



DEVELOPMENT OF AGROFORESTRY MODELS

Agri-silvi-horticulture Model : Casuarina - Moringa - Maize

Agrisilvihorticulture

Agrisilvihorticulture is the system in which a combination of trees, horticultural crops and agricultural crops are grown on the same unit of land in some form of spatial mixture or sequence. In the present model *Casuarina equisetifolia* is the tree species, *Moringa oleifera* is the horticultural component and Maize is the agricultural crop.

Tree species : *Casuarina equisetifolia*

Casuarina (known locally as 'savukku' in Tamil) is an useful multipurpose tree (MPT) suited for agroecological conditions of Tamil Nadu. It is drought resistant, nitrogen fixing and fast growing with desirable stem, crown and branch characteristics for agroforestry. It produces excellent, sturdy poles which are suited for scaffolding and farm construction. Wood is excellent as fuelwood and the pulp is valued in paper and rayon industry. *Casuarina* grows under a wide range of soil and climatic conditions.



Casuarina - moringa - maize model

Horticultural species: *Moringa oleifera*

Moringa is a small or medium sized tree, ideal for agroforestry as it casts very little shade. Flowering occurs during February -March. The tender fruits (drum sticks) and leaves are highly nutritious vegetables and rich in vitamin A (6780 mg carotene/100gm of leaves) calcium, phosphorous and iron. Medicinal properties like improvement in vision/eyesight, bone formation and blood purification have been attributed to this tree. Flowers and buds are also valued as green vegetable. The wood is soft and used in manufacture of toys. The tree grows best in sandy loam or clayey loam soils within a pH range of 6 -7.5. The management of *moringa* tree (var:PKM-1) in agrisilvihorti model is described.

Agricultural crops

Crops such as maize, fodder sorghum, bajra, ragi, pulses, sesamum, groundnut etc. can be cultivated with Casuarina and Moringa under rainfed conditions. Under irrigated conditions tomato, lady's finger, brinjal, turmeric, plantain and chilli can also be taken as intercrops. In the present model maize (*Zea mays*) was intercropped with Casuarina and Moringa and the economic production worked out.

Development of the model

Raising of agricultural crop by the onset of monsoon (May-June) and planting of Casuarina and Moringa seedlings in the field is carried out simultaneously. Parallel watering channels are taken 7m apart. Three month old potted seedlings of Casuarina and one month old potted seedlings of Moringa (var:PKM-1) are planted alternately in pits of size 30cm³ at 2m distance between plants in each channel. Thus the density of Casuarina and moringa remains as 325 trees/ha. A basal dose of 25gm each of N,P &K fertilizers is added to each pit at the time of planting for Casuarina.3 at 2m distance between plants in each channel. Thus the density of Casuarina and moringa remains as 325 trees/ha. A basal dose of 25gm each of N,P &K fertilizers is added to each pit at the time of planting for Casuarina

For Moringa, 100gm each of N and P fertilizer and 50gm K is added to the pit in the third month. At the end of sixth month an additional dose of 100gm urea may be added for better establishment. Biofertilizers like *Frankia* or *Azospirillum* can also be mixed with the soil in the pits for better establishment. During the initial two months weeding is essential. Maize (*Zea mays*) is dibbled at 60 x 25 cm apart as per package of practices in the interspace between Casuarina - Moringa rows.

Maintenance of the trees in model

Casuarina and Moringa grows well and fast under irrigated conditions. The seedlings are watered once in a week for the initial two months and later on, no separate watering to the tree seedlings is given. However, during the post harvest period and during the dry season, tree rows are irrigated at fortnightly intervals. Casualty replacement is done within a month's period. Periodical cultural operations such as weeding, soil working etc. are carried out twice a year. Lower lateral branches of Casuarina upto nearly half the height of canopy are pruned during the second and third year and the pruned material can be used as fuelwood.

For Moringa, when the seedlings reach 75cm height, the growing tip is cut to induce more branches. New flowering shoots appear within 4-5 months. Additional cultural operations such as soil working, application of FYM may be carried out for moringa alone twice a year for better growth, flowering and fruiting.

Productivity and yield

Casuarina seedlings grow very fast and attain an average height of 7m by the end of third year. Similarly, the basal girth also increases from 14.7cm in first year to 28cm overbark at the end of third year. At this stage the trees can be harvested and marketed. The tap root grows to a depth of 1.8m by the end of the third year. Most of the lateral roots are clustered around the taproot within a radius of 0.6 - 0.75m indicating less competition for resources with agricultural crop.

Moringa starts flowering at the age of five months and each tree yields about 15 drum sticks in the first flowering. In the subsequent years a four fold increase in yield is obtained. Thus on an average, each tree yields about 70 drum sticks/year. During the three year period, 68,250 drumsticks/ha can be harvested from the model.

Economic returns

Each Casuarina tree yields a pole of size 3-3.5m length, 28cm basal girth and 10cm top girth (ob) at 3 years age. No perceptible reduction in maize yield was noticed upto third year. The average grain yield of maize amounted to 2 t/ha and stover 1.5 t/ha. The tender fruits of Moringa (drumsticks) are sold in the market as vegetable and fetches a net income of Rs 38,055/ha, while the income from Casuarina works out to Rs 13,666/ha. Thus a combined net income of Rs 51,721 (from Casuarina and Moringa) over a period of three years can be anticipated. This is in addition to the income from agricultural crop which works out to Rs 6,250/ha/yr. Thus the average annual net income from the model amounts to Rs 23,490/ha/yr (Table 1).

Table 1. Economic returns (Rs/ha) from Agrisilvi horticulture model (Casuarina-Moringa-Maize)

Tree: Casuarina (espacement 7 X4 m;
density 325 trees/ha, age 3yr.)

No of poles /ha.....	325
Income from poles @ Rs 45/pole.....	14,625
Fuel wood (t/ha).....	1.3
Income from fuel wood (farm gate price) @ Rs 700/ton.....	910
Total income	15,535
Expenditure.....	1,869
Net income.....	13,666
Average annual net income (Rs/ha/yr).....	4555

Horticultural species: Moringa

(espacement 7X4 m; density 325 trees/ha, age 3yr.)

No of drumsticks/ha.....	68,250
Total income @Rs 60/100fruits.....	40,950
Expenditure.....	2,895
Net income.....	38,055
Average annual net income(Rs/ha/yr)..	12,685

Agricultural crop: Maize

Grain yeild (t/ha/yr).....	2.0
Stover yeild (t/ha/yr).....	1.5
Income from grain @ Rs 4000/t.....	8000
Income from stover @ Rs 500/t.....	750
Expenditure.....	2500
Net income from Maize (Rs/ha/yr).....	6250
Average annual net income from the model.....	23,490
NPV at 12% discount rate.....	48,164

Insect pests and diseases

Pests and disease problems are not of serious nature to Casuarina in agroforestry. However, incidence of stem wilt or black blister bark of grown up trees caused by fungus *Trichosporium vesiculosum* and defoliation in young saplings by insect borer *Indarbela quadrinotata* occurs depending upon edaphic and climatic factors. This can be controlled by management practices like preventing soil moisture stress conditions, removal of dead and diseased plant parts from the field and prophylactic treatments with suitable fungicides like Carbendazim (0.05%).

Moringa is also normally free from any serious diseases. However the pest problem of defoliators and bud borers is occasionally encountered. This can be effectively controlled by spraying Malathion (0.05%).

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Prepared by

M.George, S.Viswanath and P. Manivachakam
Forest productivity & Agroforestry Division, IFGTB, Coimbatore-2

For further information contact:

Director,
Institute of Forest Genetics & Tree Breeding,
P.O.Box 1061, Forest Campus, Coimbatore 641002
Ph: 91-422-2431540, E-mail:ifgtb@satyam.net.in