Multilayer Farming in Maharashtra (WOTR)

Multilayer Farming Systems For Ensuring Food Diversity And Increasing Resilience (India)

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DESCRIPTION

Multilayer farming, also known as multi-tier farming, is a technique of intercropping crops of different heights, root and shoot patterns, and maturation times in small plots of land. This technique is cost-effective, easily adaptive, and participatory, providing a large number of food groups to farmers to improve their nutritional levels, providing insurance against crop failure, reducing pest and disease incidence, and improving soil properties and soil fertility conditions. Multilayer farming minimizes crop-weed competition, and soil erosion, and optimizes resource utilization resulting in higher returns and better nutritional value. It promotes sustainable agriculture, maintains a balanced diet, increases income per unit area, and reduces the risk of crop failure.

Multilayer farming is an agricultural model that aims at achieving maximum production per unit area by utilizing water, manure, and land resources to their full potential. This method is based on the synergies between the different crops and plants planted on a given piece of land. This method is cost-effective and yields more benefits than other farming systems. By cultivating four to five crops with the same amount of fertilizer and water required for a single crop, farmers can increase their income, and multiple crops can be harvested yearly using the same piece of land.

Multilayer farming is based on scientific, ecological, and economic principles, promoting crop diversification, maximizing productivity, utilizing resources more efficiently, and promoting intensive input use. Moreover, it ensures the sustainability of farm resources and the environment in the long term.

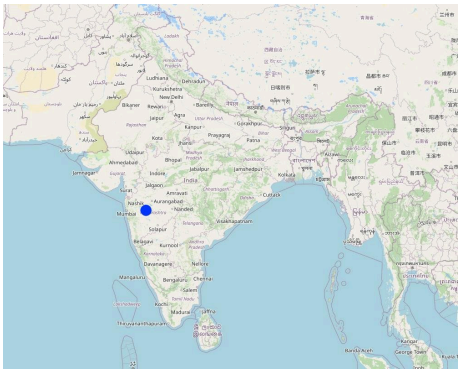
The multilayer farming system mainly consists of an overstory of trees or shrubs with an understory of economic or forage crops. By incorporating these principles, farmers can achieve greater yields and financial success while promoting environmental sustainability.

As a part of the program's approach, WOTR (Watershed Organisation Trust, the project implementing partner trained women change-makers) to spread awareness among villagers about the importance of nutrition and a healthy diet. Since 2018, the active promotion of multilayer farming to address food and nutrition insecurity in Maharashtra is undertaken. As a result, 1124 plots across 150 villages in Maharashtra have adopted this unique farming method to enhance food and nutrition security.

The multilayer farming system involves several steps to ensure maximum productivity from the available resources.

1.The first step is land preparation, which involves applying 300 kg of cow dung or vermicompost along with one kg of Trichoderma powder per 36 x 36 feet plot. Trichoderma is a bio-fungicide that helps to prevent fungal infections in plants and roots.
2.Next, eight beds of 3 x 36 feet are prepared with 1.5 to 2 feet of space left in between. These beds need to be arranged in the North-South direction to ensure that plants receive adequate sunlight.
3.After preparing the bed, 1-foot deep channels are dug to drain excess water so ensuring that the crops are not waterlogged.
4.Finally, in the middle of each bed, vegetable and fruit crops are planted according to a crop planning chart. By planting a variety of crops in the same plot, the multilayer farming system ensures the effective utilization of resources and provides an even distribution of income and employment throughout the year by producing several off-season crops.

LOCATION



Location: Ahmednagar, Maharashtra, India

No. of Technology sites analysed: 100-1000 sites

Geo-reference of selected sites
- 74.75607, 19.09

Spread of the Technology: applied at specific points/ concentrated on a small area

In a permanently protected area?: Nee

Date of implementation: 2018

Type of introduction
- [ ] through land users' innovation
- [ ] as part of a traditional system (> 50 years)
- [x] during experiments/ research
- [x] through projects/ external interventions

The multilayer farming system has numerous benefits that make it an effective and sustainable farming method. It makes effective use of soil, water, and other resources, reducing waste and increasing productivity. Additionally the system reduces climate-specific damage and enhances soil health, helping to maintain an ecological balance in the environment. The soil covered minimizes water loss due to soil evaporation, generating a higher income per unit area with an even distribution of income and employment throughout the year. The multilayer farming system generates jobs and allows for better utilization of labor while reducing the impacts of climate-specific hazards such as high-intensity rainfall, soil erosion, and landslides. Multilayer farming also utilizes soil moisture at different depths and solar energy at different heights, improving soil characteristics and adding organic matter to the soil. It reduces pests and disease infestation and provides micro-climate conditions which ensure better productivity of crops underneath. Overall, multilayer farming is a sustainable and efficient farming method that not only maximizes productivity but also enhances soil and environmental health while promoting economic and social well-being.

Bed preparation for multilayer farming (WOTR Team)

Planting of fruits and vegetable crops in multilayer farming (WOTR)

CLASSIFICATION OF THE TECHNOLOGY

Main purpose

- [x] improve production
- [x] reduce, prevent, restore land degradation
- [ ] conserve ecosystem
- [ ] protect a watershed/ downstream areas – in combination with other Technologies
- [ ] preserve/ improve biodiversity
- [ ] reduce risk of disasters
- [x] adapt to climate change/ extremes and its impacts
- [ ] mitigate climate change and its impacts
- [x] create beneficial economic impact
- [x] create beneficial social impact
- [x] Ensure nutritional security

Land use

Land use mixed within the same land unit: Nee

Cropland

- Annual cropping: cereals - wheat (winter), cereals - sorghum, Sugarcane, Horticulture crops like Pomegranate, Guava, Mango etc, Onion, pulses

Number of growing seasons per year: 2
Is intercropping practiced? Ja
Is crop rotation practiced? Ja

Water supply

- [ ] rainfed
- [x] mixed rainfed-irrigated
- [ ] full irrigation

Purpose related to land degradation

- [x] prevent land degradation
- [x] reduce land degradation
- [ ] restore/ rehabilitate severely degraded land
- [ ] adapt to land degradation
- [ ] not applicable

Degradation addressed

physical soil deterioration - Ps: subsidence of organic soils, settling of soil

biological degradation - Bc: reduction of vegetation cover, Bq: quantity/ biomass decline, Bs: quality and species composition/ diversity decline, Bp: increase of pests/ diseases, loss of predators

SLM group

- improved ground/ vegetation cover
- irrigation management (incl. water supply, drainage)
- home gardens

SLM measures

agronomic measures - A1: Vegetation/ soil cover, A2: Organic matter/ soil fertility, A5: Seed management, improved varieties

vegetative measures - V1: Tree and shrub cover

management measures - M1: Change of land use type, M4: Major change in timing of activities

TECHNICAL DRAWING

Technical specifications

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs

- Costs are calculated: per Technology area (size and area unit: **1**; conversion factor to one hectare: **1 ha = ha**)
- Currency used for cost calculation: **INR**
- Exchange rate (to USD): 1 USD = 80.0 INR
- Average wage cost of hired labour per day: 200

Most important factors affecting the costs

1. Availability of family labour to manage the field operations 2. Availability of dairy animals at the household level to meet the FYM needs

Establishment activities

1. Land Preperation (Timing/ frequency: June)
2. Preperation of beds for seed sowing (Timing/ frequency: June)
3. Sowing of seeds for fruits (Timing/ frequency: Early June)
4. Fencing of the field (Timing/ frequency: Before the sowing)

Establishment inputs and costs (per 1)

Specify input	Unit	Quantity	Costs per Unit (INR)	Total costs per input (INR)	% of costs borne by land users
Labour					
Land preparation	person days	2.0	200.0	400.0	100.0
Preperation of beds for sowing	Person days	3.0	200.0	600.0	100.0
Equipment					
Fencing material	Lumpsum	1.0	5000.0	5000.0	100.0
Plant material					
Seeds for fruit trees (seeds and planting material)	Plant	100.0	50.0	5000.0	100.0
Fertilizers and biocides					
Fram yard manure	Tons	10.0	600.0	6000.0	100.0
Other					
Miscellaneous		1.0	2000.0	2000.0	100.0
Total costs for establishment of the Technology				**19'000.0**	
Total costs for establishment of the Technology in USD				*237.5*	

Maintenance activities

1. Sowing of seeds (Timing/ frequency: June-July/October-November/April/March/April)
2. Application of organic manures (Timing/ frequency: Across the year at critical growth stages)
3. Irrigation (Timing/ frequency: Across the year at critical growth stages)
4. Bio-inputs (Timing/ frequency: Based on the plant needs)
5. Harvesting of leafy vegetables, fruits, fodder and other produces (Timing/ frequency: Multiple plucking during the year)
6. Sales of farm produces (Timing/ frequency: Multiple times during the year)

Maintenance inputs and costs (per 1)

Specify input	Unit	Quantity	Costs per Unit (INR)	Total costs per input (INR)	% of costs borne by land users
Labour					
Sowing of seeds	Person days	8.0	200.0	1600.0	100.0
Application of FYM and other inputs	Person days	5.0	200.0	1000.0	100.0
Maintenance and monitoring of the field	Person days	50.0	100.0	5000.0	100.0
Harvesting	Person days	20.0	200.0	4000.0	100.0
Plant material					
Seeds and planting material	Kg	0.25	1000.0	250.0	100.0
Fertilizers and biocides					
Farm yard manure and other inputs	Tons	5.0	750.0	3750.0	100.0
Other					
Other cost	Lumpsum	1.0	1000.0	1000.0	100.0
Total costs for maintenance of the Technology				**16'600.0**	
Total costs for maintenance of the Technology in USD				*207.5*	

NATURAL ENVIRONMENT

Average annual rainfall

- < 250 mm

Agro-climatic zone

- humid

Specifications on climate

- [ ] 251-500 mm
- [x] 501-750 mm
- [ ] 751-1,000 mm
- [ ] 1,001-1,500 mm
- [ ] 1,501-2,000 mm
- [ ] 2,001-3,000 mm
- [ ] 3,001-4,000 mm
- [ ] > 4,000 mm

- [ ] sub-humid
- [x] semi-arid
- [ ] arid

Average annual rainfall in mm: 561.0
Deccan Plateau, Hot Semi-Arid Eco-Region as per the ICAR classification of Ecological Zone
Name of the meteorological station:
https://krishi.icar.gov.in/jspui/bitstream/123456789/30264/1/MH14.pdf
Length of growing period: less than 90 days
Rainy days: 44

Slope
- [ ] flat (0-2%)
- [ ] gentle (3-5%)
- [x] moderate (6-10%)
- [ ] rolling (11-15%)
- [x] hilly (16-30%)
- [ ] steep (31-60%)
- [ ] very steep (>60%)

Landforms
- [x] plateau/plains
- [ ] ridges
- [ ] mountain slopes
- [x] hill slopes
- [ ] footslopes
- [ ] valley floors

Altitude
- [ ] 0-100 m a.s.l.
- [ ] 101-500 m a.s.l.
- [x] 501-1,000 m a.s.l.
- [ ] 1,001-1,500 m a.s.l.
- [ ] 1,501-2,000 m a.s.l.
- [ ] 2,001-2,500 m a.s.l.
- [ ] 2,501-3,000 m a.s.l.
- [ ] 3,001-4,000 m a.s.l.
- [ ] > 4,000 m a.s.l.

Technology is applied in
- [ ] convex situations
- [ ] concave situations
- [x] not relevant

Soil depth
- [ ] very shallow (0-20 cm)
- [x] shallow (21-50 cm)
- [x] moderately deep (51-80 cm)
- [ ] deep (81-120 cm)
- [ ] very deep (> 120 cm)

Soil texture (topsoil)
- [ ] coarse/ light (sandy)
- [ ] medium (loamy, silty)
- [x] fine/ heavy (clay)

Soil texture (> 20 cm below surface)
- [ ] coarse/ light (sandy)
- [ ] medium (loamy, silty)
- [x] fine/ heavy (clay)

Topsoil organic matter content
- [ ] high (>3%)
- [ ] medium (1-3%)
- [x] low (<1%)

Groundwater table
- [ ] on surface
- [ ] < 5 m
- [ ] 5-50 m
- [x] > 50 m

Availability of surface water
- [ ] excess
- [ ] good
- [ ] medium
- [ ] poor/ none

Water quality (untreated)
- [x] good drinking water
- [ ] poor drinking water (treatment required)
- [ ] for agricultural use only (irrigation)
- [ ] unusable

Water quality refers to: both ground and surface water

Is salinity a problem?
- [ ] Ja
- [x] Nee

Occurrence of flooding
- [ ] Ja
- [x] Nee

Species diversity
- [ ] high
- [ ] medium
- [x] low

Habitat diversity
- [ ] high
- [ ] medium
- [x] low

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

Market orientation
- [ ] subsistence (self-supply)
- [x] mixed (subsistence/ commercial)
- [ ] commercial/ market

Off-farm income
- [ ] less than 10% of all income
- [x] 10-50% of all income
- [ ] > 50% of all income

Relative level of wealth
- [ ] very poor
- [x] poor
- [x] average
- [ ] rich
- [ ] very rich

Level of mechanization
- [x] manual work
- [ ] animal traction
- [x] mechanized/ motorized

Sedentary or nomadic
- [x] Sedentary
- [ ] Semi-nomadic
- [ ] Nomadic

Individuals or groups
- [x] individual/ household
- [x] groups/ community
- [ ] cooperative
- [ ] employee (company, government)

Gender
- [x] women
- [x] men

Age
- [ ] children
- [x] youth
- [x] middle-aged
- [ ] elderly

Area used per household
- [x] < 0.5 ha
- [x] 0.5-1 ha
- [ ] 1-2 ha
- [ ] 2-5 ha
- [ ] 5-15 ha
- [ ] 15-50 ha
- [ ] 50-100 ha
- [ ] 100-500 ha
- [ ] 500-1,000 ha
- [ ] 1,000-10,000 ha
- [ ] > 10,000 ha

Scale
- [x] small-scale
- [ ] medium-scale
- [ ] large-scale

Land ownership
- [ ] state
- [ ] company
- [ ] communal/ village
- [ ] group
- [ ] individual, not titled
- [x] individual, titled

Land use rights
- [ ] open access (unorganized)
- [ ] communal (organized)
- [ ] leased
- [x] individual

Water use rights
- [x] open access (unorganized)
- [ ] communal (organized)
- [ ] leased
- [ ] individual

Access to services and infrastructure

health	poor	good
education	poor	good
technical assistance	poor	good
employment (e.g. off-farm)	poor	good
markets	poor	good
energy	poor	good

Comments

The district is one among the progressive districts of Maharashtra and is well connected with a good network of roads and railways.

roads and transport	poor ✓ good	
drinking water and sanitation	poor ✓ good	
financial services	poor ✓ good	

IMPACTS

Socio-economic impacts

Crop production

decreased ✓ increased

Round the year farm, produce of vegetables and fruits is available from multilayer fields. The data is based on the observation of land users, there has not been any study to assess possible qualitative improvements

product diversity

decreased ✓ increased

Farmers grow multilayer crops in smaller land sizes thus increasing the diversity of the products and the nutrition quality at the household level

irrigation water availability

decreased ✓ increased

The use of micro irrigation led to a more efficient use of the same quantity of water allowing for the irrigation of land for a longer duration

expenses on agricultural inputs

increased ✓ decreased

Organic inputs such as cow dung, cow urine, etc were used. This reduced the cost of the inputs.

farm income

decreased ✓ increased

Income from farms increased as farm yields increased. Excess produce of vegetables and fruits is sold in the market.

diversity of income sources

decreased ✓ increased

As the farmers shift from mono-crop to multilayer cropping. This reduces the risk of crop failure faced by mono-crop farmers.

Intake of Nutritional Food

None ✓ None

Intake of nutritional food increased as the availability of fruits and vegetables no longer depended exclusively on markets

Socio-cultural impacts

food security/ self-sufficiency	reduced ✓ improved	
health situation	worsened ✓ improved	Nutritional food available for consumption

Ecological impacts

evaporation

increased ✓ decreased

Crop cover for a longer duration over the soil, reducing evaporation losses

soil moisture

decreased ✓ increased

Use of organic practices and covering the soil with crop and dry crop litter for a longer duration increased the soil moisture retention capacity

soil cover	reduced ✓ improved	
soil organic matter/ below ground C	decreased ✓ increased	Bio-inputs and dry crop litter added to the soil increased the soil organic matter
biomass/ above ground C	decreased ✓ increased	
plant diversity	decreased ✓ increased	Crop diversity: vegetables and fruit crops are grown

pest/ disease control

decreased ✓ increased

As multiple crops are grown, pest and disease infestation is reduced

Off-site impacts

COST-BENEFIT ANALYSIS

Benefits compared with establishment costs

Short-term returns	very negative ✓ very positive	
Long-term returns	very negative ✓ very positive	

Benefits compared with maintenance costs

Short-term returns: very negative ☐☐☐☐☐✓☐ very positive

Long-term returns: very negative ☐☐☐☐☐✓☐ very positive

CLIMATE CHANGE

-

ADOPTION AND ADAPTATION

Percentage of land users in the area who have adopted the Technology

- ☐ single cases/ experimental
- ☑ 1-10%
- ☐ 11-50%
- ☐ > 50%

Of all those who have adopted the Technology, how many have done so without receiving material incentives?

- ☐ 0-10%
- ☐ 11-50%
- ☐ 51-90%
- ☑ 91-100%

Has the Technology been modified recently to adapt to changing conditions?

- ☑ Ja
- ☐ Nee

The Vegetable and fruits crops are modified based on the Household requirement

To which changing conditions?

- ☐ climatic change/ extremes
- ☑ changing markets
- ☐ labour availability (e.g. due to migration)

CONCLUSIONS AND LESSONS LEARNT

Strengths: land user's view

- Diversified vegetables and fruits available for household consumption
- Increase in household income, as the excess produce is sold in the market and also reduced dependency on markets to purchase fruits and vegetables
- Small farm plot (1300 sq. ft) is utilized under multilayer farming, remaining farmland is available for cereal, etc

Strengths: compiler's or other key resource person's view

- Water use efficiency because of the use of micro irrigation and reduction of evaporation as the crops and dry matter cover the soil
- A good micro-climate of the multilayer farm plot is maintained
- Availability of a good range of food groups to farmers may lead to improvement in nutritional parameters especially for women and children
- Improved soil health due to mixed cropping system and enhancement soil microbial activities

Weaknesses/ disadvantages/ risks: land user's viewhow to overcome

- Labor engagement throughout the year Mechanization suitable for small farm plots
- Availability of farm yard manure to ensure cultivation following natural farming practices Promotion of animal husbandry (dairy) in convergence with the government departments

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's viewhow to overcome

- The produce from multilayer farming is diversified and comes in small quantities. Therefore the selling of these small quantities of produce is done in the local market. Creation of farmers' collectives for selling larger amounts of produce in the market
- Availability of irrigation is important to ensure the sustainability of intervention Some water based enterprises can be developed to support the farmers not have irrigation facilities

REFERENCES

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Full description in the WOCAT database
https://qcat.wocat.net/af/wocat/technologies/view/technologies_6724/

Linked SLM data
n.a.

Documentation was faciliated by

Institution
- Alliance Bioversity and International Center for Tropical Agriculture (Alliance Bioversity-CIAT) - Kenya
- Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)
- Ecociate Consultants (Ecociate Consultants) - India

Project
- Soil protection and rehabilitation for food security (ProSo(i)l)

Links to relevant information which is available online
- How is multilayer farming done?: https://wotr.org/2020/07/18/how-multilayer-farming-is-done/
- Enhancing Household Food and Nutrition Security With Multilayer Farming: https://www.csrmandate.org/enhancing-household-food-and-nutrition-security-with-multilayer-farming/
- Kitchen Garden, Multilayer Farming Boost Food Security in Maharashtra: https://wotr.org/2020/05/07/kitchen-garden-multilayer-farming-boost-food-security-in-maharashtra-2/