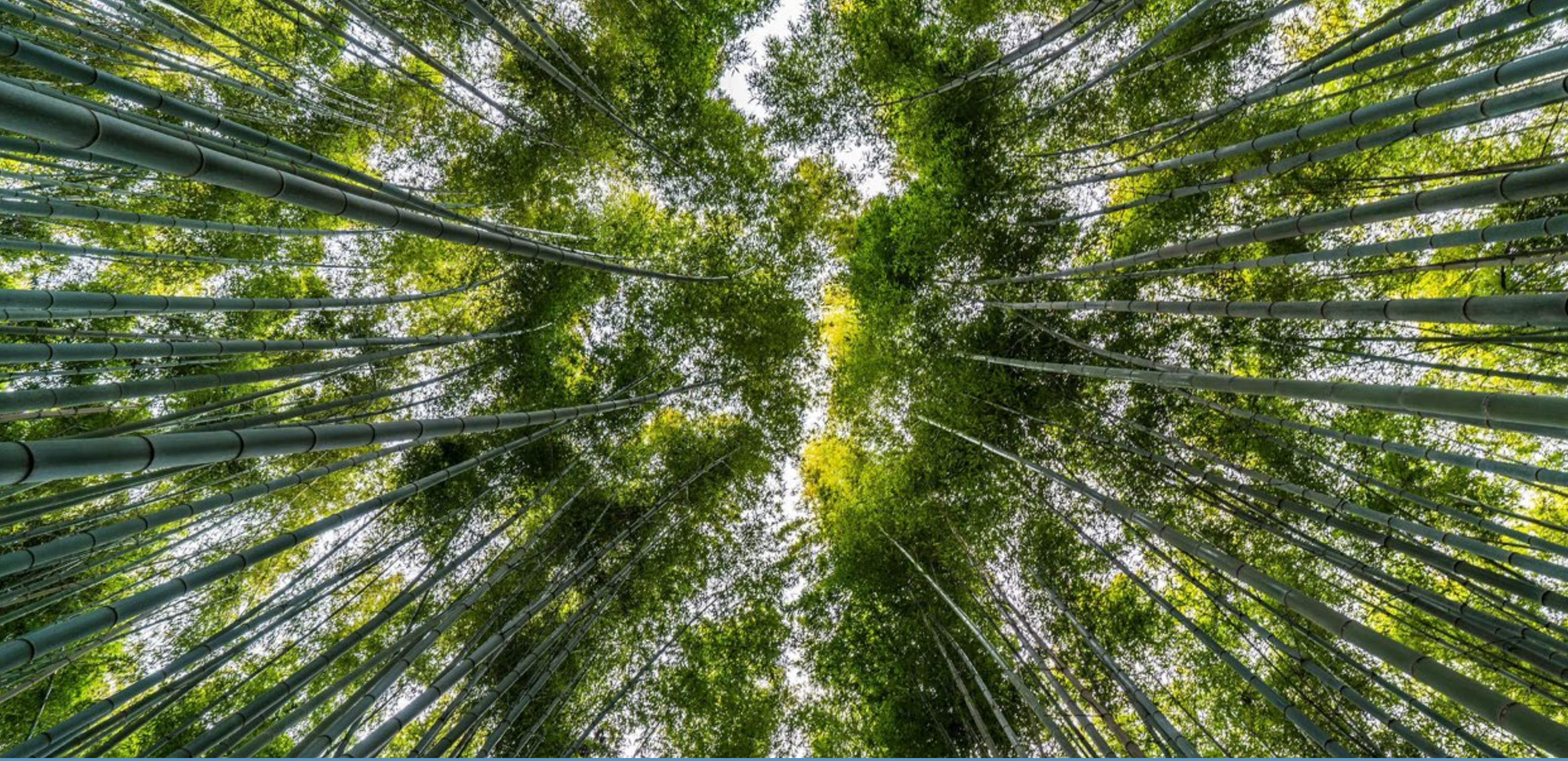

Forestry Best Management Practices

INTERVENTION CATEGORY: MANAGEMENT

DESCRIPTION

Forestry Best Management Practices (BMPs) are practical methods in forest management to achieve goals related to water quality, water quantity, silviculture, wildlife and biodiversity, aesthetics, and/or recreation. This factsheet relates mainly to water security impacts of forestry BMPs in natural as well as planted forests. Natural-forest silviculture can be defined as the practice of controlling the establishment, growth, composition, health and quality of natural forests to meet diverse needs and values. Similarly, although they are often established primarily for timber production, sustainably managed planted forests have the potential to provide important social and environmental benefits.[1] To realize these benefits, it is important that planted forests are responsibly managed using best practices.[2] Certification schemes such as FSC aim to ensure sustainable forestry that integrates environmental, social, and economic benefits.

A sustainable forestry management plan prescribes the silvicultural operations required to ensure that forest management adheres to sustainable development principles. Commonly included practices are canopy alterations to induce natural regeneration, the harvesting of mature trees, planting, and thinning to improve timber quality and stand growth. Suitability of these measures for enhancing sustainability of the natural ecosystem should be evaluated in the local context; for example, some forests are dense by nature and excessive thinning may have adverse impacts.

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WATER SECURITY CHALLENGES (WSCs) ADDRESSED

TYPE		IMPACT	MAGNITUTE	DEPTH OF EVIDENCE BASE
Water availability	Groundwater recharge	Increased mean annual groundwater recharge	★★☆	★★☆
	Dry season flows	Maintained dry season flows	★★☆	★★☆
Disaster risk	Flood risk	Reduced peak discharge	★☆☆	★☆☆
Water quality	Erosion and sedimentation	Reduced on-site erosion and sediment yields	★★★	★★☆
	Nutrients and pollutants	Reduced in-stream nutrient and pollutant concentrations	★★☆	★★☆

Literature on WSC impacts (particularly related to water availability) is inconclusive and difficult to generalize, particularly for areas outside the United States. Impacts of forestry BMPs on water availability differ across geographies and climates. A synthesis of the impact of ecologically-based forest thinning on water yield across the U.S. showed a linear increase in annual water yield with increases in the percentage of forest removed. A range of 22–40 mm of water yield for 10% reduction in forest basal area was found.[3] Increases in water yield resulting from forest harvesting are, however, not distributed equally over the seasons. In southern U.S. forests, it was estimated that around 60% of the observed increase in water yield due to deciduous tree harvesting occurred in the late summer to early winter period, with the majority of this increase occurring during the low-flow months of August, September, and October.4 Also in other areas of the world, annual runoff can increase by a statistically significant amount following light thinning treatments, although the amount of the increase may still remain far below an ecologically and economically significant level. Based on a study in two Turkish catchments, it was recommended to only practice cutting treatments that aim to increase water yield when annual precipitation is over 400–500 mm. In addition to annual rainfall amounts, seasonal dynamics (especially the amount of precipitation occurring in months following the cutting treatments) affect the effectiveness of forest thinning. The importance of rainfall during months preceding the treatment increases with watershed size.[5] In the Yoshino River catchment (Japan), monthly discharge increased substantially in forests that are properly maintained by thinning, even during drought season. Here it was shown that sustainable forest management can help alleviate water shortages during extreme events.[6] A case study in China reports how insufficient management has led to over-dense forests and negative effects on water yield.[7]

A review of water quality impacts of forestry BMPs in the southeastern U.S. found that most previous studies found a positive impact on water quality, especially when forests are located closer to streams.[8] Similarly, a nation-wide review of forestry BMP impacts on water quality found a strong case regarding positive water quality impact, in particular related to erosion and in-stream sediment loads.[9] It should however be noted that there is a huge range in the reported impacts on sediment loads (from insignificant to 99%), and a knowledge gap still exists to design effective sustainable forestry plans across different landscapes.[8] In general, forest harvesting and site preparation can increase erosion, sediment and nutrient losses to streams. However, deployment of BMPs typically allows for water quality recovery within 2–5 years after forest operation disturbances.[10]

OTHER BENEFITS

WHAT?	HOW?
Biodiversity	Provision of habitat, food, and cover for a variety of wildlife species. Optimized diversity of native plant and animal species. Planted forests can also complement the biodiversity values of natural forest, for example by acting as a wildlife corridor and as a supplemental habitat and food source[1]
Economic benefits from timber production	The forest owner may gain substantial revenue from forest thinning treatments, with wood potentially processed in sawmills or used for fuel generation.
Job creation	Additional staff may be employed to perform the necessary management activities.
Soil quality	Maintenance of soil characteristics to ensure the potential of the site to continue productivity at current and historic levels
Aesthetics and recreation	Creation of an aesthetically pleasing environment, providing different opportunities for recreation.

LINKAGES TO CLIMATE CHANGE

Mitigation: In general, forest BMPs contribute to forest health and thus to long-term functioning of the forest as a carbon sink. However, the rotation and destination of any timber produced (particularly in planted forests/plantations) affects the effectiveness of the forest as a carbon sink. Where plantations are established by replacing forests or other long established natural vegetation, the short-term release of carbon during establishment must be balanced against the longer-term sequestration in the timber.[11]

Adaptation: Well-managed forests regulate hydrological processes, mitigate extreme events, and provide a cooling effect as temperature rise under climate change.

DESIGN-ENABLING CONDITIONS AND TYPICAL CONSTRAINTS

- In forests managed for wood production, silvicultural interventions may be necessary to address the relative depletion of commercial tree species caused by past logging interventions, to increase the growth of commercial species, and to optimize the commercial value of the forest. The intensity of interventions will vary depending on, for example, accessibility, markets, site quality, management objectives and ownership.[2]
- Potential biological and physical constraints to design and implementation of forestry BMPs are soil type, aspect and degree of slope, distance to water source, deer population density, proximity and visibility to public, and season.
- Tree species determine specifics of silvicultural operations, such as whether two or three thinnings may be carried out before regeneration.
- Policies with regard to logging may be at odds with management needs to maintain healthy forest structures.[7]
- Effective implementation of forestry BMPs can be constrained by insufficient logger training and landowner knowledge of sustainable practices.[9]
- All stakeholders, including local communities, need to be included in the relevant aspects of forest management, decision-making and policy formulation.[2]
- The geographical and hydrological setting of forests needs to be considered in development of management plans. For example, thinning in riparian areas could have negative impacts on stream habitat and water temperature.

COMMON RISKS AND TRADE-OFFS

- A risk exists with regard to insufficient understanding of forest BMPs implications, and a thorough watershed-specific study is required for developing an effective sustainable forest management plan.
- In several parts of the world, increasingly strict bans on logging, aimed at forest conservation, may in fact conflict with sustainable cutting/thinning treatments.[7]
- Forestry management generally requires construction of roads, which can add to sediment loading.

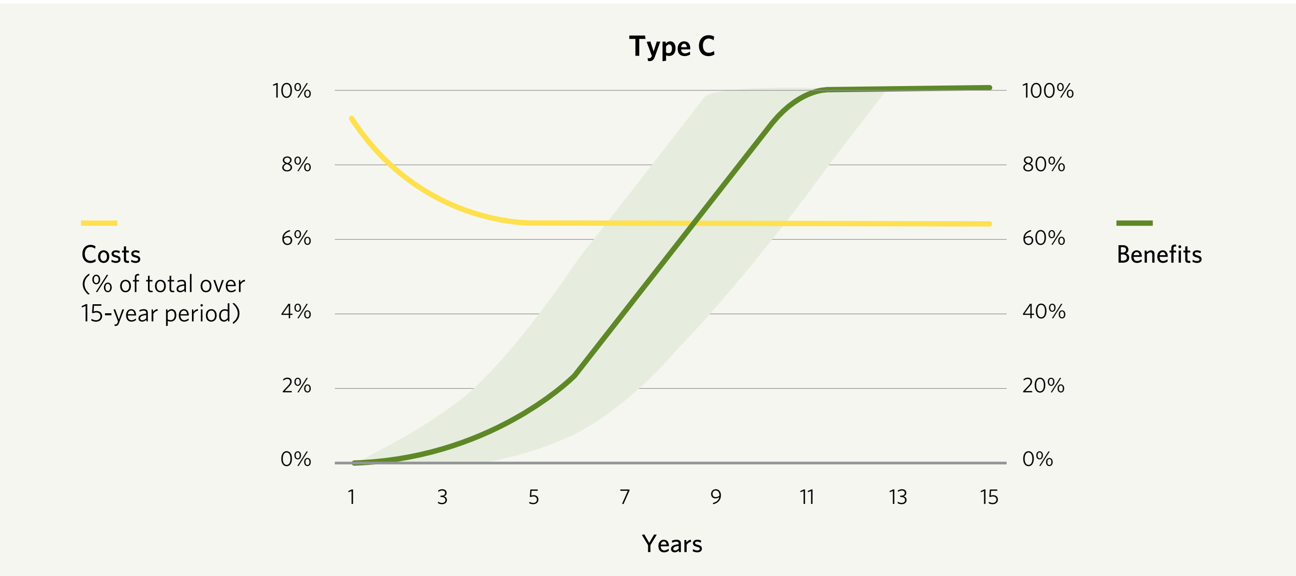
MONITORING OPPORTUNITIES

- Implementation of forestry BMPs can be regularly monitored through combination of satellite remote sensing, field visits and surveys among land owners. Shortwave infrared satellite bands can be used to detect silviculture operations.[12]
- Downstream flows and water quality need to be monitored for evaluating water security benefits obtained from forestry BMPs.

IMPLEMENTATION COSTS AND TIMING OF BENEFITS

Capital costs of forestry BMPs are relatively low, as it is largely a management-oriented NbS with recurring activities such as canopy alterations to induce natural regeneration, harvest of mature trees, planting, and thinning. Initial costs may be related to purchase of any specific equipment and general costs associated with switching to new practices (e.g., training).

A comprehensive review of global economic assessments of water-related benefits of forestry BMPs found that 8 out of 10 studies identify sound business cases when evaluating investments in forest management.[13] Benefits typically begin to accrue when silvicultural operations start, and increase gradually.



Forest thinning (Source: Getty)

EXAMPLES

Sierra Nevada, United States[3]

Brief description: Forest management costs and benefits related to water quantity were evaluated in eleven watersheds of the northern Sierra Nevada. Economic value of incremental water supply was determined in relation to three downstream uses: hydropower, irrigation, and municipal/industrial use.

Lessons learnt:

- The estimated increase in water yield from forest thinning across all 11 watersheds was 0–6% of the average annual streamflow based on the gauge records across the watersheds
- Despite the narrow water quantity focus, potential economic benefits from forest thinning, largely from the potential for increased hydropower production, can be substantial. In some watersheds and management scenarios, they suffice to fully offset the cost of thinning

Region of Valencia, Spain[14]

Brief description: A hydroeconomic modelling framework was applied to a planted pine forest. The optimal schedule of silvicultural interventions in the stands of the catchment was determined to maximize the total net benefit in the system. Silvicultural operation costs according to stand density and canopy cover were modeled using local cost databases.

Lessons learnt:

- Efficient forest management can produce an important increase in groundwater recharge, which could provide substantial benefits to groundwater users and forest owners, clearly surpassing the operating costs. Discounted net present value was quantified at €335 / ha. The value of this increased recharge is higher under water scarcity conditions and with high-value uses.

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