

Agenda item 4.c.i Water-Energy-Food Systems

Draft toolkit for scaling up climate technology solutions in agrifood systems

TEC 33 & Joint session of the TEC - CTCN Advisory Board
15 – 17 and 18 September 2026 | Bonn, Germany



United Nations Climate Change
Technology Executive Committee

Titus Ngandu
TEC Member

Update from the activity group

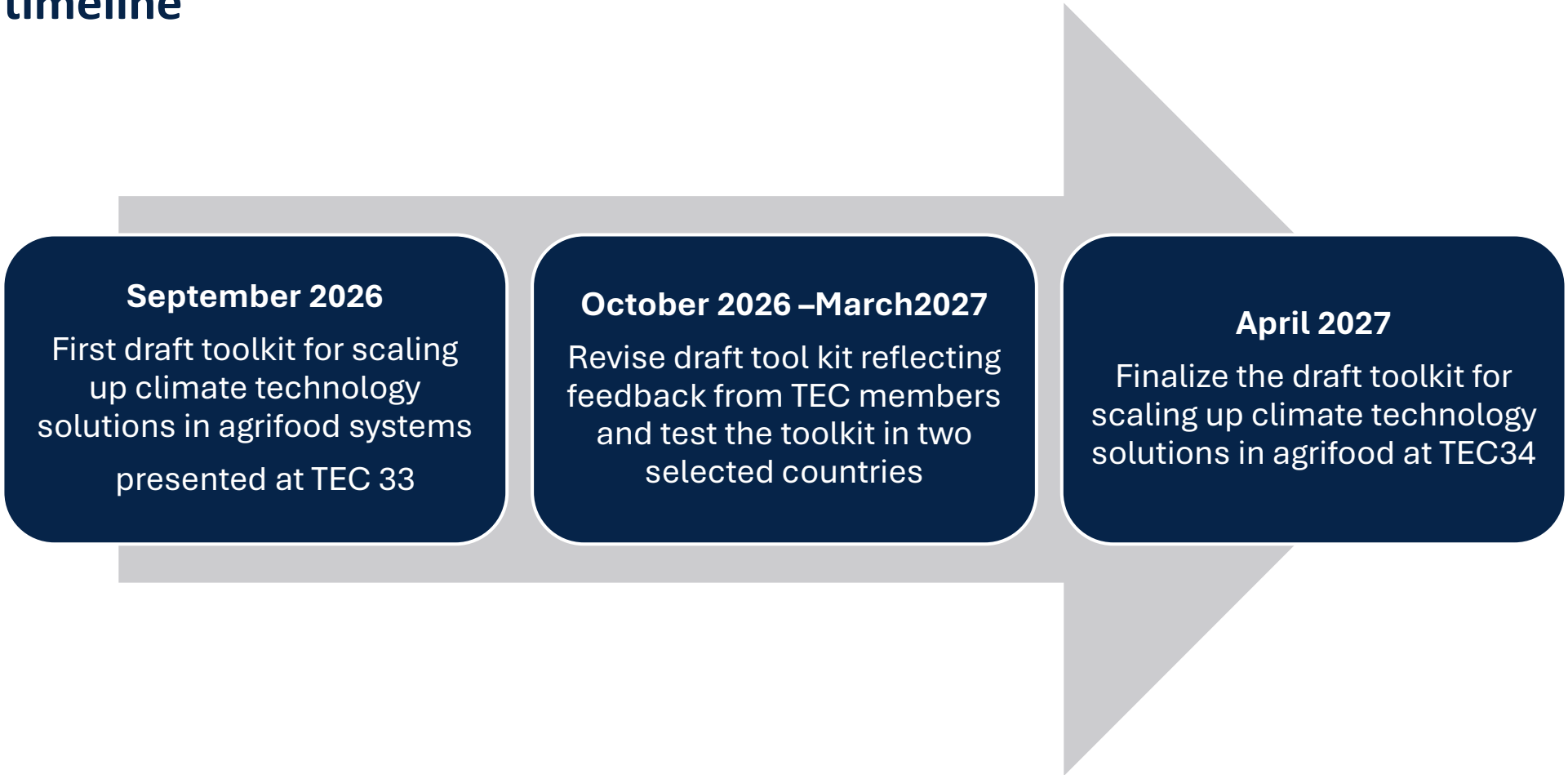
- Building on TEC's climate-smart agriculture work, this activity addresses knowledge gaps in the water-energy-food nexus and identifies adaptation technologies – indigenous, innovative and digital (e.g. early warning systems) – to strengthen NAPs and NDC ambition in agriculture.
- Building on the joint publication *Climate Technologies for Agrifood Systems Transformation*, the TEC agreed to develop with FAO a practical toolkit by 2027 to advance technology transfer in agrifood systems, remove barriers and support climate-resilient development.

The revised **draft toolkit**:

- Applies a **value-chain-based and context-specific approach** to the identification and prioritization of climate technologies;
- Links technology options to **investment planning and financing instruments**;
- Addresses enabling conditions, including **institutional coordination, market readiness and innovation systems**;
- Integrates **inclusive approaches**, including gender-responsive and locally grounded solutions; and
- Supports coherence between **climate objectives and agrifood systems transformation strategies**.



Work timeline



Agenda item 4.c.i Water-Energy-Food Systems

Draft toolkit for scaling up climate technology solutions in agrifood systems

TEC 33 & Joint session of the TEC - CTCN Advisory Board
15 – 17 and 18 September 2026 | Bonn, Germany



United Nations Climate Change
Technology Executive Committee

Irini Maltoglou, Veljko Vorkapic, Julian Mashingaidze
FAO, Climate Change Team

Acknowledgements

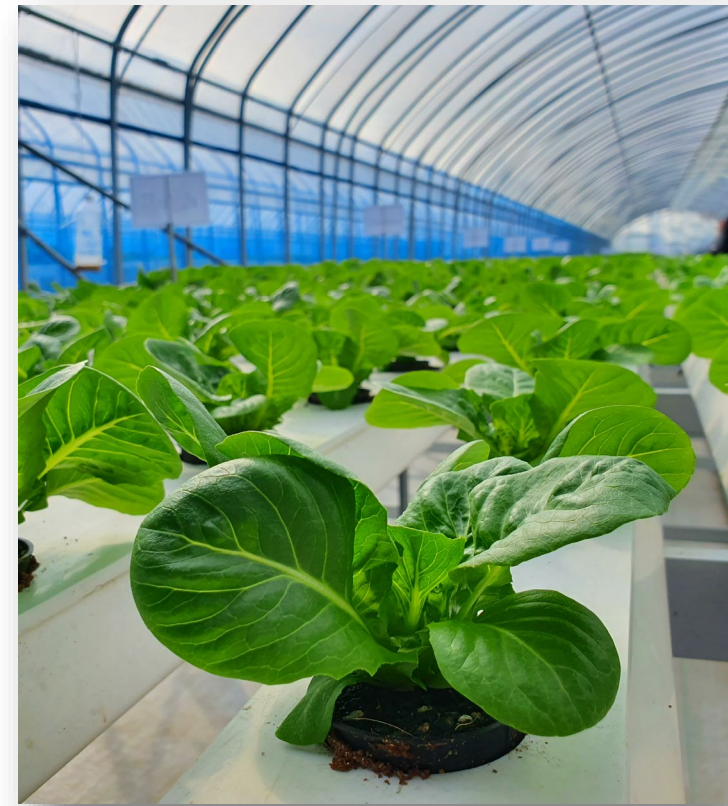


- Authors and supporting team

- Veljko Vorkapic, Julian Mashingaidze
- TEC team and activity group members
- Climate Change Management team



- Review and input

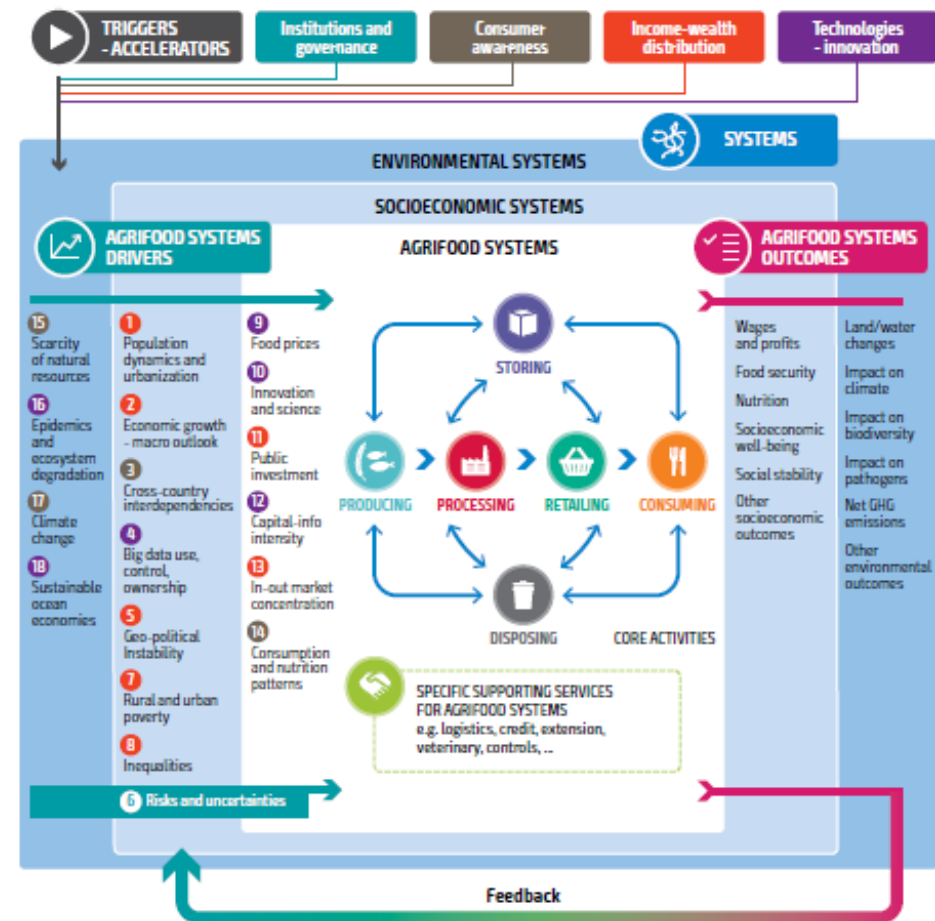


Agrifood systems, climate technologies and triggers for transformation

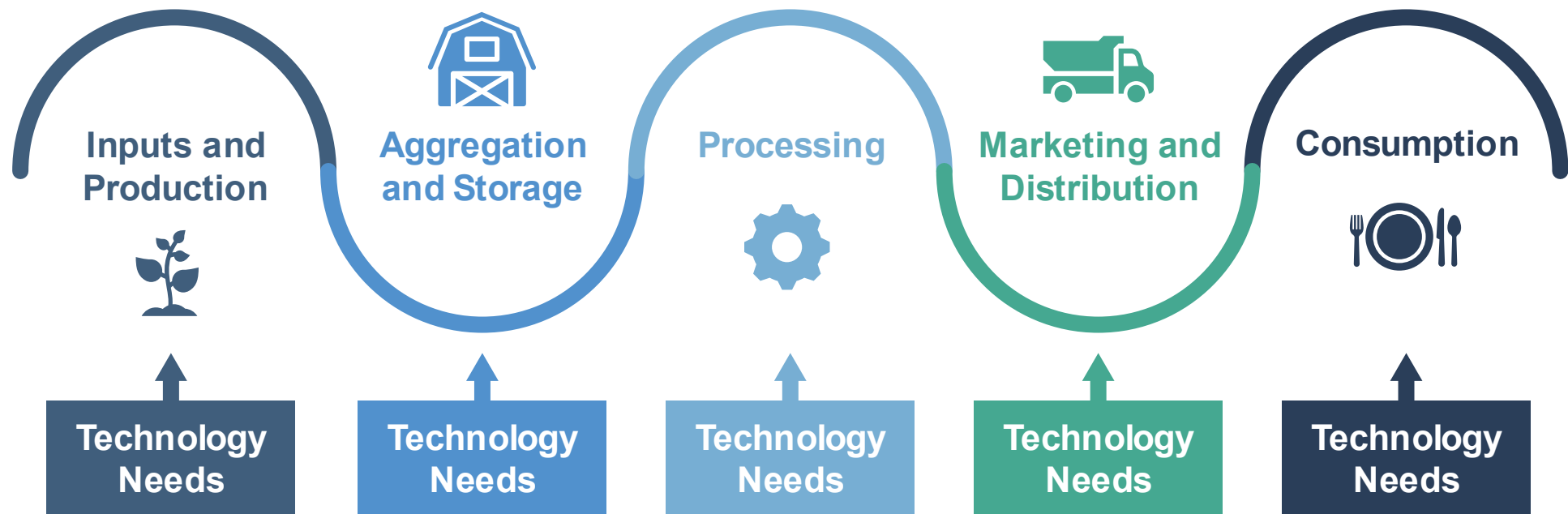
Agrifood systems encompass the entire **range of actors** and their **interlinked value-adding activities** in the primary **production** of food and non-food agricultural products, as well as in food storage, aggregation, **post-harvest** handling, transportation, **processing**, distribution, marketing, disposal and **consumption**.

The systems cover **crops**, **livestock**, **fisheries**, **aquaculture** and **forestry**.

The Intergovernmental Panel on Climate Change (IPCC 2000) defines technology as ‘a piece of equipment, technique, practical knowledge or skills for performing a particular activity’.



Agrifood systems and climate technologies interlinkages



- Need to focus on the **relevant value chains**, identify **technology options**, assess **viable** and required technologies, considering end needs and users

Overview and recommendations

- **GST highlights insufficient progress and calls for urgent acceleration of climate action** through scaled-up technology deployment, transfer, and innovation, **recognizing agrifood systems as central** to adaptation, resilience, and food security, and emphasizing the need to turn global goals into actionable pathways.
- **TIP calls for country-driven technology priorities by shifting from planning to large-scale implementation through capacity-building, enabling environments, finance, and partnerships.**
- **FAO TEC policy work has highlighted that climate technologies in agrifood systems are an essential means of accelerating needed progress,** but their effective scaling requires a value-chain, context-specific approach that balances trade-offs, builds capacity, improves cross-sector integration, and mobilizes tailored finance aligned with investment needs and NDCs.



“A Toolkit for Scaling Up Climate Technology Solutions in Agrifood” [Current title]

Objective of the Toolkit

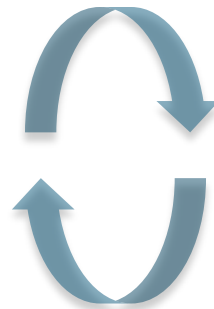


Translate **global climate and technology goals** into actionable, investment-ready pathways for agrifood systems



Provide a **structured, step-by-step toolkit**:

System → Value chain → Market → Technology → Investment



Bridge from agrifood systems to technology to **concrete implementation** & required financing



Ensure **contextualization**:
Tailored to national and subnational agrifood systems

The overall toolkit workflow

The toolkit workflow: chapters, analytical steps and outputs

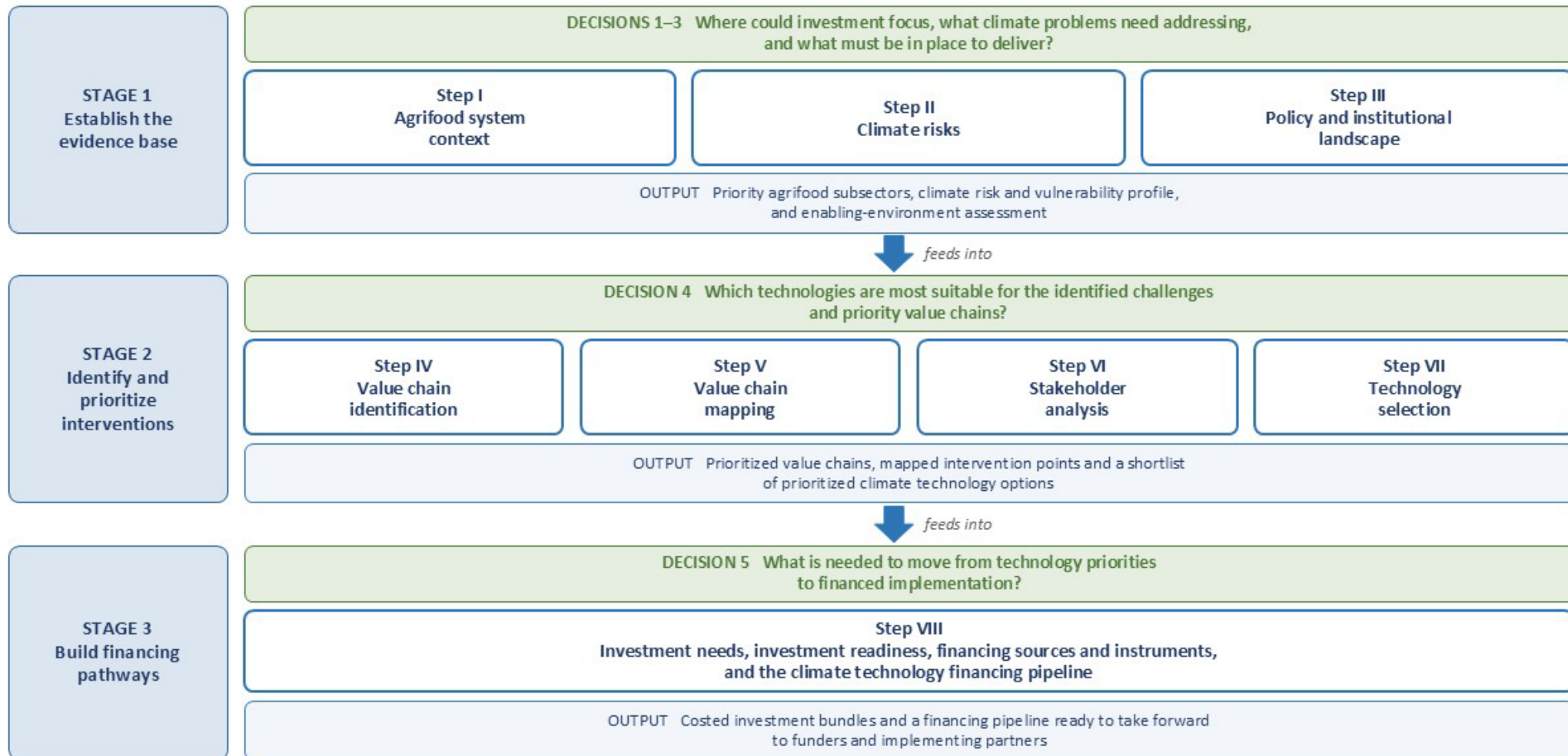


Figure 1. Draft for discussion all boxes, arrows and text are editable PowerPoint shapes.

Structure of each analytical step

- Each step follows **a consistent structure**, guiding users from the **purpose** of the analysis to its practical application and **outputs**:
 - **Why** this step matters
 - **Decision** supported and **purpose**
 - **Key analytical questions** – the issues to be addressed
 - **Suggested analytical methods** – recommended approaches
 - **Suggested data sources**
 - **Expected outputs**
 - **Example** / template – illustration of what a completed output looks like in practice

Stage 1: Establish the evidence base

- Step I – **Agrifood system context**
 - Understand the economic, social and food-security importance of agrifood subsectors
 - Consider production, trade, employment, livelihoods and natural resources
 - Develop a longlist of candidate value chains
- Step II – **Climate change context and risks**
 - Identify key climate hazards and vulnerabilities
 - Map impacts across value-chain stages and locations
 - Identify affected and vulnerable groups
- Step III – **Policy, institutional and innovation landscape**
 - Assess policies, institutions, innovation systems and services
 - Identify enabling conditions and gaps
 - Understand who can support or constrain technology uptake

Stage 2: From value chains to intervention points

- Step IV – **Prioritize value chains**
- Step V – **Map the value chain**
- Step VI – **Value chain actors and stakeholder analysis**
- Step VII – **Selecting the technologies for implementation**
 - Production → aggregation/storage → processing → marketing/distribution → consumption, identify gaps and opportunities and points of intervention, consider the complete technology package

Stage 3: From technology priorities to investment

- Step VIII – **Investment planning and financing pathways**
- For each priority value chains:
 - Define the intervention bundle
 - Estimate investment needs
 - Assess investment readiness
 - Match financing
 - Build the pipeline

Aspects of the toolkit

- **Value-chain based**: technology is assessed within the system where it will be deployed
- Evidence-based: **builds on existing** national **information** and makes **assumptions transparent**
- **Context-specific**: can be adapted to national and subnational circumstances
- **Participatory**: stakeholder knowledge and validation are integrated throughout
- **Inclusive**: considers differentiated access, participation and benefits
- **Investment-oriented**: moves beyond technology prioritization toward financing
- **Flexible**: individual steps can also be used separately where a specific analysis is needed
- **Traceable**: each investment priority can be followed back to the evidence and decisions that support it

Two examples

- Turkmenistan
- Cambodia

Turkmenistan - policy setting: Nationally Determined Contributions, agriculture policy, targets and goals

Recognising its high vulnerability as a landlocked, predominantly desert country (80% Karakum and other deserts), **Turkmenistan prioritises adaptation** given rising temperatures, declining and erratic precipitation, intensifying droughts, dust storms, soil salinity and Amu Darya water stress. Its NDC (2022) **targets a 20% GHG** cut by 2030 against the 2010 level; agriculture accounts for ~12.4% of national emissions.

Turkmenistan's agriculture policy aims to modernise a centrally-planned, monoculture-dominated sector into a competitive, climate-resilient and **diversified agri-food system, while safeguarding food security, rural livelihoods and fragile desert and water resources.**

Agriculture Policy Priorities – Turkmenistan (2022–2052)

1. **Modernise irrigation and water management:** rehabilitate the Garagum Canal (70% of national water use, >900,000 ha), introduce telemetry and drip, and reduce conveyance losses from 50% by deploying digital water control.
2. **Improve livestock productivity and animal health** through improved breeds, biosecurity and a national animal-identification system, and address pasture degradation under the 2015 Law on Pastures.
3. Boost rural incomes and on-farm productivity by scaling favourable agricultural loans (5% pa over 10 yrs; 1% pa for machinery), expanding daikhan and private fruit/vegetable enterprises, and lifting labour productivity from its current level of USD 7,800 per worker.
4. Strengthen **food security and nutrition**, pursuing the national self-sufficiency objective in wheat while addressing rising adult obesity (up 50%, 2012–22) and the NCDs that now drive 75% of hidden agri-food costs.
5. **Expand exports and high-value horticulture** beyond raw cotton and wheat, building on the growth in tomato exports (up 43-fold by volume, 2015–24) and developing branded fruit, vegetable, wool and other value chains.
6. Strengthen sanitary and phytosanitary (SPS) systems **and food safety regulation**, through traceability, GAP/HACCP adoption, modern laboratories and border-control coordination.
7. Build climate resilience and manage land degradation, responding to **projected 755k ha of degraded irrigated land and 4.5 Mha of degraded pastures** by scaling up climate-smart practices, salt-tolerant varieties, agricultural insurance and the NAPCD.
8. Accelerate digital and institutional modernisation under the Concept for Digital State Land Cadastre 2025–2030: digital land registry, remote-sensing crop monitoring, animal-ID and national spatial data infrastructure.

Agriculture and natural resources: key statistics

- **84%** of land is used for agriculture.
- Only **3.6%** is cropland
- Forests cover **~5%** of the land area.
- Severe Water Stress Index: **135%** (freshwater withdrawal relative to total available renewable resources)

Map of Turkmenistan



Parameter	Value
Country area (1,000 ha)	49,121
Land area (1,000 ha)	46,993
Agricultural land (1,000 ha)	39,672 (84%)
Cropland (1,000ha)	1,680 (3.6%)
Permanent pastures and meadows (1,000 ha)	37,947 (81%)
Forest area (1,000 ha)	2,330 (~5%)
Long-term average precipitation (mm/year)	~160*
Cropland area irrigated (1,000 ha)	1,606 (96% of cropland)

Data source: FAO AQUASTAT 2012. * 1990 when showing the *

Crops
Livestock
Forestry protected
Some fisheries

Food security: main food staples

Rank	Food item	Food supply (kcal/capita/day)	Share (%)
1	Wheat and products	1212	43.8
2	Milk – Excluding Butter	539	19.5
3	Sugar (Raw Equivalent)	163	5.9
4	Bovine Meat	132	4.8
5	Potatoes and products	113	4.1
6	Mutton & Goat Meat	99	3.6
7	Rice and products	60	2.2
8	Grapes and products (excl wine)	55	2.0
9	Sunflowerseed Oil	40	1.4
10	Eggs	39	1.4
Total (kcal/capita/day)		2766	

- **Wheat and milk are essential food stuffs, 63.3%**
- Followed by meat potatoes rice and horticulture

Crop production

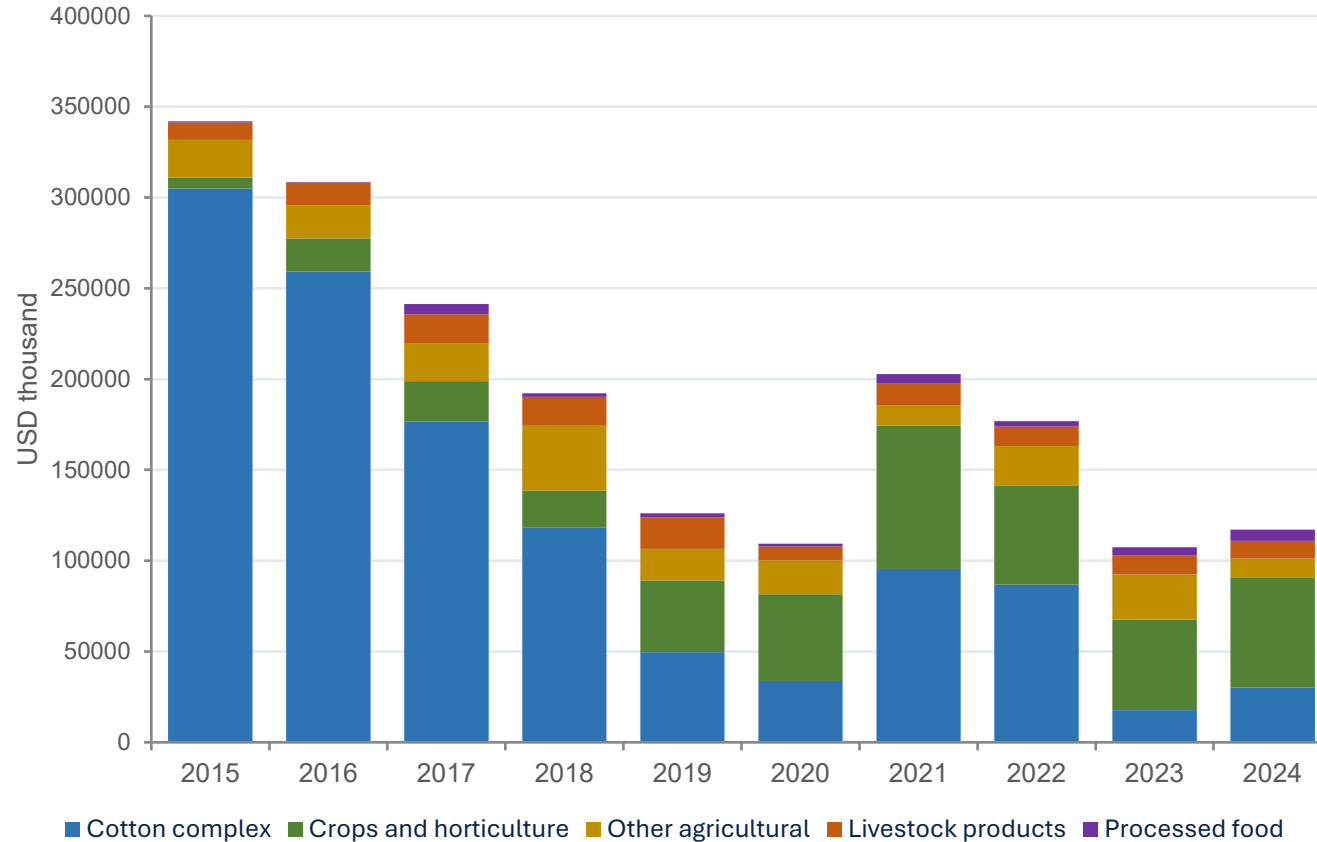
- Wheat, potatoes, cotton, horticulture

Rank	Crop	Production (tons)	Area Harvested (ha)
1	Wheat	1,330,000	814,915
2	Potatoes	824,320	53,855
3	Watermelons	650,528	27,928
4	Seed cotton, unginned	600,238	580,030
5	Tomatoes	351,042	10,363
6	Grapes	345,577	19,995
7	Sugar beet	273,979	17,900
8	Onions and shallots, dry (excluding dehydrated)	89,340	3,252
9	Rice	85,536	18,834
10	Carrots and turnips	73,255	2,168
11	Cabbages	65,966	4,017
12	Apples	65,525	6,122
13	Barley	64,559	32,587
14	Other vegetables, fresh n.e.c.	59,597	1,575
15	Cucumbers and gherkins	35,591	1,455

Source: FAOSTAT production data (QCL), Turkmenistan, 2024; trade figures from FAOSTAT trade extract, 2015–2024

Agricultural exports, 2015 - 2024

Total reported agrifood export value, USD thousand. Covers crops, livestock, processed food and the cotton complex

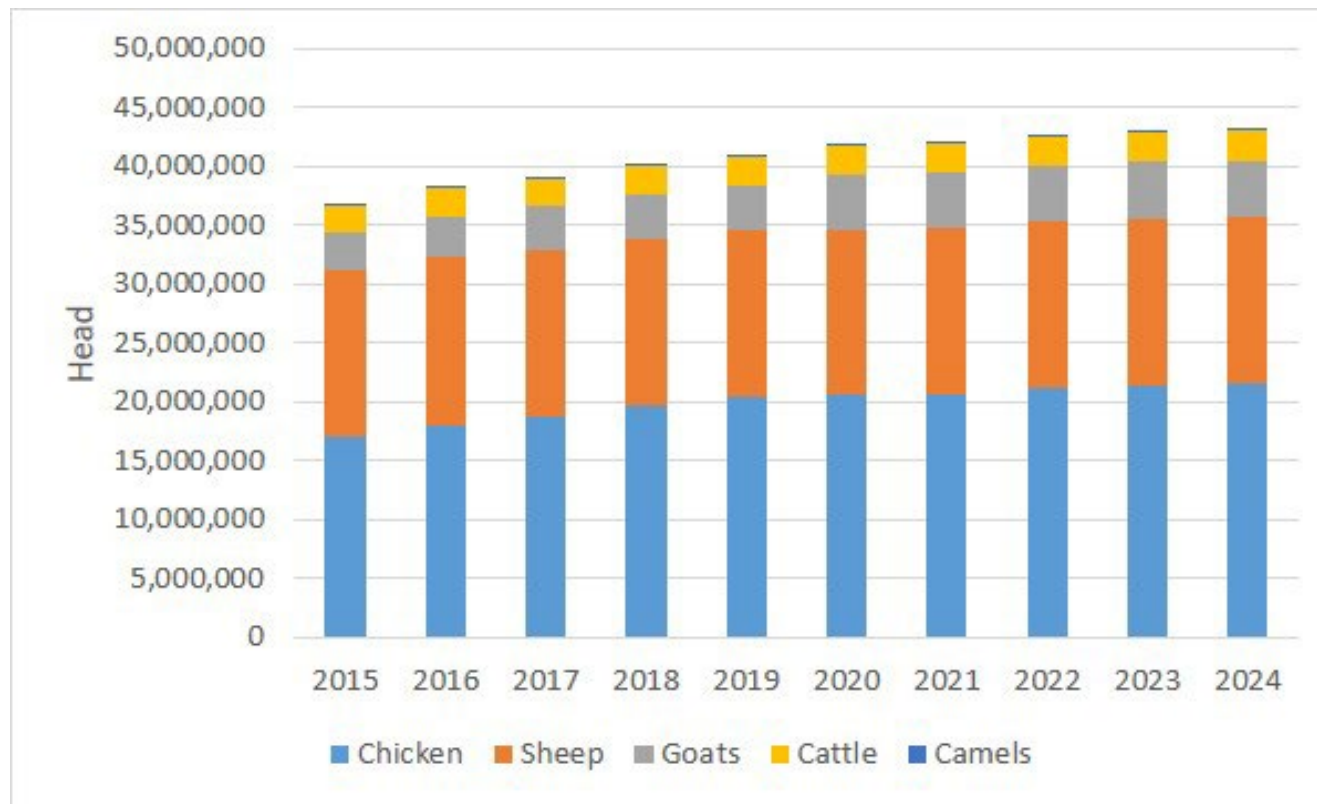


Overview

- Cotton and tomatoes are the main export products.
- Livestock products are a real but small export line: USD 9.7 million in 2024, 8.35 of the total, and they have never exceeded USD 17.3 million in the series.
- Processed food is the fastest-growing category from a very low base USD 0.6 million in 2015 to USD 6.0 million in 2024 mostly chocolate, pastry and confectionery.

Livestock sector

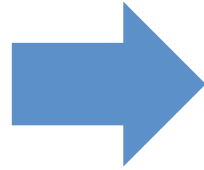
Head counts, 2015 -2024. FAOSTAT stocks



Source: FAOSTAT trade extract, Turkmenistan, 2015–2024. Partner-country mirror statistics.

Value chains for mapping and implementation

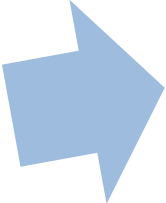
- Wheat
- Cotton
- Potatoes
- Horticulture
- Livestock



**Focus value chains for
intervention and on the ground
implementation**

Mango in Cambodia

Aim is to improve climate resilience while investigating diversification of agrifood systems and related livelihoods



The main climate related impacts:

- Droughts
- Heavy rains and floods
- Changes in rainfall patterns
- Unreliable water supply
- Heat stress
- Pest and diseases

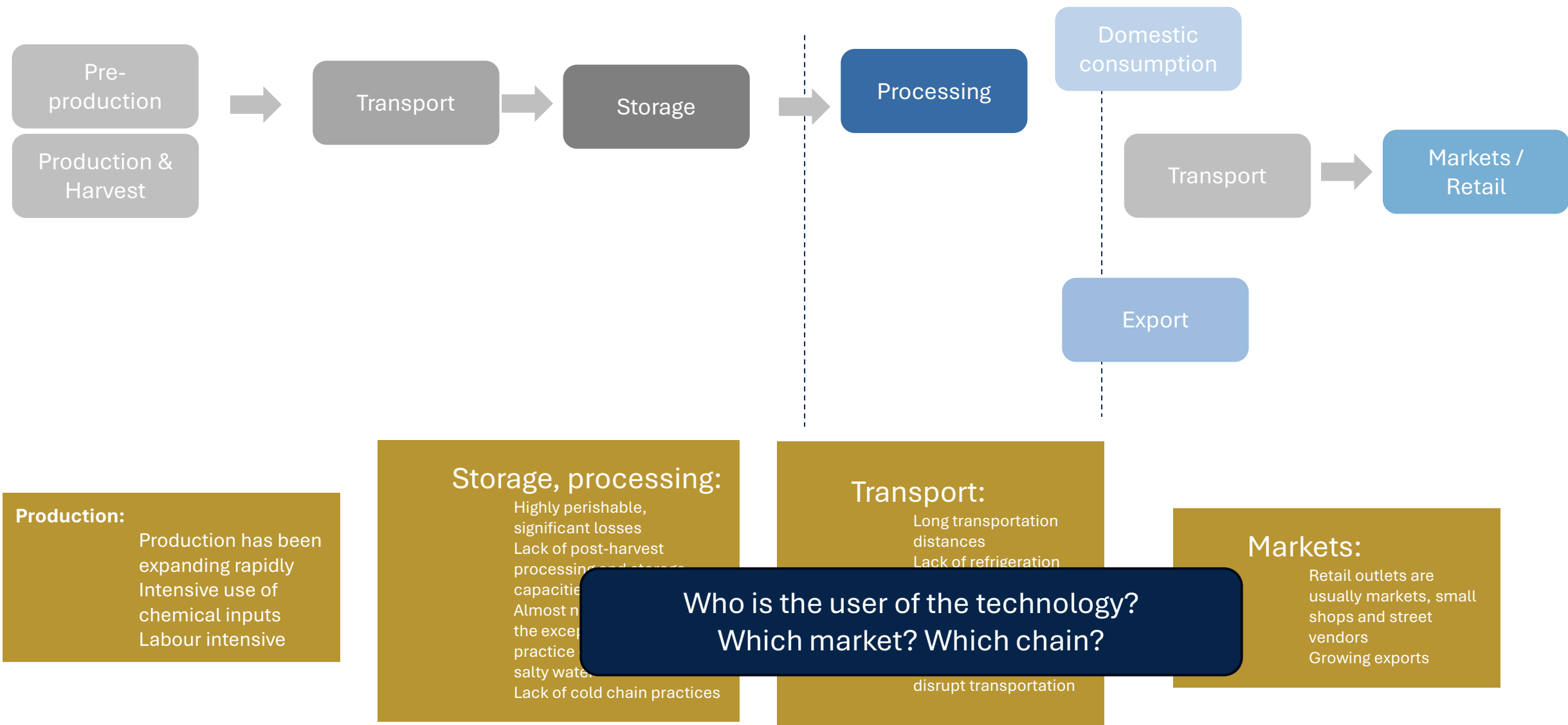
Current issues in the mango value chain:

- Clarity on market outlet
- Lack of postharvest storage and processing capacity
- Lack of cold chain practices
- Inadequate packing and transportation
- Pest and diseases
- Delays in the supply chain

Adaptation needs:

- Climate-resilient production practices
- Strengthening post-harvest handling and infrastructure
- Enhancing market access and value addition
- Building capacity and knowledge
- Fostering partnerships and enabling policies

Mango: Value Chain Components



The overall toolkit workflow

The toolkit workflow: chapters, analytical steps and outputs

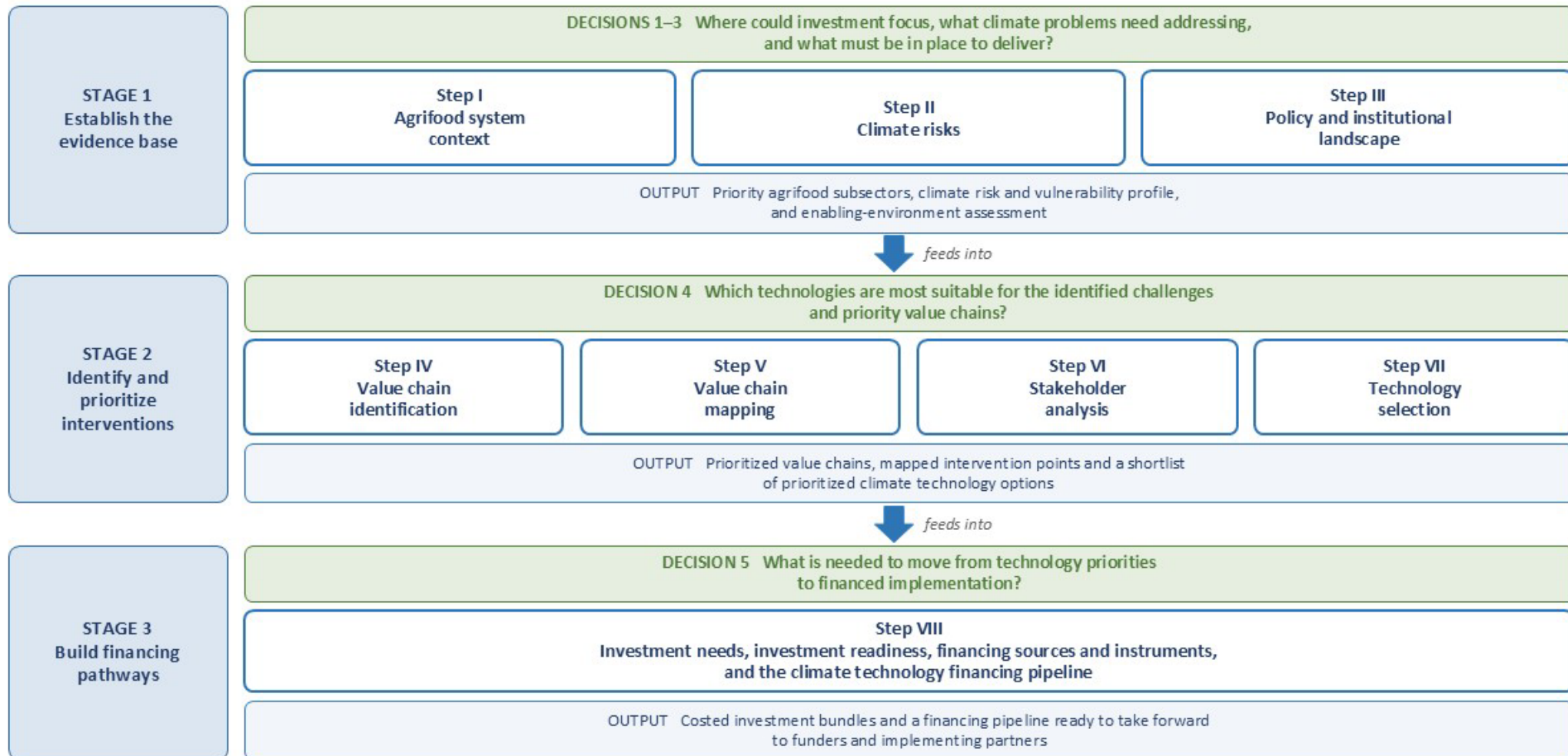


Figure 1. Draft for discussion all boxes, arrows and text are editable PowerPoint shapes.

Concluding remarks – moving to implementation

- Building on ongoing structural foundations and core policies and targets policies, NDC, NAPs, TNAs
- Context specific needs and tailored technology intervention points throughout country identified value chains

Thank you



United Nations Climate Change
Technology Executive Committee

TEC 33 & joint session of the TEC - CTCN Advisory Board