

Multi-layer Cropping : Ideal Approach for Better Yield and Increasing Farm Income

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Introduction:

The demand for agricultural commodities is growing. To meet up the ever-increasing targets as per demand, productivity needs to be raised. This can be realized in two ways – increasing the area of cultivation or increasing the efficiency of inputs. The scope for the former is minimal & for the latter, the primary information is the most abundant solar energy. So, the production per unit area of land, time & inputs can be increased by improving efficiency. In India, primarily farmers (about 85%) comes under small and marginal farmers. Shortly, the availability of land for cultivation will be reduced with increasing population and rapid urbanization, land degradation due to soil erosion, and soil salinity. As per the estimate, in India, more than 95% of holding will be under small and marginal holders by 2050 (Agrawal R.L., 1995). To solve this problem, a multi-storied cropping system will be a potential and efficient option to provide food, nutrition, and income security to the growing population of India (Awasthi O.P. et al., 2008). This has possible because of the diverse agro-climatic condition, enormous biodiversity, and wide variation in soil fertility, large cultivable land area in the geographical boundary of India.

What is Multi-layer Cropping?

Multi-layer cropping is a system of growing crops together at different heights simultaneously on the same piece of land. It is also referred to as multi-storied cropping or multi-tier cropping. Multilayer is made up of two words:- Multi & layer. Multi means many, and layer means strata of different heights.

This type of cropping is mainly practiced in orchards and plantations to make optimum use of solar energy even under high plant density.

Why is it needed?



Every individual is aware of the over-population problem, which is increasing due to day by day. Due to the rise in population, farmland is growing down. Food shortages in many parts of the world & the threat of insufficient supplies shortly continue to stimulate more intensive agricultural practice, for example, Multi-layer Cropping. This method will help the farmers get a good yield and more earnings from the same land using the available resources. It also solves the problem of feeding the growing population due to less availability of cultivable land.

Objectives of Multi-layer Cropping:

- The main objective of multi-layer farming is maximum and effective use of vertical space.
- Optimum use of per unit area of land for production.
- Harvesting of crops regularly all around the year.
- Conservation of water along with increasing productivity.

Principle of Multilayer Cropping:

- Multilayer Farming is based on the principle of high-density planting and making the ultimate and efficient use of manure, water, land, labour, and vertical space.
- This cropping system also works on the principles of minimization of production cost and inputs use, developing an organic and sustainable farming system to mitigate the use of chemicals, and ensuring each household's food and nutritional security.

Crops Nature in Multi-layer Cropping:

- The base crop should have tall-growing, widely spaced, perennial. The root system of crops should be of varying depth to draw nutrients from different layers.
- Crops at lower height should have characteristics of growing in shade & humidity. The crops growing at top height must grow in direct sunlight & bear a more evaporation rate.
- Crops planted on the surface of the soil should be leafy. Harvesting of these leafy crops is done directly by uprooting them.
- The climbing plants should be appropriately staked for their growth and development. These climbing plants can reach up to roof structure, so they should be managed properly with training
- The straight-growing plants should be pruned, so they don't occupy more space, and their harvesting should be done after harvesting.

Benefits of Multi-layer Cropping:

The following are some of the benefits of practicing a multi-layer farming system:

- ✓ Multi-layer cropping generates employment and provides income regularly.
- ✓ It decreases the investment cost by four times and relegates the needs of an expensive playhouse. The shade can be made with the help of local materials like bamboo and leafy grass.
- ✓ The multi-layer cropping structure allows the right amount of sunlight to reach the crops, and even in peak summer, yield is excellent.
- ✓ It also helps in the conservation of water and moisture in the soil.
- ✓ The amount of fertilizers equal to one plant in field farming is sufficient for four crops inside the multi-layer structure.
- ✓ One of the significant benefits of this type of cropping system is no effects of climate change. There has become one ecosystem under the structure; therefore, crop production is not affected by external factors.
- ✓ A multi-layer cropping system helps to eradicate weeds' germination, which helps increase production and productivity.
- ✓ It helps in the optimum use of available cultivated land for agricultural production as the farmers can produce many agricultural commodities from small areas.
- ✓ There is less attack of pests and diseases in this cropping system.

The Process of Multi-layer Cropping

- First of all, you have to select land. The area of land depends on the number of crops you want to plant. It will be great if the chosen land is of geometric shape (Square or Rectangle).
- After selecting land, reclamation of land should be done. A different operation such as primary tillage and secondary tillage should be done, and a large amount of FYM and vermicompost should be added to the soil.
- Some fungicide also should be added to the soil before sowing as there is more moisture at the root zone, due to which different fungi may attack.
- Then, we have to build a house-like structure. We can use bamboo or other wooden pegs to make a framework of the house. The roof's frame can be made with small bamboos, and different grasses are spread over the top. This will prevent direct sunlight.
- It will be great if we cover the whole structure from all around. This can be done with the help of different types of grasses.
- The use of wooden pegs and grasses will drastically reduce the investment cost.
- It will be great if the pH of the soil is near to neutral. If it is too acidic or too alkaline, the production will be reduced severely.
- In this method, four or five different crops are cultivated in the same field at a specific time. It uses a multi-layer seed sowing method where different vegetables and fruit crops are sown in deep, middle, top, and topmost soil layers based on their respective root zone.
- The seeds of creeper vegetables such as bottle guard, bitter guard, etc., are sown in small pits filled with a mixture of organic manure and soil to facilitate germination.
- The grown seedlings are then stalked over a homemade trellis. The trellis allows the area underneath to be planted with shade-loving vegetables like turmeric, ginger, spinach, etc.

Growth Pattern of Crops:

- ✓ In multi-layer cropping, we can grow different 3-4 crops in the same field at the same time. But we have to sow the seeds properly.

- ✓ In the first layer, we have to sow such types of plants that take maximum germination time than others.
- ✓ The next crop should grow in the 2nd layer & this crop must germinate faster than the deepest crop and slower than the topmost crop.
- ✓ The next crop should mature at ground level in the 3rd layer, and it should grow and matures before other crops.
- ✓ 1st layer crop should mature at maximum height. It is a fruit crop that grows for a long time—this need to be grown in certain spaces and should be less in number.

Management Practices:

These types of cropping systems need good management practices as different crops are harvested at different times.

- For climbing crops, there should be a good stake. Weak seedlings should be removed & trellis should be made for climbers.
- The leafy crops growing on the surface should be harvested regularly.
- There should be provision for insect traps within the structure.
- This type of cropping cannot be done in open places. So, we should create a shading structure with bamboo and wild grass.
- Training of different crops can be done to make good space under the structure, improve production quality, and maintain tree size.
- Too much irrigation can be harmful. So, proper irrigation should be done to preserves the moisture.

Example/Model of Multilayer Cropping:

Here, we are going to make multi-layer cropping of colocasia, potato & leafy vegetable like coriander.

- ✓ Colocasia is long duration crop. It is planted in January. Colocasia takes (7-8) months to fully mature enough to harvest. It germinates up to ground level after (2-3) months after sowing. For (2-3) months,



i.e., during colocasia's germination time, the upper and middle layers of soil remain unused.

- ✓ We saw the colocasia at the deepest layer of (25-30) cm in January. Then, we select potato.
- ✓ The potato is sown at the middle layer of soil at a depth of (10-15)cm from the ground in the same month of January.
- ✓ Potato matures within (2-3) months, and it takes (20-30) days to germinate up to the ground. So Again, the topmost level of soil remains unused for (20-30) days.
- ✓ Now, we select a leafy vegetable that matures within (20-30) days. This leafy vegetable is sown at a depth of 5cm from the ground. Now, our all three layers are occupied with crops that have different germination and maturation time. This creates a multi-layer system.
- ✓ In January, the leafy vegetable is ready to harvest, and we harvest it. As soon as we harvest it, the middle layer crop, i.e., potato, germinates out.
- ✓ After the harvest of Potato, Colocasia germinates out.
- ✓ In this way, we get the production of three crops from the same unit of land.
- ✓ In October, we harvest colocasia. Then land again becomes fallow for next two months until January.

Research Findings:

Vegetable Cultivation Under 3-tier System in Bihar:

Under this system, three models were introduced in the Vaishali and Samastipur districts of Bihar, and farmers were able to grow three different vegetables on the same piece of land at a time.

Following three models are developed & demonstrated-

- Model 1: Bitter gourd + Cowpea + Elephant foot yam
- Model 2: Pointed gourd + Okra + Cucumber
- Model 3: Pointed gourd + Okra + Amaranths

Name of technology	Productivity (q/ha)	Income (Rs/ha)
Model 1	Upper 273 q/ha+ Middle 120 q/ha+ Lower 350 q/ha	3,60,000
Model 2	Upper 195 q/ha+ Middle 135 q/ha + Lower 113 q/ha	2,29,000
Model 3	Upper 203 q/ha+ Middle 121 q/ha + Lower 77 q/ha	2,25,000
Traditional Method (bitter gourd)	125-150	45,000-50,000

Economics in Multi-tier Cropping System in Cotton Production

Multitier systems	Cost of Cultivation (rs/ha)	Gross Return (Rs/ha)	Net return (Rs/ha)	B/C ratio
T1. Cotton +radish + cluster bean+ beet root	51046	150278	99232	2.9
T2. Cotton +radish + beet root +coriander	41932	132266	90334	3.2
T3. Sole cotton	29038	53320	24282	1.8

Source: Sankaranarayanan,K.,Nalayini,P and Rajendran,K.(2011). Multi-tier cropping system for profitability and stability in Bt cotton production. Central Institute for Cotton Research,Regional Station ,Coimbatore 641003

Vegetable Based Multitier Cropping System, WB- This is a success story with 5 combinations of horticultural crops in Malda district of WB for 6 years 2014-2019. Among the different 5 combinations, T5 proved to be the highest income giving combination with highest B:C ratio.

Sl. No	Treatment	Crop combinations
1	T1	Cucumber+Brinjal
2	T2	Ash gourd+Brinjal
3	T3	Ash gourd+ leafy vegetables (spinach, coriander)
4	T4	Bitter gourd + leafy vegetables (amaranthus)
5	T5	Bitter gourd+ elephant foot yam

Treatment	Cost of cultivation (in '000)	Gross Income (in '000)	Net Income (in '000)	B:C Ratio
T1	155.00	513.93±3.89	358.93±1.53	2.31
T2	145.00	561.34±1.24	416.34±2.19	2.87
T3	89.00	362.24±2.12	273.24±3.02	3.07
T4	90.00	238.03±0.95	148.03±2.28	1.64
T5	164.75	680.85±3.38	516.09±2.42	3.13

Treatment	Main Crop Yield (t/ha)		Companion Crop Yield(t/ha)		LER
	Sole Crop	As intercrop	Sole Crop	As intercrop	
T1	158.3	113.00	207.1	151.00	1.44
T2	289.3	250.00	207.1	150.06	1.59
T3	289.3	250.27	111.8	80.00	1.58
T4	135.1	125.47	111.8	71.03	1.57

T5	135.1	125.20	368.4	270.50	1.66
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Source: Sultana, Samima& Roy, Rakesh & Das, Bhabani&Mondal, Adwaita& Rahman, Feroze. (2020). Vegetable Based Multitier Cropping System: A Model for Higher Income for the Farmers in Old Alluvial Soils of West Bengal. *Advances in Research*. 30-34. From this table , we can get the clear idea that in case of T5 combination, LER is highest (1.66) .So, there is 66% yield advantage when grown under multilayer cropping compared to growing as sole crop.

Conclusion:

Multilayer Cropping system is a very effective technique in today's agriculture scenario where land use under farming is degrading at a faster rate. In most cases, interspaces are left unutilized. In that case, a good amount of returns can be earned through this system, where production will be increased by at least 2 to 3 times than mono-cropping. Many farmers in different countries are unwillingly killing themselves because they work hard in their land, but they don't get a good production. Farmers who are willing to do work are deprived of different resources like irrigation and good area of agricultural land. So, they can be motivated through the government scheme, NGO, extension workers to do a multi-layer system of cropping, which helps to uplift the economic condition of farmers. The Multilayer Cropping System is indeed a boon to small & marginal farmers.

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