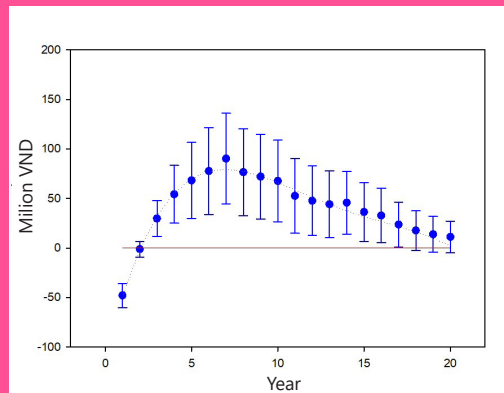
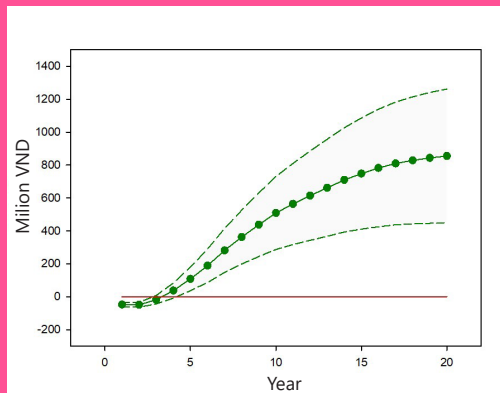


ECONOMIC EFFICIENCY

Total investment cost of the agroforestry option is 55 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 to 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 profits of the agroforestry option increase progressively and peaks in the 7th year. From the 4th to 11th year, the agroforestry option could get profits of more than 50 million per ha per year and more than 30 million from 12th to 16th year. Then there is a decline to 11 million in the 20th year.



A profit simulation of the agroforestry option over 20 years



A cumulative profit simulation of the agroforestry option over 20 years

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RESEARCH
PROGRAM ON
Forests, Trees and
Agroforestry

PESTS AND DISEASES PREVENTION (1)

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).

- Anthracnose (*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 *Valydamicyn* 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.

HARVESTING

1. FORAGE GRASS

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.

2. LONGAN

Grafted longan usually bears fruit from the second or third year, yet in accordance with tree growth, it is possible to cut flowers off and just keep fruits from the 4th year onwards. Longan harvesting season in Northwest is from 15th August to 5th September. Collecting longan fruit should follow requirements of the market, avoid crushing fruits and breaking branches.

3. SOYBEANS

Time to harvest soybeans is when leaves turn to yellow, exposing the matured pods. Cut off and take the plant and pods, leave leaves on the field.

4. COFFEE

Coffee bear fruits after 2-year establishment. 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 next year.

PESTS AND DISEASES PREVENTION (1)

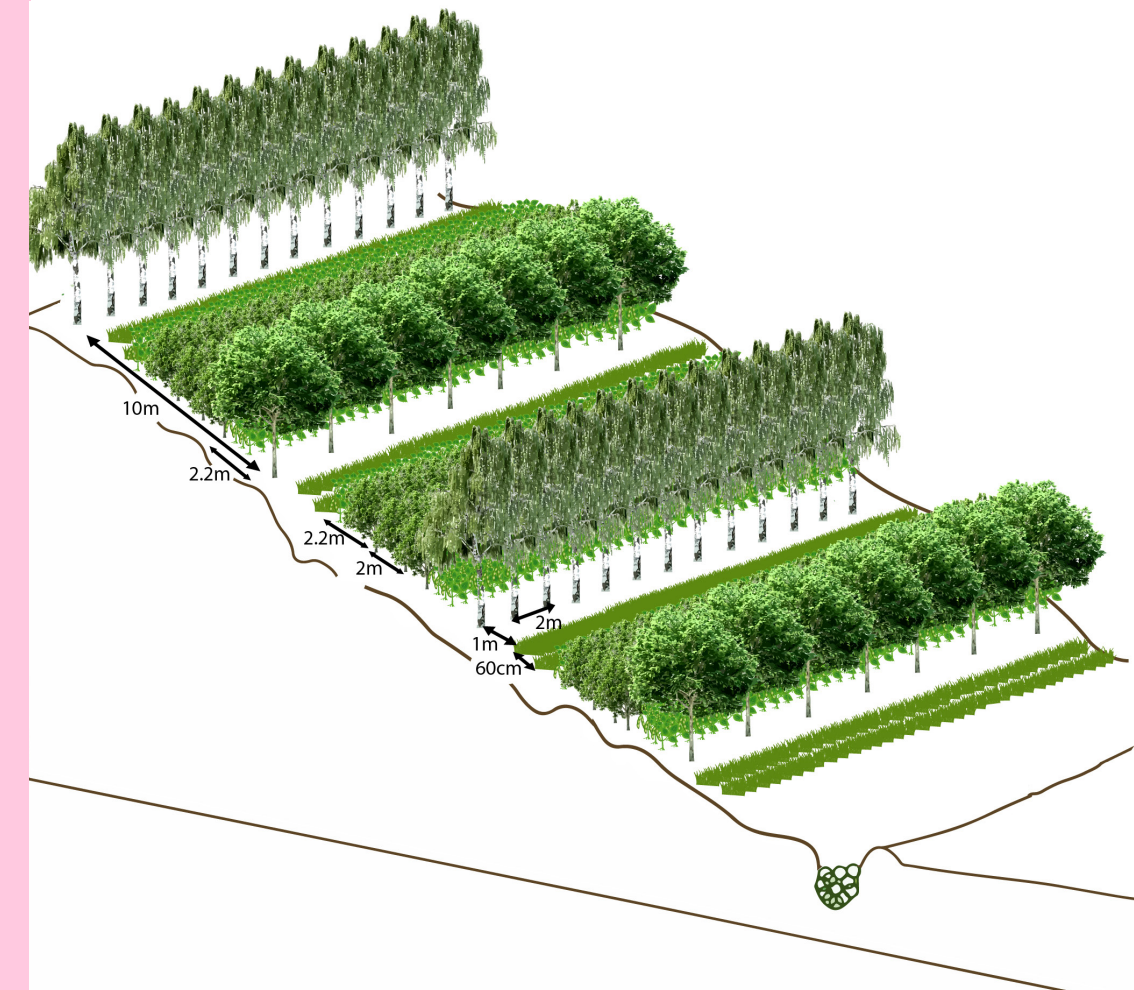
1. LONGAN

Some common pests and diseases harmful to longan:

- Longan stink bugs (*Tessaratoma papillosa* Drury.) attack young shoots, flowers and fruits. Prevention by removal of leaves that have bug eggs, shaking tree and collecting stinking bugs and burn. Using pesticide with *Cypermethrin* active ingredients according to using instructions (for example, Sherpa 25EC, 10-20 ml mixed in a 16-liter bottle, spraying 10-12 bottles for 1 ha. This dosage is used for the agroforestry option. For mono-longan system with plant spacing 5 x 5 m, it requires about 20 bottles).
- Stem borer/limb borer (*Cerambycidae*): Prevention by weeding and pruning, apply dense lime-water mixture on the stem/ base.
- Longan bugs (*Toxoptera citricida*): that harming to flowers and green fruits. Management method is similar to stink bugs.
- Witches' broom phenomenon on longan (*Eriophyes dimocarpì*) (shoots and leaves are curly, leaves cannot grow): This disease is caused by a filamentous virus which is transmitted by vectors *Eriophyes dimocarpì* Kuang mites on longan trees in Vietnam. Remove and burn infected branches, pruning to keep airy canopy.

2. 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 vatatrix*): 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



AGROFORESTRY TECHNICAL MANUAL



OPTION: ACACIA - LONGAN - COFFEE - SOYBEANS - FORAGE GRASS

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INTRODUCTION

Arabica coffee (*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 system including coffee, it is necessary to intercrop with windbreaks and shade trees to increase coffee productivity and quality.

Longan (*Dimocarpus longan*) is a sub-tropical fruit species, it requires a period of cold climate, but not temperatures below zero, before flowering and fruiting. Longan has a wide adaptability and is suitable at altitudes that are lower than 800 m. Its root system is quite strong and can adapt to a variety of soils with pHs ranges from 5.5-6.5. Longan is sensitive to water logging, prefers porous soil, and grows well in hilly land.

Acacia mangium and *Acacia auriculiformis* are imported into Vietnam, along with other hybrid Acacia that is later widely used for purpose of afforestation to improve ecological environment, produce wood and materials for the pulp and wood chip processing industry. This tree adapts widely and grows well on medium thickness soil which has good drainage, near-neutral pH, slightly acidic. Due to growing fast characteristic and nitrogen fixing ability, the acacia can be introduced into new establishment period to generate shadow, contribute to land improvement and support other crops in agroforestry option.

In this agroforestry option, forage grass (mulato or guinea) are planted on contour lines, under acacia and longan rows to reduce soil erosion and provide food for livestock. Soybeans are intercropped between coffee trees when the canopy has not closed, usually in the first 3 years. Soybeans contributes to soil fertility improvement, diversifies products and increases income for households.

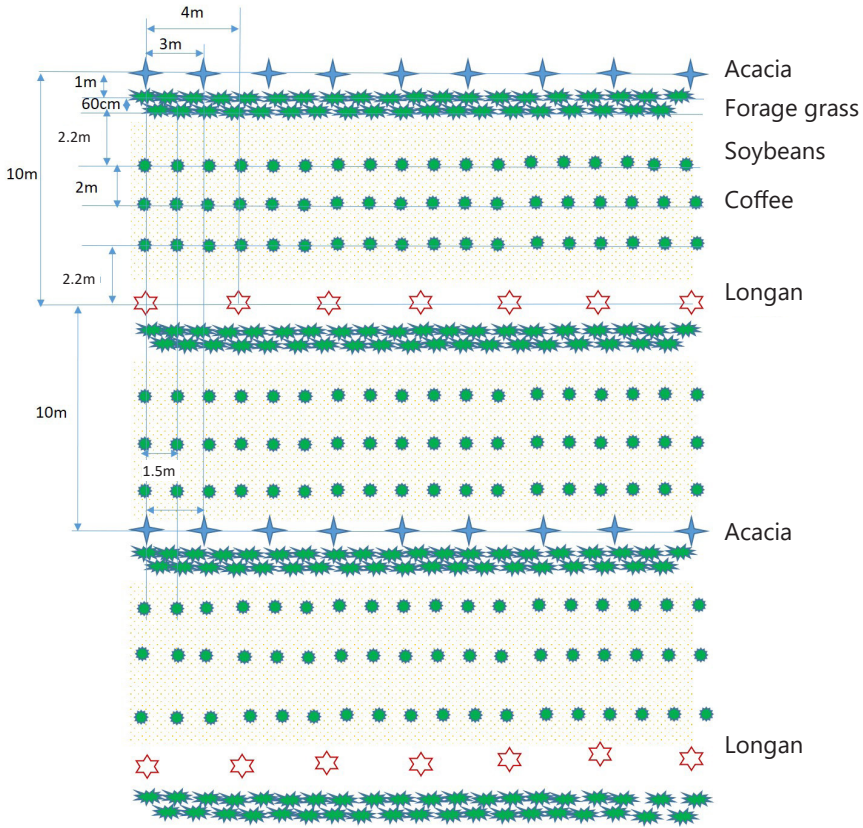
DESIGN

Contour planting is designed in the agroforestry option to minimize soil erosion. A longan row alternates with a acacia row in a distance of 10 m. Distance between longan tree is 4 m and acacia tree is 2 m. Hence, about 125 longan trees and 300 acacia trees could be planted in one ha.

Two rows of forage grass (mulato or guinea) are planted closely and 1 m apart to each longan/ acacia 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 as rice then plant on field as designed above.

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

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



Distance and layout of trees and crops in Acacia - Longan - Coffee - Soybeans - Forage grass option

PLANTING TECHNIQUES AND FERTILIZING (1)

1. LONGAN

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 15-20 kg manure, 1 kg NPK in the ration of 5:10:3 (or equivalent) and 0.5-1 kg lime powder per hole before planting 30 days and cover by soil.

Top dressing fertilizer application:

- From the first to third year: Apply 1-1.5 kg NPK in the ratio of 13:5:10 (or equivalent) per tree.
- From the fourth year onwards: Considering each tree condition and its yield, it is possible to apply about 30-50 kg manure, 1-1.2 kg Urea, 1.5-1.7 kg Superphosphate, 1-1.2 kg Potassium chloride per tree.

2. ACACIA

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

Basal fertilizer application: Apply 0.6 kg NPK per hole

Top dressing fertilizer application: Annually 0.2 kg NPK per tree.

PLANTING TECHNIQUES AND FERTILIZING (2)

3. FORAGE GRASS

- Dig a grassy trench 20-25 cm deep on the contour lines, which is below acacia and longan 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

- Planting along contour line between coffee rows. Dig the holes for sowing seeds at distance of 70 cm between rows and plant spacing is 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 from plant and cover with soil.

PRUNNING AND CANOPY FORMATION (1)

1. LONGAN

In establishment period: Pruning and canopy forming when tree is young to build a strong frame and produce a desirable shape and height.

- Prune off the top of the tree at 60-70 cm from the graft union to promote branching. When those branches develop well, keep 3-4 strong branches grow 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 turning to distinct directions. Similarly, repeat with secondary branches to create the third level branches. Yet, those are not limited in number and length, only thin away the dense interior branches.
- Remove any suckers at ground level and any shoots on the trunk below the graft union.

Pruning time: Pruning three to four times per year

- The 1st time: End of February - beginning of March, remove weak, disease and disordered growing branches and twigs.

PRUNNING AND CANOPY FORMATION (2)

- The 2nd time: End of May - beginning of June, cut off weak branches that do not bear fruit and do fruit's pruning/thinning.
- The 3rd time: After harvesting (in August-September), remove suckers, diseased and broken branches.
- The 4th time: When buds grow up to 5-7 cm, remove weak branches, keep two to three strong and healthy/ main branches.

2. ACACIA

- From the third year onwards, pruning branches at ground level under one second 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 the 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.



Acacia - Longan - Coffee - Soybeans - Forage grass option in Dien Bien province