Indian Farming 76 (10): 58-61; October 2026

Accounting of good agricultural practices in the north-western foothill agroforestry system

Rajesh Kaushal[1]*, Raman Jeet Singh[1], Abhimanyu Jhajhria[1], Anil Kumar Malik[1] and M.H. Ansari[2]

[1]*ICAR-Indian Institute of Soil and Water Conservation, Dehradun, Uttarakhand 248 195*
[2]*Veer Kunwar Singh College of Agriculture (Bihar Agricultural University, Sabour), Dumraon, Buxar, Bihar 802 136*

Accounting for Good Agricultural Practices (GAPs) in agroforestry provides a practical basis for understanding system performance and value. It goes beyond recording adoption to consider inputs invested, costs incurred, production obtained and resources conserved. For farmers, it identifies practices that raise income and reduce risk; for scientists, it measures performance and trade-offs; for policymakers, it supplies evidence for programmes and incentives. The GAPs accounting also brings in soil and water conservation, nutrient recycling, carbon storage, biodiversity and climate resilience, and with a baseline and monitoring it supports productive farms, improved livelihoods and resilient agroforestry systems.

Keywords: Carbon requestration, Land degradation, Nutrient recycling, Water conservation

AGROFORESTRY, the integration of trees with crops and livestock, makes agriculture more productive, diversified and resilient, providing food, fruit, fodder, fuelwood and timber while contributing to soil conservation, water management, biodiversity and climate resilience. Good Agricultural Practices (GAPs) apply available knowledge to production and post-production while addressing environmental, economic and social sustainability. This matters especially in agroforestry, where trees require long-term investment and their effects on crops, soil and water change as they grow.

Good agricultural practices in the context of hill agroforestry

The GAPs in agroforestry include selecting the right tree for the right site, quality planting material, appropriate spacing, protection of young plants, soil and water conservation, nutrient and weed management, pest control, and timely pruning and harvesting, designed to local soil, climate, slope, water and market conditions. Managing tree–crop interactions to avoid competition for light, water and nutrients is equally essential. Thus, GAPs should address productivity and profitability, soil and water conservation, resource-use efficiency, environmental sustainability and climate resilience, and social and livelihood sustainability.

Meaning of GAPs accounting

The GAPs accounting means assessing which practices are followed, what they cost, what they produce, what resources they conserve and what benefits they provide:

GAP Accounting = Practice + Cost + Production + Conservation + Benefit

In agroforestry, it goes beyond recording whether a practice was followed to examine what changed because of it and whether the benefits justify the investment accounting for crop and tree production, labour and input costs, soil and water conserved, nutrients recycled, carbon stored, income generated and livelihood benefits.

Importance of GAPs accounting in hill agroforestry

Agroforestry is particularly relevant where land and water are limited and farmers face erosion, variable rainfall and climate risk, making it necessary to assess performance beyond crop yield alone. Conventional farm accounts miss much of this. Labour invested in contour planting or mulching appears as reduced soil loss and steadier production over several years, while tree planting costs today deliver fruit, fodder, timber and carbon storage later. Accounting identifies these costs, benefits and trade-offs for the following reasons:

***Fragile soil resources*:** Hill soils are vulnerable to erosion through slope, intense rainfall and poor ground cover, and soil loss steadily reduces productive capacity. Agroforestry reduces soil loss; GAPs accounting quantifies the gain and treats soil conservation as an investment in long-term productivity.

Simultaneously occurrence of water scarcity and



Multiple benefits of agroforestry (Eucalyptus and apiculture)

***excess runoff*:** Hill farming faces water shortage in dry periods and excessive runoff in intense rainfall. Leaf litter, fine roots and mulching improve soil structure, slowing runoff and raising infiltration and soil-water storage. Accounting establishes how much water is conserved and what it contributes to production.

***Small and fragmented landholdings*:** Small, fragmented holdings demand practices that generate multiple products from limited land. Agroforestry integrates trees, crops and livestock, reducing dependence on a single commodity, and accounting captures these multiple outputs to give a complete picture of productivity and livelihood benefits.

***Efficient use of limited farm resources*:** Hill farmers have limited land, water, labour and finance. GAPs accounting shows whether these are used efficiently by weighing the cost of a practice against the production, income and conservation benefits obtained.

***Climate variability and resilience*:** Hill agriculture is exposed to intense rainfall, temperature fluctuation and seasonal drought. Agroforestry supports adaptation and mitigation by diversifying production, improving soil moisture, ameliorating microclimate and storing carbon; accounting assesses how far this reduces vulnerability and stabilizes income.

***Balancing short-term costs with long-term returns*:** Trees take longer than annual crops to yield income, and establishment, protection and pruning add cost, while some environmental benefits accrue only gradually. Accounting should weigh immediate costs against long-term benefits, giving a realistic basis for judging viability and designing incentives.

***Evidence for policy and incentives*:** Many GAPs benefit more than the individual farm. Soil conservation reduces downstream sediment, and trees store carbon and support biodiversity. These wider benefits justify public support, ecosystem service payments and climate finance, and accounting supplies evidence built on measurable outcomes rather than trees planted.

***Multiple benefits are often not captured*:** Income from crops, fruit, timber, fodder and fuelwood is easily measured, but reduced erosion, improved fertility, water conservation, carbon storage and biodiversity are usually omitted from farm accounting. GAPs accounting brings them in and demonstrates the full value of agroforestry.

Major GAPs components for agroforestry-based hill farming

Major GAP components include species selection, quality planting material, proper spacing, soil and water conservation, nutrient management, pruning, pest management and sustainable harvesting.

***Right tree, right site*:** Species selection is the first and most important GAP. The choice should reflect climate, altitude, rainfall, soil depth, slope, water availability, purpose and market demand, and the tree must be compatible with associated crops. The principle is the right tree for the right site and the right purpose.

***Quality planting material*:** Healthy, vigorous, disease-free and preferably locally adapted planting material from reliable sources is essential for establishment and long-term productivity; superior material of known performance improves returns



Quality planting material: Key to a successful agroforestry model



Intercropping of field crops with appropriate spaced tree rows

in commercial agroforestry. Survival should be monitored, since poor survival raises replacement cost and labour.

***Appropriate spacing and arrangement*:** Excessive tree density increases competition for water, nutrients and sunlight. Accounting should consider tree density, spacing, canopy development, crop yield near and away from trees and overall land productivity. The objective is not maximum tree biomass but optimum combined productivity of trees and crops.

Soil and water conservation: Contour planting, vegetative barriers, grass strips, mulching, cover crops, trenches, bunds and rainwater harvesting reduce runoff and erosion and improve infiltration and soil moisture. Effectiveness can be assessed through changes in runoff, soil loss, moisture storage, infiltration and soil organic matter.

***Nutrient and organic matter management*:** Nutrient management should rest on soil testing, appropriate manure and fertiliser use, and recycling of tree litter and crop residues, which build nutrient cycling, organic matter and moisture. Accounting should cover nutrient inputs, removals and biomass recycled on farm.

***Pruning and canopy management*:** As canopies close, shade competes with crops. Timely pruning improves light availability, maintains tree form and yields biomass for fodder, fuelwood, mulch or compost, matched to species and objective; selective thinning maintains the tree–crop balance where density is too high.

***Pest management*:** Regular monitoring allows early detection of pests and diseases. Integrated pest management should be preferred, using preventive, cultural, mechanical and biological measures, with pesticides only when necessary and at recommended doses, reducing costs and environmental and health risks.

***Sustainable harvesting*:** Harvesting should occur at appropriate maturity and use, with attention to quality, market demand, cost and prices, and by methods that minimise damage to remaining trees, soil and crops. Where species coppice or regenerate naturally, appropriate regeneration maintains future productivity.

A framework for GAPs accounting

GAPs accounting should link practices with inputs used and benefits obtained, assessing not only adoption but contribution to production, resource conservation, income and resilience.

Table 1. Framework for GAPs accounting in hill agroforestry

Accounting area	What should be accounted for?	Key indicators
Production	Tree, crop and livestock outputs	Yield, growth, fruits, timber, fodder
Soil	Soil conservation and improvement	Soil loss, SOC, moisture, fertility
Water	Water conservation and use	Runoff, infiltration, water storage
Nutrients	Nutrient use and recycling	Fertilizer use, nutrient balance, litter recycling
Economics	Costs, returns and savings	Cost, income, net return, B:C ratio
Environment and resilience	Wider environmental and livelihood benefits	Carbon, biodiversity, income diversification, stability

The framework should weigh benefits against trade-offs: higher tree density may raise biomass and carbon while reducing crop yield. The aim is the optimum combined benefit of trees and crops, the overall performance of the system rather than any single component.

Measuring change: The importance of a baseline

Accounting should begin with a baseline assessment before a new practice is introduced, giving a reference for measuring changes in production, soil, water, input use and income. Monitoring change over time is essential. The basic approach is: Baseline → GAP intervention → Measurement → Change → Benefit. Where a soil conservation practice is introduced, soil loss, runoff and crop performance can be compared before and after adoption, as can farm income, input use or tree survival. This shows what changed because of the practice.

Accounting for costs and benefits

Costs include planting material, labour, fertiliser, manure, irrigation, protection, pruning, pest management and harvesting; benefits include crop and tree products, household consumption, reduced input costs, soil conservation, water saving and other environmental gains. Timing matters, since trees may need several years to generate significant returns, so long-term benefits must be weighed against the initial investment.

Accounting at different scales

Benefits arise at several levels. Farmers gain products, income and reduced risk; watersheds gain lower runoff, erosion and sediment movement and better water availability; landscapes and society gain carbon storage, biodiversity conservation and climate resilience. Accounting should therefore separate private benefits to farmers from wider public benefits, a distinction that matters when designing incentives.

Implications for farmers, scientists and policymakers

For farmers, GAPs accounting shows whether a practice justifies the investment involved. Recording planting, labour, input, irrigation, protection, pruning and harvesting costs alongside crop and tree production reveals actual returns, while recognizing otherwise invisible services such as improved soil moisture, reduced erosion, nutrient cycling, carbon storage and biodiversity. Aligning it with the TEEBAgriFood framework helps farmers see how management influences natural, human, social and produced capital.

For scientists, the TEEBAgriFood framework strengthens GAPs accounting with a systematic multiple-capitals approach linking practices to ecosystem-service flows, outcomes and impacts. Baseline-based assessment can quantify changes in productivity, soil and water conservation, nutrient cycling, carbon storage, biodiversity, resource-use efficiency, returns and resilience, and can expose trade-offs such as greater tree biomass against possible yield reduction.

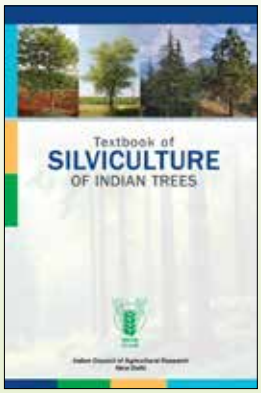
For policymakers, integrating GAPs accounting with the TEEBAgriFood framework offers an entry point for mainstreaming ecosystem-service assessment into agroforestry planning. Evaluation should move beyond trees planted towards changes in capital stocks, service flows and environmental, economic and social outcomes, with indicators built into agroforestry, watershed and climate-resilient farming programmes. Where farmers generate public benefits through carbon storage, biodiversity, erosion control and water regulation, valuation provides the evidence base for targeted incentives and payments for ecosystem services.

SUMMARY

Accounting of good agricultural practices in agroforestry offers a comprehensive way to assess production, costs, resource conservation and wider ecosystem service benefits, moving beyond yield-based assessment to consider crop and tree outputs, soil and water conservation, nutrient cycling, carbon storage, biodiversity, economic returns and resilience. A baseline and monitoring over time identify the actual benefits and trade-offs. Integration with the TEEBAgriFood framework links changes in natural, human, social and produced capital with ecosystem-service flows and outcomes, strengthening farmer decisions, scientific assessment and policy mainstreaming.

*Corresponding author email: kaushalrajesh1@gmail.com

Textbook of Silviculture of Indian Trees



The contents of the book are synthesized to provide information about individual species from classification, taxonomy, origin, distribution, silvicultural characters, forest types, flowering, fruiting, propagation, cultivation practices, agroforestry systems, tree improvement and its multiple-uses. The book covers important tropical and temperate species along with photographs that will act as ready reckoner for species identification and information. Hence, the purpose of the book is to document recent advances and its multiple uses in different species ranging from tropical, arid to temperate parts of India.

TECHNICAL ASPECTS

Pages: viii + 164; Price: ₹ 800.00, US$ 100.00; Postage: ₹100

ISBN No.: 978-81-7164-309-7

For obtaining copies, please contact:

Business Unit

ICAR-Directorate of Knowledge Management in Agriculture

Krishi Anusandhan Bhawan – I, Pusa, New Delhi 110012

Tel: 011-25843657; email: businessuniticar@gmail.com

website: www.icar.gov.in

SCAN QR Code