D-10. Resilience measures that strengthen existing routes www.life-links.org/docs/framework

It is acknowledged that metrics, indicators and KPIs are context-specific and highly depend on the nature of the supply chain, the transport modes and logistics nodes, the actors and stakeholders and other factors. Table D-9a explains for which steps in the Life-Links Framework metrics or indicators are likely needed (quantitative or qualitative), along with illustrative examples of quantitative metrics. Examples were sourced from guidelines and tools listed in resource D-5. Last updated: January 2026.

Examples of metrics and indicators for selected steps of the Life-Links Framework		
Step	**What is being measured**	**Metrics examples**
Step 1.1 Identify hazards and characterize exposure	Hazards	• Days above critical heat thresholds per year (e.g. >40°C dry-bulb) • Flood depth at a port (from sea level rise to storm surge) at a 100-year return period • Number of thunderstorms above wind force ?? per year
	Exposure	• Km of road/rail within a 100-year floodplain • % of warehouses within mapped wildfire zones • Number of workers/drivers along a corridor routinely exposed to heat
Step 1.2 Assess logistics vulnerabilities, risks and impacts	Logistics vulnerabilities *(see also Table D9-b)*	• Average km between farms and nearest aggregation points (sourcing / connectivity) • % of packhouses with tested backup power (redundancy / energy reliability) • % of freight vehicles or shipments with real-time tracking (visibility / information flow)
	Risk of disruption	• Hours or days of impassable road segments or bridges • Hours or days of delays in berthing at ports • Hours or days of waiting time at packhouses
	Impacts from disruptions *(connected to benefits stakeholder resilience)*	• Loss of income for farmers and middlemen as fresh produce cannot reach packhouses • Additional costs due to rerouting of sea container ships due to port closures • Number of downtime hours in a factory due to shipment delays
Step 1.3 Assess exacerbating effects from climate change	Exacerbated logistics challenges	• Increase in days that roads are impassable due to more heavy rainfall in 2030 • Increase in berthing delays as ports to higher risk index for severe thunderstorms from today to 2050
	New future climate hazards	• Days at a logistics hub with temperature exceeding 35°C (which did not happen in the past)
	Compounding	• Increase in days with power blackouts due to heatwaves that affect rail operations
Step 2.2 Assess feasibility and effectiveness for resilience*	Feasibility	• See Table 8 for examples economic, technological, institutional, socio-cultural, environmental-ecological, geophysical
	Resilience – vulnerability reduction *(see also Table D9-b)*	• Reduced average km between farms and aggregation points (strengthened sourcing / local connectivity) • Increased share of packhouses or logistics assets with backup power and spare capacity (enhanced redundancy) • Higher share of shipments with end-to-end digital visibility and alert systems (improved visibility / information resilience)
	Resilience - risk reduction	• Reduction in days of impassable roads segments or bridges (next year, in 2030, 2050)

Examples of metrics and indicators for selected steps of the Life-Links Framework		
Step	**What is being measured**	**Metrics examples**
		• Reduction in delays in berthing at ports • Reduction in waiting time at packhouses • Reduction in average expected annual disruption hours (EADH) on critical links (baseline vs 2030, 2050)
	Resilience – system level outcomes	• Increased on-time delivery performance across supply-chain nodes • Reduced annual value of losses (in USD) from logistics disruptions • Robustness of performance across scenarios (range of on-time delivery under multiple climate or socio-economic futures) • Continuity of goods flows during disruptions (% of planned shipments or volumes delivered) • Improved coordination across partners (average waiting or idle time ↓ at aggregation points / packhouses) • Existence of a monitoring–evaluation–learning (MEL) cycle to update measures over time) • Sustained or increased incomes of logistics-dependent actors (e.g. farmers, drivers, warehouse operators)
Step 2.3 Add safeguards and decarbonization and sustainability opportunities	Equity	• % of resilience investments benefiting vulnerable or low-income groups along the corridor
	Justice	• Extent to which decision-making includes representation from affected local communities (e.g. # of stakeholder consultations or representation share)
	Inclusion	• % of women or minority-owned SMEs participating in supply chain resilience projects or contracts
	Co-benefits	• Reduction in tonnes CO_2 (absolute) or tonnes CO_2 per tonne-km (intensity)
	Climate compatibility	• Change in total lifecycle GHG emissions of the measure compared to baseline (% or tonnes CO_2e)
	Maladaptation safeguards	• Change in population or asset exposure among vulnerable groups relative to baseline (% change)
Step 3.1 Commit to package of action measures	Business case *(connected to feasibility assessment in Table 8 and value creation in Table 13)*	• Number of people benefiting from enhanced climate resilience flood measures at ports • Increased income of smallholder farmers benefiting from closer aggregation points • Volume of additional goods storage capacity due to packhouse expansion • Reduced risk of fines due to regulatory non-compliance
Step 3.2 Agree collaboration, financing, and monitoring	Project implementation	• Actual versus planned timelines, costs, other factors
	Outcomes	• Actual versus expected impacts on resilience, sustainability, other
* Note: Standard supply-chain performance indicators (e.g. reliability, responsiveness, flexibility, cost, and asset-management metrics such as those in the Supply Chain Operations Reference (SCOR) model) remain useful for company-level monitoring and can complement the Life-Links resilience metrics by showing how resilience measures affect logistics performance over time.		

The following Table presents examples of metrics for the nine attributes of resilience.

Examples of metrics and indicators for resilience relevant to exposure/vulnerability reductions of transport, logistics and supply change[1]		
Attribute	**Definition**	**Metrics examples**
Sourcing	Average distance freight consignments move in a supply chain, SCE or trip, and how far and from where goods are procured.	• Average length of haul for total freight tonnage or for tonnage by specific transport modes • Share of tonne-km with origin or destination outside the country • Import penetration by commodity group as a share of total sales
Intermodality	Extent to which using different transport modes spreads disruption risk, and the ability to switch modes before or during disruptions.	• Share of freight tonne-km moved by different modes • Share of freight moved on intermodal services • Spatial density of intermodal terminals compared to network length • Differences in average transit time between modes, including intermodal services • Differences in average reliability of modes
Redundancy	Amount of spare capacity and inventory in the logistics system to buffer interruptions to the flow of goods.	• Average utilization of network and terminal capacity • Average utilization of vehicle capacity • Average level of inventory as the ratio of the value of inventory to sales for different commodity groups or business sectors
Scheduling	Degree to which production and logistics processes are synchronized (e.g. just-in-time, replenishment) and flexibility in timing and coordination of flows.	• Average order lead times (based on company surveys) • Share of orders delivered just-in-time by commodity group or business sector • Distribution of freight deliveries over the 24-hour cycle
Diversity	Range of options available for routing freight, suppliers, carriers, clients, or energy sources.	• Indices of alternative routing options for different modal networks • Share of freight vehicles with access to mobile communications • Share of suppliers visible in digital supply chain mapping platforms
Visibility	Degree of supply chain and supplier visibility; stakeholder awareness and capacity, and the nature and speed of communication about disruptions.	• Performance standards for transport alerting systems • Share of freight vehicles with access to mobile communications • Country-specific metrics used by online supply chain risk and resilience platforms
Workforce	Capacity, safety, wellbeing, and awareness of logistics workers, contractors and suppliers in managing disruptions.	• Number of logistics worker days lost due to disruptions • Frequency of workplace accidents in logistics operations • Share of workers trained in emergency and digital logistics procedures
Cyber and digital	Robustness of digital systems, data, and communications against cyber attacks, system failures, and data breaches.	• Number of cyber incidents affecting logistics operations per year • Share of logistics partners meeting minimum cybersecurity standards • Average system downtime due to digital failures
Protection of goods in transit	The degree to which goods are safeguarded against damage, spoilage, contamination, theft, or loss during transport, handling, and storage.	• Cargo losses during transport and storage as a share of total shipments • Share of perishable goods arriving within acceptable temperature ranges • Number of theft or tampering incidents reported in transit

[1] McKinnon, A. (2024). Evaluating the relationships between connectivity, decarbonisation and resilience in freight transport: Applications to Central and Southeast Asia, Working Paper, International Transport Forum, Paris. https://www.itf-oecd.org/sites/default/files/sipa-methodology-relationships.pdf