



# OIL PALM AGROFORESTRY

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# Agroforestry

**AGROFORESTRY** – a set of specific practices that combine trees, crops and/or livestock at different scales:



**Plot scale**, a practice that combines woody perennials (trees, shrubs, palms, bamboos, etc), agricultural crops and/or animals on the same land management unit in some form of spatial arrangement or temporal sequence to obtain income, food, fodder, fuel, building materials, etc.



**Landscape scale**, the intersection of farmers and forest and all trees in agricultural land and multi-functional landscapes produce and provide ecosystem services locally, regionally and globally.

## Oil Palm Agroforestry

A mixture of oil palm, perennial crops, annual crops and or livestock/fisheries, with oil palm population varying from 30-80% of the oil palm population in a monoculture system.

### Why Agroforestry/ Oil Palm Agroforestry?

- Agroforestry has various socio-economic and environmental benefits and advantages and increases resilience to the effects of climate change.
- Oil palm agroforestry has the potential to contribute to the sustainable pathway through a greener palm oil supply chain, i.e., efficient in the productive use of land, efficient in the labour and capital, and reduced environmental impacts.

# The Benefits and Advantages of Agroforestry

## At plot level

- **Efficiency in land uses:** Land Equivalent Ratio, i.e., the sum of relative yields of all components compared to a 'current practice' monocultural production mode, is higher than 1.
- **Efficiency in the use of labour:** Return to Labour is higher than the daily wage rate indicating that agroforestry is profitable .
- **Efficiency in the use of capital:** Net Present Value (discounted flow of financial equivalents of all inputs and outputs of a land-use system; dependent on the discount rate used) is higher.
- **Increased livelihood resilience and food security** through diversified income and food sources along the year.
- **Flexibility and risk management (high adaptability to the local context):** maintenance of multiple options in the face of variations in weather, prices, labour availability, pests and diseases e.g Ganoderma.
- Maintained and improved soil fertility and biodiversity of soil macrofauna.
- Increased aboveground (agro)biodiversity .



van Noordwijk M, Coe R, Sinclair FL. 2019. Agroforestry paradigms. In: van Noordwijk M, ed. *Sustainable development through trees on farms: agroforestry in its fifth decade*. Bogor, Indonesia: World Agroforestry (ICRAF) Southeast Asia Regional Program. pp 1-14.



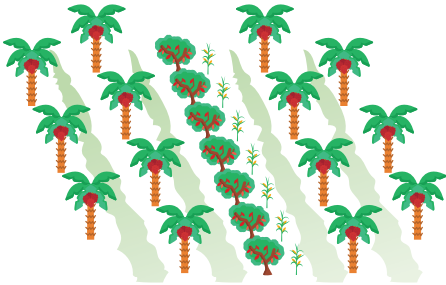


## At landscape level:

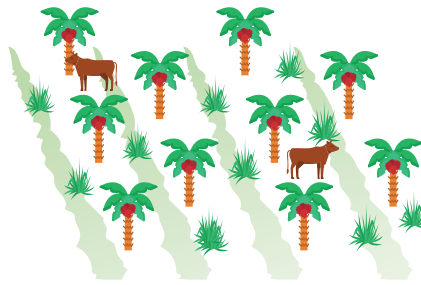
- **Biodiversity and Ecosystem services maintenance:**
  - Carbon sequestration and less GHG emissions → climate change mitigation;
  - Buffering capacity of watersheds from fluctuations in rainfall → climate change adaptation;
  - Biodiversity (including above and belowground macrofauna) in situ and habitat quality improvement for wildlife and pest predators, increased richness and diversity of insect pollinators.
- **New jobs in rural areas** for non-agricultural activities such as harvest and post-harvest processing, including for women → gender equality in rural areas.
- **Reduced erosion and prevention of landslides** in sloping land, trees can because of the strong root system around the soil matrix.
- **Avoided deforestation and degradation:** avoidance of degradation of the resource base beyond the natural recovery capacity.

# Options of Oil Palm Agroforestry Designs

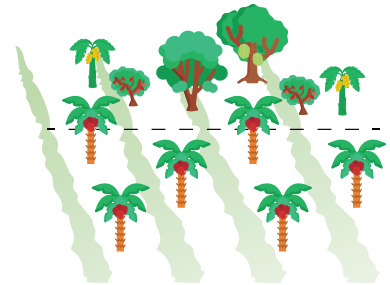
**1** Single or double row with annual or perennial crops



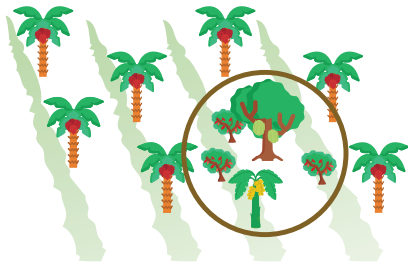
**2** Agrosilvopastoral: livestock and fodder



**3** Split plot with perennial crops (fruits or timber)



**4** Sisipan with annual or perennial crops



**5** Border with perennial crops (fruits or timber)



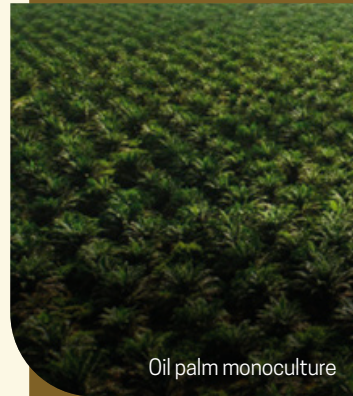
## Designing Oil Palm Agroforestry

### Things to consider in designing oil palm agroforestry

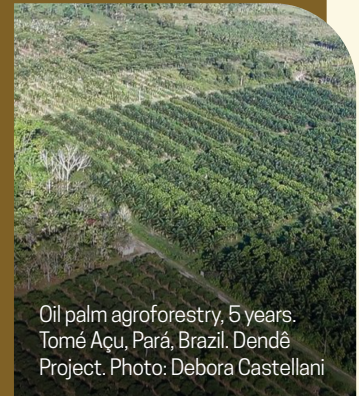
- **Choice of the companion tree/crop species:** Farmers' preference, biophysical suitability – govt program alignment, market demand.
- **Oil palm population:** varies from 30-80% of monoculture system to remain profitable.
- **Potential the tree/crop species:**
  - **Fruit trees:** cocoa, dogfruit, stink bean, matoa, longan, avocado, mangosteen
  - **Palm:** sugar palm, areca nut
  - **Timber trees:** mahogany, teak, *Shorea* sp.
  - **Annual crops:** ginger, galangal, turmeric, kale, spinach, cayenne pepper, eggplant, cucumber, long beans, watermelon
- **Spacing** between oil palms and companion trees/crops - the horizontal and the vertical distance.
- **Supply stability:** meet the processing capacity of palm oil mills (in terms of quality and quantity) by increasing the capacity of independent smallholders.

## Monoculture VS Agroforestry

### (Oil palm agroforestry in Brazil)



Oil palm monoculture



Oil palm agroforestry, 5 years. Tomé Açú, Pará, Brazil. Dendê Project. Photo: Debora Castellani

### A double row of oil palm with annual and perennial crops:

- Annual crops: up to the first 3-4 years (cassava, maize, legumes)
- Perennial crops: cocoa, açai (*Euterpe oleracea*), banana, bacaba (*Oneocarpus bacaba*), pepper, timber, and legume.
- Land preparation: slash and fill, organic fertilizer.

# Land Productivity, Environmental and Economic Performance Indicators

Mixed oil palm+cocoa has more water percolating to groundwater reserves and a higher benefit-cost ratio (BCR) than oil palm monoculture and mixed oil palm+pepper. The Land Equivalent Ratio can be 1.44, showing considerable 'land sparing' potential relative to monocultures for each commodity separately.

Systems	Land productivity and environmental performances indicators				Economic performance indicators		
	Relative to mono-cultures	Relative to natural forest			NPV (USD ha <sup>-1</sup> )	RtL (USD Person day <sup>-1</sup> )	BCR*
	LER <sup>1)</sup>	C stock	WUE	Groundwater recharge			
Monoculture OP	1.00	0.20	0.85	1.02	11062	30.9	2.5
OP + Cocoa	1.44	0.15	0.69	1.13	14656	30.4	3.1
OP + Pepper	0.99	0.13	0.87	0.87	21603	12.9	2.1

Note:

- WUE= water use efficiency; NPV = Net Present Value; RtL = Return to Land;
- The Land Equivalent Ratio (LER) or the sum of relative yields of all components (with unsatisfied demand) compared to a 'current practice' monocultural production mode (LER values below 1 indicate that specialized (segregated) land use is more efficient than integrated ones)
- The benefit-cost Ratio (BCR) is the ratio of benefit and total production cost. BCR above 1 indicates profitable land use systems.

Khasanah N, van Noordwijk M, Slingerland M, Sofiyudin M, Stomph D, Migeon AF, Hairiah K. 2020. Oil palm agroforestry can achieve economic and environmental gains as indicated by multifunctional land equivalent ratios. *Frontiers in Sustainable Food Systems*. DOI=10.3389/fsufs.2019.00122.

The Livelihoods Funds collaborates with World Agroforestry (ICRAF) Indonesia, SNV Indonesia and MUSIM MAS under the Palm project, which strives to contribute to the sustainable pathway of the oil palm industry through promoting regenerative agriculture practices among independent smallholders. In particular, the project fosters the replanting of oil palm from the monoculture into agroforestry systems.

### **CIFOR-ICRAF INDONESIA PROGRAM**

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