



Ministry of Tourism and
Environment

Hazardous Waste in Noonu Atoll

Baseline Assessment and Sustainable Alternatives



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List of Acronyms

HHW	Household Hazardous Waste
IWMC	Island Waste Management Centre
POPs	Persistent Organic Pollutants
SIDS	Small Island Developing States
S.W.A.P	Sustainable Waste Alternatives Program
VOCs	Volatile Organic Compounds
ESM	Environmentally Sound Management
PPE	Personal Protective Equipment
LED	Light Emitting Diode (lighting)
CFL	Compact Fluorescent Lamp
SAP	Strategic Action Plan
UNDP	United Nations Development Programme
SPREP	Secretariat of the Pacific Regional Environment Programme
NGO	Non-Governmental Organization
WDC	Women's Development Committee
M&E	Monitoring and Evaluation
FENAKA	State-owned utility managing island powerhouses
WAMCO	Waste Management Corporation (Maldives)

Executive Summary

This report assesses hazardous waste in Noonu Atoll, establishes a baseline and recommends safer product alternatives. Conducted by Zero Waste Maldives under the Sustainable Waste Alternatives Program (S.W.A.P.) program, the study covered all 13 inhabited islands through surveys, interviews, field visits, and focused engagements on Manadhoo, Magoodhoo, and Maafaru.

Key hazardous waste streams include used oils, healthcare waste, fiberglass from boatbuilding, and various household hazardous wastes (HHW) such as batteries, chemicals, paints, e-waste, and diapers.

Despite Noonu Atoll's remote location, the availability of consumer products mirrors that of Malé; as stakeholders noted, "almost everything available in Malé is available in the islands." This means the hazardous waste profile is similar to urban areas, though dispersed in smaller volumes.

Waste management remains weak, with open burning still common. Segregation efforts in Noonu are better than in many islands, largely due to Soneva-led initiatives [1], but consistent sorting and proper HHW storage at Island Waste Management Centers (IWMCs) are still lacking.

While FENAKA handles the off-island transport of used lubricating oil, most other HHW is mixed with municipal waste, informally dumped, or openly burned—posing risks to soil, water, and air quality. Despite community concern, clear guidelines and protective measures are lacking, and awareness seldom translates into safer practices. No acute health issues have been reported, but there is growing concern over long-term exposure to hazards like fiberglass dust and toxic fumes.

This report identifies high-risk hazardous product categories in Noonu Atoll and recommends safer alternatives based on their risk profile, usage, and disposal practices. Priority items include solvent-based paints, synthetic pesticides, chemical cleaners, single-use and lead-acid batteries, mercury-containing fluorescent lamps, aerosol sprays, and disposable diapers. These products contribute to environmental pollution and pose health risks through burning, leaching, and improper handling.

To address these challenges, the report's core recommendation is to promote environmentally friendly alternatives such as low-Volatile Organic Compounds (VOC) or water-based paints, copper-free antifouling boat coatings, botanical pesticides (e.g., neem)[2], biodegradable cleaning agents (like vinegar), rechargeable batteries, LED lighting, reusable or biodegradable diapers, and mercury-free medical devices. These solutions are drawn from proven practices in other Small Island Developing States and local programs like Soneva Namoonaa[1] and Parley Maldives[3].

Beyond product substitution, broader strategic actions are proposed:

- Develop local HHW by-laws and integrate Environmentally Sound Management (ESM) principles
- Strengthening the capacity of Island Councils and IWMC staff
- Invest in infrastructure (e.g., HHW storage areas, compliant incinerators, Personal Protective Equipment (PPE) for workers)
- Launch sustained public awareness campaigns
- Foster strong public-private-community partnerships

Community engagement is essential, particularly through gender-inclusive approaches. Women's groups can lead safer household practices, while men in industrial roles can model safe handling of hazardous materials.

Ultimately, the goal is to position Noonu as a model for toxic-free waste management—minimizing hazardous waste at the source and managing unavoidable waste safely. This aligns with national targets and global commitments, including the SDGs[4] and the Minamata Convention[5].

Section 1: Introduction

1.1 Background and Rationale

Zero Waste Maldives, in partnership with the Ministry of Tourism and Environment and funded by the VESHI Small Grant Programme, is leading the Sustainable Waste Alternatives Program (S.W.A.P.) to improve hazardous waste management in Noonu Atoll. The project involves assessing hazardous waste across all 13 inhabited islands and recommending safer product alternatives to reduce waste at the source.

Although geographically remote, Noonu Atoll has access to a wide range of hazardous consumer goods—such as fuels, batteries, electronics, and pesticides—through regular supply shipments from Malé. As a result, its consumption patterns and hazardous waste profile closely mirror those of the capital. This presents both a challenge and an opportunity: while island-level interventions are essential, lasting solutions must also address national supply chains and import practices by engaging suppliers and shaping policy at the source.

The continued use and poor management of hazardous materials—including household chemicals, electronic waste, automotive fluids, and industrial by-products—pose serious threats to the Maldives' ecosystems and public health. Improper disposal can release toxins like persistent organic pollutants (POPs) and heavy metals into the environment, contaminating soil, water, and marine life.

A core rationale behind this project is that a comprehensive, island-level assessment is critical for identifying high-risk products and informing effective substitution strategies. These actions are foundational for shifting toward more sustainable consumption and production patterns—essential for long-term environmental protection and public health in the Maldivian context.

1.2 Objectives and Scope

The primary goal of this consultancy is to assess hazardous waste in Noonu Atoll and recommend safer alternatives to high-risk products. Findings and recommendations are compiled in this report.

This assessment covers all 13 inhabited islands of Noonu Atoll, Maldives. While baseline data was collected across the atoll, detailed fieldwork—including site visits and stakeholder consultations—was concentrated on three representative islands: Maafaru, Manadhoo, and Magoodhoo. This focused approach enabled deeper analysis of hazardous waste management in diverse community settings.

The study examines hazardous waste from households, institutions (e.g., schools, health centers), businesses (e.g., shops, boatyards), and municipal services (e.g., powerhouses, waste centers). Resort and uninhabited islands were excluded unless their activities impacted nearby communities (e.g., through waste transfers). The assessment spans the full lifecycle of hazardous materials—from import and use to disposal—recognizing that most hazardous waste in Noonu originates from imported products.

Key objectives include:

- Data collection for inhabited islands
- Conducting surveys, site visits, and stakeholder consultations
- Analyzing waste streams, quantities, handling practices, and exposure risks
- Identifying high-risk product categories contributing to hazardous waste
- Proposing safer alternatives based on availability, affordability, performance, and local suitability
- Providing guidance for piloting selected alternatives on designated islands
- Compiling all findings into a single report, including a baseline assessment

Expected outcomes include a clear understanding of hazardous waste in Noonu, identification of key problem products, and actionable recommendations. The project aims to reduce hazardous waste generation, improve local waste management, and support a shift toward safer, more sustainable product use in the atoll.

1.3 Study Area Context – Noonu Atoll

Noonu Atoll (Southern Miladhunmadulu), located in the northern Maldives, comprises 13 inhabited islands with a total population of approximately 12,503 [6]. The atoll capital, Manadhoo (~1,745 residents), serves as the main administrative and commercial hub, hosting the regional hospital and key government offices. Other notable islands include Velidhoo (~1832 residents), Kedhikulhudhoo (~1556 residents), Holhudhoo (~1428 residents) and Maafaru (~919 residents), which hosts an international airport. [6]

Population sizes vary significantly—from Velidhoo, the most populous island, to Magoodhoo and Fodhdhoo, with populations under 400. The islands are spread across an area of roughly 40 km by 30 km, presenting logistical challenges for coordinated waste transport and service delivery. [6]

Population density is especially high in Henbadhoo (4,611 people/km²), Miladhoo (4,175/km²), and Velidhoo (2,944/km²), placing intense pressure on limited waste infrastructure and increasing the potential for environmental and public health risks. In contrast, Kedhikulhudhoo, with a land area of over 2.09 sq. km, offers greater flexibility for planning IWMCs and implementing hazardous waste segregation. [6]

Space-efficient solutions are crucial for smaller, densely populated islands like Henbadhoo and Miladhoo, where land constraints limit infrastructure options. The significant share of working-age residents (18–35) across the atoll also presents a key opportunity to promote green employment, sustainable practices, and community-led hazardous waste initiatives. [6]

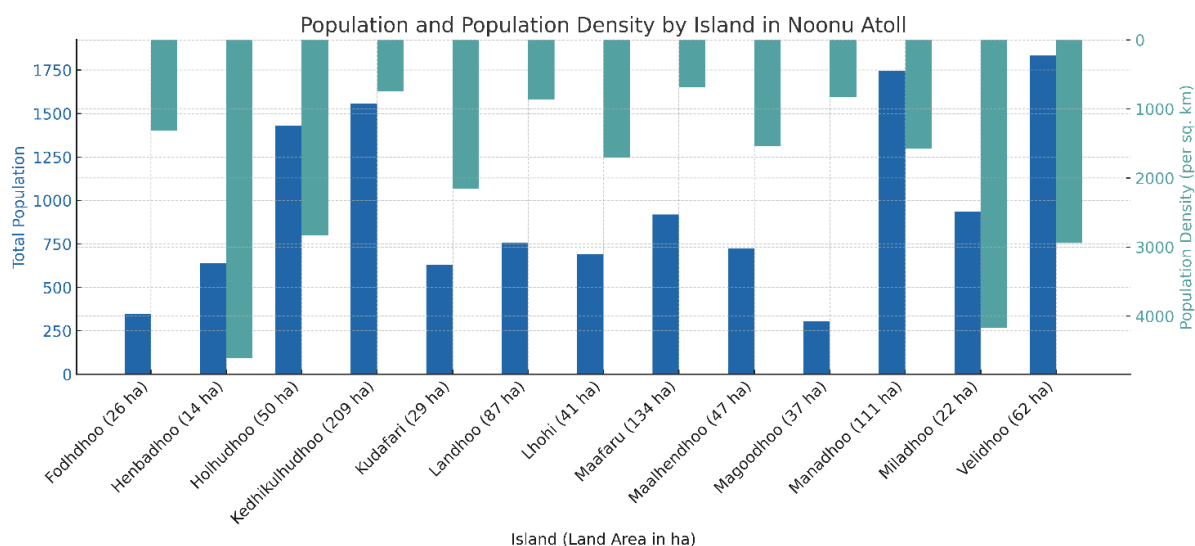


Figure 1: Noonu Atoll Demographics Adapted from Census 2022 data [6]

Each inhabited island in Noonu Atoll has an IWMC designed to collect, partially segregate, and temporarily store waste. These facilities are intended to support periodic **waste transfers** to the **Vandhoo Regional Waste Management Centre** in Raa Atoll—a **centralized landfill** serving Noonu, Raa, Baa, and Lhaviyani atolls. However, in practice,

waste transfer from Noonu is irregular and mainly limited to bulky or non-burnable materials.

IWMCs typically consist of basic **fenced yards** or **sheds** where waste is **stockpiled**. Due to space and equipment constraints, **open burning** is common to **reduce waste volume**. Equipment such as **glass crushers**, **compactors**, and carts is available on some islands but remains limited and inconsistent, impacting local waste handling capacity.

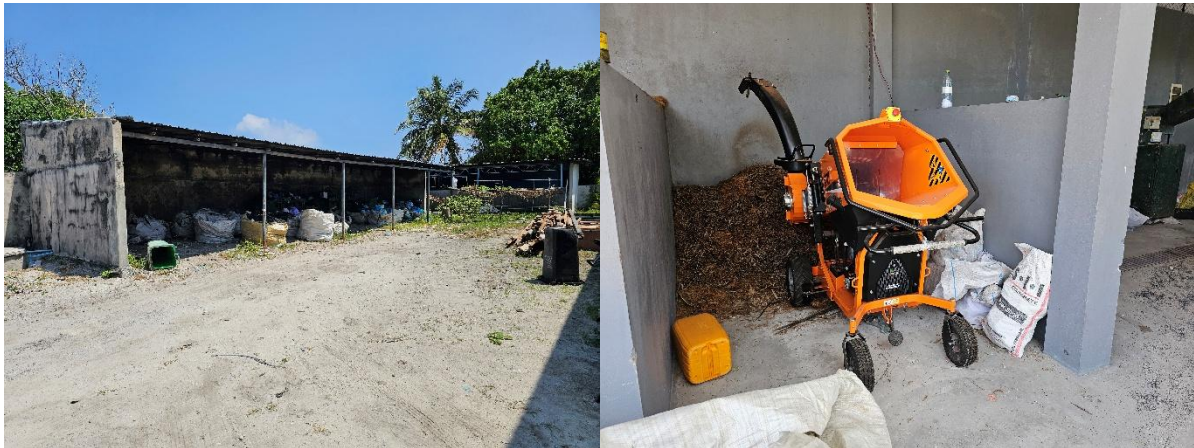


Figure 2: Typical IWMC with waste management equipment

The state utility **FENAKA** operates **diesel generators** on every island and manages the **collection** and **removal** of **used oil**. However, other **hazardous wastes**—such as **batteries**, **chemicals**, and **electronic waste**—lack formal removal pathways and often **accumulate** in **households** or at **IWMCs**.

The people of Noonu Atoll rely on a mix of livelihoods, including **fishing**, **boat building**, **small-scale agriculture**, **public service** (especially in Manadhoo), and a **growing tourism** sector, with several resorts providing **local employment**. Education and health services are available on the larger islands, all of which have health centers, while **Manadhoo** houses the **atoll hospital**.

Awareness of general waste issues is **moderate**, with some exposure to past projects by Non-Governmental Organization (**NGOs**) and agencies like United Nations Development Programme (**UNDP**). However, **hazardous waste** has **not** been a specific **focus**. Traditional disposal practices—such as **dumping waste** into the **sea** or **burying** it in **pits**—still influence **behavior**, despite being **unsuitable** for **modern hazardous materials** like **plastics**, **batteries**, and **chemicals**.

Local institutions like **Women’s Development Committees** (WDCs) play an active role in **community health** and **environmental initiatives**. **Youth groups** and **NGOs** also exist on several islands but require additional **support** and **capacity-building** to effectively address **hazardous waste challenges**.

Noonu Atoll reflects a common **Maldivian pattern**: increased **modern consumption** and **hazardous waste** generation, met with **limited waste management** infrastructure.

1.4 Methodology

The assessment used qualitative techniques to gain a comprehensive understanding of hazardous waste in Noonu Atoll.

Data Collection Tools and Field Methods

Primary data collection involved:

- **Structured and semi-structured questionnaires** administered to Island Councils, IWMC staff, healthcare professionals, FENAKA operators, shop owners, and boatyard managers.
- **Observational checklists** used during site visits to IWMCs, powerhouses, healthcare facilities, boat building sites, and retail shops. These included **photographic documentation** of infrastructure and practices.
- **Stakeholder consultations** and **focus group discussions** for qualitative insights on local perceptions and challenges.
- **Mini waste audits** on select islands, inspecting inbound cargo, shop inventories, and waste sites to correlate product use with waste generation.
- A **desk review** of national policies and literature, including the *Maldives Waste Management Regulation (2021)* and *Baseline Assessment on Chemical Use and Risks (2022)*, for regulatory context.

Fieldwork Summary

Fieldwork took place from **February 18–24, 2025**, with some follow-up activities in March. Intensive field activities were conducted on three focus islands: **Maafaru**, **Manadhoo**, and **Magoodhoo**.

Key field activities included:

- **Meetings with Island Councils** on all three islands to discuss waste practices, infrastructure, and community concerns.
- **Site visits to IWMCs** to observe segregation, storage, and disposal methods.
- **Retail shop assessments** to identify the availability of hazardous products and opportunities for safer substitutes.
- **Inspections of sector-specific waste sources**, such as lube oil storage at powerhouses, hospital waste units, and fiberglass waste from boat building.
- **Review of sewerage and treatment infrastructure** in Manadhoo.

Stakeholder Engagement

A broad stakeholder engagement strategy was essential for gathering diverse insights and promoting community awareness. This included:

- **Formal meetings** with Island Councils and FENAKA staff.
- **Direct interviews** with shopkeepers, healthcare workers, and boatyard operators.
- **Household surveys** and informal conversations with community members, aimed at uncovering behavioral drivers and barriers to safe waste practices.

This inclusive approach ensured data collection captured both **technical realities** and **community perspectives**.

Data Analysis Approach

- **Qualitative data** (e.g., interviews, observations, reported waste types, product availability) were analyzed **thematically** to identify key patterns, community attitudes, and recurring issues.

This **analysis** provided a holistic view of hazardous waste generation, handling, and challenges in Noonu Atoll, forming the evidence base for the subsequent risk analysis and recommendations.

1.5 Report Structure

This report is organized into six key sections to deliver a comprehensive analysis of hazardous waste management in Noonu Atoll and to propose practical, context-appropriate solutions:

- **Section 1: Introduction**
Covers the background, objectives, scope, and methodology of the assessment.
- **Section 2: Baseline Assessment of Hazardous Waste in Noonu Atoll**
Presents findings on existing hazardous waste streams, current management practices, regulatory context, community awareness, and key challenges observed across the islands.
- **Section 3: Product-Level Analysis and Risk Assessment**
Identifies hazardous products available in the local market, prioritizes high-risk categories for substitution, and evaluates associated environmental and health risks.
- **Section 4: Viable Alternatives and Substitution Strategies**
Propose safer, context-appropriate alternatives for key hazardous products.
- **Section 5: Overall Conclusions and Strategic Recommendations**
Summarizes key insights from the assessment and presents high-level, actionable strategies to improve hazardous waste management in Noonu Atoll. This section includes a roadmap for phased implementation.

Section 2: Baseline Assessment of Hazardous Waste in Noonu Atoll

2.1 Overview of Noonu Atoll's Waste Management Infrastructure

Waste management in Noonu Atoll, in line with national practices, is centered around **IWMCs** on each inhabited island. These centers serve as collection points for sorting and temporarily storing waste before it is transferred to the **regional facility at Vandhoo in Raa Atoll**, which also handles waste from Raa, Baa, and Lhaviyani atolls.

The effectiveness of this system—particularly for hazardous waste—depends heavily on **island-level implementation**, including proper segregation, safe handling, and reliable logistics. However, the availability of key waste management equipment (e.g., **glass crushers, compactors, trolleys, pickups, woodchippers**) varies widely across islands, impacting operational efficiency.

While the **volume of hazardous waste** on each island is relatively low, the **variety is high**. Common sources include **households, diesel powerhouses, boatyards, healthcare facilities, small-scale industries** (e.g., carpentry, fiberglass work), and **municipal operations** such as pest control and construction.

Accurately quantifying these waste streams remains a challenge due to **minimal formal record-keeping**. One exception is **FENAKA's oil logs**, which track used lubricant disposal from powerhouses. For most other hazardous materials—like batteries, solvents, or cleaning chemicals, Island Councils provided only qualitative estimates. This assessment suggests that **total hazardous waste generation across Noonu may be a few tons per year** (excluding general waste). Though modest in volume, such waste can cause **disproportionate environmental harm** in fragile island ecosystems, especially when **improperly mixed with general waste**, a common practice due to the perception that quantities are too small to warrant separate handling.

Table 1 summarizes the key hazardous waste types observed or reported on three representative islands:

- **Manadhoo** (large, urbanized)
- **Magoodhoo** (small, rural)
- **Maafaru** (medium-sized, with an airport)

This cross-section reflects a diversity of waste sources and management challenges across the atoll.

Table 1: Summary of Key Hazardous Waste types, sources, and examples in Noonu Atoll

Hazardous Waste Type	Typical Sources on Islands	Examples of Products in Category	Primary Risks
Used Oil & Automotive Waste	Diesel generators (Fenaka), fishing boats, vehicles, machinery, airport operations (Maafaru)	Used lubricating oil, oily filters, grease, lead-acid batteries	Soil/water contamination (hydrocarbons, heavy metals), toxic air emissions (if burned), corrosivity (battery acid)
Healthcare Waste	<ul style="list-style-type: none"> Health centers (Magoodhoo, Maafaru) Atoll Hospital (Manadhoo) 	Sharps, infectious waste (bandages), pharmaceutical waste (expired medicines), small quantities of pathological waste, chemical waste	Disease transmission, environmental contamination, toxic emissions (if burned)
Fiberglass Waste	Boat building & repair (Extensively in Manadhoo , small scale in Magoodhoo and Maafaru) Interviews indicate the largest scale in Lhohi	Resin-soaked materials, fiberglass dust, off-cuts	Respiratory irritation (dust), toxic fumes (styrene, volatile organics if burned)
Household Hazardous Waste (HHW)	Everyday consumer products in households (All 3 islands)		
<ul style="list-style-type: none"> Batteries 	Torches, remotes, small electronics (dry cell), vehicles, solar power backup (lead-acid)	Single-use dry cell batteries, lead-acid vehicle batteries	Heavy metal leaching (lead, mercury, cadmium), toxic fumes (if burned)
<ul style="list-style-type: none"> Cleaning Chemicals 	Households, commercial establishments	Bleach, acid-based toilet cleaners, drain openers, disinfectants	Corrosive/irritant chemicals, toxic gases (if mixed), water pollution
<ul style="list-style-type: none"> Pesticides & Insecticides 	Households (mosquito control), home gardens, limited agriculture	Mosquito coils, bug sprays, rodenticides, herbicides, chemical fertilizers	Acute toxicity, groundwater contamination, harm to non-target organisms
<ul style="list-style-type: none"> - Paints & Solvents 	Household maintenance, construction, small projects	Leftover paints, thinners, turpentine, aerosols	VOCs, heavy metals, flammability, air/soil/water contamination
<ul style="list-style-type: none"> E-waste 	Phones, computers, TVs, appliances, fluorescent light tubes	Discarded electronics, Compact Fluorescent Lamp (CFL) bulbs	Heavy metal leaching (lead, mercury, cadmium), flame retardants, toxic emissions (if burned)
<ul style="list-style-type: none"> Used/Burnt Diapers 	Households	Disposable diapers (plastics, super absorbent polymers)	Toxic emissions (dioxins, furans if burned), non-biodegradable waste volume
<ul style="list-style-type: none"> Aerosol Cans 	Households, commercial	Insecticides, air fresheners, paints	Residual contents, pressurized propellants (flammable), toxic fumes (if burned)
<ul style="list-style-type: none"> Fluorescent Light Bulbs 	Households, institutions	CFLs, tube lights	Mercury release (if broken or burned), neurotoxin
Construction & Demolition (C&D) Waste	Infrastructure projects (housing, public facilities) – (All 3 Islands)	Paint cans, solvent containers, spent welding rods, asbestos (from old structures)	Leaching of chemicals, asbestos fibers (if airborne), soil/water contamination
Airport-Specific Waste	Maafaru Airport operations	Solvents, hydraulic fluids, other chemical wastes	Environmental contamination, specific occupational hazards

2.2 Quantities and Distribution of Hazardous Waste in Noonu Atoll

Hazardous waste data in Noonu Atoll is limited due to poor record-keeping—except for used oil, which FENAKA tracks. However, recent assessments provide reliable estimates of annual waste generation by type.

Although overall volumes are modest, the **range of waste types is broad**, and even small amounts can significantly impact Noonu’s fragile island ecosystems.

The Figure 3 and Table 2 summarizes estimated annual quantities by waste type, alongside national context and typical island-level distribution.

Key Highlights:

- **Used oil** is one of the largest streams—up to **15 tonnes/year** atoll-wide.
- **Healthcare waste** from hospitals and clinics totals **20–30 tonnes/year**.
- **E-waste and batteries** (dry cell and lead-acid) contribute **over 150 tonnes/year**.
- **Fiberglass waste** from boatbuilding adds several tonnes/year, mainly from **Manadhoo** and **Lhohi**.
- **Used diapers** form a major domestic stream, estimated at **100–200 tonnes/year**, often burned or landfilled.
- **Used diapers** represent a large-volume domestic waste stream—estimated at **100–200 tonnes per year**—primarily burned or landfilled with general waste.

Manadhoo generates the most due to its size and infrastructure. **Maafaru** adds airport-related waste. Mid-sized islands (e.g. **Velidhoo, Holhudhoo**) generate moderate waste across types, while smaller islands (<300 people) produce less but still handle hazardous items like batteries and pesticides.

Local councils noted that **hazardous waste is often mixed with general waste**, due to perceived low volume—pointing to a need for better awareness, policy, and infrastructure.

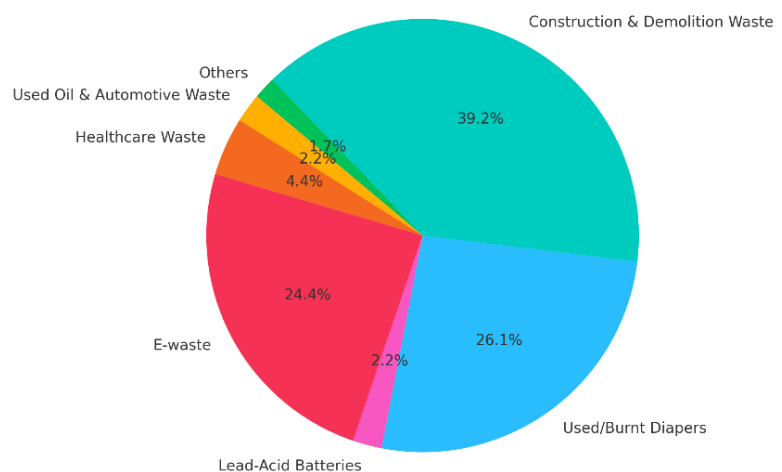


Figure 3: Estimated Annual Hazardous Waste Composition in Noonu Atoll (tonnes/year)

Table 2: Estimate volume of waste by type [7]

Hazardous Waste Type	Sources	Example Products	Waste Generation (tonnes / year)		Waste Distribution in Noonu Atoll
			Noonu Atoll	National	
Used Oil & Automotive Waste	Powerhouses, boats, vehicles	Used lubricating oil, filters, lead-acid batteries	10-15	>2500 [8]	Most islands; highest in Manadhoo, Velidhoo
Healthcare Waste	Hospitals, health centers	Sharps, bandages, expired medicines	20-30	~>500	Manadhoo (hospital), other islands (health centers)
Fiberglass Waste	Boat building, carpentry	Fiberglass off-cuts, sanding dust	2-5	~300-500	Mainly Manadhoo and Lhoi
E-waste	Households, offices, schools	Old electronics, CFL bulbs	130-150	~3400	All inhabited islands
Lead-Acid Batteries	Vehicles, solar, boats	Used lead-acid batteries	10-15	~200-400	All islands; higher in larger islands
Dry Cell Batteries	Households, remotes, torches	AA, AAA, phone batteries	1-2	~24-45	All inhabited islands
Cleaning Chemicals	Households, shops	Bleach, toilet cleaners	<1	~10-20	All inhabited islands
Pesticides/Insecticides	Households, agriculture	Bug sprays, coils, herbicides	<1	~10-20	All inhabited islands
Paints & Solvents	Construction, maintenance	Leftover paint, thinners	<1	~15-25	All inhabited islands
Used/Burnt Diapers	Households	Disposable diapers	100-200	~3,000 - 5,000	All inhabited islands; high in larger islands
Aerosol Cans	Households, shops	Air fresheners, sprays	<1	~10-20	All inhabited islands
Fluorescent Bulbs	Households, institutions	CFLs, tube lights	<1	~5-10	All inhabited islands
Construction & Demolition Waste	Buildings, infrastructure	Rubble, painted wood, asbestos	150-300	>110,000	Manadhoo, Maafaru, other urbanized islands
Airport-Specific Waste	Maafaru Airport	Oils, solvents, absorbents	1-3	>5,000	Maafaru only

2.3 Current Hazardous Waste Management Practices

Hazardous waste management in Noonu Atoll is at a **developing stage**, with most islands lacking dedicated systems. Management is typically **ad hoc**, with hazardous items often treated as general waste. Key practices and challenges are summarized below:

Used Oil:

FENAKA collects and stores used oil from powerhouses in drums, with periodic transfers to Raa Vandhoo or Malé. However, **private sources (e.g., boats)** may dispose of oil improperly. Storage risks include **corroded drums and leakage**, especially during rain.



Figure 4: Used oil containers stored in Manadhoo Fenaka Powerhouse

IWMC Practices:

All inhabited islands have IWMCs, but these are **not equipped or mandated** to segregate hazardous waste. **Batteries, aerosols, and chemicals** are often burned or dumped with general trash. Occasional informal segregation occurs but lacks consistency or safe storage.

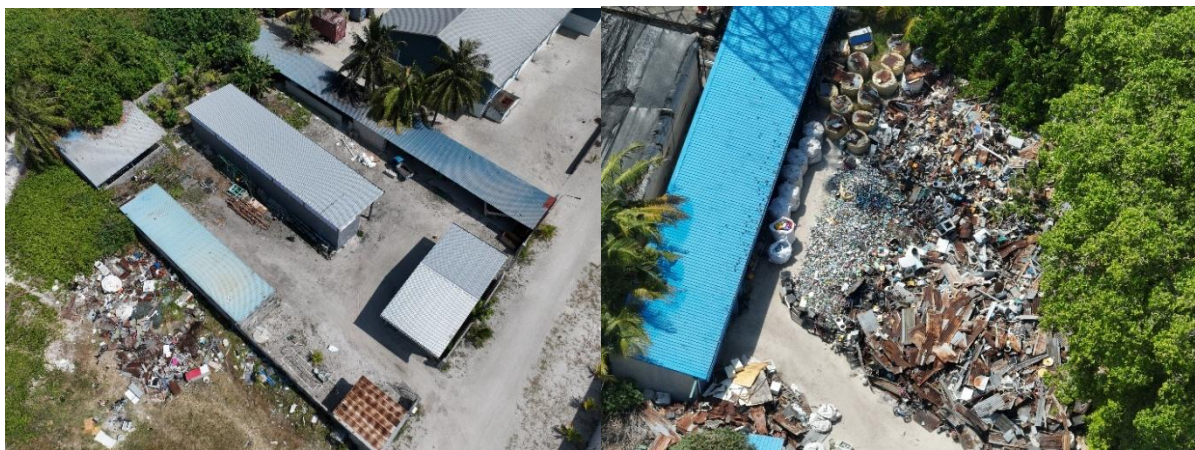


Figure 5: IWMC in Manadhoo (left) and Maafaru (Right)

Burning and Burial:

Open burning is common for reducing waste volume and includes **fiberglass, healthcare waste, diapers, and paint cans**, despite the release of **toxic emissions**. Non-burnable waste is sometimes **buried in pits or low-lying land**, risking long-term soil and groundwater contamination.



Figure 6: Open burning site next to IWMC in Magoodhoo(Left) and located independently in Manadhoo(Right)

Transfers to Regional Facility:

Some non-burnable waste is transferred to **Raa Vandhoo** via infrequent boat pickups (often project-based). **Used oil is more reliably removed**, while other hazardous waste removal remains inconsistent and underfunded.



Figure 7: Plastic bottles in Jumbos in Manadhoo IWMC (left), Plastic and Metal Bales in Magoodhoo IWMC (Right)

Healthcare Waste:

Medical waste is **partially segregated**. Sharps are typically incinerated or burned on-site in low-tech drums. **Manadhoo Hospital** is constructing a proper incinerator, and **Holhudhoo** has a donated “smoke-free” unit. However, most islands still rely on **basic burning** methods with exposure risks.

Household Hazardous Waste (HHW):

HHW (e.g., batteries, cleaners, insecticides, paints, e-waste, diapers) is **widespread but thinly distributed**. Most of it ends up **burned or buried**. Only a few islands practice ad hoc stockpiling (e.g., batteries or e-waste) for future removal.



Figure 8: Waste collection in Magoodhoo (Left), Designated HHW area in Magodhoo IWMC has aluminum cans(right)

Boatbuilding & Fiberglass Waste:

Manadhoo hosts an active boatyard where **fiberglass boats** are built and repaired. Workers indicated that **fiberglass off-cuts**, **used resin cans**, and **sanding dust** are common wastes. Currently, these are **burned on-site** in open air once accumulated. Other islands have smaller scale boat repair. Fiberglass dust was observed in Manadhoo yard, and no specialized vacuum or dust containment is used – workers sweep it out, and wind can carry it. There are **no containment or disposal protocols** causing toxic fumes and exposing workers to **respiratory hazards**.

C&D and Industrial Waste:

Small industries and construction projects generate **paints, solvents, asbestos, and welding waste**, typically **burned, buried, or dumped**. There are **no specific guidelines** for managing hazardous C&D waste. It is common to **dump C&D waste** on the **beach** near the areas which are facing **coastal erosion**.



Figure 9: Boat Building Area in Manadhoo (Top Left), Fiber glass waste burnt(Top Right), Open Resin container (Bottom Left), Fiber glass dust and cut pieces on the ground (Bottom Right)

Community Perceptions:

Hazardous waste is **largely unrecognized** as a separate issue outside healthcare. Most councils view it as **low-volume and manageable** within general waste systems.

Community consultations revealed a general concern about hazardous waste, but this rarely translates into **safe practices** or **long-term awareness**. Many workers—particularly in **fiberglass handling**—use **inadequate protection** like **surgical masks** instead of proper **respirators**, reflecting gaps in both **awareness** and access to **PPE**.

Long-term **health** and **environmental** risks are often not well understood. **Council members** noted impacts are “**not noticeable**,” though they acknowledged potential delayed effects. **No island** reported having specific **HHW initiatives**. **Hazardous waste** is **typically mixed** with **general waste**. This highlights the need for **targeted awareness** campaigns and structured programs. Initiatives like **Soneva Namoon** and **Parley Maldives** show that **community-led** change is possible when supported by **training** and **resources**.

Summary of Key Challenges

- Lack of SOPs/guidelines **for segregation or handling of HHW**
- Minimal infrastructure **for safe storage or removal**
- Perception that quantities are too small to matter
- Cost and logistics **of transporting waste to Vandhoo or Thilafushi**
- Unsafe reuse **of hazardous containers by residents**

In essence, hazardous waste is **co-managed with general waste**, leading to **uncontrolled burning, burial, and stockpiling**. Addressing these gaps is essential for transitioning to safer, more sustainable practices in the atoll. Figure 10 shows HHW flow scenarios for when improperly disposed and a preferred disposal method is used.

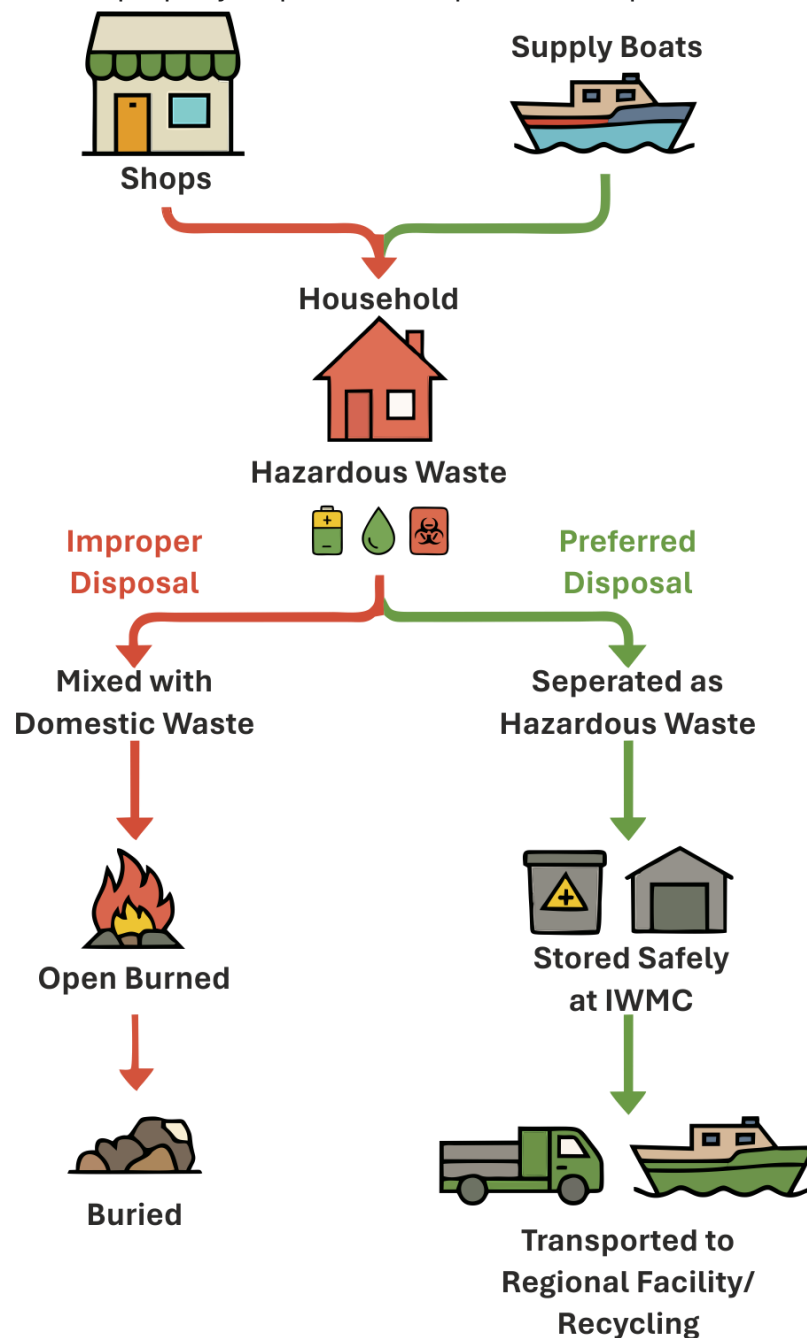


Figure 10: HHW Flow Diagram

2.4 Regulatory and Policy Framework

Hazardous waste management in Noonu Atoll exists within a broader national and international regulatory context. However, local implementation and enforcement remain limited.

National Policies

The Maldives National Solid Waste Management Policy (2008, updated 2015)[9] provides the foundation for waste governance, emphasizing prevention, reuse, recycling, polluter pays principle, infrastructure development, and stakeholder engagement. The Strategic Action Plan (SAP)[10] promotes a circular economy and includes specific goals for improving hazardous waste management (SAP Policy 2). Additionally, the Single-Use Plastic Phase-Out Plan (2020–2023) supports this by banning specific products and encouraging alternatives.

Local Gaps

Despite strong national direction, Island Councils in Manadhoo, Magoodhoo, and Maafaru reported a lack of local regulations or written guidelines for hazardous waste. This regulatory gap makes it difficult to enforce HHW source segregation, safe storage, or standardized handling—leaving practices inconsistent and reliant on individual initiative.

International Commitments

The Maldives is party to key conventions:

- The Basel Convention guides the sound management of hazardous waste and limits transboundary movement.[11]
- The Stockholm Convention addresses POPs.[12]
- The Minamata Convention regulates mercury-containing waste.[5]

The S.W.A.P. project supports these commitments, particularly under the Stockholm Convention. However, for international and national policies to be effective, local regulations and enforcement mechanisms must be developed and strengthened.

Section 3: Product-Level Analysis and Risk Assessment

Building on the baseline findings, this section examines in detail the high-risk product categories in Noonu Atoll that contribute most to hazardous waste and associated risks.

3.1 Availability of Hazardous Products in Noonu Atoll

Field surveys and **council consultations** confirmed that **hazardous** waste generating products are **widely available** across Noonu Atoll. Despite its remoteness, stakeholders noted that “**almost everything available in Malé is available in the islands.**” Products enter the atoll through:

- **Local shops** selling cleaning chemicals, pesticides, paints, batteries, and more
- **Direct imports via boats** from **Malé** for bulk and specialized products
- **Manadhoo** acting as a **commercial hub**, supplying smaller islands

This widespread availability implies that Noonu’s potential for **hazardous waste generation** mirrors that of urban areas. As such, managing **hazardous waste** requires systems tailored to island contexts. Efforts to introduce **safer alternatives** should target **major suppliers** in **Malé**, creating an upstream change that benefits the **entire atoll**.

3.2 Priority Products for Substitution

Based on **usage**, **disposal practices**, and **potential risk**, the following product categories are prioritized under the **S.W.A.P.** initiative for substitution:

- **Paints and Solvents** – Common in boatbuilding and household use; contain VOCs, heavy metals, and toxic solvents
- **Pesticides/Herbicides** – Widely used for pest control; toxic to humans and ecosystems
- **Cleaning Chemicals** – Include corrosive and reactive agents like bleach and ammonia
- **Batteries (Dry-cell and Lead-acid)** – Ubiquitous in electronics and vehicles; hazardous when burned or dumped
- **Aerosol Sprays** – Contain flammable propellants and harmful active ingredients
- **Fluorescent Bulbs** – Contain mercury; hazardous if broken or burned
- **Disposable Diapers** – Significant waste volume; release toxins when burned
- **Other Plastics** – Not covered by the phase-out plan but hazardous when burned or landfilled

Addressing these prioritized product categories through the promotion and adoption of safer alternatives is expected to lead to a substantial reduction in the generation of hazardous waste and the associated risks in Noonu Atoll.

3.3 Risk Assessment of Priority Products

This section systematically assesses the potential human health and environmental risks associated with the prioritized product categories. These risks primarily stem from the hazardous components within these products and the various pathways through which humans and the environment can be exposed, particularly during their use and improper disposal.

Table 3: Risk Assessment of Prioritized Hazardous Products

Product Category	Hazardous Components	Exposure Pathways	Health Risks	Environmental Risks
Paints and Solvents	VOCs, heavy metals, solvents	Inhalation, skin contact, burning	Respiratory irritation, CNS damage, cancer	Air, soil, marine pollution
Pesticides and Herbicides	Organophosphates, pyrethroids, rodenticides	Skin contact, inhalation, runoff	Acute poisoning, reproductive harm, cancer	Water contamination, biodiversity loss, bioaccumulation
Cleaning Chemicals	Bleach, ammonia, acids/alkalis	Skin/eye contact, inhalation, ingestion	Chemical burns, respiratory problems	Water pollution, persistent toxicity
Single-Use Batteries	Lead, mercury, cadmium	Leaching, burning	Neurotoxicity, organ damage	Soil/water contamination, bioaccumulation
Aerosol Spray Products	Flammable propellants, active ingredients	Inhalation, explosion, fire	Respiratory effects, poisoning	VOCs, toxic emissions
Fluorescent Bulbs	Mercury	Breakage, disposal	Neurotoxicity	Mercury release, aquatic toxicity
Disposable Diapers	Plastics, Super Absorbent Polymers	Burning, landfilling	Respiratory issues, exposure to toxins	Air pollution, microplastics, leachate
E-waste	Lead, mercury, arsenic, flame retardants	Burning, leaching	Neurological damage, carcinogens	Persistent environmental toxins
Used Oil	Hydrocarbons, heavy metals	Spills, improper dumping	Soil/marine toxicity, carcinogens	Water/soil contamination
Fiberglass Dust	Glass fibers, styrene resin	Inhalation during sanding/cutting	Respiratory irritation, chronic lung effects	Airborne particles, occupational hazard

At-risk groups in Noonu regarding hazardous waste include: waste management workers (exposed to mixed waste hazards), power house and boatyard workers (exposed to oil, fiberglass, solvents), men and women handling household waste and cleaning chemicals (exposed to chemicals, smoke from burning trash), children (playing near waste sites or in homes with chemicals within reach), and the general community through environmental pathways (air, water, food chain).

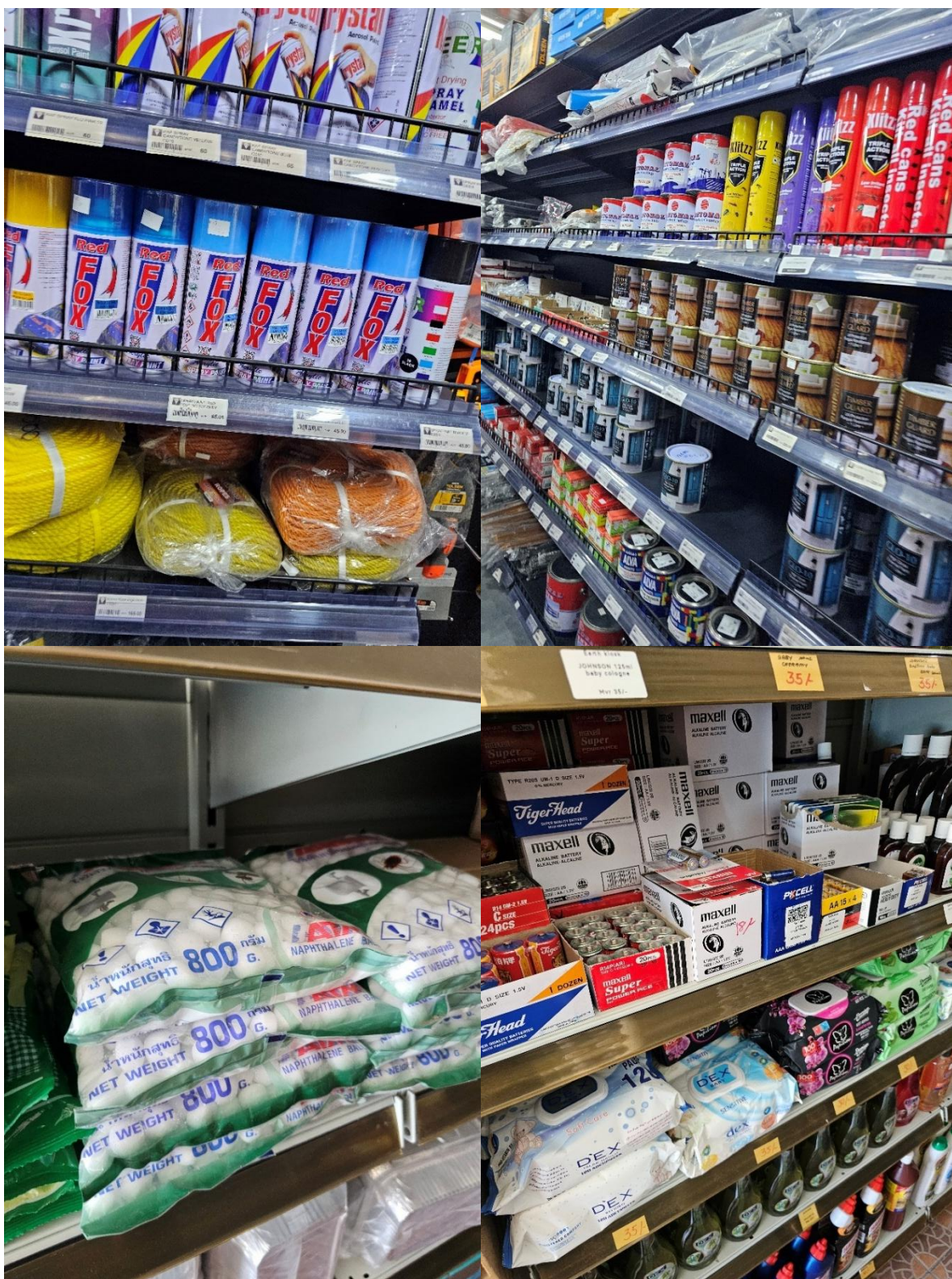


Figure 11: Examples of Hazardous Household Products Available in Manadhoo; Paints and Aerosols (top) Naphthalene Balls (Bottom left) and Batteries and cleaning chemicals (Bottom right)



Figure 12: Examples of Hazardous Household Products Available in Magoodhoo; adhesives (top left), aerosol sprays (top right), and household cleaning chemicals (bottom left).

Section 4: Viable Alternatives and Substitution Strategies

A **core goal** of the **S.W.A.P.** project is to **prevent hazardous waste** generation by promoting **safer product alternatives**. This section outlines a practical **framework** for evaluating **substitutes** and **recommends** specific **replacements** for **high-risk** product categories identified in **Section 3**.

4.1 Framework for Evaluating Alternatives

The selection of **safer alternatives** to **hazardous** products requires a robust evaluation **framework**. This ensures that proposed substitutes are **not only environmentally** superior but also **practical, economically** viable, and **culturally** appropriate for **Noonu Atoll**. The primary criteria guiding this evaluation include:

- **Environmental and Health Safety:** The alternative must exhibit significantly lower human health toxicity (acute and chronic) and ecotoxicity than the product it replaces. This includes assessing risks like carcinogenicity, mutagenicity, reproductive toxicity, endocrine disruption, and persistence in the environment. Preference is given to readily biodegradable products. The alternative should also be free from, or contain markedly lower levels of, hazardous chemicals such as heavy metals, POPs, and high-VOC solvents. Furthermore, the overall life-cycle impacts—from raw material sourcing and manufacturing to use and disposal (e.g., reduced greenhouse gas emissions, minimized resource depletion)—are key considerations.
- **Performance and Efficacy:** The alternative must perform its intended function effectively and meet user needs satisfactorily. A significant drop in performance can be a major barrier to adoption, regardless of environmental benefits.
- **Availability and Accessibility:** The alternative should be reasonably available within the Maldives, whether through existing local suppliers in Noonu Atoll or Malé, or be easily importable. A reliable supply chain is crucial for sustained adoption.
- **Affordability and Economic Viability:** The cost of the alternative should be comparable to, or not prohibitively higher than, the conventional product. A comprehensive life-cycle cost assessment, including durability and potential savings in disposal, is important. For businesses, the economic impact of switching (e.g., retooling, retraining) should be manageable.
- **Ease of Use and Practicality:** The alternative should be simple to use and ideally not necessitate significant changes in existing practices or specialized equipment, unless such changes are feasible and well-supported. Safe handling and application are also paramount.
- **Cultural Acceptability and Social Impact:** The alternative should align with local customs, preferences, and social norms. Community acceptance is vital for the widespread and sustained adoption of new products and practices.

- **End-of-Life Management:** The disposal pathway for the alternative product or its waste must be environmentally sound and manageable within Noonu Atoll's existing or planned waste infrastructure. This includes assessing recyclability, compostability, or ensuring the alternative is genuinely less harmful if landfilled.
- **Regulatory Fit:** Substitutes must support national policy goals (e.g., single-use plastic phase-out) and comply with existing import and environmental regulations.
- **Gender & Social Considerations:** Solutions should consider gender roles and social equity, ensuring inclusive adoption and avoiding unintentional disadvantages.

This comprehensive framework, adapted from established principles of alternatives assessment, has guided the research and recommendations for the product categories prioritized in 4.2.

4.2 Recommended Alternatives for Key Product Categories

Based on the **evaluation framework**, the following **alternatives** are **recommended** for prioritized hazardous product categories in Noonu Atoll. These aim to **virtually eliminate** or **significantly reduce** hazardous waste from these sources.

Paints and Solvents

Alternative Products:

- **Non-toxic/Low-VOC Paints:** Transitioning to water-based (latex) paints for buildings is advised due to their generally lower VOC content compared to oil-based paints. Prioritizing low-VOC paints and finishes is crucial. Natural paints made from plant oils, minerals, and natural pigments are emerging options, though availability may vary. Internationally recognized brands like ECOS Paints and AFM Safecoat offer non-toxic, zero-VOC paints. Regional suppliers such as Sigma Paints might provide lower VOC options, and Non Toxic Paint Supply is another potential source, pending verification of shipping to the Maldives. [13], [14]
- **Copper-Free Antifouling Boat Paints:** Critical for Noonu Atoll's boat building and maintenance sector, alternatives to toxic copper-based antifouling paints are needed.
 - **ECONEA™-based paints:** Utilize tralopyril, a non-metallic biocide effective against hard fouling, safer for marine environments than copper, especially for aluminum hulls [15]
 - **Silicone-based foul-release coatings:** Create a non-stick surface that prevents marine organism adhesion or allows easy cleaning with boat movement; they do not leach biocides [16]
 - **Water-based antifouling paints:** Some formulations are water-based, reducing solvent emissions.
- **Biodegradable Solvents and Cleaners:** Citrus-based solvents (d-limonene) and other plant-derived solvents can replace petroleum-based solvents for cleaning tools and surfaces. Specialized industrial cleaners like ESTISOL® esters are designed as VOC replacements.

Considerations for Noonu Atoll:

Availability and cost of these alternatives in the Maldives, particularly Noonu Atoll, are key adoption factors. Performance in tropical marine conditions, especially for boat paints, needs thorough validation. Training for painters on new application techniques might be necessary. Given the prevalence of fiberglass boats, adopting suitable, less hazardous paints and resins is a high priority.

Pesticides and Herbicides

Alternative Products and Practices:

- **Least-Toxic Pesticides:**
 - **Diatomaceous Earth:** Natural, powdered substance killing insects by desiccation.
 - **Neem Oil:** Botanical insecticide/fungicide disrupting insect life cycles; generally safe for beneficial insects when used correctly.[2]
 - **Insecticidal Soaps:** Potassium salts of fatty acids disrupting insect cell membranes; effective against soft-bodied insects. Can be purchased or homemade.[17]
 - **Essential Oil-Based Repellents:** Oils like peppermint, thyme, rosemary, clove, and citronella can repel pests; often used in homemade sprays.[18]
- **Integrated Pest Management (IPM):** An ecosystem-based strategy focusing on long-term pest prevention through biological control, habitat manipulation, modified cultural practices, and resistant varieties. Pesticides are used sparingly, targetedly, and only when monitoring indicates necessity. For mosquito control, shift from chemical fogging to methods like *Bacillus thuringiensis israelensis* (Bti) for larval control in stagnant water (non-toxic to humans), alongside mosquito net distribution and traps.[19]
- **Homemade Solutions:**
 - **Vinegar-based weed killer:** White vinegar (especially horticultural strength) can kill weeds. Adding liquid soap improves adherence. Best for isolated weeds as it's non-selective.[20]
 - **Boiling water:** Simple, effective for weeds on paths/driveways.[21]

Considerations for Noonu Atoll:

Many botanical and homemade alternatives to chemical pesticides are suitable for household pest and weed control. Promoting IPM principles can significantly reduce synthetic chemical reliance. Assess local availability of commercial least-toxic products (neem oil, diatomaceous earth). Education on correct preparation and safe use of homemade remedies is crucial.



Figure 13: Illustration of alternative least toxic pesticides

Cleaning Chemicals

Alternative Products:

- **Non-toxic, Biodegradable Cleaners:** Typically based on plant-derived surfactants, enzymes, citric acid, vinegar, and baking soda. International "eco-friendly" brands include Foodmax Clean (citrus oil-based degreaser), Jusu All-Purpose Cleaner, and Koala Eco. Suppliers in Malé may supply biodegradable cleaners suitable for marine, industrial, and institutional use.[22]
- **Simple Homemade Cleaners:** Promote readily available, cost-effective household ingredients. [23]
 - **All-purpose cleaner:** Vinegar and water mixture.
 - **Scouring powder:** Baking soda as an abrasive cleaner.
 - **Glass cleaner:** Vinegar and water, or lemon juice and water.



Figure 14: Illustration of simple homemade cleaners

Considerations for Noonu Atoll:

Promoting simple homemade recipes with vinegar and baking soda is highly feasible and cost-effective. Assess local availability and cost of commercial biodegradable cleaners. Awareness campaigns should highlight their effectiveness and safety, countering misconceptions about the need for harsh chemicals.

Single-Use Batteries

Alternative Products:

- **Rechargeable Batteries:** Nickel-Metal Hydride (NiMH) and Lithium-ion (Li-ion) offer longer lifespans, reducing waste and long-term costs.
- **Appropriate Chargers:** Smart chargers prevent overcharging and extend rechargeable battery life and performance. [24]
- **Solar-Powered Devices and Chargers:** For items like lights and remotes, integrated solar panels or separate solar chargers can eliminate disposable battery needs.



Figure 15: Illustration of alternative to single use batteries

Considerations for Noonu Atoll:

- **Availability and Cost:** Rechargeable batteries and chargers are imported; higher initial cost can be a barrier. Bulk purchasing or subsidies could help.
- **Charging Infrastructure:** Reliable electricity for recharging is generally available on inhabited islands.
- **End-of-Life Management for Rechargeables:** Rechargeable batteries eventually become hazardous waste. A recycling program for ALL battery types is essential. [25]

Aerosol Spray Products

Alternative Products and Systems:

- **Propellant-Free Dispensing Systems:** Manual pump spray bottles are widely available for cleaners, air fresheners, and personal care items. Advanced propellant-free systems like Flairosol® offer continuous spray without harmful propellants and are often refillable[26]
- **Non-Aerosol Product Formulations:** Many products are available in non-aerosol forms (solid/roll-on deodorants, liquid/paste polishes, manual spray insecticides)
- **VOC-Replacement Solvents:** For essential industrial/specialized aerosol applications, safer solvents like ESTISOL® esters can reduce VOC emissions[27]

Considerations for Noonu Atoll:

Promoting manual pump sprays and non-aerosol versions is the most straightforward approach. Availability of products using advanced dispensers like Flairosol depends on manufacturers targeting the Maldivian market.

Fluorescent Light Bulbs

Alternative Products:

- **Light Emitting Diodes (LEDs):** The most energy-efficient lighting, with significantly longer lifespans (40,000-100,000 hours vs. 8,000-15,000 for CFLs). LEDs consume much less energy (e.g., 8W LED replaces 60W incandescent or 14W CFL), produce less heat, and contain no mercury [28]



Figure 16: Illustration of CFL(Left) and LED(Right) bulbs

Benefits:

- **Energy Savings:** Reduce electricity use by 75%+ compared to incandescent, and significantly more than CFLs
- **Reduced Maintenance Costs:** Longer lifespan means fewer replacements, saving on bulb and labor costs
- **Improved Light Quality:** Superior color rendering, wider color temperatures, smoother dimming
- **Environmental Safety:** No mercury eliminates hazardous exposure risk upon breakage/disposal

Considerations for Noonu Atoll:

While LEDs have a higher initial cost than CFLs, their lifespan and energy savings result in lower life-cycle costs. Bulk purchasing for island councils/facilities could improve affordability. Selecting high-quality LED products is important for performance.

Disposable Diapers

Alternative Products:

- **Reusable Cloth Diapers:** Modern cloth diapers (cotton, bamboo, hemp) are washable, reusable for years, cost-effective long-term, and generally free from chemicals in disposables, potentially reducing skin irritation[29], [30]
- **Biodegradable/Compostable Disposable Diapers:** Some brands offer diapers from plant-based materials (bamboo viscose, FSC-certified wood pulp), claiming enhanced biodegradability. Although better than normal diapers, they are far from meeting environmental safety expectations. [31]

Considerations for Noonu Atoll:

- **Cloth Diapers:**
 - **Washing and Drying:** Requires sufficient clean water and laundry facilities. Line-drying is feasible in a tropical climate. Time commitment for washing needs consideration
 - **Upfront Cost:** Higher initial investment for a set can be a barrier
 - **Community Acceptance/Stigma:** Social perceptions and convenience influence adoption
- **Biodegradable/Compostable Disposables:**
 - **Actual Biodegradability:** Many require industrial composting conditions (high temperatures, controlled moisture, specialized microbes) unlikely in island IWMCs or backyard composting. Thus, they may not degrade much faster than conventional diapers in landfills or if open-burned. The term "biodegradable" can be misleading without clear disposal qualifications
 - **Waste Management Infrastructure:** Most municipal systems, including in the Maldives, don't permit diapers in organic streams due to pathogen concerns and mixed materials
 - **Cost and Availability:** Generally, more expensive and potentially limited availability



Figure 17: Illustration of reusable cloth diapers and biodegradable diapers

Given the prevalent open burning of disposable diapers in Noonu Atoll, alternatives reducing plastic burning or introducing less harmful materials are beneficial. Feasibility of cloth diapers (water/sanitation needs) or ensuring true end-of-life degradation of "eco" disposables requires local pilot testing.

Plastic Packaging and Single-Use Items

Alternative Products and Systems:

- **Reusable Alternatives:** Promote widespread use of reusable items: cloth/jute shopping bags, durable water bottles, glass/stainless steel food containers, reusable coffee cups.
- **Natural Fiber Packaging:** For items needing packaging, explore options from jute, cotton, coconut coir, palm leaves, or bamboo, especially for locally produced goods. [32]
- **Cellulose-Based Packaging:** Materials like paper, cardboard, and wood-pulp cellophane are generally biodegradable/compostable if not plastic-lined or food-contaminated.[33]
- **Sustainable Packaging Suppliers:** Companies like GreenTech Packs (Maldives) offer biodegradable/compostable bags (starch composites, plant fibers). IPI provides aseptic cartons with increasing renewable content (paperboard, sugarcane-derived biopolyethylene).
- **Beeswax Wraps:** Alternative to plastic cling film for food storage; reusable and compostable (cotton coated with beeswax, jojoba oil, tree resin).[34]

Considerations for Noonu Atoll:

Many reusable alternatives are implementable with community awareness and behavior change. Assess availability and cost-effectiveness of alternative packaging for local businesses. Supporting local production of items like cloth bags (e.g., MACCS in World Bank pilots) offers local benefits. The national single-use plastic phase-out plan supports these alternatives.



Figure 18: Illustration of alternative packaging for single use plastics

E-waste (Electronic Waste)

Alternative Strategies and Management [35]:

- **Extended Product Lifespan:** Encourage longer use of electronic devices through careful handling and repair. Promote the purchase of durable and repairable products.
- **Repair and Reuse:** Support local or regional repair facilities. Facilitate the donation or resale of functional electronics to extend their usability.
- **Dedicated Collection and Storage:** Establish clearly marked collection points at IWMCs or other central locations for discarded e-waste, ensuring it is stored separately from other waste streams to prevent contamination and breakage.
- **Phased Regional Recycling:** Explore partnerships with established e-waste recyclers in Malé or internationally for periodic collection and environmentally sound recycling of accumulated e-waste. This may involve collaboration between atolls or with national entities.
- **Awareness and Education:** Conduct campaigns to inform the community about the hazardous components in e-waste (e.g., heavy metals like lead, mercury, cadmium; flame retardants) and the importance of separate disposal.

Considerations for Noonu Atoll:

The logistical challenges and costs associated with collecting, storing, and transporting e-waste from outer islands to central processing facilities are significant. Building local capacity for basic repairs could reduce waste generation. The initial setup of secure storage at IWMCs is a crucial first step. Collaboration with national agencies or private sector partners will be vital for sustainable recycling solutions.



Figure 19: Illustration of common E-waste

Used Oil

Alternative Practices and Management:

- **Reduction at Source:** Promote regular maintenance of boat engines, generators, and other machinery to optimize performance and reduce oil leakage and the frequency of oil changes.
- **Designated Collection Facilities:** Establish dedicated collection points at harbors, workshops, and IWMCs for used oil. These should use sealed, leak-proof containers and, ideally, have secondary containment (bundling) to prevent spills.
- **Responsible Storage:** Ensure collected used oil is stored safely, away from water sources and sensitive environments, awaiting transport for proper disposal or recycling.
- **Explore Recycling/Re-refining Options[36]:** Investigate possibilities for transporting collected used oil to Malé or regional facilities for re-refining or processing into other usable products (e.g., industrial burner fuel, if appropriate pollution controls are in place). Partnering with fuel suppliers or industrial users could be explored.
- **Training and Awareness:** Provide training to mechanics, boat operators, and generator users on the environmental risks of improper oil disposal and the correct procedures for collection and storage.

Considerations for Noonu Atoll:

Given the reliance on boats and generators, used oil is a significant hazardous waste stream. Establishing a reliable collection and transportation system is paramount. The cost of appropriate storage containers and potential transportation for recycling needs to be factored. Collaboration with entities like Fenaka Corporation (for generator oil) or transport providers could facilitate collection.



Figure 20: Illustration of re-refining used oil

Fiberglass Dust and Waste

Alternative Practices and Management (Primarily for Boat Building/Repair):

- **Dust Minimization during Work:**
 - **Wet Methods:** Employ wet sanding and cutting techniques to significantly reduce airborne dust.
 - **Local Exhaust Ventilation:** Use tools equipped with vacuum attachments or implement localized dust extraction systems in work areas.
 - **Personal Protective Equipment (PPE):** Ensure consistent and correct use of appropriate PPE, including respirators (e.g., N95 or higher), gloves, and coveralls, for all workers involved in fiberglass handling.
 - **Designated Work Zones:** Conduct fiberglass work in designated, well-ventilated areas, preferably away from residential zones or sensitive ecosystems, to contain dust.
- **Fiberglass Waste Management[37]:**
 - **Waste Segregation:** Collect fiberglass scraps and dust separately from other waste streams.
 - **Secure Disposal:** If recycling is not feasible, ensure fiberglass waste is disposed of in a way that minimizes environmental release (e.g., bagged and landfilled in a designated section of the IWMC, avoiding open burning which releases harmful fumes and fibers).
 - **Explore Reuse/Recycling (Long-term)[38]:** While challenging, investigate any emerging opportunities for reusing offcuts or recycling fiberglass waste through specialized facilities.
- **Material Efficiency:** Optimize cutting patterns for fiberglass sheets to minimize waste generation.

Considerations for Noonu Atoll:

Fiberglass boat building and repair are vital local industries. The primary focus should be on worker safety (reducing inhalation and skin contact) and minimizing the release of dust and fibers into the marine and terrestrial environment. The cost of specialized dust control equipment and high-quality PPE can be a barrier and may require support or subsidies. Training on safer work practices is essential. Current disposal options for fiberglass waste are limited in island settings, making containment and responsible landfilling the most practical immediate approach.

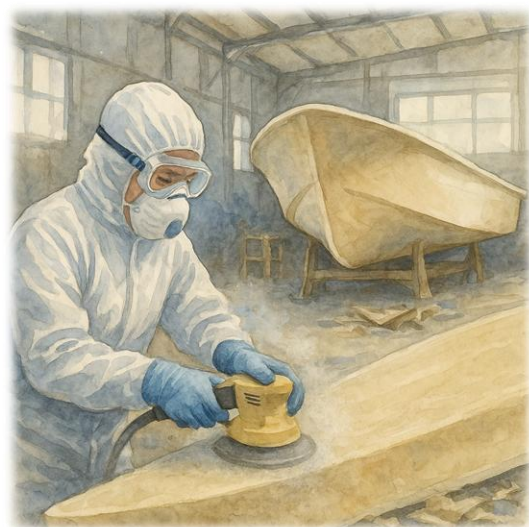


Figure 21: Illustration of doing fiberglass work with proper PPE

Summary of Hazardous Waste Generating Alternatives

Table 4: Summary of Hazardous Waste Generating Alternatives

Hazardous Product Category	Safer Alternative(s)	Key Benefits
Paints and Solvents	Non-toxic/Low-VOC paints (e.g., water-based, natural paints), Copper-free antifouling boat paints (e.g., ECONEA™-based, silicone-based), Biodegradable solvents (e.g., citrus-based)	Reduced VOC emissions, lower human health toxicity, less harm to marine environments, fewer hazardous chemicals.
Pesticides and Herbicides	Least-toxic pesticides (Diatomaceous Earth, Neem Oil, Insecticidal Soaps), Integrated Pest Management (IPM), Homemade solutions (vinegar, boiling water)	Reduced chemical exposure for humans and ecosystems, protection of beneficial insects, long-term pest prevention, cost-effective for homemade solutions.
Cleaning Chemicals	Non-toxic, biodegradable cleaners (plant-derived surfactants, enzymes, citric acid), Simple homemade cleaners (vinegar, baking soda)	Reduced exposure to harsh chemicals, improved indoor air quality, lower environmental impact, cost-effective for homemade solutions.
Single-Use Batteries	Rechargeable batteries (NiMH, Li-ion) with smart chargers, Solar-powered devices and chargers	Significant reduction in battery waste, lower long-term cost despite higher initial investment, conservation of resources. Proper end-of-life recycling is still crucial.
Aerosol Spray Products	Propellant-free dispensing systems (manual pump sprays, advanced dispensers like Flairosol®), Non-aerosol product formulations (solid, roll-on, paste, liquid)	Elimination or reduction of harmful propellants and VOCs, reduced inhalation risks, often refillable options available, reduced container waste if refillable.
Fluorescent Light Bulbs	Light Emitting Diodes (LEDs)	No mercury content (safer disposal), significantly longer lifespan, major energy savings, reduced maintenance costs, improved light quality.
Disposable Diapers	Reusable cloth diapers, Biodegradable/compostable disposable diapers (with caveats on disposal infrastructure)	Reduced plastic waste and chemical exposure (cloth), potential for less harmful materials if properly composted (biodegradable), long-term cost savings (cloth).
Plastic Packaging & Single-Use Items	Reusable alternatives (cloth bags, durable bottles/containers), Natural fiber packaging (jute, coir), Cellulose-based packaging (paper, cardboard), Beeswax wraps	Drastic reduction in plastic waste and pollution, conservation of resources, support for local production of alternatives, alignment with plastic phase-out policies.
E-waste (Electronic Waste)	Extended product lifespan (repair, reuse), Dedicated collection and phased regional recycling, Proper separate storage	Reduced leaching of heavy metals and hazardous chemicals into the environment, conservation of valuable materials through recycling, mitigation of health risks from improper disposal.
Used Oil	Reduction at source (regular maintenance), Designated collection facilities, Responsible storage, Exploration of recycling/re-refining options	Prevention of soil and water contamination, protection of marine ecosystems, potential for resource recovery through re-refining.
Fiberglass Dust and Waste	Dust minimization (wet methods, ventilation, PPE), Secure disposal of waste, Material efficiency, Exploration of recycling (long-term)	Improved worker health and safety (reduced respiratory/skin irritation), minimized release of persistent fibers into the environment, reduced volume of hazardous waste if efficiency is improved.

Section 5: Overall Conclusions and Strategic Recommendations

5.1 Summary of Key Findings and Priority Risks

This assessment in Noonu Atoll identifies diverse hazardous waste streams, inadequate management, and an urgent need for intervention. Key findings include:

- **Diverse Wastes:** Significant generation of used oils, healthcare waste, fiberglass, and various HHW like batteries, chemicals, pesticides, paints, e-waste, and diapers occurs across the atoll.
- **Inadequate Practices:** Current handling is often unsafe. Apart from FENAKA's used oil collection, many hazardous wastes are mixed with general waste or openly burned, including fiberglass, some healthcare waste, and diapers, releasing toxins. IWMCs lack proper hazardous waste segregation or storage.
- **Regulatory Gaps & Low Awareness:** The absence of specific local hazardous waste regulations and limited technical capacity hinders ESM. While general risk awareness exists, it often doesn't translate to protective behaviors due to a lack of knowledge on alternatives.
- **High-Risk Products:** Many hazardous consumer products are common. Priority risks stem from oil-based paints/solvents (especially in boatbuilding), synthetic pesticides, strong chemical cleaners, single-use batteries, aerosols, fluorescent bulbs, and diapers, which contaminate ecosystems and pose health risks.

Noonu Atoll faces typical Small Island Developing States (SIDS) challenges: exposure to hazardous materials, limited infrastructure, and the need for prompt action to prevent long-term damage.

5.2 Overarching Strategic Recommendations

Addressing these challenges requires an integrated approach combining policy, technical interventions, and community engagement.

Policy and Regulatory Enhancements

- **Develop Local HHW Regulations/By-Laws:** Collaboratively establish atoll/island-level HHW regulations aligned with national policies and international principles. These must define HHW, mandate source segregation (batteries, oil, paints, etc.), outline safe handling, prohibit open burning of hazardous waste, and potentially license high-volume generators.
- **Strengthen Enforcement:** Establish mechanisms for compliance, including inspections and penalties for improper disposal. Operationalize national enforcement provisions locally, potentially with trained local environment officers.

- **Integrate ESM Principles:** Embed ESM (waste prevention, reuse/recycling, safe disposal, worker safety) into all waste management planning, including island-level hazardous waste management plans.
- **Adopt Model Regulations:** Utilize existing model bylaws from other SIDS or international guidance (UNEP/ Secretariat of the Pacific Regional Environment Programme (SPREP), ISLANDS Programme) to inform local rules, such as bans on high-risk products once alternatives are established.

Institutional Strengthening and Capacity Building

- **Targeted Training:** Provide comprehensive training to Island Councils, IWMC staff, utility workers, healthcare staff, and business operators on HHW issues, safe handling, regulations, and emergency response.
- **Improve Data Collection & Monitoring:** Establish simple HHW record-keeping and reporting systems on each island to track progress and inform decisions, potentially adapting SPREP frameworks.
- **Sustained Technical Support:** Ensure ongoing guidance for Councils from relevant Ministries or NGOs during the implementation of new systems and alternatives. Foster peer learning networks.
- **Community Capacity & Awareness:** Empower community groups (WDCs, school eco-clubs) through training to lead local awareness and education efforts on HHW.

Investment in Infrastructure and Technology

- **Upgrade IWMCs for HHW Storage:** Equip all IWMCs with dedicated, covered, and contained hazardous waste storage areas with appropriate containers and basic spill response kits.
- **Ensure Sound Disposal/Treatment Options:** Invest in mechanisms for regular transfer of collected HHW (batteries, e-waste) to regional/national facilities. This may include a consolidated atoll-level temporary storage site. Ensure any new healthcare waste treatment (e.g., Manadhoo incinerator) meets high standards or explore non-burn technologies.
- **Hazardous Waste Transport Logistics:** Establish a reliable, scheduled transport service for collected hazardous waste from islands to a central point or disposal facility, potentially through public-private partnerships.
- **Provide PPE and Tools:** Equip all relevant workers with appropriate PPE (gloves, goggles, respirators) and tools for safe HHW handling, with systems for replenishment.
- **Emergency Preparedness:** Develop island-level spill response capabilities and an atoll-wide emergency communication protocol for chemical incidents.

Community Awareness and Engagement

- **Public Awareness Campaigns:** Launch sustained atoll-wide campaigns (e.g., "Toxic-Free Noonu") using diverse channels to promote HHW danger awareness and safer alternatives identified in this report.
- **Behavior Change Initiatives:** Implement activities like "HHW collection days" or "Green Island Challenges" to reinforce positive behaviors.
- **Institutionalize Education:** Integrate HHW topics into school curricula and support Eco-Club projects to engage youth.
- **Partnerships & Inclusion:** Foster collaborations with local and national NGOs. Ensure Women's Development Committees and other community groups are actively involved in planning and implementation, ensuring inclusive solutions.

Roadmap for Implementation

A phased approach is recommended:

- **Short-term (Year 1-2):** Focus on foundational actions: Finalize and approve local by-laws. Initiate adoption of readily available safer alternatives. Upgrade IWMC storage. Launch intensive public awareness. Establish regular HHW collection and transport.
- **Medium-term (Year 3-5):** Normalize HHW separation and alternative use. Implement any larger capital projects (e.g., medical waste treatment). Begin modest enforcement of regulations. Measure outcomes against baseline data.
- **Long-term (Year 5-10):** Aim for Noonu Atoll to be a model for HWM. Consider advanced initiatives (e.g., comprehensive e-waste recycling) and ensure financial sustainability through government budgets and other mechanisms.

Implementation will require initial project/donor funding, transitioning to sustained government budget allocations and potential private sector contributions.

Concluding Remark

This report provides a clear path for Noonu Atoll to transform its hazardous waste management. Implementing these recommendations will protect public health and the Atoll's fragile ecosystems.

Success will position Noonu Atoll as a leader in sustainable waste management, contributing to national and global Sustainable Development Goals. The actionable solutions herein require diligent implementation and sustained commitment from all stakeholders to achieve a healthier, toxic-free future for the Atoll.

Annexures

Annex 1 – Survey Questionnaire

Survey Questions to Stakeholders				
#	Questions	Manadhoo	Magoodhoo	Maafaru
1	What types of hazardous waste are generated on the island?	Used oil from power generation Waste generated from fiberglass works Hospital waste Household hazardous waste; Batteries, cleaning chemicals, bug spray, naphthalene balls, paints, etc... Used and burnt diapers at the waste management center	Used oil from power generation Health center waste Household hazardous waste; Batteries, cleaning chemicals, bug spray, naphthalene balls, paints, etc...	Used oil from power generation Health center waste Household hazardous waste; Batteries, cleaning chemicals, bug spray, naphthalene balls, paints, etc... Waste generated from airport
2	How is hazardous waste currently managed on the island?	Lube oil is transported out by Fenaka Fiberglass waste is cut and burnt on site and remaining waste is managed at the island waste center Hospital waste is burnt at the hospital when their burning set up works, otherwise managed/burnt at the waste management center. Currently incinerator is being built, expected to be completed in 2025 Other waste is managed at IWMC and transported to Vandhoo for end of life management	Lube oil is transported out by Fenaka Health center waste is burnt at the hospital when their burning set up works, otherwise managed/burnt at the waste management center Other waste is managed at IWMC and transported to Vandhoo for end of life management	Lube oil is transported out by Fenaka and Airport (Maldivian) Health center is burnt at the hospital when their burning set up works, otherwise managed/burnt at the waste management center Other waste is managed at IWMC and transported to Vandhoo for end of life management
3	Are there any specific regulations or guidelines in place for the management of hazardous waste?	No	No	No
4	Are there any known health or environmental impacts associated with hazardous waste on the island?	Not known. Although it is understood that long term effects are possible, from fiber dust and other chemicals	Not known. Although it is understood that long term effects are possible, from fiber dust and other chemicals	Not known
5	What are the community's perceptions and concerns regarding hazardous waste on the island?	Although concerned, effective protective measurements are not taken by users. Regular masks are used instead of N95 or other for fiber works also.	Although concerned, effective protective measurements are not taken by users	Although concerned, effective protective measurements are not taken by users
6	Are there any existing initiatives or programs related to hazardous	No	No	No

Survey Questions to Stakeholders				
#	Questions	Manadhoo	Magoodhoo	Maafaru
	waste management on the island?			
7	What are the challenges and opportunities for improving hazardous waste management on the island?	Not a lot of hazardous waste is generated for separate management, except for health related waste which gets managed seperately	Not a lot of hazardous waste is generated for separate management, except for health related waste which gets managed seperately	Not a lot of hazardous waste is generated for separate management, except for health related waste which gets managed seperately
8	What resources are available for hazardous waste management on the island?	Glass crusher Compressing machine Trolley Pickup Wood chipper	Glass crusher Compressing machine Trolley Pickup Wood chipper	-
	General comments to household goods	Generally all goods available in Male' are available in the islands. The source of goods is not only shops, but also boats from Male'. People procure items directly from Male' and get them delivered to the island via boats. Manadhoo as the capital also serves as a major sourcing location for the other islands, with larger shops with more variety available in Manadhoo, including dedicated hardware shops also available in Manadhoo		

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