

B. Nutrient and fertilizer recommendation for mature cacao trees based on 1 t DFCB/ha with 1,241 plants at 3 m x 3 m spacing

Nutrient	Nutrient Removal from cropping (kg/t per year)			Nutrient (kg/ha)	Fertilizer Grade	
	Cacao beans	Pod husks	Total		Per ha (kg)	per tree (g)
N	21.3	14.5	35.8	28.5	135 ^a	108 ^a
P	4.0	1.8	5.8	4.9	62 ^b	49 ^b
K	9.5	62.7	72.2	40.8	107 ^c	86 ^c
Ca	1.0	5.6	6.6	4.3	33 ^b	26 ^b
Mg	3.0	3.0	6.0	4.5	50 ^d	40 ^d

a-Ammonium sulfate (21-0-0)

b-Solophos (18% P2O5)

c-KCl (0-0-60)

d-Dolomite [CaMg(CO3)2, 12% MgO

Sensitivity Analysis of Coconut plus Cacao Cropping at different Coconut Fertilizer

Basic Assumptions in analysis:

- Price of inputs (fertilizer, wage rate, labor rates) are based on 2012 national average rates and prices.
- Price of Product (copra and cocoa beans) are based on 2012 national average farm gate prices. With corresponding 5% increase per year.
- Interest rate at 18% based on Land Bank of the Philippines 2012 interest rate.
- Yield estimates (copra and cocoa beans) in 5 years were generated from the BAS (2012) crop statistics for 2007-2011, while due to unavailability of data, yield estimates for the next 6-10 years were estimated using the moving average method of forecasting.

**Techno Guide on Coconut Intercropping
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**Coconut-Cacao
Intercropping**

Technology

CACAO

- In a small farm or a plantation, at least five recommended clonal materials to be grown at the same period, since cacao trees are normally incompatible in terms of flowering and pollination;
- Under monoculture, a 3 m x 3 m triangular spacing (1,241 plants/ha) is desirable to be grown when intercrop with coconuts (coconut-cacao long term cropping system);
- Recommended hybrid varieties are Criollo, Trinitario and Forastero (Phil. Recommends for Coconut, 1993). Commonly propagated by seeds grown in the nursery with regular watering as practical; seedlings are ready for transplanting in 6-8 months with 4-6 pairs of green true leaves are present; the use of budded clonal seedlings offers a true-to-type seedlings which achieve earlier higher yields;
- In the initial years of crop establishment, shade of other tree crops ("nurse crops") like coconut, *Gliricidia*, *Leucaeria* or *Erythrina* and other comparative crops is desirable; under coconut cacao monocropping system, shade trees are later pruned;
- Proper and timely pruning is required: 1) to train, shape and achieve the economical tree height; 2) to have adequate air circulation and sunlight penetration within the crop; 3) to minimize incidences of pest and diseases; and 4) to produce higher and quality yields;
- Adequate fertilization is an important component of the integrated crop management of the cacao or cocoa tree crop.
- The major insect pests of the crop are cacao pod borer (causes uneven ripening and unfilled beans), *Helopetis* (attacks immature pods) and *Apogonia* (leaf eaters) that are active at nighttime. While, the most important diseases are: black pod disease; red root disease (causing wilting and yellowing of leaves and eventual death of trees); white rot disease (causing wilting of leaves, leaving white mycelium and vascular streak disease (*Oncosbasidium theobromae*), characterize by brownish horizontal streak of infected twigs and causes the eventual death of shoots (Ministry of Agriculture of Malaysia).
- Harvesting – is done when pods turns yellowish or reddish orange in color. Pick cacao fruits only when they are fully mature (147 days) Harvesting should be done regularly to avoid overripe pods in the trees. Usually, the cacao crop has peak-harvest and off-season periods. The peak-harvest period is the result of flowering during the rainy season. Selective harvesting is done by hand using knives or machetes. Puling the pods from the tree damages the flower cushions and destroys the bark.

- The following are some of the very important considerations in the postharvest handling of cacao beans: 1) avoid injuring the beans during pod-splitting (pods cut open to extract the beans); 2) wet cocoa beans should undergo fermentation for 7 days in order to kill the seeds and enhance the chocolate flavor; 3) dry under the sun or by a mechanical dryer; 4) dried beans are kept in gunny sacks and stack on raised platforms. Avoid damp conditions to control fungus attack which lower the bean quality.
- Dried fermented cacao beans (DFCB) are best graded before marketing, following the acceptable or standard grading system in the country. The criteria for grading are the number of beans per 100 g, % fungus infection, % pest incidence and % slaty beans ("flat" beans).

COCONUT

With the coconut trees are already established and already at bearing stage, the main farming practices are fertilization, underbrushing-weeding, mulching of the main rootzone of coconut (also considered the fertilizing zone at trunk base of trees), and harvesting. Post-harvest and primary processing practices (seasoning of partially immature nuts for 7-10 days, dehusking and copra processing) are common in small to medium scale farms. If sold to coconut desiccating plants, dehusked nuts are immediately marketed. Coconut husks await decortication/defibering, while coconut shells are converted to charcoal and sold to activated carbon processors.

A separate fertilization for the stands of coconut and the cacao crop is recommended. There are two average inorganic/mineral fertilizer recommendations for coconut: 1) using the combination of single fertilizers (ammonium sulfate plus common salt (for potassium-rich soils) or potassium chloride (0-0-60) for soils deficient in K; and 2) using ready-to-apply multinutrient fertilizers as the 14-5-20-0.02 (B), now commercially available like COCOGROW (ATLAS Brand) in 25 kg. capacity bags.

These two fertilizer recommendations are compatible with the application of appropriate organic fertilizers (compost, cocopeat, commercial organic fertilizers). If capital resources to purchase organic fertilizers is available, any of these organic fertilizers (total N, P and K of at least 5%) may be applied together with the mineral fertilizers (options 1 and 2) indicated below at the rate of 3-4 times of the periodic rates indicated. Organic fertilizers should be applied about a month ahead of the application of the inorganic/mineral fertilizers. Organic fertilizers serve best as soil conditioners and fertilizer supplements to the coconut-cacao cropping system.

For Coconut

Option 1

Application of Single-Fertilizers (per tree):

6 months from FP	200 g AS + 200 g NaCl or 200 g KCl
1 year	500 g AS + 450 g NaCl or 600 g KCl
2 years	750 g AS + 750 g NaCl or 900 g KCl
3 years	1.0 kg AS + 1.25 kg NaCl or 1.5 kg KCl
4 years	1.25 kg AS + 1.35 kg NaCl or 1.70 kg KCl
5 years and onwards	1.50 kg AS + 1.70 kg NaCl or 2.00 kg KCl

AS – Ammonium sulfate (21-0-0);
NaCl – Sodium chloride (common salt);
KCl – Potassium chloride (0-0-60)

Option 2

Application of ready-to-apply multinutrient fertilizer (per tree):

Age/Stage	Rate of 14-5-20 (multi-nutrient Fertilizer ^a)
Field-planting (FP)	400 g
6 months from FP	600 g
1 year	1.25 kg
2 years	1.50 kg
3 years	2.00 kg
4 years	2.50 kg
5 years and onwards	3.00 kg

^a contains 14% N, 5% P₂O₅, 20% K₂O plus 15% Cl, 4.5% S, 0.02% Boron, Ca.

For Cacao

A. Average nutrient needs and suggested fertilizer grade for immature cacao plants (g per plant)^a

After field planting (month)	N	Nutrient P ₂ O ₅	Rate K ₂ O	MgO	Fertilizer Grade 14-14-14 ^b
1	6.4	6.4	6.4	-	45
4	8.5	8.5	8.5	-	60
8	8.5	8.5	8.5	-	60
12	12.8	12.8	12.8	-	92
18	17.0	17.0	17.0	-	121
24	27.3	27.3	27.3	4.5	192 ^c
Total	80.5	80.5	91.7	4.5	570

^a PCARRD 1989

^b Estimated from PCARRD's 1989 study

^c Plus 19 g KCl (0-0-60 fertilizer) + 30 g dolomitic limestone (dolomite)