dapat meningkatkan kesadaran pentingnya polinasi dalam agroekosistem dan peningkatan pendanaan untuk penelitian polinasi.

Bumitama Gunajaya Agro

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Terima kasih

Open Innovation BGA Tahun 2025