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# Guidelines for Integrating Nature-based Solutions for Resilient Agriculture and Forestry in Tonga

March 2026

**SPREP Library Cataloguing-in-Publication Data**

Guidelines for integrating Nature-based Solutions for resilient agriculture and forestry in Tonga.
Apia, Samoa : SPREP, 2026.

36 p. 29 cm.

ISBN: 978-982-04-1526-3 (print)
978-982-04-1525-6 (ecopy)

1. Conservation of natural resources – Tonga.
2. Forests and forestry – Management – Tonga.
3. Sustainable agriculture – Tonga. I. Pacific Regional Environment Programme (SPREP). II. Title.

630.9612



**Citation**
Foliaki, D. E. (2026). *Guidelines for Integrating Nature-based Solutions for Resilient Agriculture and Forestry in Tonga*. Suva: SPREP.

**Images**
Front cover: Aerial of Tongatapu - Utulei Lui
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This report was prepared by Teulava Consultants for SPREP under the contract titled 'Mainstreaming of Nature-based Solutions in national policy frameworks' for the SPREP component of the PPIN Project.

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# 1. Introduction

The Kingdom of Tonga is a small island nation where strong communal ties, customary land tenure, and traditional ecological knowledge have shaped livelihoods and resource management systems for millennia. Communities have historically relied on a close relationship with land and sea, supported by both indigenous traditional practices and modern governance to manage natural resources sustainably. While Tonga is endowed with rich terrestrial and marine ecosystems, it faces challenges common to Pacific Island countries in responding to climate change impacts and identifying effective resilience and adaptation pathways. These challenges are increasingly threatening food security, ecosystem health, and rural livelihoods.

At the policy and national planning level, the Tonga Strategic Development Framework III guides cross-sectoral planning which are further implemented through sectoral plans and operational action plans and strategies. This includes the National Biodiversity Strategy and action plan (NBSAP) and Joint National Action Plan (JNAP) 2 to strengthen biodiversity and resilience to climate change and recovery efforts from natural disasters. The Government has also launched the Agriculture, Food and Forestry Sector Plan (TASP II, 2023–2035), which prioritises climate-resilient and sustainable land management through ecosystem-based approaches. A full list of policies and plans aligned to the Agriculture and Forestry sector is provided in Annex 1.

Stakeholder engagement highlighted elements of good practice aligned with principles of Nature-based solutions (NbS) yet also identified key areas of improvement to strengthen agroforestry, reforestation, watershed protection, and integrated farming. Specifically, there is limited national guidance for identifying and implementing NbS in these sectors. This NbS Guidelines will address that gap by providing a practical, evidence-based guide to provide systematic assistance to the agricultural and forestry sectors in designing Nature-based Solutions projects that will support food security, social well-being and resilience to climate change impacts that have negatively affected productivity in these sectors.

## How to Use these Guidelines?

**Government officers and Policy makers** – sections 2 & 4

**Agricultural officers** - Section 2, 3, 4

**Communities** - Section 3 & 5

## Situational Analysis and Rationale

Climate change is the most significant threat to Tonga's agriculture and forestry systems, as identified in the Tonga Agriculture Sector Plan (TASP). Increasingly frequent cyclones, prolonged droughts, extreme rainfall, rising temperatures, and sea-level rise are disrupting traditional farming systems. These impacts reduce crop productivity and reliability, degrade soils, and threaten freshwater resources, particularly fragile groundwater lenses on low-lying islands. Climate variability also increases pest and disease pressures and contributes to coastal and lagoon pollution through sediment and nutrient runoff. Institutional and data gaps further constrain effective management and responses. The MAFF Corporate Plan (2025–26) highlights fragmented and outdated legislation, limiting coordinated land-use management and ecosystem protection. Land-use mapping and spatial planning tools are underdeveloped and monitoring of forest cover and ecosystem condition is also limited. Notably, Tonga lacks a comprehensive national forestry inventory, restricting the ability to track biodiversity, tree cover, and ecosystem health.

At the community level, farmers already apply traditional practices aligned with Nature-based Solutions (NbS) principles, which include mixed cropping, soil management, and natural pest control. However, these practices are poorly documented and not well integrated with scientific research on tree–crop interactions. This limits their recognition, scaling, and inclusion in national planning.

The Guidelines address these gaps by strengthening knowledge, capacity, and implementation systems, supporting the documentation and validation of traditional practices combined with scientific evidence. To overcome constraints in seedlings supply, the Guidelines promote decentralised community nurseries linked to strengthened national systems, ensuring access to climate-resilient and culturally important species. Therefore, translating knowledge into practice, demonstration farms on NbS case studies are proposed as training hubs and evidence platforms. The Guidelines also introduce practical measures for slope land management and coastal restoration, supported by improved governance and enforcement. Finally, they promote organic and low-chemical farming approaches and strengthen the role of women and community groups, ensuring inclusive, locally driven, and sustainable NbS implementation.

**BOX 1: NATURE BASED SOLUTIONS INTERVENTIONS SUMMARY**

**An Intervention is NOT a Nature-based Solution if:**

- It is a concrete/ engineered structure without ecological function
- Monoculture plantation without ecosystem restoration objectives
- Limited benefits or single objective
- Project increases erosion, salinity intrusion, or biodiversity loss.
- Short-term gains cause long-term vulnerability.
- No documented community participation.
- No Grievance mechanism

# 2. Nature-based Solutions: Standards and Design Guidelines

## 2.1 Nature-base Solutions Criteria and Principles

**An intervention qualifies as NbS if it meets ALL the following criteria:**

| CRITERION | QUALIFICATION REQUIREMENT | WHAT THIS MEANS | EVIDENCE REQUIRED |
|---|---|---|---|
| **A. ECOSYSTEM-LED DESIGN** | The intervention must use natural ecosystem processes as the primary mechanism for addressing a societal challenge. | ▸ Agroforestry improving soil conditions and structure<br>▸ Forest buffers reducing soil erosion<br>▸ Mangrove or coastal forest restoration enhancing marine ecosystem<br>▸ Assisted natural regeneration restoring watershed hydrology.<br>▸ Coastal forests buffers winds and salt sprays<br>▸ Agroforestry systems further promote having perennial trees ad integral part of the systems<br>▸ Organic farming using animal manure and biological pests and disease control<br>▸ Promoting fruit and socially useful trees planting in urban agroforestry systems | ▸ Design document showing ecosystem function pathway (e.g., erosion reduction via vegetation cover).<br>▸ Species list prioritizing native/local species.<br>▸ Map showing ecological alignment (slope, soil, hydrology).<br>▸ More coastal forest replanting<br>▸ More trees being planted on farmlands, not just in forested areas<br>▸ Increased use of organically sound pests and diseases control measures<br>▸ Cultural and social significant trees species being propagated and planted e.g. heilala |
| **B. DEMONSTRABLE CO-BENEFITS** | Must produce measurable benefits in at least two domains:<br>(1) Climate resilience/ mitigation,<br>(2) Livelihoods/food security,<br>(3) Biodiversity/ ecosystem services. | ▸ Agroforestry providing wind protection (resilience) + fruit income (livelihood) + habitat connectivity (biodiversity).<br>▸ Mangrove restoration providing storm surge protection + fisheries nursery habitat.<br>▸ Reforestation improving carbon stock + reducing erosion.<br>▸ Agroforestry systems accommodate livestock management as with cattle under coconuts<br>▸ Communal land management efforts increase community care for the ecosystem (Toutu'u systems) | ▸ Indicator framework identifying at least two benefit domains.<br>▸ Baseline and target values (e.g., canopy %, yield stability, erosion reduction). |

| CRITERION | QUALIFICATION REQUIREMENT | WHAT THIS MEANS | EVIDENCE REQUIRED |
|---|---|---|---|
| **C. AVOIDS MALADAPTATION** | Intervention must not increase long-term climate, ecological, or social risk. | ▸ Encourage planting of cyclone-resistant variety species eg. Coconut, agathis sp, mangroves in exposed coastal zones.<br>▸ Avoid clearing existing native forest to establish "restoration" plots elsewhere.<br>▸ Avoid agroforestry species that increase invasive risks.<br>▸ Avoid blocking natural drainage patterns.<br>▸ Avoid downstream crop cultivations on slope land<br>▸ Avoid monoculture of crops and trees<br>▸ Increase planting of less popular trees for commercial uses (wood carving) for they will be cut down illegally | ▸ Climate risk screening checklist.<br>▸ Invasive species assessment.<br>▸ Hazard exposure map review.<br>▸ Appropriate slope land farming practices list available<br>▸ Demonstration plots established<br>▸ Seedlings (seedbanks) available for planting |
| **D. SAFEGUARDS + INCLUSIVE GOVERNANCE** | Must apply biodiversity, social, and governance safeguards with participatory decision-making. Refer to EIA Guidelines for meeting social, health, cultural and governance requirements. | ▸ Biodiversity safeguards<br>• Prioritise native species and habitat connectivity; avoid monocultures for "restoration."<br>• Manage invasive species risks.<br>• Avoid conversion of high-value natural habitats.<br>▸ Social safeguards<br>• Free, prior, informed participation<br>• Benefit-sharing arrangements<br>• Protection of vulnerable groups and community grievance mechanism.<br>• Landholder consent<br>• Inclusion of women, youth, and vulnerable households in design and benefit-sharing.<br>▸ Governance safeguards<br>• Clear roles, transparent procurement, conflict-of-interest controls.<br>• Monitoring and reporting responsibilities assigned | ▸ Signed consultation records.<br>▸ Safeguard screening form.<br>▸ Participation data (gender-disaggregated).<br>▸ Governance structure documented. |

**BOX 2: RISKS THAT AFFECT EFFECTIVE NATURE-BASED SOLUTIONS INTERVENTIONS**

1. **Land Tenure/ Ownership** - ensure feasibility within hereditary/ land ownership/lease systems. Obtain signed consent before implementation.
2. **Land to Sea compatibility** - Must not transfer impacts downstream (e.g., upstream land clearing causing coastal sedimentation).
3. **Ineffective monitoring plan** - Must include at least one ecological and one livelihood indicator from the National Core Indicator Set (section 2.5)
4. **Lack of Maintenance plan** - Required for seedling survival, invasive management, and adaptive response to cyclone/drought events.

## 2.2 Steps to Designing NbS Project

| STEP | PURPOSE | KEY ACTIONS | DELIVERABLES |
|---|---|---|---|
| **1. SCOPING & PROBLEM IDENTIFICATION** | Clearly define the problem and feasibility context | ▸ Define societal challenge (e.g., erosion, cyclone risk, drought) and geographic boundary<br>▸ Compile baseline ecological & socio-economic data<br>▸ Map land tenure and governance constraints<br>▸ Screen policy and safeguard requirements<br>▸ Define measurable indicators<br>▸ Identify how the communities (public) may benefit or have positive/negative contributions to the initiative | ▸ Problem statement<br>▸ Baseline report<br>▸ Land tenure map<br>▸ Safeguard screening note<br>▸ Indicator framework<br>▸ Community perceptions and potential to influence the initiative is realised |
| **2. STAKEHOLDER ENGAGEMENT & CO-DESIGN** | Ensure inclusive and culturally appropriate planning | ▸ Map stakeholders (landholders, women, youth, ministries, NGOs)<br>▸ Agree participation rules and grievance mechanisms<br>▸ Conduct co-design workshops<br>▸ Integrate local knowledge with technical inputs<br>▸ Confirm roles and stewardship responsibilities | ▸ Stakeholder map<br>▸ Consultation report<br>▸ Agreed objectives<br>▸ Signed community agreements |

| STEP | PURPOSE | KEY ACTIONS | DELIVERABLES |
|---|---|---|---|
| **3. SELECTION OF NBS OPTIONS** | Identify the most suitable and feasible interventions | ▸ List NbS options (e.g., mangroves, agroforestry, watershed restoration)<br>▸ Apply multi-criteria screening (ecology, tenure, climate benefit, cost)<br>▸ Conduct site suitability analysis<br>▸ Select integrated portfolio<br>▸ Document trade-offs and mitigation<br>▸ Research reports and documentation collated | ▸ Options assessment matrix<br>▸ Selected NbS portfolio<br>▸ Risk & trade-off note |
| 4. PLANNING IMPLEMENTATION | Prepare for effective and legally compliant delivery | ▸ Develop detailed workplan and site maps<br>▸ Secure landholder consent and approvals<br>▸ Prepare nurseries and logistics<br>▸ Build community capacity<br>▸ Phase implementation (pilot → scale)<br>▸ Workforce and qualifications outlined | ▸ Approved implementation plan<br>▸ Signed land agreements<br>▸ Species list & nursery plan<br>▸ Training records<br>▸ Sound workforce secured |
| 5. FINANCING MECHANISMS | Ensure financial viability and sustainability | ▸ Cost full lifecycle<br>▸ Blend funding sources (government, donor, climate finance)<br>▸ Establish incentives (PES, value chains, micro-enterprises)<br>▸ Integrate into existing programmes<br>▸ Define financial community/ governance systems<br>▸ In-kind contributions considered | ▸ Budget & financing plan<br>▸ Funding agreements<br>▸ Financial governance framework |
| 6. MONITORING & ADAPTIVE MANAGEMENT | Track performance and adjust as needed | ▸ Develop M&E framework with ecological and social indicators<br>▸ Establish baseline and annual targets<br>▸ Train community monitors<br>▸ Pre-define adaptive triggers<br>▸ Conduct annual learning reviews | ▸ Monitoring reports<br>▸ Survival & impact data<br>▸ Adaptive management plan<br>▸ Annual review workshop summary |

**BOX 3: LAND TO SEA PLANNING GUIDELINES**

1. **Hydrology first:** Manage water flow from uplands to reefs (reduce sediment/nutrient loads).
2. **Protect critical buffers:** Maintain/restore coastal buffers, steep slopes, coastal vegetation, and mangroves.
3. **Right practice, right place:** Match land use to slope, soil depth, rainfall, exposure, and salinity.
4. **Connectivity:** Link protected areas and restored corridors (forest–farm–coast).
5. **Risk layering:** Combine measures across zones (upland erosion control + mid-slope agroforestry + coastal buffers).
6. **Gradual sequencing:** Start with high-benefit, low-risk actions (buffers, invasive control, assisted regeneration) before complex interventions.

## 2.3 Financing mechanisms for Tonga NbS

**A. Payments for Ecosystem Services (PES)**

- Suitable where beneficiaries can be identified:
  - Downstream communities paying for upstream watershed protection (sediment reduction, water reliability)
  - Tourism operators supporting coastal ecosystem buffers
- Minimum PES design requirements: defined service, measurable indicators, payment triggers, transparent governance.

**B. Carbon and blue-carbon pathways**

- Forest carbon: reforestation/assisted regeneration with credible MRV.
- Blue carbon: mangrove restoration where feasible and ecologically appropriate.
- Practical guidance: start with readiness i.e mapping, baseline carbon estimates, leakage risk management, maintenance plan, and benefit sharing.

**C. Incentives for private-sector and community enterprises**

- Link NbS to livelihoods:
  - agroforestry value chains (fruit, timber substitutes)
  - nurseries as micro-enterprises
  - multipurpose species where appropriate
- Incentive options: matching grants, concessional credit, tax/fee relief, performance-based community grants.

**D. Blended finance and programme integration**

- Combine:
- government budgets (extension, forestry operations)
- donor finance (adaptation, biodiversity)
- climate finance pipelines (readiness → project)
- community contributions (labour, stewardship)
- Integrate NbS into ongoing programmes to reduce transaction costs and improve sustainability.

## BOX 4: NBS FINANCING GUIDELINES

- **Clear business case:** quantified benefits (risk reduction, avoided losses, productivity gains, ecosystem services).
- **Costed lifecycle plan:** (maintenance 3–5 years minimum), replacements, monitoring.
- **Tenure certainty:** signed landholder/leaseholder agreements and stewardship responsibilities.
- **Implementation capacity:** nursery supply chain, trained teams, procurement plan, delivery schedule.
- **Safeguards compliance:** biodiversity/social/governance safeguards and grievance mechanism.
- **Monitoring, Review and Verification (MRV) plan:** baseline, indicators, monitoring method, data governance.
- **Revenue or financing pathway:** grants + co-financing, or PES/carbon/value-chain revenues.

## 2.4 Standard NbS indicators for Tonga

| Domain | Indicator | Unit | Calculation Method | Data Required | Frequency | Notes |
|---|---|---|---|---|---|---|
| **Carbon / Climate** | Above-ground biomass change | $tCO_2e$/ha | AGB × 0.47 × 44/12 | Tree DBH, height, species equations | Every 2–3 years | 44/12 converts C to $CO_2e$ |
| | Change in carbon stock | $tCO_2e$/ha/ year | $(AGB_2 - AGB_1) \times 0.47 \times 44/12$ | Baseline & follow-up biomass | Every 2–3 years | Use consistent plots |
| | Mangrove / blue-carbon area restored | ha | Total mapped restored area (GIS) | GPS/GIS mapping | Every 2–3 years | Can pair with carbon estimates |
| **Vegetation** | Species composition & diversity | Index / count | Standard diversity indices (e.g., Shannon) | Species inventory | Every 2–3 years | Select one consistent index |
| | Canopy cover | % | (Canopy area ÷ plot area) × 100 | Transects or drone imagery | Every 2–3 years | Keep method consistent |
| | Survival rate of seedlings | % | (Living ÷ planted) × 100 | Seedling survey | 6–12 months | Target ≥70% after 12 months |
| | Tree density | seedlings/ha | Count ÷ plot area | Plot counts | 6–12 months | Useful for regeneration tracking |
| **Erosion & Sediment** | Erosion (erosion pins) | mm/year | Change in soil level over time | Pin measurements | Seasonal (wet/dry) | Average across pins |
| | Sediment trap capture | kg/m²/year | Sediment weight ÷ trap area | Collected sediment | Seasonal | Best in sloped areas |
| | Turbidity | NTU | Direct meter reading | Water samples | Seasonal | Compare wet vs dry seasons |
| | Buffer continuity | % | (Intact buffer length ÷ total stream length) × 100 | Field survey / GIS | Annual | Include buffer width where relevant |

| Domain | Indicator | Unit | Calculation Method | Data Required | Frequency | Notes |
|---|---|---|---|---|---|---|
| **Water Regulation** | Dry-season flow | Yes/No or L/s | Flow measurement (bucket/meter) | Seasonal field data | Seasonal | Compare baseline vs post-restoration |
| | Soil organic matter | % | Lab test (LOI method) | Soil samples | Annual | Proxy for infiltration |
| | Ground cover | % | (Covered ground ÷ total area) × 100 | Field observation | Seasonal | Target >70% in erosion-prone areas |
| | Conductivity / salinity | µS/cm or ppt | Meter reading | Water samples | Seasonal | Key for coastal systems |
| **Livelihoods & Food Security** | Yield (productivity) | kg/ha | Yield ÷ harvested area | Farm records | Annual | Compare across seasons |
| | Yield variability | % | (Std dev ÷ mean) × 100 | Multi-year yield data | Annual | Lower = more stable |
| | Income diversification | # sources | Count income streams | Household survey | Annual | Can expand to weighted index |
| | Revenue diversification | % | (Non-primary ÷ total income) × 100 | Income records | Annual | Measures resilience |
| | Participation (gender/ youth) | % | (Target group ÷ total participants) × 100 | Attendance records | Annual | Tracks inclusivity |
| | Benefits to vulnerable groups | % | (Benefits to vulnerable ÷ total) × 100 | Financial records | Annual | Includes PES, inputs |

## BOX 5: INDICATOR NOTES

- Select practical indicators for measuring the progress of NbS intervention.
- Update and expand list to include relevant indicators specific to project needs.
- Keep methods consistent over time to ensure comparability.
- Use baseline and repeated measurements for all change indicators.
- Frequencies are minimum recommendations and can be adapted to project-specific needs

## 2.5 Practical Application for Forestry and Agriculture

| Step | Purpose | Key Actions | Deliverables |
|---|---|---|---|
| **Step 1: Define Outcome Pathways** | Clarify what the NbS intervention aims to achieve and why | ▸ Identify and prioritise key challenges (e.g. erosion, drought, low productivity)<br>▸ Engage stakeholders (communities, government, NGOs, private sector) to understand problems, traditional knowledge, and roles<br>▸ Define intended outcomes across key areas:<br>- Risk reduction (erosion, cyclones, drought)<br>- Water regulation (watershed stability, salinity)<br>- Food security & productivity<br>- Biodiversity restoration<br>- Carbon sequestration<br>▸ Livelihoods & economic benefits<br>▸ Develop a causal pathway: Intervention → Ecosystem Change → Societal Benefit Example: Coastal planting → Reduced sediment → Improved water quality → Increased crop stability<br>▸ Prioritise 3–5 key outcomes to monitor | ▸ Outcome pathway diagram<br>▸ Clear priority outcomes (3–5)<br>▸ Shared understanding among stakeholders |
| **Step 2: Select a Balanced Indicator Set** | Ensure performance is measured at different levels | ▸ Select indicators across three levels<br>- Impact (long-term change): e.g. improved yield stability, reduced sediment<br>- Outcome (ecosystem response): e.g. canopy cover %, survival rate<br>- Output (activities delivered): e.g. hectares restored, seedlings planted<br>▸ Ensure indicators align with priority outcomes from Step 1<br>▸ Keep the set simple and balanced (avoid too many indicators) | ▸ Balanced indicator matrix (impact, outcome, output)<br>▸ Indicators aligned with project goals |
| **Step 3: Apply SMART + Feasibility Filters** | Ensure indicators are practical, measurable, and realistic | ▸ Check each indicator is: Specific – Measurable – Achievable – Relevant – Time-bound (SMART)<br>▸ Assess feasibility:<br>- Can communities or local staff measure it?<br>- Is equipment affordable and available?<br>- Is monitoring frequency realistic?<br>▸ Remove indicators that are too complex, costly, or not useful | ▸ Final, practical indicator list<br>▸ Indicators suitable for field conditions |

| Step | Purpose | Key Actions | Deliverables |
|---|---|---|---|
| **Step 4: Establish Baseline + Targets** | Enable tracking of change over time | ▸ Collect baseline data before implementation<br>▸ Set targets: Annual targets, Mid-term targets, Endline targets<br>▸ Align with national frameworks where relevant (e.g. NBSAP, NDCs)<br>- Example: Baseline canopy cover = 25%Year 1 = 35%Endline = 60% | ▸ Baseline dataset<br>▸ Clear target framework<br>▸ Measurable progress benchmarks |
| **Step 5: Assign Roles + Reporting Flow** | Ensure accountability and consistent monitoring | ▸ Define roles and responsibilities (community, government, technical teams)<br>▸ Set monitoring frequency (e.g. 6 months, annually, 2–3 years)<br>▸ Establish data flow: Community → District → National systems<br>▸ Develop supporting tools: – Responsibility matrix – Reporting schedule – Annual review process<br>▸ Define adaptive triggers (e.g. survival rate <70% →replanting) | ▸ Monitoring responsibility matrix<br>▸ Reporting schedule<br>▸ Adaptive management protocol |

# 3. Guidelines for Practical Design and Management of Tree-Crop Systems

## 3.1 Field Design Standards: spacing, orientation, pruning, thinning

| Design element | Guideline standard | Practical "field rule" |
|---|---|---|
| **Tree–crop spacing (general)** | ▸ Use wider spacing in cyclone-prone/ exposed sites and tighter spacing in sheltered sites; avoid closed canopy where crops need light.<br>▸ Space selections would be determined by the tree-crop selections, cropping systems, geographical situation, and the terms of land lease/ ownership<br>▸ Close spacing forces trees to soar into unmanageable heights<br>▸ Adequate spacing allows lateral branching with ability to flower aggressive (fruit trees) and develop strong woody stems (sandalwoods)<br>▸ Tree crops often suited farm boundaries and areas with least potential for agricultural activities<br>▸ Wider spacing and light-canopy cover trees such as Coconut palms and Pinus caribaea are favourable as pastures for livestock | ▸ Start with 8-12 m between large canopy trees (breadfruit/mango),<br>▸ 5-8 m for mid-canopy fruit (citrus/ avocado),<br>▸ 3-4 m for short-lived plants (banana/ papaya).<br>▸ Adjust to light needs and soil depth.<br>▸ Wood stands i.e. woodlots are suitable for rocky coastal and high cliffs regions where agricultural crops will struggle<br>▸ Planting of timber trees and other native trees with aggressive growth nature are often recommended along Tax Allotment boundaries<br>▸ Trees that favour repeated pruning such as Bischofia javanica and Erythrina spp. are favourable for intensive tree-crops inter-plantings<br>▸ Nitrogen fixing tree species, which are, most often mid-size shrubs better suited agroforestry systems |
| **Orientation (wind + sun)** | ▸ Align shelterbelts perpendicular to prevailing damaging winds; align crop alleys for adequate sunlight penetration.<br>▸ Contour planting of erosion buffers is recommended on slope lands<br>▸ Leaving strips of forest stands – untouched on slope lands minimises soil erosion<br>▸ Conserve secondary forests in parts of the Tax allotments for windbreaks, sunlight management, soil and moisture management and pest/diseases control<br>▸ Integrate lower and ground cover crops such as Pandanus and Bamboos in shelterbelts to maximise micro wind control | ▸ Place windbreaks on windward boundaries<br>▸ avoid long continuous "solid walls"<br>▸ use staggered rows to reduce wind turbulence.<br>▸ Depending on the intensity of prevailing winds, 2 or more rows of trees may be required |

| Design element | Guideline standard | Practical "field rule" |
|---|---|---|
| **Pruning** | ▸ Maintain tree health + light balance; reduce cyclone drag.<br>▸ Timely pruning is necessary for all tree crop types. Timber trees develop clean logs with timely pruning.<br>▸ Tree pruning, of fungal-free tree species, are also useful for yams staking and surface mulching on exposed lands<br>▸ Appropriate pruning to most trees is necessary prior to occurrences of natural disasters such as tropical cyclones and prolonged droughts<br>▸ Tree pruning is a vital part of fruit tree-crop management as it trigger flowering on all fruit bearing trees<br>▸ In Tonga, trees flowering usually starts prior to the end of the third quarter hence fruiting occur from November to February annually. Therefore, tree pruning is advisable for the period of March to June each year | ▸ Annual selective pruning (remove weak forks, crossing branches; lift canopy gradually).<br>▸ Avoid heavy pruning right before cyclone season (Nov-April)<br>▸<br>▸ Pruning of Sandalwood trees are of paramount importance the development of the core woods. The tree main stem shall be cut at 2-2.5-meter heights to initiate core wood developments<br>▸ Cut and apply wood biomass within the cleared areas to provide surface mulching, suppress weeds and maintain soil moistures |
| **Thinning** | Thin to prevent overcrowding and restore crop-light balance.<br>▸ Thinning helps individual trees to develop physiologically according to resource-owners' preferences. For example, timber planted for timber requires careful and systemic thinning to enhance stem developments. Thinning of breadfruit trees enhances seasonal fruiting etc.<br>▸ Manase Siua of 'Eua, the biggest Kava grower in the whole of Tonga, starts kava harvesting after year 3. Half of the Kava plants are selectively harvested alternatively. This implies that increase open spaces encourage the remaining Kava plants to develop biomass a lot faster. Evidently, Manase Siua confirmed that the total yield is doubled through this thinning process | ▸ Thin when canopy closure suppresses understorey crops (e.g., crop decline, persistent shade, poor airflow/disease).<br>▸ To avoid "thinning to waste", the Aotearoa Tonga Forest Products Ltd carry out selective thinning process by which smaller logs are being utilised for fencing and other construction purposes |

## 3.2 Species selection: shade tolerance, rooting behaviour, cyclone resilience

| Selection factor | Action guide | Practical screening questions |
|---|---|---|
| **Shade tolerance** | Match crop light needs to canopy density; use multi-strata but manage canopy to protect staples (taro/yam).<br>▸ Manage Vanilla support structure and canopy to allow adequate light receptions by the Vanilla crop<br>▸ Open up new forested area for the Kava crop and inter-planting of Kava with other crops indicates that Kava requires high percentage of shade after planting. According to Tevita Fonokalafi, a Kava grower in Vava'u, gradual changes in clearing of a forested area for Kava cultivation is an essential part of Kava growing. Essentially, Fonokalafi confidently explained that the young Kava seedlings (1-5 months old) require 50-85% shade, this is why immediate planting of Kava after clearing the forest undergrowth is vital, to be followed by slowing killing the larger trees through ring-barking and sometimes burning at the tree base. The slow defoliation of the canopy means slow exposure to more direct sunlight, which is needed from six months onward<br>▸ Manase Siua, who utilises vast grassland areas is adopting an intensive intercropping of Taro (Alocasia, Colocasia and Xanthosoma taro), Banana and Kava as a means of managing shade. Cropping on open fields is often attractive to mechanization although careful land management is advised<br>▸ Yams cannot tolerate heavy shades hence favouring high sunlight exposure<br>▸ Cattle survive well under coconut and forest shades | "Will this tree create heavy shade within 3–5 years?"<br>"Can I prune to maintain 40–60% canopy cover where crops are grown?" |
| **Rooting behaviour** | Use deep-rooted / wind-firm trees for windbreaks and slopes; mix rooting depths to reduce competition and stabilise soils.<br>Larger trees, native and exotic, rooting systems are often incompatible with food/root crops. Vanilla and Kava are amongst the ones that strive well near larger trees<br>▸ Most timber trees develop strong and aggressive rooting systems, therefore noted as not being favourable for intercropping with agricultural food crops<br>▸ Deep-rooted trees are resilient to severe tropical cyclones and tsunami thus favourable for coastal soil erosion | "Does this species tolerate drought and anchor well?"<br>"Will it compete with nearby crops on shallow soils?" |

| Selection factor | Action guide | Practical screening questions |
|---|---|---|
| **Cyclone resilience** | Use wind-firm species, diversify species/ages, avoid brittle canopies, and prune for wind.<br>Example: It is stressed that all trees, especially larger trees, are prone to tropical cyclones. However, appropriate interventions through tree management such as sound thinning and pruning, and careful species selection are vital to developing resilient tree/crop systems. Here are a few local lessons;<br>▸ Locals cut and remove all Cassava crown, 30-60 cm from the base, to avoid crop damages and to save the developed tubers. Lolomana'ia Fili of 'Eua shared his experience as a prominent Cassava grower that Cassava is amongst the most resilient food crop and removal of the crown prior to cyclone strikes minimised food shortages.<br>▸ Lolomana'ia also explained that on the Banana crops, all leaves should be removed to avoid complete damage. And with the banana plants with fruit bunch nearing maturity, they can be pushed to the ground as they will continue to mature after cyclone<br>▸ For coastal forests, it is advisable to plant coastal tree species, especially the ones that are known to be growing within the vicinity. | "Has this species performed well after cyclones locally?"<br>"Does the structure resist strong winds?" |

## 3.3 Reduce herbicide dependence: tree-based weed suppression options

| Option | Practical guide |
|---|---|
| **Shade suppression (designed canopy)** | Managed shade reduces light for aggressive weeds.<br>▸ Encourage the use of green cover crops such as Mucuna for shade suppression as well as for soil improvements<br>▸ Use pruned canopy to shade inter-rows during peak weed growth while maintaining crop light.<br>▸ Multi-strata cropping, as in the traditional cropping systems, is an effective weed suppression technique<br>▸ Use of thick mulching with tree biomass and coconut fronds are effective ancient weed suppression techniques<br>▸ Select less seed production fallow species such as Sesbania and Moringa to minimise weed infestation of high seed production species such as panicum grasses and Leucaena |
| **Mulching from pruning** | ▸ Prunings create a mulch layer that suppresses weeds and conserves moisture.<br>▸ Establish hedgerows/alley systems and apply pruning to crop rows.<br>▸ Living fences is a good source of mulching materials<br>▸ Slashed ground cover/shrubs, with proper and timely incubations to suppress weed seeds is a major source of mulching materials<br>▸ Tu'imoala Mahu'inga of Tofoa Tongatapu used to cultivating yams yearly ('Ufi Tokamu'a) he emphasised that applying appropriate yam staking techniques (Felei) is the best form of yam cultivation that ensures high yield. Accordingly, Mahu'inga explained that the higher the yam vine climbs, the better the yield would be. Further, the Felei produces surface mulching that suppresses weeds, maintains soil moisture and restricts soil splashes on the yam leaves, thus causing damages in which Anthracnose (fungal diseases) enters the plant. |

| Option | Practical guide |
|---|---|
| **Cover crops / Living ground cover** | ▸ Competes with weeds, protects soil, improves infiltration.<br>▸ Use seasonal covers/legumes in alleys; maintain >70% ground cover on erosion-prone soils.<br>▸ Mucuna is a proven and tested cover crop with peculiar tangible benefits to the ecosystems<br>▸ Cover crops could also be a source of fodder for animal feeds |
| **Hedgerows / Alley cropping** | ▸ Tree/shrub strips suppress weeds, reduce evaporation, and provide organic matter inputs.<br>▸ Rows of leguminous shrubs; periodic pruning; keep alleys in crops.<br>▸ Hedge rows provide buffers for pests and diseases<br>▸ Provides windbreaks and salt sprays of crops<br>▸ Planted along the slope's contours, hedgerows minimise soil erosion<br>▸ Continual cutting of the top portions of the hedgerows provides mulching materials as well as animal feed |

## 3.4 Seedling production & guaranteed availability (MAFF and private-run nurseries)

| Component | Minimum standard | Output |
|---|---|---|
| **Nursery production planning and management** | Annual production plan by island group (Tonga/Ha'apai/Vava'u/Eua/ Niuas) aligned to restoration and grower demand:<br>Establish nurseries managed by women groups, NGOs<br>An inventory of the operational nurseries is necessary to understand the number of nurseries, purposes in which they are operating, capacities, species selections, locations, accessibilities etc.<br>Access to seed sources and suppliers is vital<br>Establish propagation methods, research and training for high value cultural/ ecological species<br>manage fruiting variability through staggered planting, species diversification, and targeted pruning/nutrition to stabilise household supply and market volume. | Seedling schedule and species mix |
| **Quality control** | Minimum "plant-able" standards (healthy roots, hardened-off seedlings, pest-free) | Reduced mortality, higher survival |
| **Distribution system** | Pre-season allocation list and community pick-up points announced through town officers, radio and social media platforms | Transparent, predictable access |

**BOX 6: PROMOTING BEE FARMING**

Promote beekeeping as a complementary enterprise in tree–crop systems to improve pollination services and diversify income. FAO provides good beekeeping practices for sustainable apiculture (hive management, disease control, productivity – see Annex 2

| Integration option | Practical guide |
|---|---|
| Apiary near orchards | Place hives near flowering tree crops (with safety/spacing) |
| Training + starter kits | Local training cycles + basic equipment support |

## 3.5 Technical training, publications, and digitization

| Priority | Practical guideline | Benefits & Deliverables |
|---|---|---|
| **Demonstration plots** | ▸ Land security is essential to ensure long-term demonstration efforts<br>▸ Appropriate demonstration design and financial sources should be secured<br>▸ Establish community demonstration plots (1-2 per district) to test spacing, pruning regimes, weed suppression, and species combinations; run seasonal learning days.<br>▸ Orientation, density, pruning, species compositions, spacings, inter-planting with other species abilities | Reduced cyclone damage, better yields |
| **Contour agroforestry plot** | ▸ Erosion control + infiltration, cropping systems and patterns, species suitability, tree-crop companionship characteristics<br>▸ Dr. Siosiua Halavatau, a Tongan Soil Scientist, recommends a "Do Not" approach to contour farming in Vava'u and 'Eua, His recommended approach of "Do Not" cut or remove strips of forests and cover crops along the slopes will go a long way in minimizing soil erosion when farming is done on the slope lands. According to him, farmers will not spend extra money on managing the strips while the benefit is immense | Lower sediment/ runoff |
| **Multi-strata orchard plot** | ▸ Income + biodiversity, species compositions, spacing, abilities to inter-planted with each other, soil types, pests and diseases tolerance, | Diversified income streams |
| **Training** | ▸ Annual training cycles for: propagation, planting, pruning/ thinning, soil cover, pest management, cyclone recovery | Trainer manuals + field days |
| **Publications & research (digital)** | ▸ Maintain a "Tonga Tree-Crop Technical Series" (short PDFs + videos) and update based on field trials | Digital library + QR-coded field sheets |
| **Digitised records** | ▸ Use simple mobile forms (species, spacing, survival, yield) feeding a national registry | Shared dataset for learning + reporting |

## 3.6 Management differences: short-term leased land vs owned land

| Land tenure context | What to implement | What to avoid |
|---|---|---|
| **Short-term leased land (higher uncertainty)** | ▸ No removal of existing forests and tree, including coconut palms in signed agreement<br>▸ Consider a tree replanting arrangement, example planting certain number of fruit trees during the lease duration<br>▸ To have a planned improve fallow systems that is proven to be effective<br>▸ Ban slashing and burning of forests and bushes<br>▸ Fast-return systems: windbreaks, boundary tree lines, short-cycle fruit (banana/papaya), nitrogen-fixing hedgerows, mulch/cover-crop weed suppression, portable beehives.<br>▸ Use written agreements for tree ownership/harvest rights. | Long-rotation timber or high-cost orchard establishment without lease security. |
| **Owned / long-term secure land** | ▸ Long-horizon agroforestry: multi-strata orchards, sandalwood companion planting, watershed buffers<br>▸ Silvopastoral systems: recognised agroforestry practice combining trees, forage and livestock; establishment commonly involves planting trees into pasture or thinning/ management of existing trees. Where culturally and practically appropriate, integrate livestock under managed tree systems to improve land productivity and reduce weeds only with controlled grazing and seedling protection. | Over-dense planting without thinning plan. |

### BOX 7: COMPANION TRIAL DESIGN NOTES

**Host strategy eg. For Sandalwood:** consider short-term and long-term hosts (often nitrogen-fixing or compatible fruit/forest species)

- Year 0 - Leucaena leucocephala (wild tamarind)
- Year 2+ - integrate coconut trees, breadfruit trees

▸ Spacing: Keep space for hosts and management access (1-2m); avoid competition and waterlogging

▸ Records: Tag host species, host pairings and track survival growth

# 4. Investment and Implementation Roadmap

| Timeline | Key Objectives | Key Activities | Expected Outputs |
|---|---|---|---|
| **Short- term 1–2 Years** | Pilot NbS projects and build capacity | ▸ Establish pilot NbS demonstration sites in selected districts (agroforestry farms, mangrove restoration, watershed protection)<br>▸ Train MAFF extension officers and community leaders on NbS design and monitoring<br>▸ Develop nursery capacity for native species<br>▸ Establish national NbS coordination mechanism<br>▸ Develop national monitoring baseline and database | ▸ 5–10 pilot NbS sites established<br>▸ Training programmes implemented<br>▸ National NbS coordination framework operational<br>▸ Baseline ecosystem and livelihood data collected |
| **Medium term 3–5 Years** | Institutionalise NbS in policies and programmes | ▸ Integrate NbS into TASP II implementation programmes<br>▸ Develop island-specific NbS standards and technical manuals<br>▸ Incorporate NbS into land-use planning and EIA processes<br>▸ Expand agroforestry and forest restoration programmes<br>▸ Establish annual National dialogue platforms for sharing lessons learnt | ▸ NbS mainstreamed into agriculture and forestry policy frameworks<br>▸ Standard operating procedures for NbS established<br>▸ Expanded restoration and agroforestry initiatives<br>▸ Evidence-based and practical NbS challenges documented and addressed |
| **Long-term 5–10 Years** | Scale up NbS through sustainable financing mechanisms | ▸ Develop climate finance proposals (GCF, GEF, bilateral aid)<br>▸ Establish Payment for Ecosystem Services programmes<br>▸ Expand NbS interventions nationally<br>▸ Integrate NbS into carbon and biodiversity markets<br>▸ Strengthen private-sector investment in NbS value chains | ▸ National NbS investment programme established<br>▸ Large-scale restoration and agroforestry expansion<br>▸ NbS integrated into national climate and biodiversity financing |

## Indicative Budget Framework in USD for Tongatapu and Outer islands

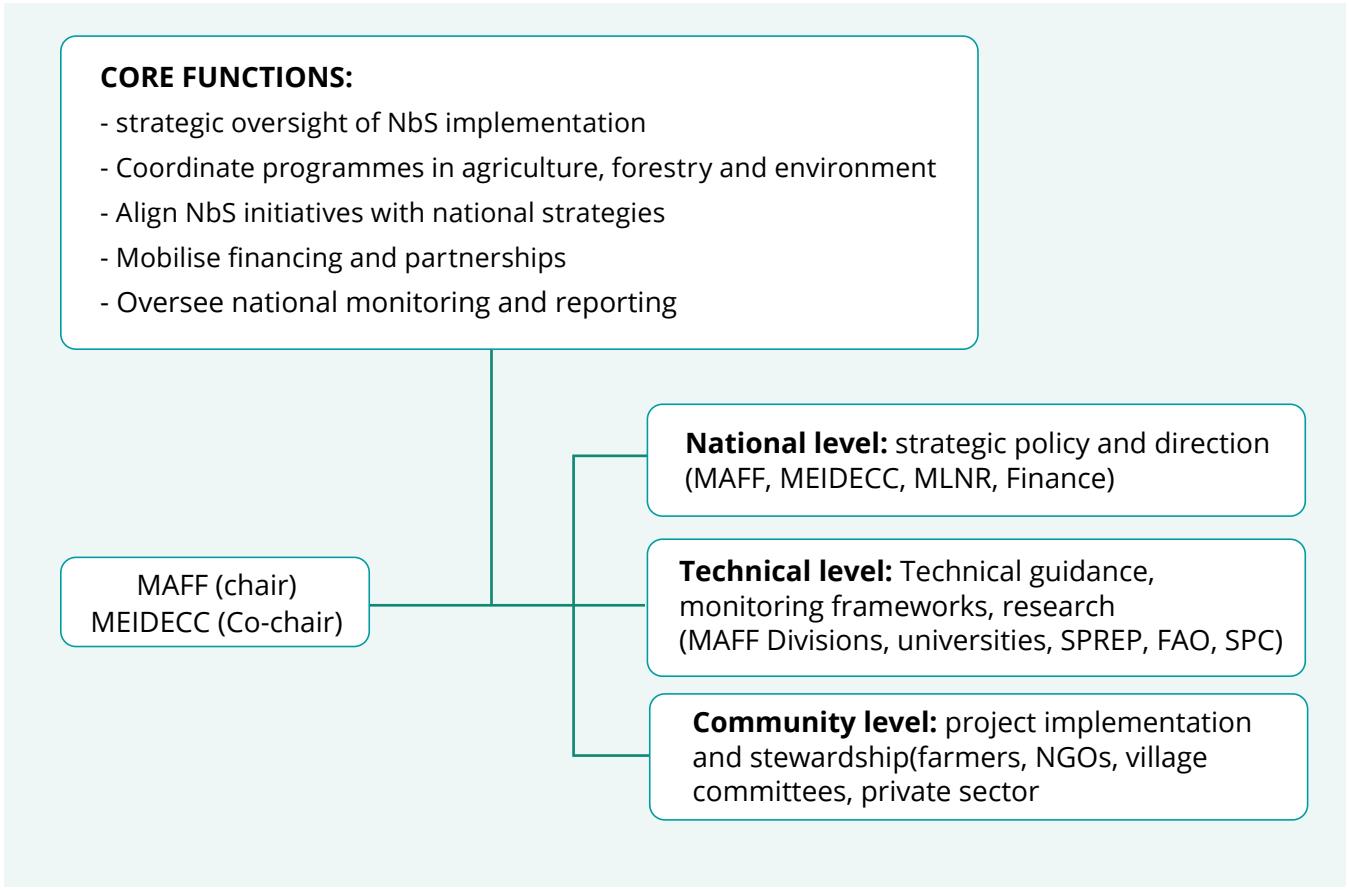
| Programme Component | Short-Term (1-2 yrs) | Medium-Term (3-5 yrs) | Long-Term (5-10 yrs) | Estimated Total |
|---|---|---|---|---|
| NbS pilot projects (agroforestry, restoration) | $1.2M | $3M | $6M | $10.2M |
| Capacity building and training | $0.5M | $1M | $1.5M | $3M |
| Nursery development and seed systems | $0.4M | $1.2M | $2M | $3.6M |
| Monitoring and data systems | $0.3M | $0.8M | $1.2M | $2.3M |
| Policy integration and coordination | $0.2M | $0.5M | $0.8M | $1.5M |
| Climate finance mobilisation and investment programmes | $0.1M | $1M | $4M | $5.1M |
| Total Indicative Budget | $2.7M | $7.5M | $15.5M | $25.7M |

Note: Funding sources may include government budgets, donor programmes, climate finance (GEF, GCF, Adaptation Fund, bilateral aid, Biodiversity funds), and private sector contributions.

## Responsibility Matrix

| Institution | Core Responsibility | Role in NbS Implementation |
|---|---|---|
| **MAFF (Ministry of Agriculture, Food and Forestry)** | Lead implementing agency | Develop technical guidelines, coordinate pilot projects, deliver extension services, manage agroforestry and forestry programmes |
| **MEIDECC** | Climate and environmental coordination | Align NbS with NDC, NBSAP and JNAP II support climate finance mobilisation; environmental safeguards |
| **MNLR (Ministry of Lands and Natural Resources)** | Land governance and spatial planning | Ensure tenure compliance, integrate NbS into land-use planning and spatial mapping |
| **District & Village Committees** | Community engagement | Support participatory planning, stewardship agreements and monitoring |
| **NGOs (MORDI, Live & Learn, VEPA)** | Community outreach and capacity building | Training, demonstration projects, community mobilisation |
| **Private Sector** | Market and investment support | Support agroforestry value chains, nursery enterprises and eco-business opportunities |
| **Regional partners (SPREP, SPC, GGGI, IUCN)** | Technical assistance | Research, training, climate data and programme support |

## NbS Coordination Mechanism through NBSAP Secretariat



# 5. Case Studies

## Case Study 1: Private Organic Farming

**Female Youth Organic Vanilla Grower**

Name of Farmer: Miss Elma 'Uhatahi
Gender: Female
Village: Veitongo, TONGA
Name of farm: Falesiu ki Moana Wahine Grower

**Figure 1:** Organic vanilla farming

Elma 'Uhatahi is a 28-year-old single girl of the village of Veitongo, who farm in her fathers 8 acres "Tax allotment" located in the village of Tokomololo in Tongatapu. Assisted financially and morally by her father, she received multiple local and regional trainings on various farming activities including yams, taro, kava and floriculture. She was attracted to and fell in love with Vanilla farming because, according to her, because it is organic and not requiring any agri chemicals. As of January 2023, she started her organic Vanilla farm by propagating a limited source of vegetatively propagated planting materials, procured from Vava'u. Her family helped her clear part of the secondary forest manually because she did not want the land to be disturbed by using of heavy machines. Fiki, Jatropha curcas cuttings were planted together with her "hardened off" Vanilla vines. Dried coconut husks were used as base-mulch to ensure that the vines are being properly anchored to the soil, weeds are suppressed and the soil moisture is maintained. Weeds dominated by Para grass or Musie 'Atele, a common cover crop for Vanilla in Tonga, are being managed by bush knives and no weedicide is used. Several large Rain trees, Samanea saman, coconut palms and fruit trees namely breadfruits, citrus varieties and mangos are left to grow inside the farm plot to provide shade, wind protection and favourable microclimate for Vanilla.

## Case Study 2: Private Organic Farming

### Organic Kava Piper methysticum

| | |
|---|---|
| Name of Farmer: | Mr ‘Alani Lisala |
| Gender: | Male |
| Village: | Leimatu’a, Vava’u, TONGA |
| Name of farm: | Magaono Kava |

**Figure 2**: Organic kava farming

Alani Lisala is a son of the late Sione Lisala, a prominent Kava grower of the village of Leimatu’a in Vava’u. The family had cultivate Kava, amongst other food crops such a yams, taro and sweet potato for several decades. They have become one of the largest Kava grower and producer in Vava’u. They cultivate Kava and other crops such as pineapple, taro varieties to provide shade and companionship for the Kava plants and yams for cash. ‘Alani migrated to New Zealand with his family in 2012 but decided to return to Vava’u in 2018 to grow Kava due to hardship in living in New Zealand. In 2025, he cultivated a total of 64 acres of Kava, and continually produces an average of 35 to 50 metric tonnes of dried Kava powder to New Zealand and Australia annually since 2021. He uses tractors and implements for land preparation due to his large-scale farming but he uses local labour forces to maintain weeds and to harvest his crops. In site where forests and trees exist, he selectively clears some of the trees and save fruit trees and coconut palms. Sometimes he prunes the trees and allows them to grow back again near Kava harvest. He applies mulching using coconut fronts and panicum grass biomasses. He uses banana stems as mulch during the planting stage to provide moisture for the young seedlings.

## Case Study 3:
## Biological Control of Invasive Trees in Forestry Landscapes

In Tonga's forestry sector, the Natural Enemies: Natural Solutions programme uses biological control to manage invasive species such as the African tulip tree (Spathodea campanulata). A joint initiative between MAFF, MEIDECC, local community – Tupou College and SPREP, introduced specific natural enemies such as gall-forming mites are released to weaken the invasive plant and allow native vegetation to recover. This approach represents a Nature-based Solution for restoring ecosystem balance, community benefits in managing invasives hindering native species growth and education awareness for youth.

**Figure 3:** Biological control of the invasive African tulip tree in Tonga

## Case Study 4: Tonga Citizen Science Initiative

Established in 2020, TCSI is a local NGO based in Sopu, Kolomotu'a, founded by Mr. Penikoni 'Aleamotua with a focus on mangrove forest restoration with community stewardship supporting coastal protection, fisheries and carbon sinks which actively promotes inclusive local governance. Mr. Aleamotu'a and his wife, Lofi have together established the Coastal Green Nursery (seedbank) cultivating up to 10 mangrove species aimed at increasing community resilience and recovery from natural disasters – cyclones, tsunami and reduce impacts of coastal erosion. Multiple ecological and community benefits observed including:

- Children and youth engagement and awareness about ecosystem services, collecting seedlings and monitoring growth rates
- Increase in juvenile fish species using the newly planted mangrove plots
- Recovery rates more than 70 percent observed over 5years since its establishment.
- Support from local fishermen in monitoring the rehabilitated sites

**Figure 4:** Mangrove restoration conducted by Tonga Citizen Science

## Case Study 5: Coconut Agroforestry with Mixed Cropping

Coconut-based agroforestry systems are common across Tonga. Coconut palms are planted across farmland while crops such as taro, yam, cassava, banana, and squash are cultivated underneath the canopy. This traditional system improves soil fertility through organic matter accumulation, reduces wind damage to crops, and enhances biodiversity. Coconut production is also an important livelihood sector across the Pacific region, providing food, oil, timber, and other products. Tonga's traditional farming systems combine crops such as yam, cassava, taro, and banana with trees such as coconut or breadfruit. Historically these systems followed shifting cultivation and fallow cycles that restored soil fertility. Today many farmers combine these traditional agroforestry systems with mechanised land preparation, irrigation, and farm roads, creating hybrid production systems. These systems maintain tree cover for wind protection and soil stability while allowing commercial crop production for export markets.

**Figure 5:** Mixed cropping and silvopastoral

# Annexes

## Annex 1 - Institutional mandates

| Institution | Core Mandate | Key Divisions | Coordination Mechanisms / National Plans | Synergies |
|---|---|---|---|---|
| **Ministry of Agriculture, Food and Forests (MAFF)** | Sustainable management of agriculture, forestry, and food systems under:<br>• Forestry Act 1961<br>• Agriculture Sector Act 2000<br>• Biosecurity Act 2015 | ▸ Forestry Division – plantations, agroforestry, timber harvesting<br>▸ Research & Extension Division: climate-smart farming<br>▸ Quarantine/ Biosecurity Division | ▸ Tonga Agriculture Sector Plan (TASP)<br>▸ National Food Security Framework (2021)<br>▸ Agriculture Sector Growth Committee (ASGC), which provides cross-sectoral oversight and links or connects public agencies, private sector actors, churches, and communities. | ▸ Forestry Division implements plantation & community forestry (carbon sequestration, erosion control).<br>▸ Coordinates with MEIDECC (EIA, climate) & MLNR (land tenure). Implements agroforestry & sustainable land-use programs.<br>▸ Contributes to AFOLU mitigation in NDC Roadmap. |
| **Ministry of Meteorology, Energy, Information, Disaster Management, Environment, Climate Change and Communications (MEIDECC)** | National lead on environment, climate change, energy, and disaster risk management under:<br>• Environment management Act 2010<br>• Climate Change Policy 2016<br>• Disaster Risk Management Act 2021 | ▸ Department of Climate Change (NDC coordination, GCF, NDA)<br>▸ Department of Environment (EIA, biodiversity monitoring)<br>▸ Meteorology & Climate Services | ▸ JNAP 2 (2018–2028) – integrates DRM + CC adaptation<br>▸ NBSAP 2 – biodiversity strategy coordination<br>▸ Tonga NDC Implementation Roadmap– mitigation/ adaptation actions<br>▸ Coastal Resilience Project (GCF) – MEIDECC lead EA | ▸ National focal point for CBD, UNFCCC, and GCF.<br>▸ Oversees coastal resilience, EIA of forestry/ocean projects.<br>▸ Coordinates cross-sector planning via JNAP Secretariat<br>▸ Integrates forestry (carbon sinks), coastal adaptation, and biodiversity. |

| Institution | Core Mandate | Key Divisions | Coordination Mechanisms / National Plans | Synergies |
|---|---|---|---|---|
| **Ministry of Fisheries (MoF)** | Conservation, management and development of Tonga's aquatic resources under:<br>• Fisheries Management Act 2002<br>• Aquaculture Management Act 2003 | ▸ Offshore Fisheries Division<br>▸ Inshore/Coastal Fisheries Division<br>▸ Aquaculture Division<br>▸ Monitoring, Control & Surveillance Unit (MCS)<br>▸ Compliance & Licensing | ▸ Tonga Fisheries Sector Plan<br>▸ Community-based Special Management Areas (SMAs) framework<br>▸ Tonga Fish Pathway Project | ▸ Implements coastal and marine resource management and SMAs.<br>▸ Coordinates with MEIDECC (Environment) and MLNR (Land / marine tenure).<br>▸ Critical to coastal ecosystem resilience and sustainable livelihoods.<br>▸ Supports integration of marine biodiversity and blue-economy approaches. |
| **MLNR (Ministry of Lands and Natural Resources)** | Administration of land tenure, minerals, and natural resources under:<br>• Land Act 1927<br>• Minerals Act 1989<br>• Cabinet mandates on marine spatial planning | ▸ Land Administration Division<br>▸ Natural Resources Division<br>▸ Survey & Mapping Division | ▸ Oceans 7 Mechanism – co-chair for marine spatial planning<br>▸ Tonga Ocean Management Plan (2021) | ▸ Oversees land allocation for forestry/ agroforestry.<br>▸ Manages coastal land tenure, reclamation, and erosion zones.<br>▸ Co-leads integrated ocean-land planning via Oceans 7.<br>▸ Enables coordination across forest, coastal, and marine spatial boundaries. |

## Annex 2: Convention and Policy Alignment

| *Policy / Legislation* | Alignment to Forestry and Agriculture |
|---|---|
| *Land Act* | Governs land tenure, leasing and inheritance. Central to agroforestry expansion, tree crop security, and long-term forestry investments. Land allocation rules influence tree planting incentives and sustainable land management. |
| *Forest Act* | Provides legal framework for forest protection, harvesting controls, and reforestation. Enables regulation of timber extraction and conservation of native forest resources. Foundation law for sustainable forest management. |
| *Environment Management Act* | Establishes EIA processes and environmental safeguards. Applies to agricultural expansion, land clearing, and forestry projects. Supports biodiversity and watershed protection. |
| *Pesticides Act* | Regulates import, sale and use of agrochemicals. Aligns with Rotterdam and Stockholm Convention obligations. Critical for safe crop production and soil protection. |
| *Biosafety Act* | Governs genetically modified organisms. Supports compliance with Cartagena Protocol and safeguards biodiversity in agriculture. |
| *Waste Management Act* | Regulates disposal of agricultural waste and chemical containers. Aligns with Basel and Waigani Convention obligations. |
| *Tonga Strategic Development Framework II (TSDF II)* | National development blueprint. Includes goals on sustainable agriculture, environmental resilience, food security, and economic diversification. Provides macro-level policy direction for forestry and agriculture integration. |
| *Tonga Agriculture Sector Plan* | Sectoral roadmap for crop productivity, value chains, biosecurity, climate resilience and food security. Key document for agroforestry scaling and sustainable farming practices. |
| *Tonga Forestry Policy* | Guides sustainable forest management, reforestation, biodiversity protection and community forestry initiatives. Supports ecosystem-based adaptation and watershed protection. |
| *Tonga Biodiversity Strategy and Action Plan (NBSAP)* | Aligns with CBD. Promotes conservation of native forests, invasive species control, and biodiversity mainstreaming in agriculture. Covers terrestrial forests, mangroves, coral reefs, and marine ecosystems. Guides biodiversity actions for forestry (native replanting), coastal rehabilitation, and species protection. Provides reporting linkages to JNAP 2 and NDC framework. |
| *Joint National Action Plan on Climate Change and Disaster Risk Management (JNAP 2)* | Integrates climate adaptation and disaster resilience into land-use planning. Strong relevance for climate-smart agriculture, coastal forest buffers and watershed restoration. Aligns sectoral plans (agriculture, fisheries, lands) with climate & DRM targets. Mechanism for monitoring and reporting on environment and ecosystem resilience. |
| *Tonga Nationally Determined Contribution (NDC)* | Commits to climate adaptation and mitigation including agriculture resilience and ecosystem restoration. Supports agroforestry and carbon sequestration initiatives. |
| *Tonga National Invasive Species Strategy and Action Plan* | Addresses invasive species threatening crops and forests. Supports biosecurity and ecological resilience. |
| *Tonga National Environment Policy* | Establishes overarching environmental management principles influencing forestry, land degradation control and sustainable agriculture. |
| *Tonga National Water Policy* | Relevant for watershed management, irrigation, soil conservation, and upland forest protection. |
| *Tonga Energy Road Map* | Indirect relevance: promotes biomass and sustainable land-use considerations; supports climate-aligned land management practices. |
| *Convention / Organisation* | Link to Tonga Forestry & Agriculture |
| *Food and Agriculture Organization of the United Nations (FAO)* | Provides technical standards for forestry, plant health, soil management, biosecurity, and climate-smart agriculture. Supports national forest monitoring, pest control, and agricultural statistics systems.<br>Practical Guidelines for Bees and pest management https://openknowledge.fao.org/server/api/core/bitstreams/3cef7eea-ad03-4a7e-80a4-e5c90f76af10/content |

| *Policy / Legislation* | Alignment to Forestry and Agriculture |
|---|---|
| *International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA)* | Supports conservation and sustainable use of crop genetic diversity (taro, yam, breadfruit). Requires policy mechanisms for access and benefit-sharing of plant genetic resources. |
| *International Fund for Agricultural Development (IFAD)* | Enables concessional finance for rural livelihoods, agroforestry systems, and climate-resilient farming investments. |
| *International Plant Protection Convention (IPPC)* | Establishes phytosanitary standards; requires quarantine and biosecurity legislation to manage invasive pests and protect export agriculture. |
| *Convention on Biological Diversity (CBD)* | Core biodiversity treaty; mandates ecosystem conservation, invasive species control, and biodiversity mainstreaming in agriculture and forestry policies. |
| *United Nations Convention to Combat Desertification (UNCCD)* | Supports sustainable land management (SLM), watershed protection, agroforestry expansion, and drought resilience strategies. |
| *United Nations Framework Convention on Climate Change (UNFCCC)* | Requires AFOLU sector GHG reporting; underpins REDD+, forest carbon, and climate-smart agriculture programming. |
| *Paris Agreement* | Anchors Tonga's NDC commitments including agriculture adaptation, forest resilience, and carbon sequestration initiatives. |
| *Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)* | Regulates trade in endangered timber and species; relevant for forest product exports and biodiversity enforcement. |
| *Rotterdam Convention* | Governs trade of hazardous pesticides; requires prior informed consent and strengthened agricultural chemical regulation. |
| *Stockholm Convention* | Regulates persistent organic pollutants; drives safer pesticide and agrochemical management systems. |
| *Basel Convention* | Controls hazardous waste movements; relevant to pesticide container disposal and agricultural waste management. |
| *Minamata Convention on Mercury* | Protects soil and water quality from mercury pollution affecting agriculture and food systems. |
| ***Convention for the Protection of the Natural Resources and Environment of the South Pacific Region (Nouméa Convention)*** | Regional framework supporting ecosystem conservation, coastal forest protection, and watershed management. |
| ***Waigani Convention*** | Prevents hazardous waste import into the Pacific region; reinforces environmental safeguards. |
| ***Secretariat of the Pacific Community (SPC)*** | Provides regional technical assistance in forestry, crop research (CePaCT), biosecurity, statistics, and climate-resilient agriculture. Critical implementation partner for Tonga's agriculture and forestry reforms. |
| ***International Union for Conservation of Nature (IUCN)*** | Supports ecosystem-based adaptation, protected area management, forest restoration, NbS standards, and biodiversity policy strengthening. Provides global conservation frameworks and tools. |
| ***Global Green Growth Institute (GGGI)*** | Supports green growth planning, climate finance access (GCF readiness), NDC implementation, sustainable land-use investment design, and policy reform for low-carbon agriculture and forestry. |
| ***International Network for Bamboo and Rattan (INBAR)*** | Promotes bamboo/rattan-based agroforestry, land restoration, and sustainable forest-product value chains. |

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Cover photo: Aerial View of Tonga'tapu, Utulei Lui

The Promoting Pacific Island Nature-based Solutions (PPIN) project is funded by New Zealand's Ministry of Foreign Affairs and Trade (MFAT). PPIN seeks to support the development of policy and legislation for Nature-based Solutions (NbS), build regional awareness and capacity, and strengthen regional cooperation amongst Pacific Island countries on NbS. PPIN is managed by IUCN in partnership with the Pacific Community (SPC), the Secretariat of the Pacific Regional Environment Programme (SPREP) and Global Green Growth Institute (GGGI).

PPIN
Promoting Pacific Islands
Nature-based Solutions

ISBN 978-982-04-1526-3
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