Agriculture, Biodiversity and Ecosystem Services in Malaysia

Rosliza J., Badrulhadza A., E.Elini E.A., Saiful Zaimi J., Nurin Izzati Z.,
Siti Noor Aishikin A.H., Hairazi R.
Malaysian Agricultural Research and Development Institute (MARDI)

Outline of presentation

1. Sustainable development in agriculture and policy
2. Research on ecosystem services in agriculture
3. Way Forward
4. Conclusion

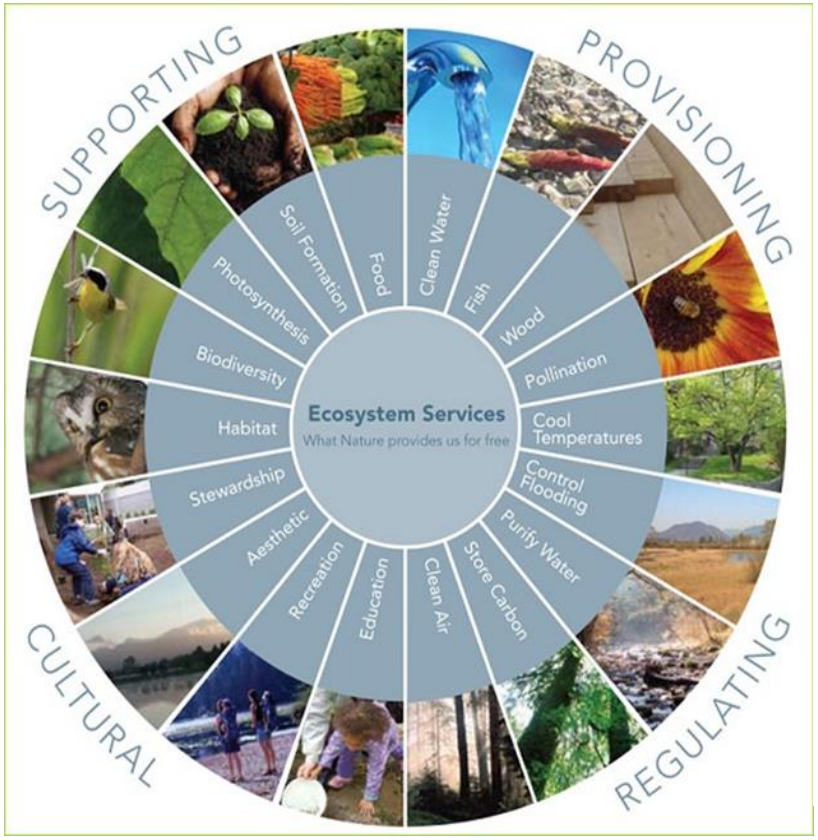
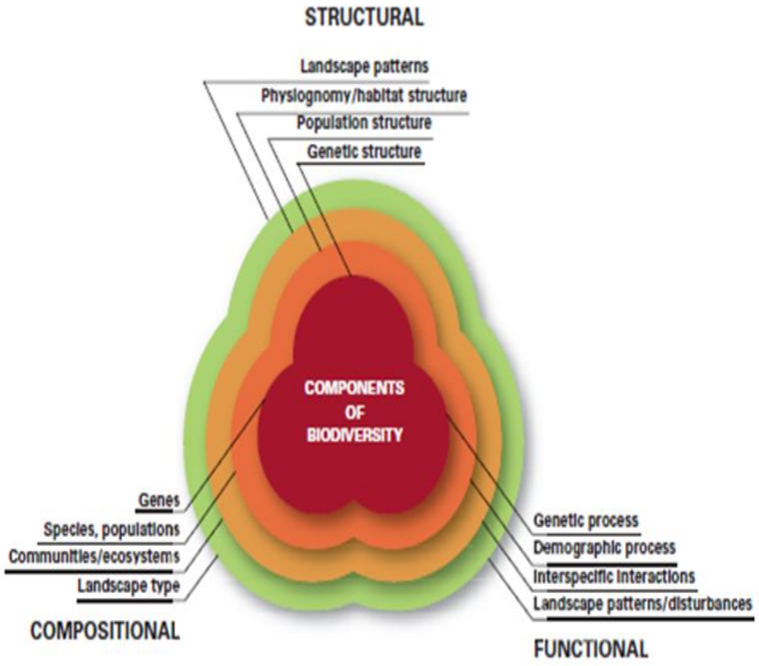


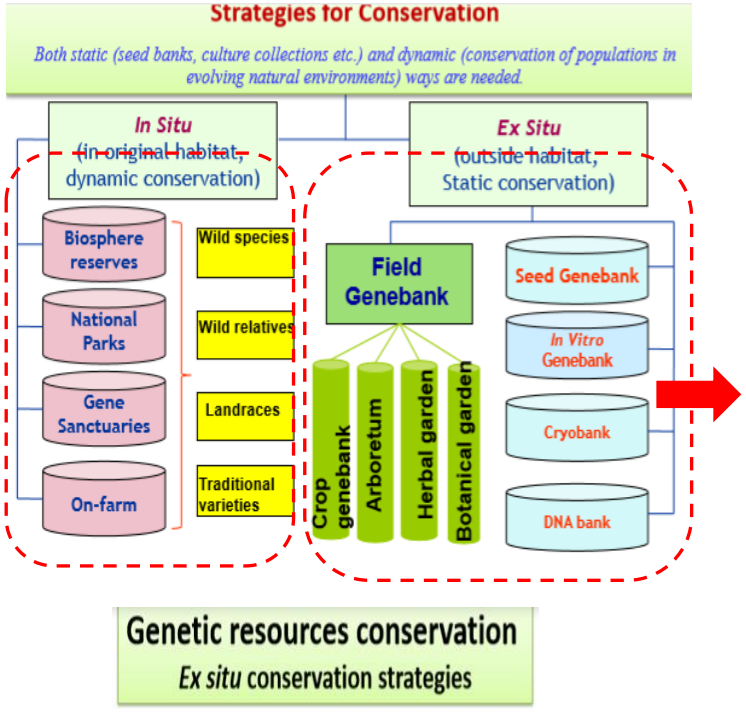
FIGURE 6

Different scales of agricultural biodiversity that support ecosystem services upon which agriculture is based (Adapted from Noss, 1990)



Agroecosystems, in particular through sustainable use of soils, may provide **important** regulating, as well as provisioning services including climate change mitigation and food production.

Biodiversity & Food System



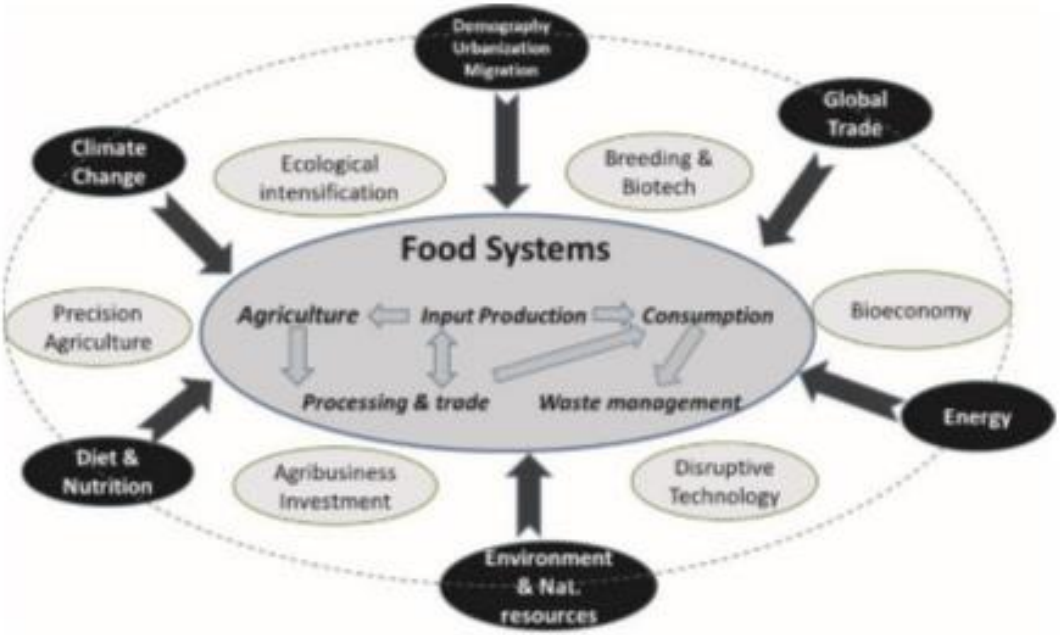
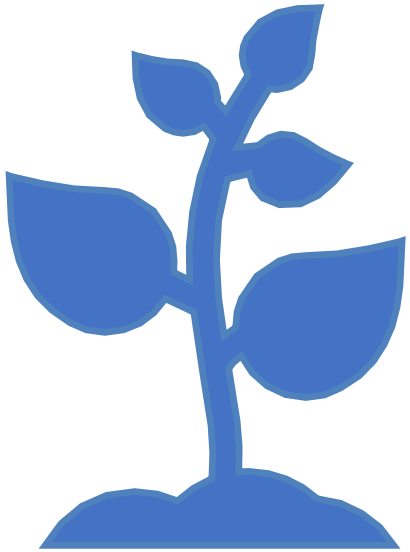
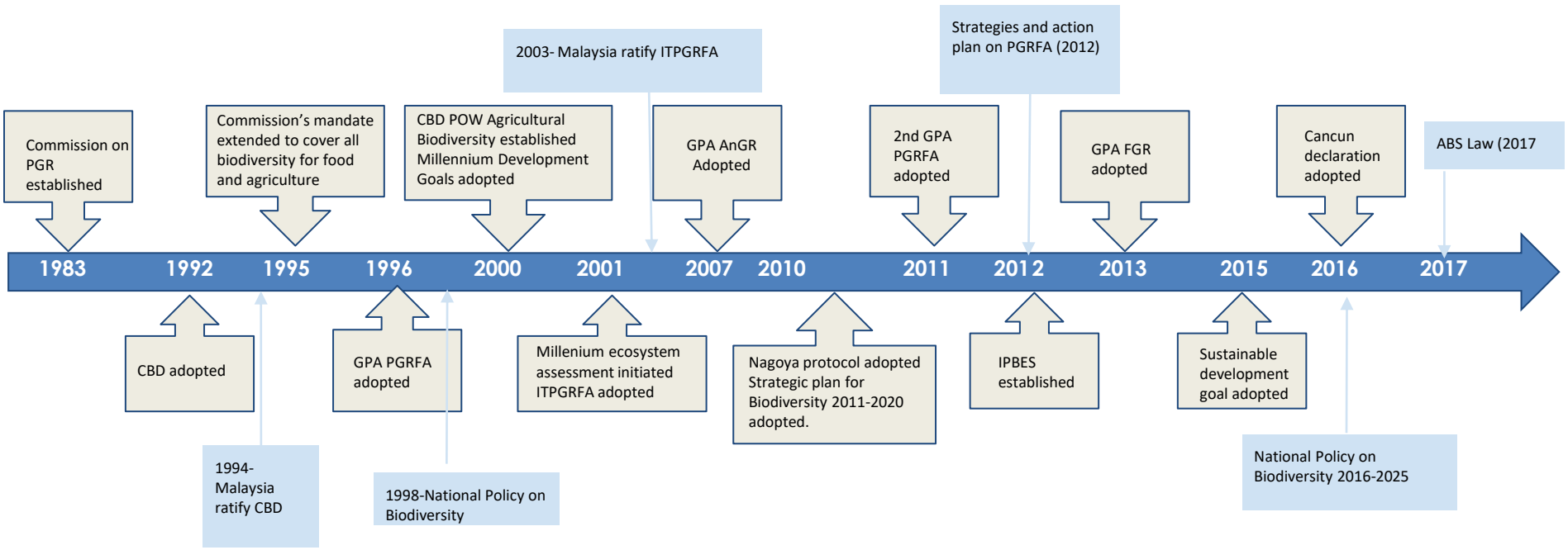


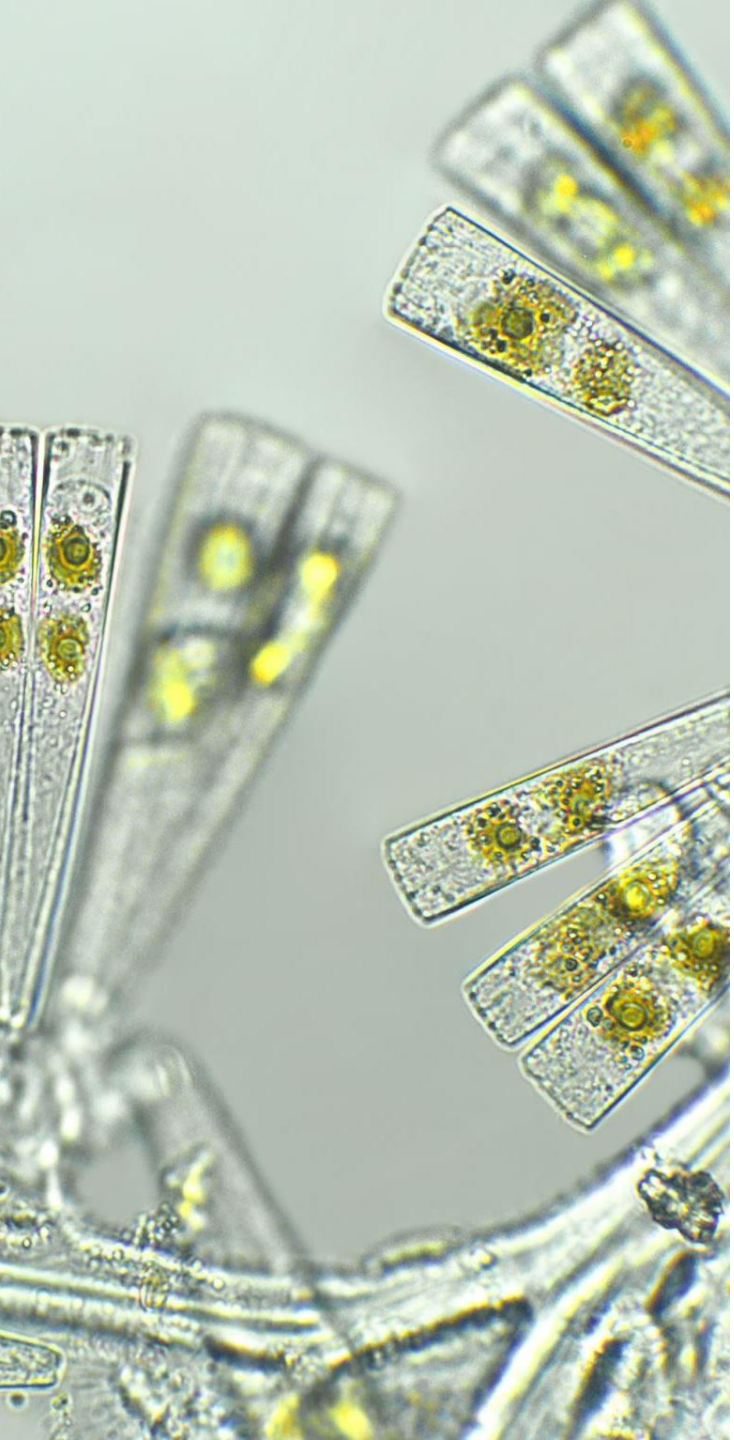
Fig. 1.1. Key drivers or threats (dark ovals) and opportunities (light ovals) of agri-food systems.



Sustainable development in agriculture and policies

KEY DEVELOPMENTS IN THE INTERNATIONAL RECOGNITION OF THE IMPORTANCE OF BIODIVERSITY FOR FOOD AND AGRICULTURE (IPBES)





Research on ecosystem services in agriculture by MARDI

- Biological control agent
- Ecoengineering in fruit ecosystem
- Ecoengineering in vegetable ecosystem
- Ecoengineering in rice ecosystem
- Valuation of ecosystem services

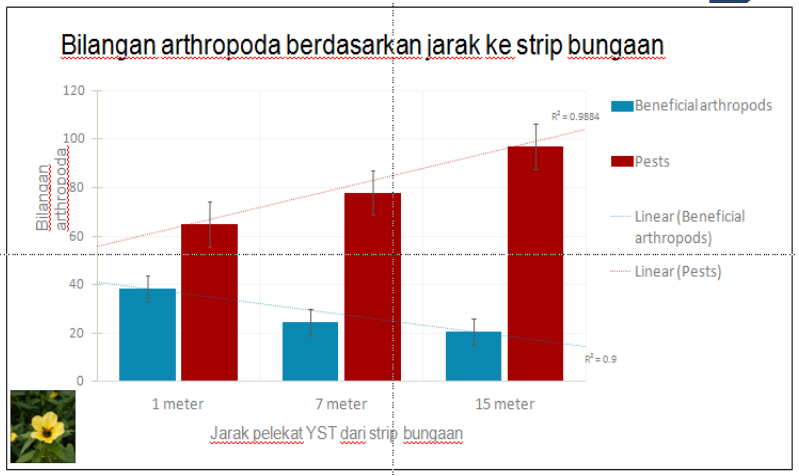
BIOLOGICAL CONTROL & BIOPESTICIDE APPLICATION IN VEGETABLES ECOSYSTEM

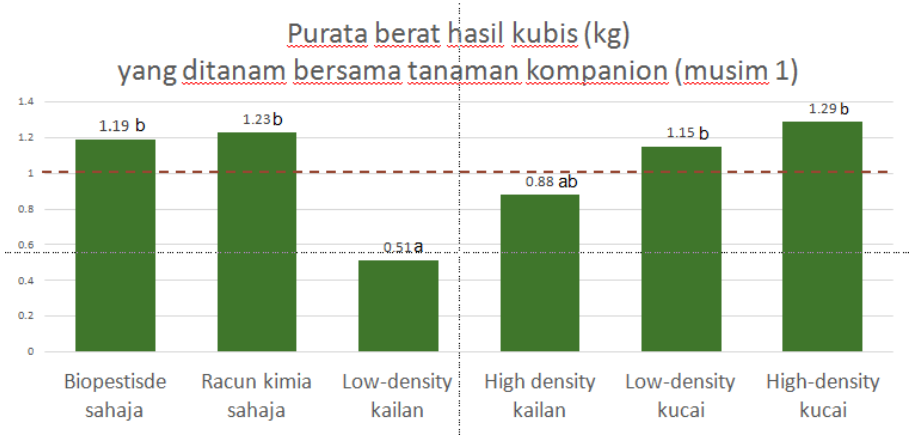
ECOENGINEERING WITH COMPANION CROPS TO REDUCE PEST IN CABBAGE FIELD

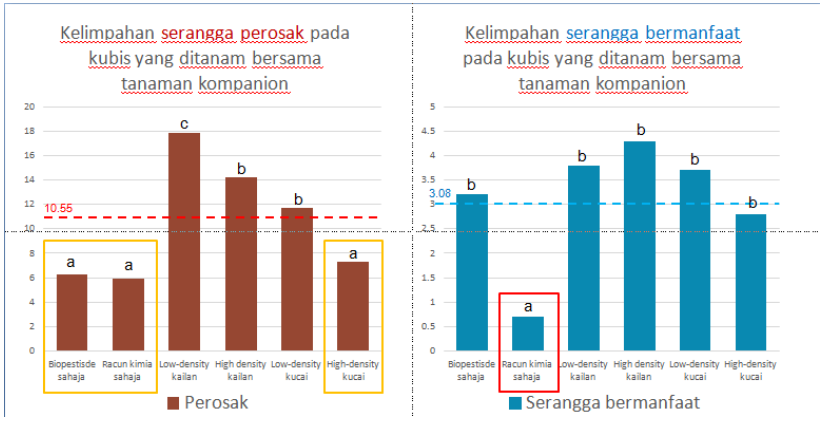
Control - Convensional

Best Yield – High Density Kucai

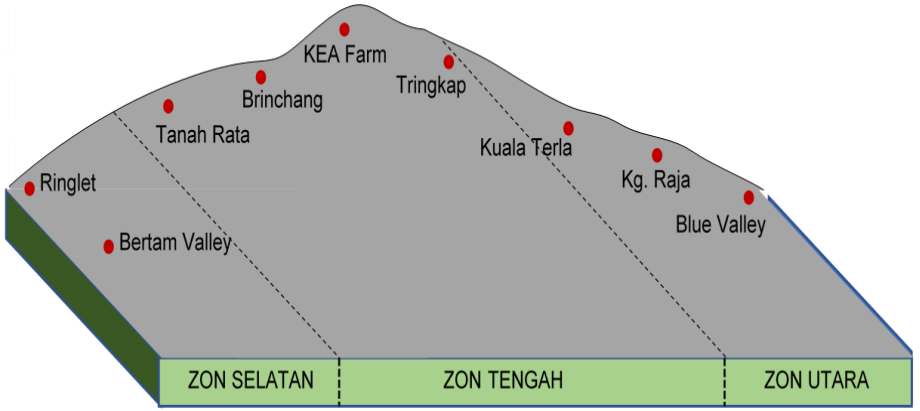
Worse Yield – Low Density Kailan







BIOLOGICAL CONTROL AGENT STATUS IN CH



Population of *P. xylostella* and percentage of parasitism in cabbage filed in 3 main zone in Cameron Highlands in year 1990, 1995 and 2011

	Pest/Biocontrol	Southern zone/year			Middle zone/year			North zone/year		
		1990	1995	2011	1990	1995	2011	1990	1995	2011
1.	*P. xylostella* (bil/10 pokok)	11.08	18.20	12.38	7.35	16.70	15.50	10.33	29.10	18.55
2.	*D. Semiclausum* (%)	3.95	10.40	5.29	27.70	17.00	6.00	5.33	5.30	9.78
3.	*C. vestalis* (%)	11.90	9.00	4.78	7.55	2.80	1.50	10.33	2.80	2.07

1) Syed AR, Sivapragasam A, Loke WH, Fauziah I. (1997). Classical control of diamondback moth: the Malaysian experience. In: Sivapragasam A, Loke WH, Hussan AK, Lim GS (eds.) The Management of diamondback moth and other crucifer pests: Proceedings of the Third International Workshop, Kuala Lumpur, Malaysia, 29 October -1 November 1996. Pp. 71 - 77.

2) Saiful Zaimi, J. Abu Zarim, U., & Mohamad Roff, M.N. (2011). A Survey of insect parasitoids of Plutella xylostella in Cameron Highlands, Malaysia. National Horticulture Conference 2011, 18-12 October 2011, Hotel Renaissance, Melaka

Biocontrol agent rearing

rearing *Plutella xylostella*

Biocontrol Lab in MARDI Cameron Highlands

Mass rearing of biological control

Preparation of cabbages in pots

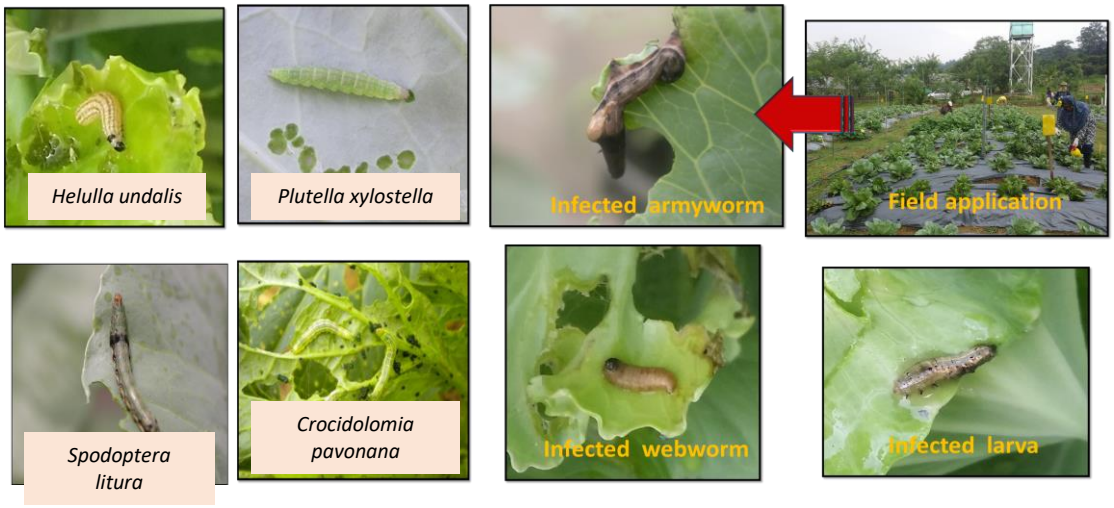
Rearing of *Plutella xylostella* as host for the parasitoid

Rearing biocontrol agents- *Diadegma semiclausum* and *Cotesia vestalis*

BIOPESTICIDE

Multi Virus Biopesticide

- Multi virus biopesticide (FMNPV) contains nuclear polyhedrosis virus (NPV) dan granulosis virus (GV)
- Suitable for controlling Lepidopteran pest on crucifers - cabbage webworm, diamondback moth larvae, tobacco armyworm and cabbage heart-caterpillar
- Application: by spraying (using knap sprayer etc)



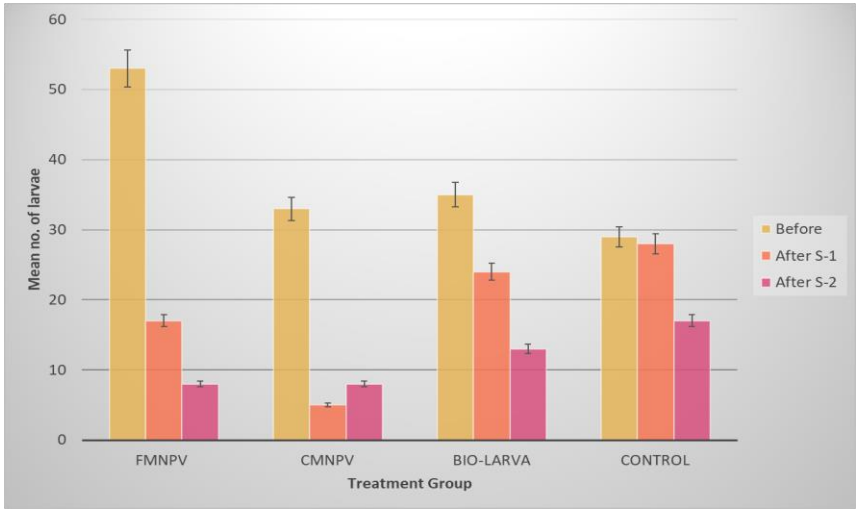
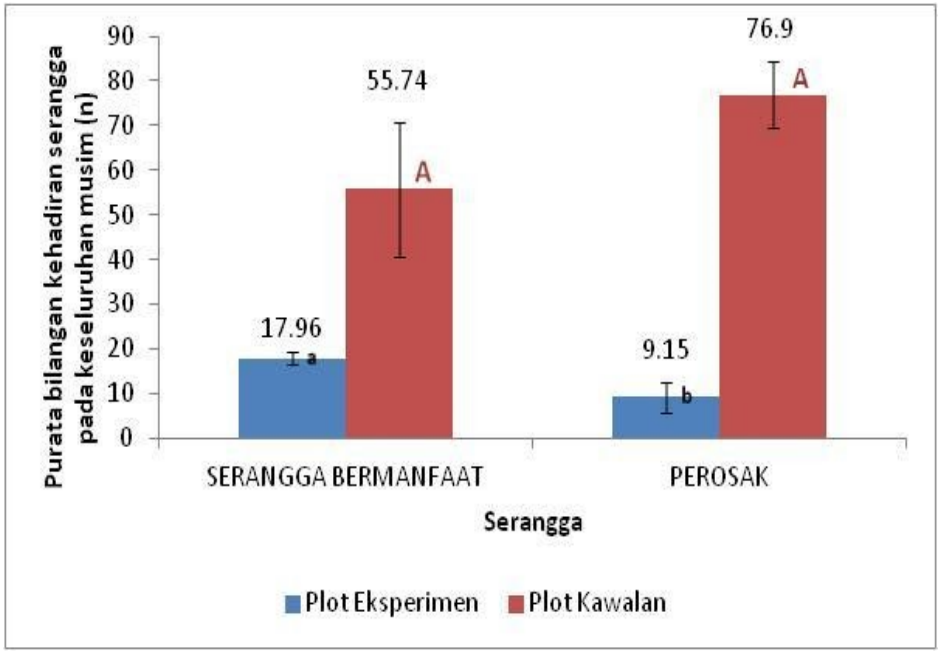


Fig. 1: Mean no. of larvae before and after spray between treatment groups (organic farm)

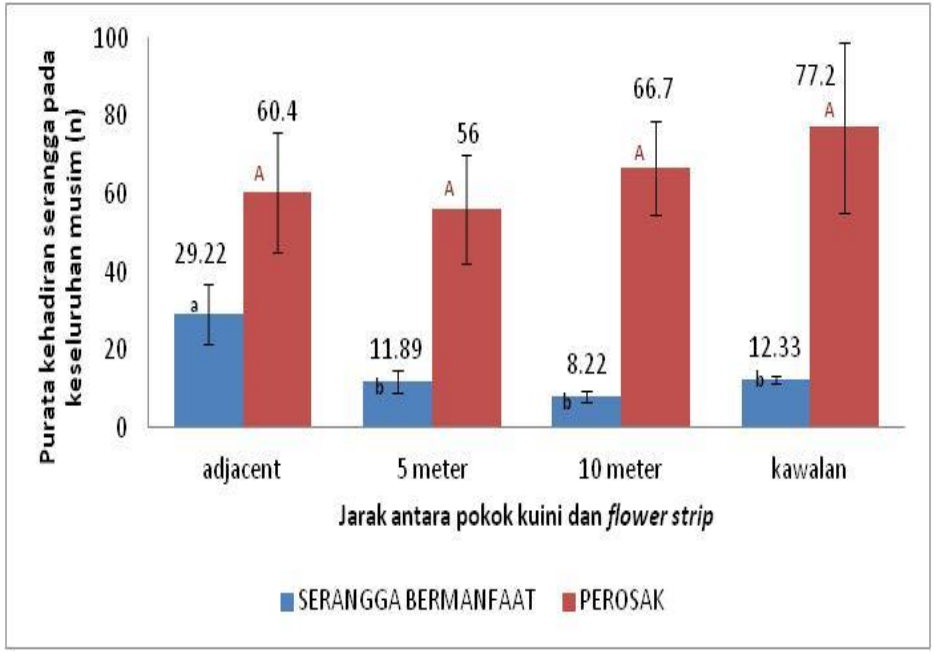
ECOENGINEERING IN FRUIT ECOSYSTEM

Ecoengineering in mangifera farm

- Pests and diseases are a major problem for *Mangifera* crops in Malaysia.
- The establishment of flower strips is an alternative method that can be used in the management of environmentally friendly pests in agriculture.
- This concept involves cultural practices such as vegetation management in habitat manipulation that works to increase the presence of beneficial insects consisting of predatory insects and parasitoids at the same time to help control biological pests



Comparison of average no of insects recorded in mango trees with three different distances from the flower strip.



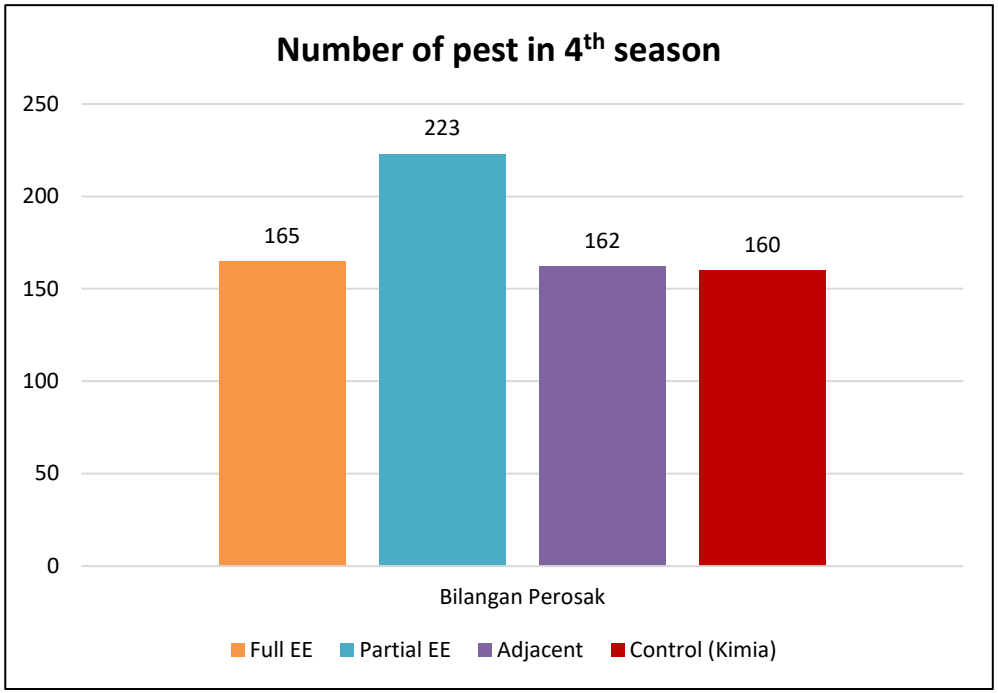
ECOENGINEERING IN RICE ECOSYSTEM

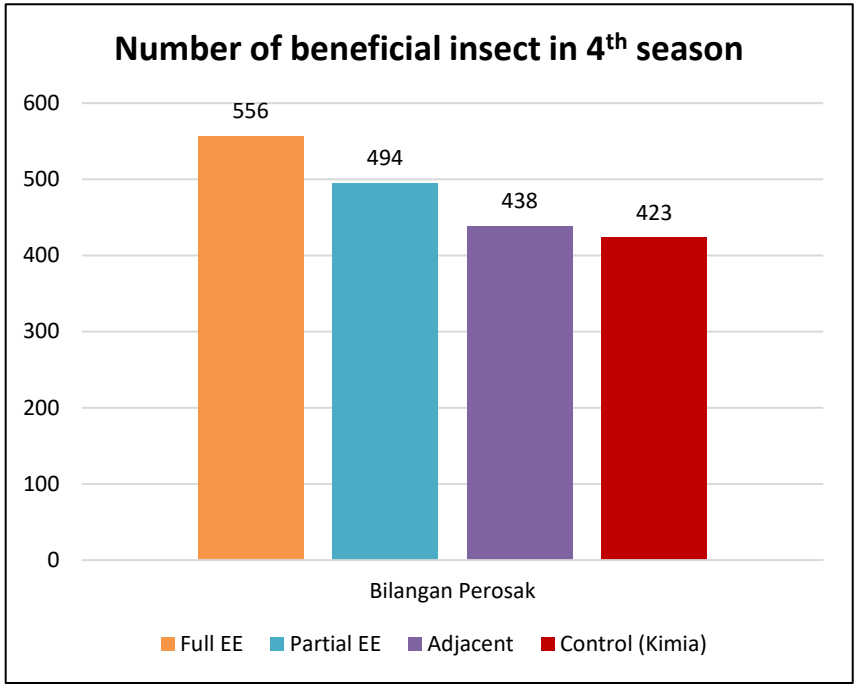
Collaboration MARDI-IADA Barat Laut Selangor

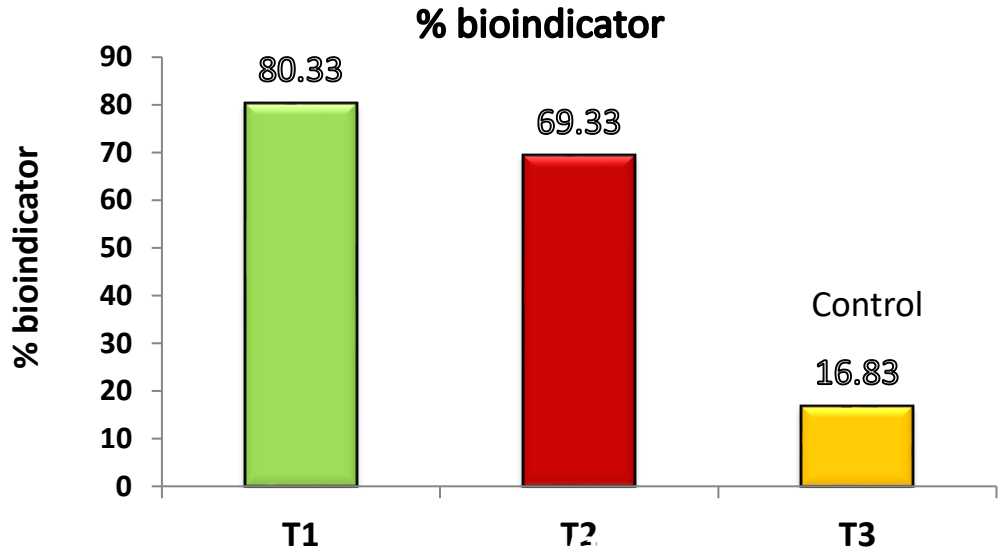
- Parit 2, Sg. Hj. Dorani, Sg. Besar, Selangor
- Planting seasons 2016-2017

YST

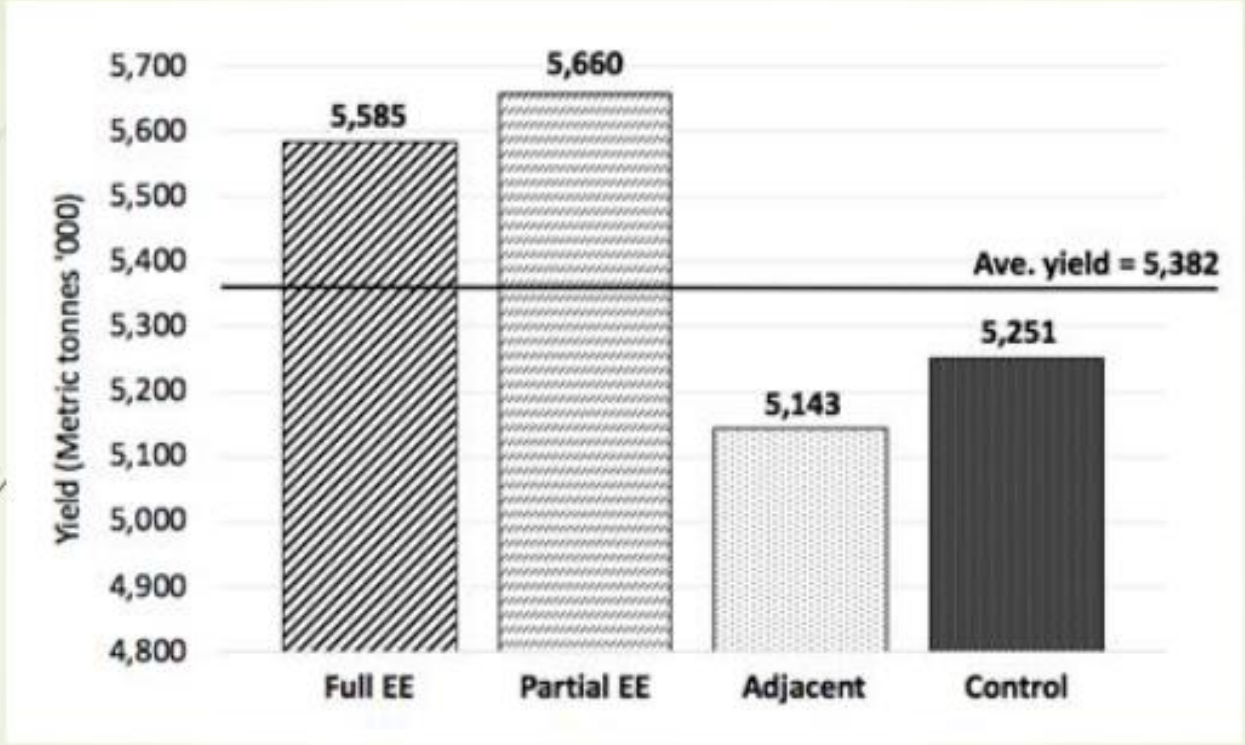
POLLEN AND NECTAR SOURCES FOR BIOCONTROL AGENTS







% bioindicator (e.g. Chironomus spp.) which related to pesticide usage. High number of bioindicator shows healthy environment and free from pesticide.



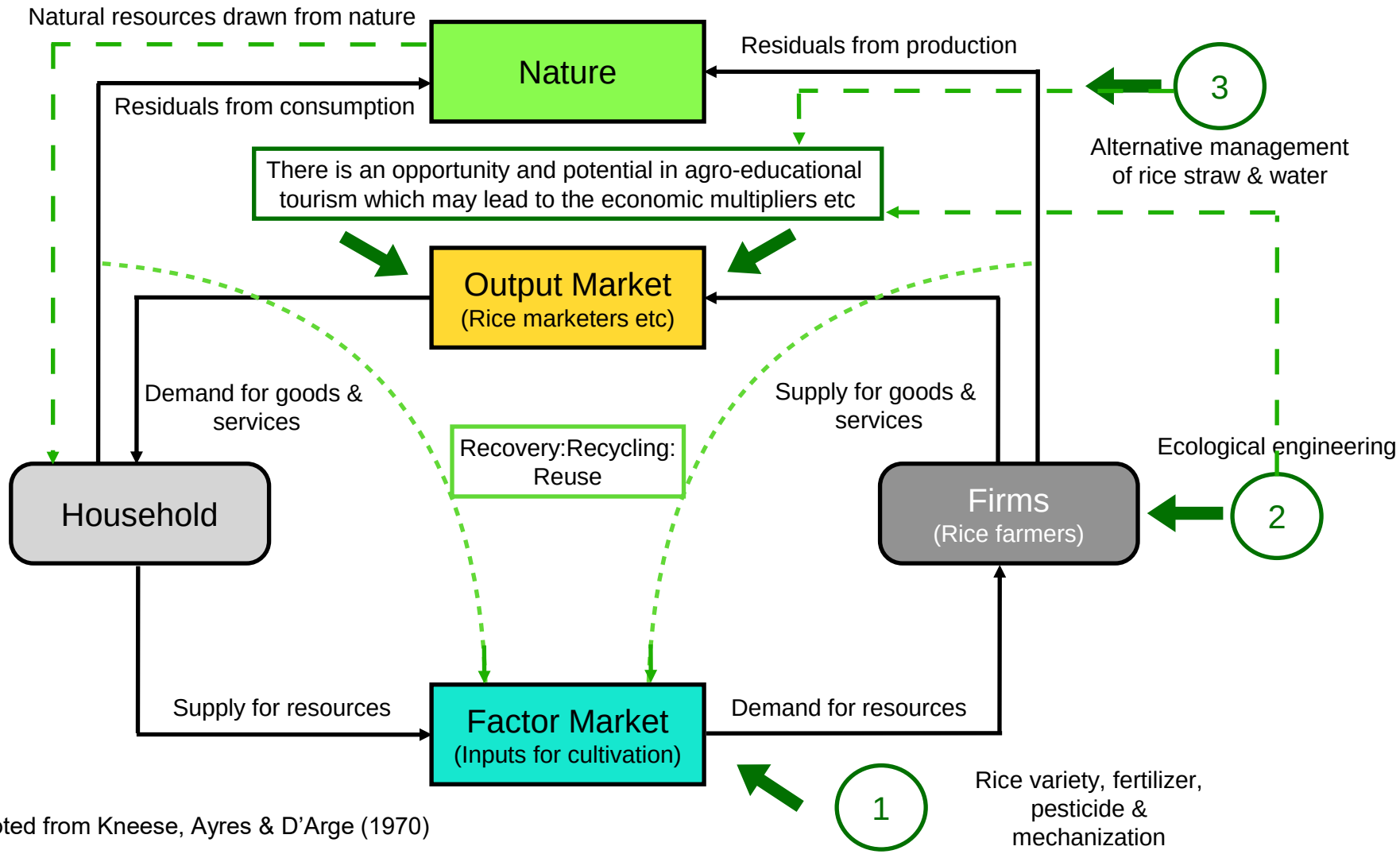
Average yield for 3 seasons

Benefit	Value (RM)	Implication	Value (RM)
Additional outputs		**Cost increment**	
Outputs more than 1.24 MT	RM 1,860.00	Cost for flower seeds	RM 200.00
		Cost for flower seedlings (estimated)	RM 1,200.00
Cost reduction		**Cost reduction**	
Pesticides	RM 200.00		
Services for pesticide spraying	RM 100.00		
Total	= RM2,160.00	Total	= RM1,400.00
Benefit value – implication value = RM760.00			

Ecoengineering vs conventional partial budget

Materials Balance Model *adapted in rice production cycle*

Research efforts by MARDI in enhancing sustainable agriculture in line with conservation of natural resources



Adopted from Kneese, Ayres & D'Arge (1970)

3

THE ALTERNATIVES OF RICE STRAW DEGRADATION AND WATER MANAGEMENT TOWARDS SUSTAINABLE ENVIRONMENTAL QUALITY

Alternative Management of Water Management in Rice Planting Experiment

Treatment	Water Management Alternative
T1 (Control)	Continuous flooding throughout the season (3-5 inches of standing water)
T2	Saturated conditions from tillering stage until heading and flooding until maturity
T3	Saturated conditions throughout the season *(without standing water)*

Comparison of Straw Management Practices in Rice Planting Experiment

Item	Without Microbe (T1 Control)	With Microbe (T2)
Method	• Straw burning (dry season) • Soil incorporation (wet season)	• Dumped (1.5 - 2.0 meters) • Use of microbes is active • It took about 3 weeks
Advantages	• Killing soil pathogens	• Restores essential nutrients (NPK, Ca, Mg, S & Si)
Disadvantages	• Stimulates germination of weeds & rice paddy • Environmental pollution • Affects the rate of seed germination • Loss of 8 - 10% of K element	• Stimulates the germination of weeds and rice paddy • Specific moisture and temperature requirements
Cost (wage)	• MADA – RM 60 • PBLS – RM 128	• Not yet determined

Source: Hairazi Rahim, Aimi Athirah Ahmad & Engku Elini Engku Ariff (2020). Penilaian Ekonomi Pengurusan Alternatif Jerami & Air dalam Penanaman Padi: Kajian Kes MADA & IADA Barat Laut Selangor. *Laporan Projek Sosioekonomi Pusat ES 2019*. Ms. 197-205

3 How much of emission reduction estimated from these alternatives?

Comparison of GHG Emission between Conventional and Alternative Practices

Indicator/Item	Straw Alternative (PBLS)		Water Alternative (MADA)		
	T1	T2	T1	T2	T3
Total Emission Calculated (mg/m2/season)	9599.23	8768.42	13125.1	8352.38	8598.34
Reduce Methane Released (%)		8.65%		36.36%	34.49%
Total Emission Calculated (kg/hectare/season)	95.99	87.68	131.25	83.52	85.98
Total Released (MT/hectare/season)	0.10	0.09	0.13	0.08	0.09
CO2 Equivalent (MT)*	2.40	2.19	3.28	2.09	2.15
Current Price (RM/ MT CO2 Eq)**	62.71	62.71	62.71	62.71	62.71
Total Price Released (RM/MT/hectare/season)	150.49	137.47	205.77	130.94	134.80

Note: *(Brander and Davis, 2012); ** (Brad and Nadja,2019)

Source: Hairazi Rahim, Aimi Athirah Ahmad & Engku Elini Engku Ariff (2020). Penilaian Ekonomi Pengurusan Alternatif Jerami & Air dalam Penanaman Padi: Kajian Kes MADA & IADA Barat Laut Selangor. *Laporan Projek Sosioekonomi Pusat ES 2019*. Ms. 197-205

3 And how much the environmental value (in monetary benefits) can be reap from these alternatives?

Estimated Monetary Benefits of Alternative Straw & Water Management Applications

Granary	Planted Area (ha)	Straw Alternative	Water Alternative	
		T2	T2	T3
MADA	100685	RM1,311,925.55	RM7,534,258.55	RM7,145,614.45
IADA Barat Laut Selangor	19057	RM248,312.71	RM1,426,035.31	RM1,352,475.29
KADA	28072	RM365,778.16	RM2,100,627.76	RM1,992,269.84
IADA Kerian	21108	RM275,037.24	RM1,579,511.64	RM1,498,034.76
IADA Seberang Perak	14140	RM184,244.20	RM1,058,096.20	RM1,003,515.80
IADA Pulau Pinang	12782	RM166,549.46	RM956,477.06	RM907,138.54
IADA Ketara	4876	RM63,534.28	RM364,871.08	RM346,049.72
IADA Kemasin Semerak	5053	RM65,840.59	RM378,115.99	RM358,611.41
IADA Pekan	5322	RM69,345.66	RM398,245.26	RM377,702.34
IADA Rompin	2920	RM38,047.60	RM218,503.60	RM207,232.40
Total Monetary Value		**RM2,788,615.45**	**RM16,014,742.45**	**RM15,188,644.55**

Source: Primary data and Ministry of Agriculture (2019)

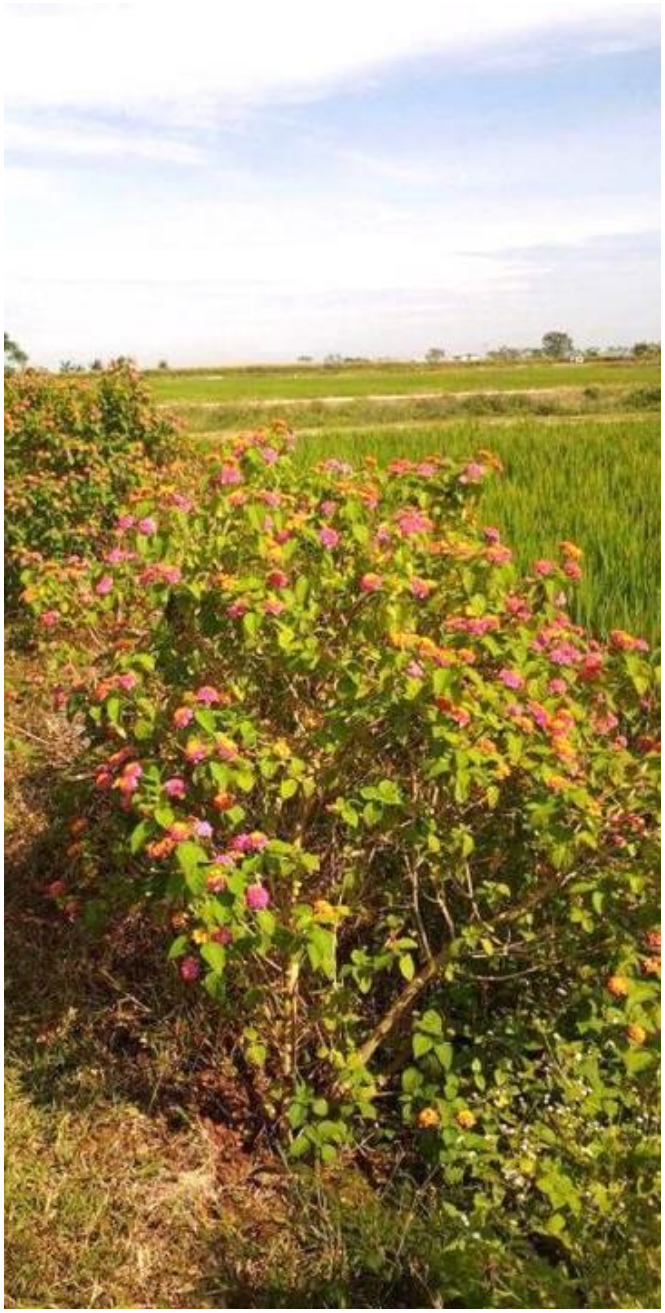
Optimistic scenario (nationwide implementation)

- Water alternative - RM15,188,644.55 until RM16,014,742.45 per season
- Straw alternative - RM2,788,615.45 per season

Source: Hairazi Rahim, Aimi Athirah Ahmad & Engku Elini Engku Ariff (2020). Penilaian Ekonomi Pengurusan Alternatif Jerami & Air dalam Penanaman Padi: Kajian Kes MADA & IADA Barat Laut Selangor. *Laporan Projek Sosioekonomi Pusat ES 2019*. Ms. 197-205

Siaran di akhbar dan media sosial

https://www.hmetro.com.my/agro/2018/02/315492/bendung-serangan-makhluk-perosak



Ecoengineering at FELCRA, Seberang Perak

Ecoengineering at MARDI, Tanjung Karang

ECOENGINEERING PLOT IN TANJUNG KARANG, SELANGOR

HYBRID RICE PLOT IN LADANG MERDEKA, MULONG KELANTAN.

Way Forward

- Integrated ecosystem services valuation needed to support agroecology transition

Conclusion

Agroecosystem should be treated as an important asset in an economy

• Ecosystem services should be valued in a similar manner as any other forms of wealth

• Need to understand the economics and ecology in assessing ecosystem services and their values and implications in a wealth accounting framework and to achieve sustainable development goals (SDGs)