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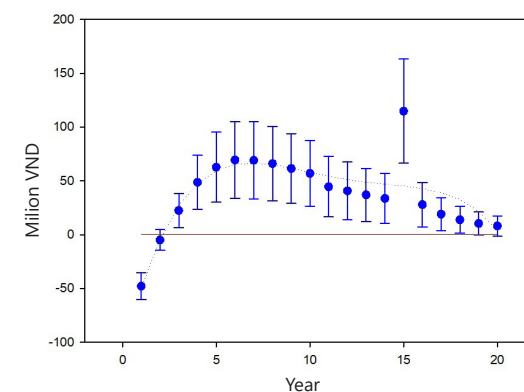
RESEARCH
PROGRAM ON
Forests, Trees and
Agroforestry

HARVESTING

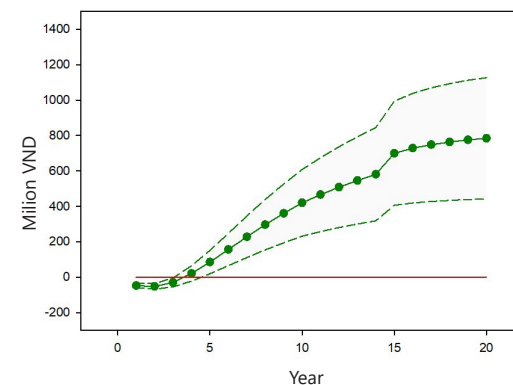
- The forage grass (mulato or guinea) can be harvested from 3 months after planting. Grass yield reach a peak in the second year, up to 15 tons/ha/year and reduce gently from the fifth year. In Northwest, it could be collected once in 30 days in the rainy season and 45 days in the dry season. Harvesting frequency depends on the number of cattle of each household, however, avoid late harvest to minimize loss of nutrients in stems and leaves after the grass has flowered. Replant grass after fifth year harvest to maintain efficiency.
- Time to harvest soybeans is when leaves turn to yellow, exposing the matured pods. Cut off and take the plant and pods, leave other residues on the field.
- Coffee bear fruits after 2 years of planting. It can be harvested when there are about 40-50% of fruits are ripe. Collect berries in 3-4 times to reduce labor cost and actively manage trees for the next year.
- Plums can be harvested after 3 years of planting. Harvest gently, avoid crushing and breaking branches / fruits. If a branch is too heavy with fruit, it is necessary to support the heavy fruit branches with the stakes.
- After 12-20 years, teak wood is ready for exploitation. Harvest by proper methods, then replace with seedlings or other tree species depending on household demand.

ECONOMIC EFFICIENCY

The total investment cost of the agroforestry option is 45 million VND per ha (containing materials and labor cost) and the agroforestry option could pay back of the loan/credit to farmers in the third and the fourth year. The first 5-years of data have been used for simulations up to 20 years based on different scenarios. The results have showed that the profit from the agroforestry option could reach about 70 million VND and 115 million VND/ha/year in the 6th year and 15th year, respectively. Profit from the 5th to 10th year can hit more than 50 million VND/ha/year and 30 million VND/ha/year in 11th to 14th year. The figure is lowered from 16th year to 8 million VND/ha/year.



A profit simulation of the agroforestry option over 20 years



A cumulative profit simulation of the agroforestry option over 20 years

PESTS AND DISEASES PREVENTION

1. PLUM

Some common pests and diseases harming to plum:

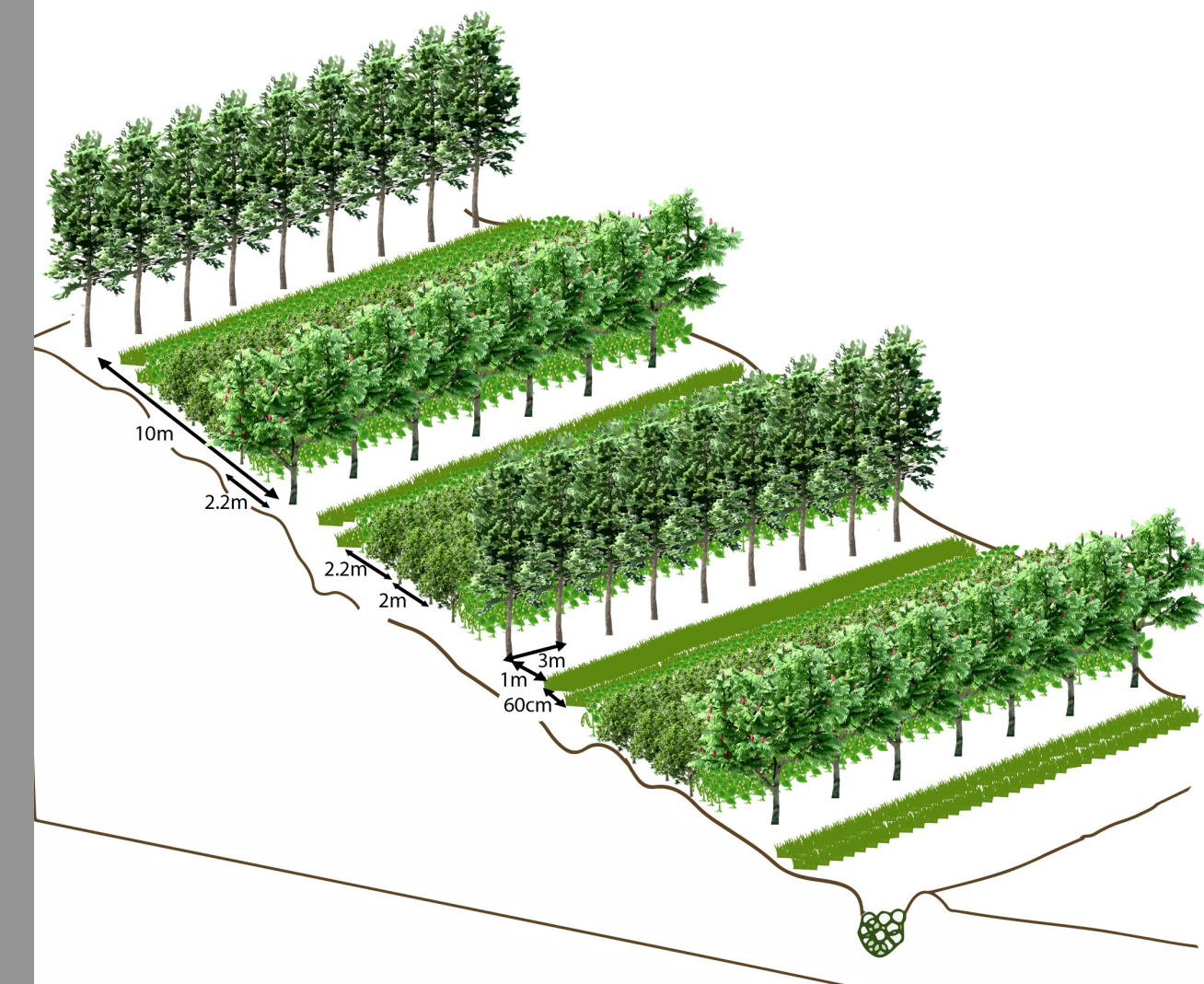
- Stem/ branch borer (*Cerambycidae*): Usually occur in March-April, causing dead and broken branches, stunted trees and death. Control by using a mixture of dense lime-water applied on the main stems, using pesticide with active ingredient *Fipronil* according to instructions (for example, Regent 0.3RG), spraying for prevention at the beginning and end of rainy season.
- Brown rot (*Monilinia fructicola*): This fungus infects fruit, creates brown rings and causes fruit to rot and. Control by pesticide with active ingredients *Cucuminoid* and *Gingerol* (for example, Stifano 5.5SL).
- Sap bleeding: Caused by fungus (*Phytophthora spp.*) in soil. Prevent by weeding, pruning branches close to the ground, and apply dense limewater mixture on the stem/ base. Use fungicides with active ingredient *Copper oxychloride* or *Copper hydroxide* according to using instructions (for example: Champion 37.5 SC, Viben - C 50 WP).

2. COFFEE

Some common pests and diseases harming to coffee:

- Stem borer (*Xylotrechus quadripes*)/twig borer (*Zeuzera coffea*): Normally, stem borer occurs and harms coffee trees from the third year onwards; the larvae destroy bark and bore into wood and cause trees to die; twig borers attack the base and bark/branches of tree; tree will wilt and die. Using pesticides with *Cartap* active ingredients according to the instructions (for example, Padan 95SP, spray evenly entire tree for prevention in April-May, October-November).
- Coffee green scale (*Coccus viridis*, *Saissetia hemisphaerica*): Attacks leaves and young shoots, sucking sap and causing defoliation and attracting black fungi. Prevent by weeding, cutting off branches bending downward. Do not intercrop coffee with cassava, orange, guava, tangerine, mango, or tea. Treat with pesticides having the active ingredient *Chlorpyrifos ethyl* according to using instructions (for example, Pyrinex 20EC).
- Mealybugs (*Planococcus spp.*): Attack fruit stem, fruit and flower, young parts of tree and cause fruit rot, leaf death and tree death. Use pesticides with the active ingredient *Chlorpyrifos ethyl* according to using instructions (for example, Pyrinex 20EC).
- Coffee red mite (*Oligonychus ilicis*): occurs in dry season and attacks leaves. The leaves lose their glossy appearance and turn a brown, yellow, or bronze color, and fall. Prevent by planting under shade of other trees, and apply adequate fertilizers. Use pesticides with *Emamectin benzoate* active ingredients according to using instructions (for example, Azimex 20EC, Autopro 700WP).
- Coffee rust (*Hemileia vataatrix*): Coffee rust is fungus that attacks coffee leaves. The first symptom is the formation of pale yellow spot on the underside of leaves; when expanding they become powdery, yellow to orange in color and cover the whole leaf causing severe defoliation, and a decrease in crop production. Usually occurs in March-April and November-December. Prevent by weeding and increasing amount of organic fertilizers. Using pesticides with *Copper hydroxide* active ingredients according to using instructions (for example, Map-Jaho, Norshield 86.2WG).
- Anthraxnose (*Colletotrichum gloeosporioides* Penz.): Causes wilting, withering, and dying fruits, branches and leaves. It may be caused by lack of adequate nutrition or a fungus. Manage by applying adequate fertilizer and destroy diseased branches. If caused by fungus, using pesticide with *Valydamycin* or *Mancozeb* active ingredients according to using instructions (for example, Suitcase, Valigreen or Vimonyl 72WP).
- Root knots caused by nematode (*Meloidogyne spp.*): Symptoms are chlorosis and defoliation in leaves, splits and rot in root system. Often occurs in one-year and two-year trees. Attack by root-knot may facilitate invasion by fungal pathogens (such as *Rhizoctonia solani*). Prevent by properly applying adequate fertilizer and lime-water sufficiently. Limit grubbing soil to avoid damaging the roots.

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AGROFORESTRY TECHNICAL MANUAL



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OPTION: TEAK - PLUM - COFFEE - SOYBEANS - FORAGE GRASS

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INTRODUCTION

Arabica coffee tree (*Coffea arabica*) has high economic value. In northern Vietnam, catimor, TN1 and TN2 cultivars are planted popularly. Coffee trees are adapted to tropical highland climates where the average temperature ranges from 20-25°C, the minimum temperature is not less than 0°C. Rainfall averages between 1,200-1,900 mm per year and is evenly distributed throughout the year. Ideal relative humidity is 70% and coffee is negatively affected by strong winds. After the rainy season, coffee starts to differentiate flower-buds and requires the low temperatures and shorter day-lengths. Hence, when designing an agroforestry option including coffee, it is necessary to intercrop with windbreaks and shade trees to increase coffee productivity and quality.

Plum trees (*Prunus salicina*) flourish in cool and cold weather, it requires an average temperature of 18°C, varying from 0-35°C. Plums grow well in the soil with high moisture, high relative humidity with annual rainfall ranging from 1,600-2,800 mm and moderate intensity light. Plum trees can be grown on different of soil types, suitable in porous soil which is retentive of moisture and well drained, with pH from 5.5-6.5, protected from winds.

Teak (*Tectona grandis*) is a large, tall and deciduous tree up to 30-40 m. Its timber is high quality, dark yellow or brownish brown in color, high durability without splitting and cracking, resistance to termite and waterproof. In Northwest, teak trees are usually harvested after 18 to 20 years after planting. In the agroforestry option, teak trees serve as windbreaks for plum and coffee trees and increase income for farmers when harvested.

In this agroforestry option, forage grass lines (mulato or guinea) are planted on contour lines, under teak and plum trees to reduce soil erosion and provide food for livestock. Soybeans are intercropped between coffee trees before the canopy closes, usually in the first 3 years. Soybeans contribute to soil fertility, diversify products and increase income for households.

DESIGN

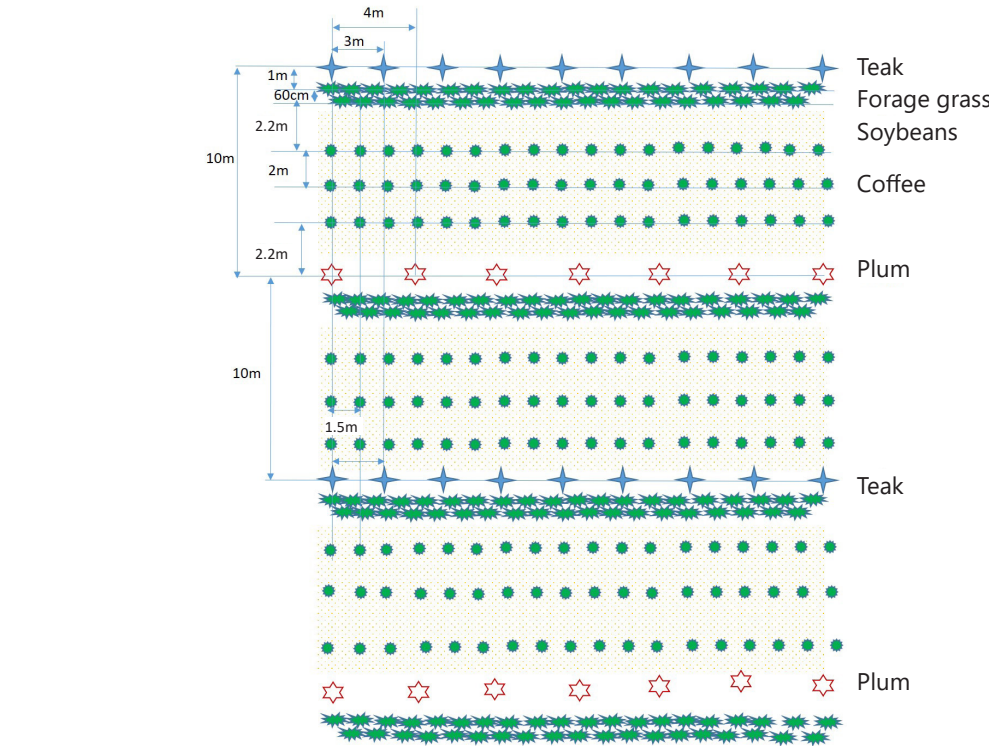
Contour planting is designed in the agroforestry option to prevent soil erosion

Teak/plum trees are planted in rows, 10 m apart. In each row, distance between teak trees is 3 m (about 204 trees per ha) and 4 m for plum (about 125 trees per ha).

Two rows of forage grass (mulato or guinea) are planted closely and 1 m apart from each teak/ plum row. Spacing between a double grass row is 60 cm. In a row, grass cuttings are planted 40 cm apart (about 1.5-2 tons of grass per ha). Grass could be grown by seed, however, to reach a high performance, it should be sown in nursery then plant seedling on field as designed above.

Coffee trees are planted 2.2 m apart from the double grass row. Thus, with this design, three rows of coffee are planted (between grass and teak/ plum rows) with row spacing of 2 m and tree spacing is 1.5 m (coffee density 2000 trees per ha).

Soybeans are intercropped between coffee rows, about 30 kg of seeds/ha/season.



Distance and layout of trees and crops in Teak - Plum - Coffee - Soybeans - Forage grass option

PLANTING TECHNIQUES AND FERTILIZING

1. PLUM

Planting hole: The size of a hole is 60 cm x 60 cm x 60 cm or 80 cm x 80 cm x 80 cm.

Basal fertilizer application: Apply 10-12 kg manure and 0.3-0.5 kg NPK in the ratio of 5:10:3 (or equivalent) for each hole before planting 30 days and cover the hole by soil.

Top dressing fertilizer application:

- In the first to third year: Apply 12-15 kg manure and 1kg NPK in the ratio of 5:10:3 (or equivalent) per tree.
- From the fourth year onwards: Apply 15-20 kg decomposed manure, 2 kg NPK in the ratio of 5:10:3 (or equivalent) per tree.
- Applying: Done three times (the 1st) in March-April, apply all manure and 30% of NPK. (the 2nd) in June-July, apply 30% of NPK. (the 3rd) in October-November, apply the remaining NPK. Dig a trench of 15-20 cm deep under the canopy, spread fertilizer evenly then cover by soil.

2. TEAK

Planting hole: The size of a hole is 40 cm x 40 cm x 40 cm

Basal fertilizer application: Apply basal fertilizer of 0.6 kg NPK.

Top dressing fertilizer application: Annually, apply 0.2 kg NPK/tree/year in the first two years.

3. FORAGE GRASS

- Dig a grassy trench 20-25 cm deep on the contour lines, which is below teak and plum rows. The forage grass grow very fast, it therefore will be prevented the nutrients and fertilizers run following along the slope.
- The forage grass can utilize nutrients and fertilizers from runoff; it is unnecessary to apply fertilizer for grass.

4. COFFEE

Planting hole: The size of a hole is 40 cm x 40cm x 40 cm.

Basal fertilizer application: Apply 5-6 kg manure and 0.6 kg NPK per hole before planting 30 days and cover the hole by soil.

Top dressing fertilizer application:

- Apply three times per year in the beginning, at mid and end of rainy season (March-April/ June-July/September-October).
- First year: Apply 30 kg Urea, 360 kg Superphosphate, 21 kg Potassium chloride per ha.
- The 2nd year: Apply 54 kg Urea, 180 kg Superphosphate, 33 kg Potassium chloride per ha.
- The 3rd year: Apply 108 kg Urea, 180 kg Superphosphate, 102 kg Potassium chloride per ha.
- Harvest years: Apply 180 kg Urea, 180 kg Superphosphate, 180 kg Potassium chloride per ha.

5. SOYBEANS

Plant along contour line between coffee rows. Dig the holes for sowing seeds at distance of 70 cm between rows with plant spacing of 20 cm.

Basal fertilizer application: Apply 16 kg Urea, 100 kg Superphosphate, 30 kg Potassium per ha, cover by 2-3 cm of soil before sowing.

Top dressing fertilizer application: When soybeans plant has 3-4 leaves, apply fertilizer of 16 kg Urea and 30 kg Potassium per ha, 3-5 cm away to plant and cover by soil.

PRUNNING AND CANOPY FORMATION (1)

1. PLUM

In establishment period

- Prune off the top of the tree at 60-70 cm above the graft union to promote branching.
- When those branches develop well, keep 3-4 strong branches growing equally in all directions, called primary branches. Again, cut the top of those primary branches when they reach about 60 cm to boost secondary branches. Keep two to three those branches facing in all directions.
- Similarly, repeat with secondary branches to create the third level branches. Remove any suckers at ground level and any shoots on the trunk below the graft union.



Teak - Plum - Coffee - Soybeans - Forage grass option in Co Noi, Mai Son, Son La province

PRUNNING AND CANOPY FORMATION (2)

- Pruning time: Prune annually after harvesting (around October) and before flowering (from February to March). Remove dead, damaged, broken and diseased/weak twigs, crossing branches, twigs growing downward, stubs, water sprouts and suckers, or thin whole plants out if necessary.

2. TEAK

From the third year, do pruning on the lower part of tree (from the base to half height of tree). Remove broken and diseased branches.

3. COFFEE

- Regularly remove suckers/ shoots growing at ground level on the trunk below graft union. Keep only main trunk. If the main stem breaks, choose an alternate healthy stem to dominate.
- Remove suckers, dead, damaged, broken and diseased/ weak twigs, crossing branches, downward growing branches, pruning secondary branches if too dense.
- Cut away all the dead and dry primary branches, and branches growing downward.
- Prune off the top of the tree if it is taller than 1.6 to 1.8 m, remove new shoot growing out.
- Maintain regular pruning, particularly after harvesting.
- If coffee trees are old and no longer yield, it is possible to prune old trees for rejuvenation 2-3 months after harvest. Use a saw to cut off and remove trunk about 20-25 cm away from the ground, cutting at an angle of 45°, with crossing face avoiding sun exposure.



Plums for fruits after 3 years in Teak - Plum - Coffee - Soybeans - Forage grass option at Co Noi, Mai Son, Son La province