Review on Multilayer farming: a way towards farmer prosperity

Abstract

Multilayer farming is an innovative agricultural strategy that redefines traditional farming practices by harnessing vertical space to cultivate multiple layers of crops within a single agricultural system. This approach is designed to overcome challenges associated with land scarcity and inefficient land use. The concept involves arranging different crops in layers, utilizing the vertical dimension to its fullest extent. The layers can include ground-level crops, vines climbing on trellises, and even trees or shrubs, creating a multi-tiered ecosystem. This arrangement optimizes sunlight exposure, nutrient distribution, and water usage, resulting in enhanced productivity.One of the key advantages of multilayer farming is its potential to significantly increase overall yield per unit of land. By strategically combining plants that complement each other in terms of growth patterns, resource requirements, and ecological interactions, farmers can create a symbiotic environment that maximizes the use of available resources.Resource efficiency is a focal point in multilayer farming. The intercropping of different plant species helps in nutrient cycling, reducing the need for external inputs. Furthermore, the diverse plant composition can deter pests and diseases, reducing the reliance on chemical interventions. The vertical stacking of crops also allows for efficient water usage through integrated irrigation systems.Beyond its practical benefits, multilayer farming contributes to biodiversity preservation. The coexistence of various plant species fosters a more resilient and ecologically diverse agricultural landscape. This can have positive effects on soil health, pollination, and overall ecosystem stability.

Keywords: Multilayer farming, vertical space, biodiversity preservation, sustainable approach

INTRODUCTION

Human want is indefinite that never satisfy. For that reasons they burned anything for theirneed.Wecanseeitfromourperipherythatindustrializationisoccurmoreandmoreday by day. Understanding that human population is increasing rapidly from past few decade and urbanizationispossiblewaytogivestayforthatpopulationbutnotincostofagricultureland.

According to the most recent United Nations figures, India has overtaken China to become the country with the largest population in the world, with 142.86 billion people. China is currently the second most populated country in the world with 142.57 billion people (Anon, 2023). A recent UNFPA research states that 25% of Indians are between the ages of 0 and 14; 18% are

between the ages of 10 and 19; 26% are between the ages of 10 and 24; 68% are between the ages of 15 and 64; and 7% are above 65. Experts say that whereas the population of Uttar Pradesh and Bihar is young, that of Kerala and Punjab is ageing. According to a number of studies conducted by various organisations, India's population is predicted to grow for about three decades before peaking at 165 crore. Anon (2023).

MULTILAYER FARMING

Farmers often try new ideas in their fields based on deep knowledge of their local environment and develop many ecologically and environmentally sound local technologies/ farming practices by innovations and adaptations. One of these practices is known as Multilayer Farming. It is based on space and time annidiation. In tropical regions, where there is more rainfall, higher temperatures, and a longer growing season, planting two or more crops on the same plot of land is increasingly usual. This approach allows for continuous agricultural production. A method of producing crops of various heights simultaneously on the same plot of land is called multilayer farming. It's also known as multi-tiered or multi-storied cropping.

The main goal of this kind of cropping is to maximise solar energy even at high plant densities. Using the resources at their disposal, this technique will assist farmers in getting more revenue and a decent output from the same area of land. It also addresses the issue of feeding the expanding population in light of the scarcity of arable land. Making better use of the vertical space is the primary goal of this kind of farming. The tallest elements in this system have foliage that requires a lot of light and evaporation, while the shorter elements have foliage that needs shade and a high humidity level. Other goals of multilayer farming include increasing output while conserving water, harvesting crops regularly throughout the year, and making the best use of the land area per unit(Srivastava*et al*., 2013).

Growthpatternofcrops

Various crops (4-5) grow at various rates and have varying heights when they are planted in layers.The initial crop develops and grows within the soil. Deep-rooted crops should germinate with the longest germination time.The next crop should emerge from the soil at the middle surface, germinating faster than the crop with deep roots and slower than the crop at the top.The following crop should reach maturity at ground level and grow and mature at the fastest rate possible, freeing up space for subsequent harvests.The last crop should reach its maximum height of maturity. It's a fruit that grows slowly. These should be

cultivated in specific areas and in smaller quantities.

Basicprinciplesofmultilayerfarming

The foundation of multilayer farming is high-density planting and optimal and effective use of manure, water, soil, labour, and vertical space. In order to reduce the amount of chemicals used, this farming system also strives to minimise production costs and input usage, promote organic and sustainable agricultural practices, and guarantee food and nutrition security for every home.Overwatering a plant can be detrimental. Thus, it is important to water properly to maintain the moisture (Shehrawat*et al*., 2023).

Objectiveofmultilayerfarming

1. One of the major objective is to maximize the use agricultural land, water, manures and fertilizers
2. Topromotesustainableagriculture
3. Toincreasetheproductionofdifferentcropsinaspecific time
4. Togenerategoodincomefromonepieceofland
5. Tominimizecrop-weedcompetition
6. Toobserveallelopathyphenomenonforfurtherresearchpurpose
7. Tominimizesoilerosion
8. Tomaintainsoiltextureandfertility

Managementpractices

It is necessary to provide appropriate staking for crops that climb. Regular harvesting of the leafy crops growing on the surface is recommended.Insect traps must to be accommodated within the building.This kind of cropping isn't allowed in public areas. Thus, we ought to erect a bamboo and wild grass shade structure.It is possible to train several crops to create adequate room beneath the building.It is best to eliminate weak seedlings and build a trellis specifically for climbers.Overwatering a crop can be detrimental. Thus, it is important to water properly to maintain the moisture.

Stepstoperformmultilayerfarming

- Selection of crops: Various crops are selected for cultivation. Crops need to vary in height and time to maturity.
- Selection and setup of the field: It is believed that geometric shapes, such as

squares and rectangles, make good terrain for multi-tier farming.

- The ideal seed is one that is pure, healthy, energetic, and has a high potential yield.
- To guard against diseases spread by seeds or soil, seeds are disinfected.
- Enough irrigation is necessary to ensure transpiration and photosynthetic activity. In irrigation, the ring basin method is effective.
- Weeding: Hand weeding, hoeing, and sickling are efficient weeding techniques in multi-layer farming.
- Manures and fertilisers are added to the soil to help crops grow and develop in the right ways. Compost, NPK, and FYM are vital for crop growth.
- Procedures both before and after harvest: Marketing and packaging: The materials are packaged and sold on the market for a profit.

Nature of cropsinmulti-layercropping

- It is recommended that crops grown in subsurface or underground soil have thick roots and a preference for shade.
- Leafy crops are ideal for planting on the soil's surface. These leafy crops are harvested directly by pulling them up.
- For the climbing plants to grow and develop properly, they need to be staked. Since these climbing plants may scale roof structures, they need to be properly trained and regulated.
- Pruning the straight-growing plants can help them take up less space, and harvesting them should come after everyone else has finished.

Advantages

- Multilayerfarminggenerates employmentandprovidesincomeroundthe year.
- Multilayer farming decreases the investment cost by 4 times and relegates the needforvery expensive Polyhouse. Bamboo and green grass, two common native resources, can be used to provide shade.
- Even at the peak of summer, the crops are able to receive the proper quantity of sunshine thanks to the multilayer farming construction.
- It also aids in the preservation of soil moisture.

- Itincreasethenutrientuse efficiency.
- The absence of climate change impacts is one of the main advantages of this kind of farming method.
- Multilayerfarmingsystemhelpsto minimizethe weed germination,whichhelps to enhanced the production and productivity.
- It helps in the better use of available cultivated land forproduction as the farmers can produce large number of agricultural commodities from small area.

Disadvantages

- Adversecompetitiveeffectorbyallelopathy.
- Labourintensive.
- Difficultyinmechanization.

Effectofmultilayerfarmingonresourceconservation

Jakhar *et al*. (2012) noted that papaya + ragi :pigeonpea (6 : 2) + gliricidia systemrecorded significantly lower water runoff, in addition to that papaya + ginger : pigeonpea (8 :2) + gliricidia system found significantly lower soil erosion.Jakhar *et al*. (2012) reported thatpapaya + ginger + gliricidia multilayer system resulted better infiltration rate as compare toothersystem.Sultana *et al*. (2020) revealed that multilayer farming model of bitter gourd + elephantfootyam resulted inhigher land equivalent ratioof system.AccordingtoTejaswinia*etal*.(2022)[a],growingofelephantfootyamasasolerecordedsignificantly higher light interception throughout its life cycle which was remain at par withelephantfoot yam + cluster bean+palak.

Effectofmultilayerfarmingonyield

Singh*etal*.(2013)revealedthatelephantfootyamequivalentyieldfoundhigher in elephant foot yam + ridgegourd multilayer farming.Swain(2014)concludedthatmango+guava+turmericmultilayerfarming recorded higher mango equivalentyield.Meena *et al.* (2017) observed that coriander equivalent yield were found significantly the highest with ber + fenugreek + okra multilayer farming.

Effect of multilayer farming on weed

Cotton + coriander + v. cowpea + cluster bean multilayer farming found significantlylower weed dry weight at 15, 30, 60 and 90 DAS and significantly higher weed smotheringefficiencyreported by Sankaranarayananb*etal*. (2012).Sankaranarayanana*et al*. (2012) revealed that cotton + cluster bean + v. cowpea +dolichossystemwas recordedsignificantlylowestdryweight of weedaswellashigherweedsmotheringefficiency.According to Tejaswini *et al*. (2022), lower dry weight of weed and higher weedsmothering efficiency (WSE) recorded significantly with the elephant foot yam + sweet corn + cowpeamultilayersystem.

Effectofmultilayerfarmingonsoilhealth

Organic carbon,availableP_2O_5andCECweresignificantlyhigherwithadoptingpapaya+ginger:pigeonpea(8:2)+gliricidia,papaya+ragi :pigeonpea(6:2)+gliricidiaand papaya +ginger +gliricidiarespectively.Besidesthatlowernutrientlosswasobservewithpapaya+ginger+gliricidia during theinvestigation ofJakhar *et al.* (2012).Mango+guava+cowpeamultilayerfarmingsystemgavesignificantlyhigheravailable$N$andK_2OwhileavailableP_2O_5wasfoundsignificantlyhigherwithmango+guava+gingermultilayerfarming. (Swain, 2014).

Economicsasinfluencedbymultilayerfarming

Jakhar*etal*.(2012)foundthatpapaya+ginger:pigeonpea(8:2)+gliricidia system resulted inmaximumnetreturn,whileincaseofB:Cratiosolepigeonpearecordedmaximum.Sankaranarayanana*et al*. (2012) noted that cotton + radish + cluster bean + beet rootsystemgavemaximumnetreturnandperdayprofitability.Whilemultilayer systemofcotton +radish+ beetroot + coriander gavemaximum B: Cratio.Mango + guava + turmeric multilayer farming resulted in maximum gross as well asnet return. Besides that maximum benefit-cost ratio found with mango + guava + cowpea(Swain,2014).Chandrashekhar *et al.* (2018), concluded from their investigation that multilayer farming system like arecanut + banana + turmeric gave maximum net return, while in the case of B : C ration arecanut + turmeric found maximum.Gross return, net return and B : C ratio were found maximum while adopting ber +fenugreek+okramultilayer farmingreported byMeena*et al*.(2017).Sultana*etal*.(2020)reportedthatbittergourd+elephantfootyamsystemgave maximumnetincomeandbenefit-

costratioascomparetoothersysteminexperimentation.Wajih*etal*.(2020)revealedthatbottleg ourd+cabbagesystemgavemaximumnetreturninadditionto thatB :C ratiowasfoundmaximum withelephantear+ IVYgourd.

Conclusion

multilayer farming represents a holistic and sustainable approach to agriculture, addressing the challenges posed by limited land resources. multilayer farming with location specific cultivation of fruit crop, field crop, legume crop and vegetable crop increasing system productivity, proper utilization of available resources and gave maximum return.

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