



TECHNOLOGY ASSESSMENT METHODOLOGY

**Agri-voltaic Technology for
Controlled Crop production
In collaboration with UNCTAD**

Presented by

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Generation of wealth and creation of employment, responsibly, in a conducive business environment

Our priority areas are Tourism, Fisheries, Agriculture and Sustainable Manufacturing

SCIENCE TECHNOLOGY AND INNOVATION R&D

Policy Formulation
Create policies to stimulate investment and business creations

Monitor and Evaluate effectiveness of policies to meet investment and business development objectives.

SIB

- Investment Facilitation
- Promotion
- Marketing Intelligence

ESA

- Business Intelligence
- Business Development

IEA

- Provision of resources, land and space

SBS

- Set standards for local products as per regulation and export requirements
- Meet international norms


SLA

- Improving application processes for businesses and thus improve the ease of doing business

- Facilitate ease of doing business
- Abstract FDI that creates value addition
- Long term: Become the ONE Investment Facilitation agency in Seychelles

- Identify business development opportunities
- Make business more resilient
- Extract potential from R&D from local resources of Seychelles
- Give Seychelles a competitive edge in tourism industry through cultural tourism
- Develop manufacturing sector

- Testing
- Identify high value products with export potential



The timelines for the technology assessment in Seychelles are informed by UNCTAD's implementation plan of the project in Seychelles from January 2022 to March 2024.

2022

- Step 1. Governance and steering**
- Step 2. Priority Setting**
- Step 3. Framing National Project Questions**
- Step 4. Setting-up National Project Goals**
- Step 5. National Project Implementation**

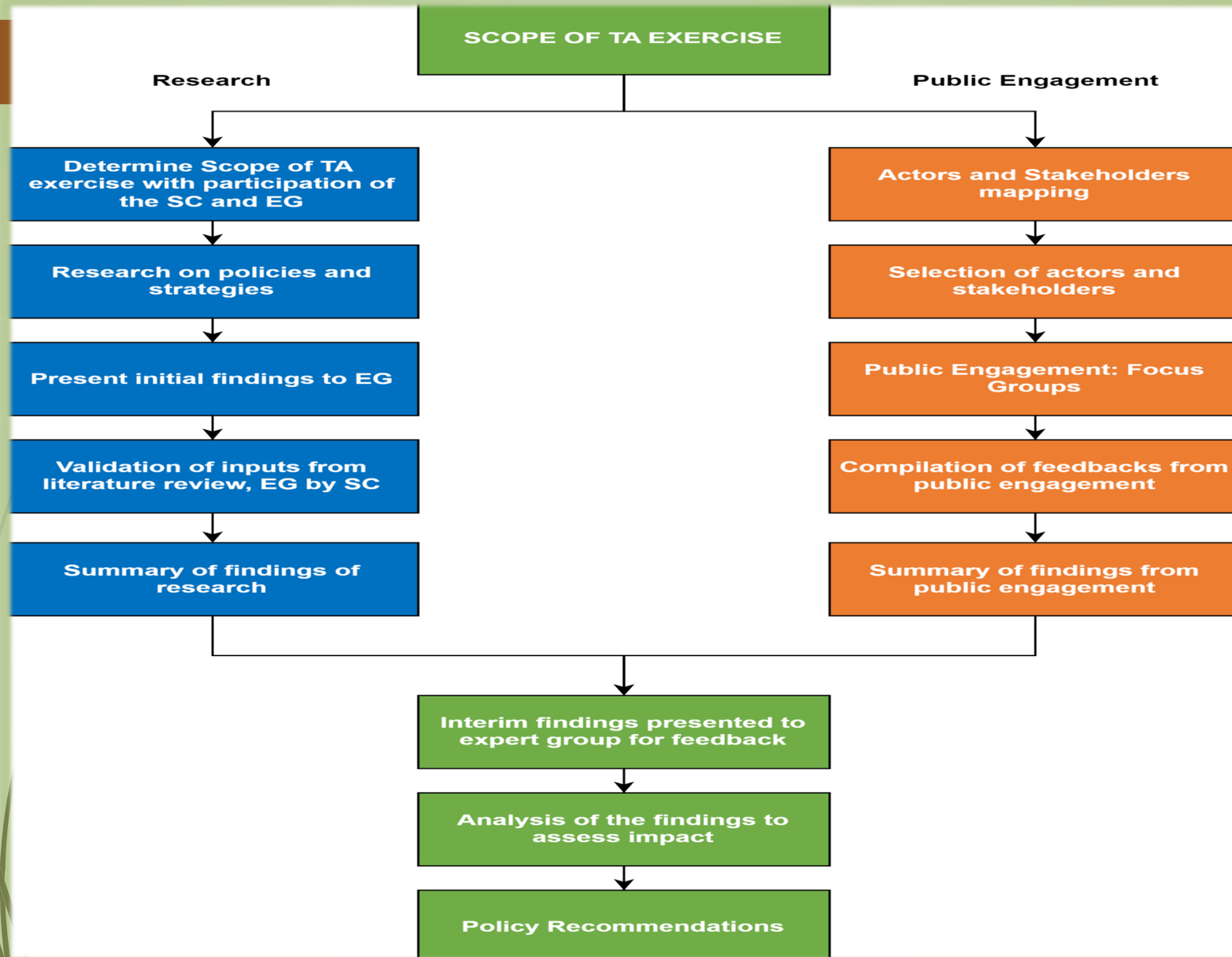
2023

- Step 6. Quality Control**
- Step 7. Reporting**

2024

- Launching of the TA Report**
- Additional elements. Pathways to Impact**

The Technology Assessment (TA) Process



- **DSTI in collaboration with key stakeholders and partners, is ensuring that the strategic objectives of the National Policy and Strategy 2016 – 2025 are met through the integration of STI across all sectors and programs of development**

- **The UNCTAD's TA initiative comes at an opportune time for the Seychelles Economic Transformation agenda**

Updated NDC

As a small island developing state, Seychelles is inherently vulnerable to climate change impacts, the country has continued to prioritize efforts that will improve its resilience.

Seychelles pledged to reduce economy-wide emissions by 26.4% by 2030 compared to business-as-usual and to achieve a decarbonized net-zero emissions economy by 2050

Industrial Policy:

**Seychelles SDG commitments
Green Industrial Policy - keeping sustainability as one of the core themes
Promote the emergence of Green Industry/Circular Industry**

- **The technologies being shortlisted in both sectors are reflective of both demand and supply**
- **On the demand side, it was more related to development priorities in both sectors, primarily, the aspect Food and Nutrition Security**
- **On the supply side, it was related to mature technologies already in the energy mix of the national renewable energy policy and strategy**

- **In consensus, the EG group proposed that in the particular case of Seychelles; Agri-Voltaic Technology for Fully-controlled Environment Crop Production is crucial to achieving food and nutrition security; and**
- **The rationale is that Agri-Voltaic technology complements both sectors in addressing the national food and nutrition security by mitigating the adverse climatic conditions that affect vegetable crop production throughout the year**



Agri-Voltaic for fully-controlled environment crop production.

What is Agri-Voltaic?

Agri-Voltaic allows the simultaneous use of land for both agriculture and photovoltaic power generation. Crops, animal grazing, and electricity can be harvested on the same land. Agri-Voltaic systems can be classified in many ways. One classification method is based on application – such as crop + solar PV or livestock +solar PV

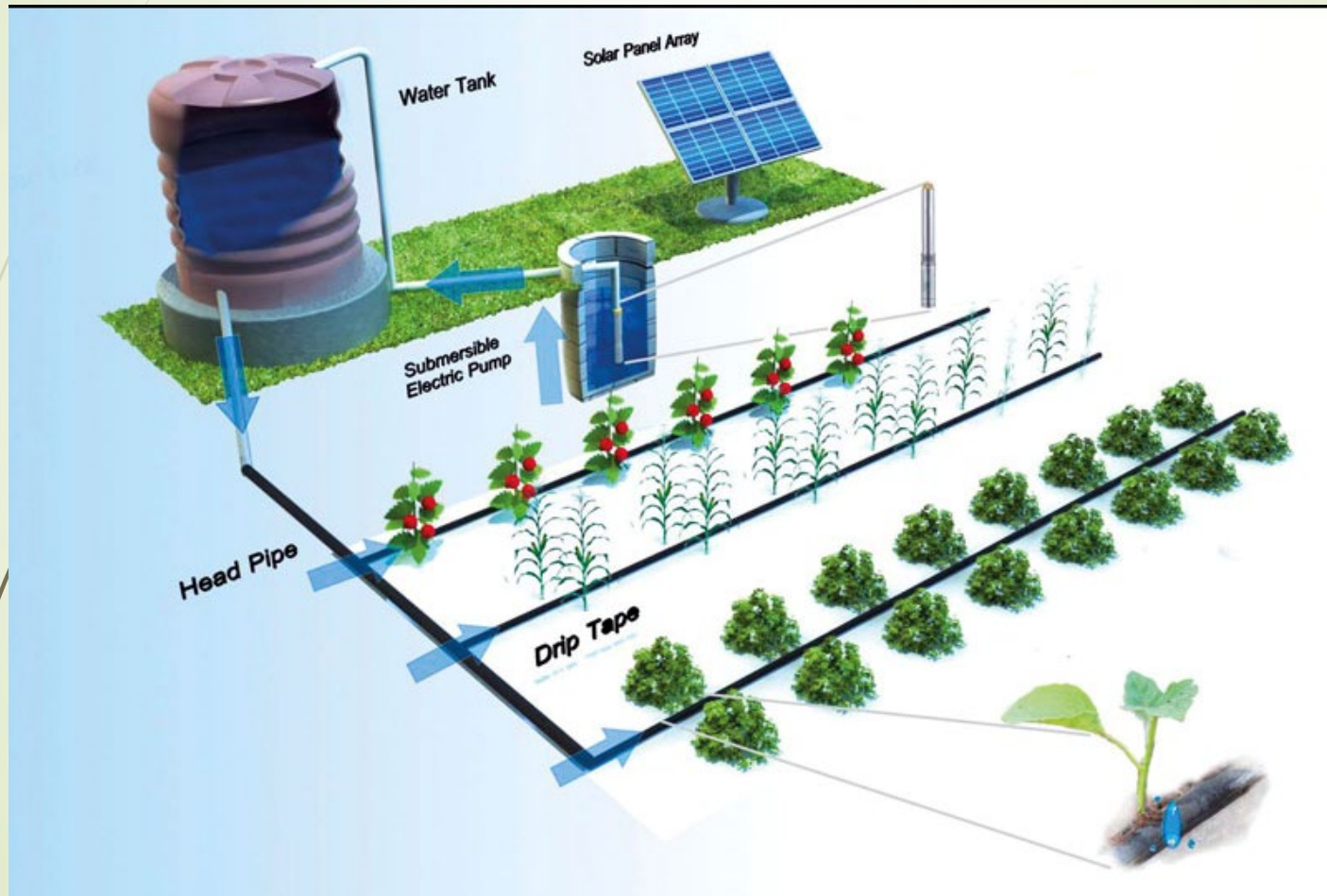
What is controlled-environment agriculture?

Controlled-environment agriculture (CEA) -- which includes indoor agriculture (IA) and vertical farming

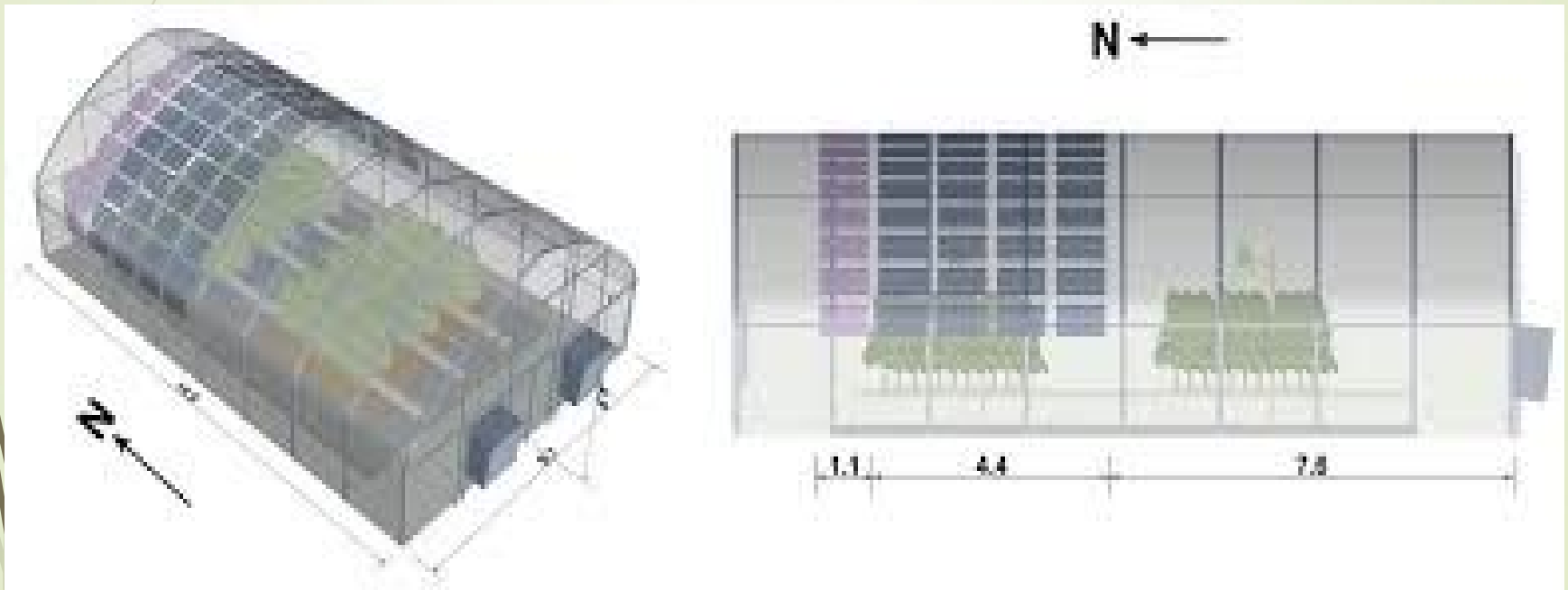
What is fully-controlled environment crop production?

It includes different farming methods compatible with closed-space or indoor agriculture, such as hydroponics, aeroponics, aquaponics, and vertical farms.

The Basic Concept of Agri-Voltaic in crop production



The Basic Concept of Fully-controlled Environment Agri-Voltaic crop production



The Stakeholders and Actors Mapping Process

The Stakeholders and Actors Mapping Matrix

A stakeholders and actors mapping matrix was developed and shared with Expert Group to identify the stakeholders and actors that will be participating in the Focus Groups (FG)

The stakeholders and actors position in the National System of Innovation (NSI) were identified.

The Secretariat of the Steering Committee (DSTI) validated and confirm the list of stakeholders and actors;

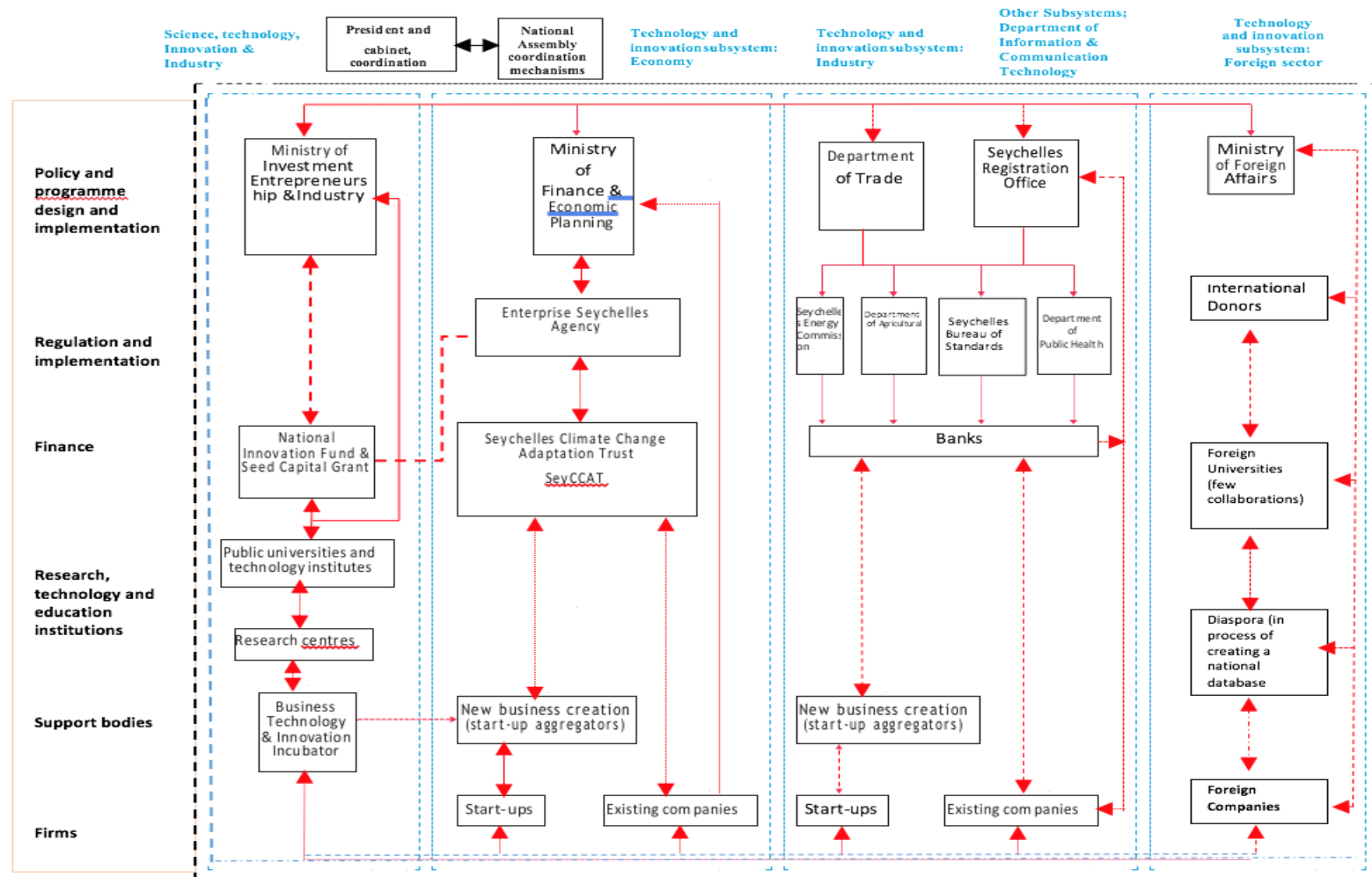
The different groups were invited to participate in FG meetings;

Three separate FG meetings were held on the following dates; and

The debate interaction were recorded.

The National System of Innovation NSI

The National System of Innovation (NSI)

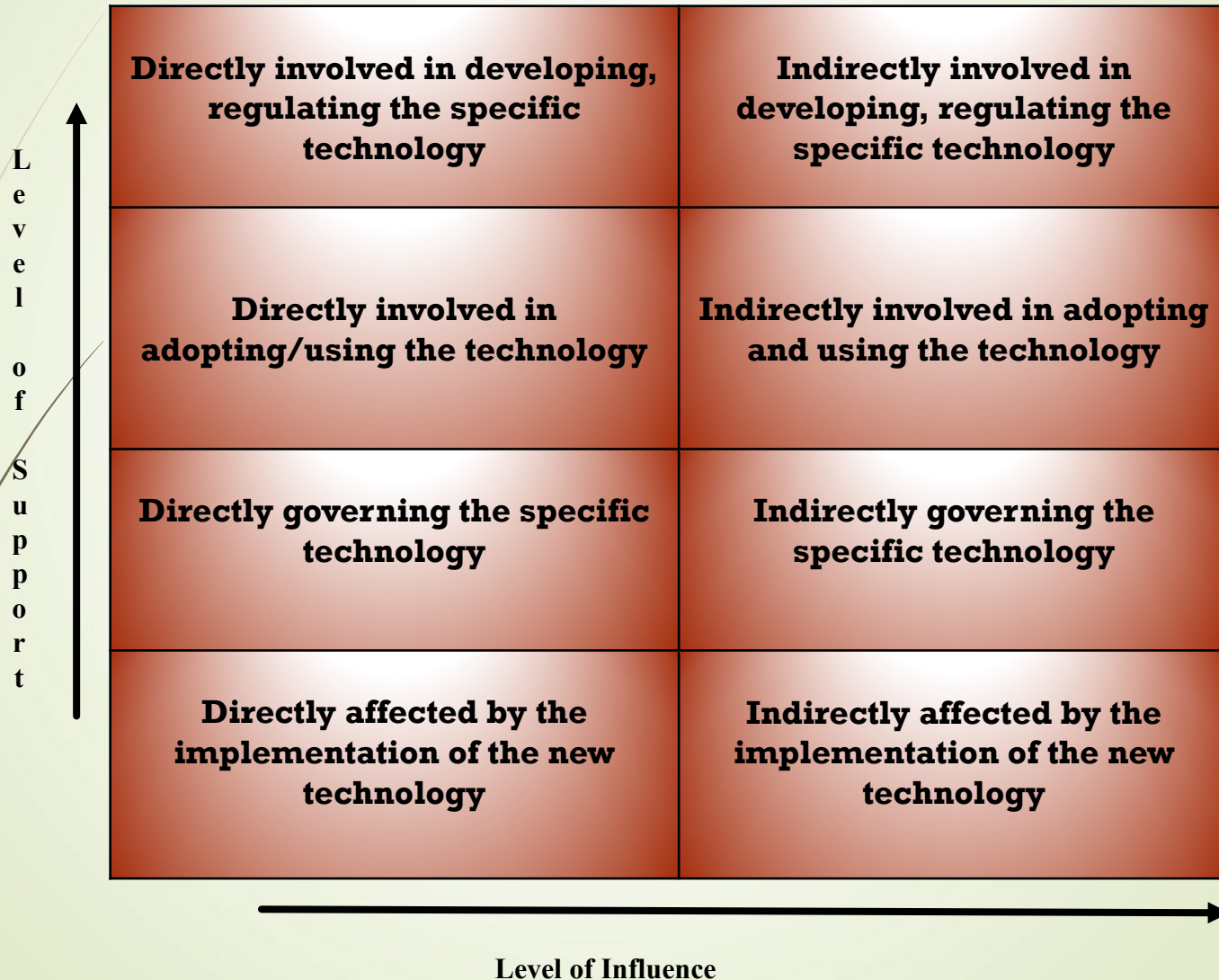


Source: UNCAD (2023)

Institutional linkages	Research outputs	Innovation ecosystem	Community-based linkages
Government ministries and agencies are the main actors providing support to the technology in terms of policy, regulatory and standards	Public expenditure on R&D was about 0.19% of GDP and not data on private expenditure	A business, technology and innovation (BTI) incubator is implementation phase, with the focus on the blue economy cluster	Local famers associations provide Support to the farming community
Low levels of inter institutional trust and between public and private sector entities	Based on the R&D survey 2017, 149 researchers were recorded.	Absence of a national innovation policy framework	Absence of a cooperative mode of Production system
Low level of institutional linkages and trusts amongst knowledge-based institutions	Most researches are initiated by foreign scientists, who have funding from abroad, often the data are do not shared.	A new industrial policy is developed and has been approved by cabinet of ministers	Farming communities are dispersed And structured as large, medium, Small and backyard farming
Public-private partnerships in the both agriculture and energy sector are low	Government agro-research laboratories are available but lack technical capacities to effectively run those infrastructures	A new industrial policy is developed and has been approved by cabinet of ministers	All photovoltaic suppliers are Centralized in the industrial Development area on the main island
Adopters of the technology are very limited in numbers	The agro-research facilities are poorly manned	Incubation space seriously lacking	Limited access to finance Facilities
Collaborative platforms (technology acquisition fund, technology) are weak	No research facilities for photovoltaic, except for standards that are set by the Seychelles bureau of standard (SBS);	Limited access to finance facilities	
	A framework for a national research foundation (NRF) has been developed but not yet implemented		
	A knowledge hub for all scientific data is in development		

Focus Groups

Mendelow's Matrix (adapted)



The Stakeholders and Actors Mapping Matrix

<p>Directly involved in developing, regulating the specific technology</p> <ol style="list-style-type: none"> 1. Department of Agriculture 2. Department of Climate Change 3. Seychelles Energy Commission 4. PUC 5. SBS 6. Planning Authority 	<p>Indirectly involved in developing, regulating the specific technology</p> <ol style="list-style-type: none"> 1. SIB 2. SLA 3. SRC 4. Special Committee for Food Security in the National Assembly
<p>Directly involved in adopting/using the technology</p> <ol style="list-style-type: none"> 1. SIAH 2. Farmers association (All) 3. Farmers (selected) waiting for the list from Agric. 4. Private farming entities (Hotels, IDC) 	<p>Indirectly involved in adopting the technology</p> <ol style="list-style-type: none"> 1. PV Suppliers 2. Consumers who buy these products 3. SCCI
<p>Directly governing the specific technology</p> <ol style="list-style-type: none"> 1. MACCE 2. MLH 3. Biosecurity Agency. 	<p>Indirectly governing the specific technology</p> <ol style="list-style-type: none"> 1. MIEI 2. Ministry of Finance Trade and National Planning 3. Ministry of Health
<p>Directly impacted (positively or negatively) by the implementation of the new Technology</p> <ol style="list-style-type: none"> 1. MIEI, (SLA, SIB, IEA) positive 2. Farmers 3. Department of Tourism 4. Community resistance (negative) 5. Availability of sustainable resources to use the technology 	<p>Indirectly affected by the implementation of the new technology</p> <ol style="list-style-type: none"> 1. TBT 2. Farmers with less road access 3. Rural farmers

Actors	Roles	Remarks
Ministry of Agriculture, Climate Change and Energy (MACCE)	The MACCE has the overarching responsibility for policies, regulations and governance to the technology	This ministry has great relevance with agrivoltaic as it has the portfolio to oversee the two sectors participating in the TA.
Ministry of Land Use and Habitat (MLUH)	The MLUH has the overarching responsibility for policies, regulations of land use and infrastructure	It is by law and regulations that any infrastructure should receive approval of this ministry.
Department of Agriculture	As it falls under the MACCE, it has the prime responsibility for policies, regulations and governance to the technology	The Department of Agriculture, apart from policy oversight, provides research facilities and extension services to farmers. They also provide training in new technologies. The department also provides subsidies and support promoters to access findings.
Department of Climate Change	Works in conjunction with the Department of Agriculture to develop policies and regulations.	Agrivoltaic is a climate-smart technology its implementation depends on the joint oversight of both the Department of Agriculture and Climate Change.
Ministry of Agriculture, Climate Change and Energy (MACCE)	The MACCE has the overarching responsibility for policies, regulations and governance to the technology	This ministry has great relevance with agrivoltaic as it has the portfolio to oversee the two sectors participating in the TA.

Actors	Roles	Remarks
Public Utility Company (PUC)	Works in conjunction with the SEC and SBS in the development of policies, regulations and standards.	Agrivoltaic will have to comply with all regulations.
Seychelles Bureau of Standard (SBS)	Works in conjunction with SEC and the PUC in the standards.	Agrivoltaic will have to comply with all standards. PV suppliers are overseen by the SBS in collaboration with the SEC and PUC to ensure that their products meet the approved national standards.
Seychelles Planning Authority (SPA)	Responsible for infrastructure development	Agrivoltaic requires infrastructure and needs the approval of SPA. The NEP provides guidelines for infrastructure development. Once promoters comply with all requirements, their plans are approved.
Seychelles Investment Board (SIB)	The SIB acts as one-stop-shop for any investment in Seychelles for both domestic and foreign investments.	Promoters in agrivoltaic need to go through SIB for support towards the approval of their projects.
Seychelles Licensing Authority	Oversight of all licensable activities at national level	Promoters of photovoltaic technology are required to have a license to operate their business.
Island Development Company (IDC)	The IDC, which is mandated to develop the outlying islands of Seychelles is one of the main agricultural producers, may need to adopt this technology to remain competitive.	Lately, the IDC has pledged to increase its agricultural outputs to help reduce the import of certain crops that can be grown locally. This state-owned company is already investing in modern technology to enhance consistency in crop production.
PV Suppliers	Agrivoltaic will open more business opportunities to PV suppliers.	The local PV Suppliers have been playing a key role in the adoption of PV as part of the energy-mix. They are key in the integration of PV in crop production.

Actors	Roles	Remarks
Private farming entities	The private farming entities are the most innovative within the farming community and they most interested in the agrivoltaic. They are putting pressure on the government to amend regulations and provide incentives for the implementation agrivoltaic.	Private farmers are large, medium and small based on their production outputs. The large and medium size farmers in crop production have been the most innovative. They are the ones that have introduced semi-controlled crop production using hydroponics technology.
Seychelles Revenue Commission	The SRC is responsible for taxation, excises and ensuring that all businesses have a tax identification registration.	The implementation of agrivoltaic technology requires importation of components that are taxable and PV suppliers need to have a TIN to operate their business.

Impacts of the Implementation of Agri-Voltaic for Controlled-environment Crop Production

Social Impact:

Technology-division between the traditional and modern farming community;
Women in general are subsistence, backyard and low-income farmers may find themselves marginalised due to the demand for high capital investment in the technology;
Access to capital is limited to small farming community, which may lead to displacement of the same in the industry;
Traditional farmers, women and lower-income farming community may suffer displacement in the competition due land scarcity;
Limited access to training in the new technology of traditional farmers may limit their participation in adopting the new technology; and
Low production cost due to the technology may affect completion in the market against the advantage of traditional farmers, women and low-income farmers.

Cultural Impact: :

Public misconceptions of Agri-Voltaic technology may create barriers to the implementation of the technology;
Farming community whereby there may resistance to adoption of the new technology;

Generally, the farming community is conservative and may not be prepared to accept the technology amid the lack of sensitization and awareness program on the technology;

Cultural consumption habits of freshly grown organic produce is strong and produce grown with this technology may face market acceptance; and
Hydroponically grown crops are yet not widely accepted by the general population.

Environmental Impact

Run-offs from production systems that may impact ecosystems in the surrounding production areas;
► Physical waste such as used polythene, plastics, panels and batteries;
► Impact on watersheds due of run-offs contamination;
► Impact on ground water due to run-offs; and
► Impact on water table, where the source of water used is from the ground in the case of the outlying islands.



**Policy Recommendations based on the TA
Methodology for Agri-Voltaics**

An inter-agency national task force, with allocation of appropriate resources, is to be established to coordinate and oversee the implementation of this action plan. It will comprise of representatives from the lead agencies and from collaborating agencies as appropriate.

Policy Recommendations	Measures and activities	Requirements	Leading and collaborating agencies	Indicative Timeframe
1. Address the regulatory gaps to allow the integration of PV in agriculture.	1. Review of existing laws, regulations and standards 2. Evaluation of synergies among existing regulations	Carryout a stakeholders' analysis based on the current NSI status to clearly identify key stakeholders to be involved in the process. Evaluate synergies and trade-offs among existing laws, regulations and standards across the energy and agriculture sector in support of the new technology	Department of Agriculture, Department of Climate Change and energy in collaboration with the Seychelles Energy Commission, SBS and other relevant agencies	Within one year from the approval of the report by the cabinet
2. Review the National Energy Policy 2010 -2030 to accommodate Agri-voltaic for Controlled environment Crop Production	1. Organize Stakeholders engagement to address the problem with the existing policy and strategic framework 2. Selection of policy and strategic options 3. Putting in place M&E framework	Development of a plan to organize the stakeholder engagement Develop evaluation criteria for the current policy and strategic framework Select the most relevant policy and strategic option to support the implementation of the technology. Develop a Monitoring and Evaluation (M&E) framework for the implementation of the reviewed policy and strategic framework	Department of Climate Change and Energy	Within one year from the approval of the report by the cabinet

Policy Recommendations	Measures and activities	Requirements	Leading and collaborating agencies	Indicative Timeframe
<p>3. Evaluate in a quantitative manner the impacts of Agrivoltaic for Controlled environment Crop Production on the environment.</p>	<p>1. Economic impact evaluation of the technology 2. Environmental, social and cultural impact evaluation of the technology</p>	<p>establish strategic context; • establish the need for expenditure; • define the objectives and constraints. • identify and priorities strategic options; • identify and quantify the monetary costs and benefits of options, for example through a pilot project; and • appraise risks & adjust for optimism bias</p> <p>Use the existing tool (the Environmental and Social Impact Assessment, ESIA) to accommodate the new technology.</p>	<p>Department of Agriculture in collaboration with Department of Climate Change and Energy and Department of National Planning</p> <p>Department of Environment, Energy and Climate Change in collaboration with Department of Agriculture , PUC, CEPS and other relevant agencies</p>	<p>For the pilot project, 6 months after the money is available For the rest, desktop evaluation within one year from the approval of the report by the cabinet, taking into account international best practices. This evaluation will be supplemented with the results of the pilot project</p>
<p>4. Facilitate access to funding mechanisms for piloting of Agrivoltaic for Controlled environment Crop Production projects before scaling to fully commercialized ventures</p>	<p>1. Review existing incentive schemes 2. Facilitate the use of existing financial incentives for renewable energy such as SEEREP loans 3. Put in place new incentive schemes as appropriate 4. Mechanism to monitor and review the incentive schemes</p>	<p>Carryout a stakeholders' analysis to set up a multidisciplinary committee and review all existing incentives in both the agriculture and energy sector Introduce new incentive schemes to support the introduction of the new technology Carryout periodic assessments to review the scheme and provide recommendations.</p>	<p>Ministry of Finance in collaboration with MACCE and other relevant agencies</p>	<p>Within one year from approval of the report by the cabinet</p>

Policy Recommendations	Measures and activities	Requirements	Leading and collaborating agencies	Indicative Timeframe
<p>5. Clarify and if necessary improve the effectiveness or expand the incentives to accommodate Agrivoltaics for Controlled environment Crop Production</p>	<ol style="list-style-type: none"> 1. Review existing incentive schemes 2. Facilitate the use of existing financial incentives for renewable energy such as SEEREP loans 3. Put in place new incentive schemes as appropriate 4. Mechanism to monitor and review the incentive schemes 	<p>Carryout a stakeholders' analysis to set up a multidisciplinary committee and review all existing incentives in both the agriculture and energy sector</p> <p>Introduce new incentive schemes to support the introduction of the new technology Carryout periodic assessments to review the scheme and provide recommendations.</p>	<p>Ministry of Finance in collaboration with MACCE and other relevant agencies</p>	<p>Within one year from approval of the report by the cabinet</p>
<p>6. Putting in place measures to improve the NIS, which will support the implementation of the Agrivoltaic for Controlled environment Crop Production</p>	<p>Implement the policy recommendations on NIS emanating from the STI Policy Reviews and using the mapping results of NIS in the TA Report</p>	<p>It is important have a diagnostic study of the NSI to under the causes of the weak linkages between actors and stakeholders in the system in order to remedy the situation.</p> <p>Develop programs to address the challenges affecting the introduction of agrivoltaics and strengthen the linkages to create synergies between actors and stakeholders within the NSI to support the implementation of the technology.</p>	<p>MIEI in collaboration with Department of Agriculture, SEC and other relevant agencies.</p>	<p>Within one year from cabinet's approval of the TA report and ST</p>

Policy Recommendations	Measures and activities	Requirements	Leading and collaborating agencies	Indicative Timeframe
<p>7. Enhance the level of institutional capacity for training, R&D, laboratory infrastructure, regional and international collaboration to support the implementation of the technology</p>	<p>1. Gap analysis</p> <p>2. Strengthen national R&D capacity and laboratory infrastructure</p> <p>3. Strengthen the extension services of MACCE</p> <p>4. Develop and implement plans and programs for training.</p> <p>5. Put in place plans and programs for R&D.</p>	<p>Carryout a situational analysis to identify the gaps in institutional capacity</p> <p>Update the data on R&D capacity and laboratory infrastructure to support the implementation of the technology</p> <p>Carryout an audit of existing regional and international collaborations in both the agriculture and energy sector, such as SADC, IOC Engage the education and training institutes, including vocational institutes to develop programs that support the implementation agrivoltaics</p> <p>Build up of the existing regional and international collaboration in R&D to support the implementation of the technology, such as CSIR</p>	<p>MIEI in collaboration with Department of Agriculture, SEC, PUC and relevant agencies SIAH in collaboration with Ministry of Education, Department of Agriculture, SEC and PUC and other relevant agencies</p>	<p>Within one year from approval of the report by the cabinet</p>

Policy Recommendations	Measures and activities	Requirements	Leading and collaborating agencies	Indicative Timeframe
8. Reassess the current land allocation system to determine how agri-voltaic can be integrated into agriculture production in Seychelles	1.Establish clear procedures to identify lands that can be allocated for trying agri-voltaic technology	Develop a criteria to determine high-tech agriculture and identify land to be allocated to the cluster of high tech agriculture such as agrivoltaics which maximizes the benefit of land use as both energy and crops are produced on the same area. Set up a new agriculture land management system to support the implementation of the technology.	MACCE in collaboration with the Ministry of Land and Housing, Seychelles Infrastructure agency, Seychelles Planning Authority	Within one year from approval of the report by the cabinet
9. Put in place measures to ensure an effective supply chain to support the technology	1.Develop schemes to ensure production continuity. 2.Application of new technologies in the supply chain 3.Put in place adequate after sales services.	Use the existing institutions to develop an effective mechanism for supply chain. Develop smart procurement and inventory system for an effective supply chain through technologies such as AI.	Ministry of Finance, National Planning and Trade in collaboration with MACCE, MIEI and relevant agencies	Within two years from approval of the report by the cabinet

Policy Recommendations	Measures and activities	Requirements	Leading and collaborating agencies	Indicative Timeframe
<p>10. Ensure that Agri-voltaic for Controlled environment Crop Production is accessible to women, traditional and low-income farmers</p>	<p>1.Extrapolate and identify the data on women, traditional and low-income farmers.</p> <p>2.Assessment of capacity.</p> <p>3.Sensitization and awareness programs.</p> <p>4.Training programs.</p>	<p>Carry out an exercise to identify and set up a database on women, traditional and low-income farmers in the agricultural sector</p> <p>Make an assessment of their capacities to uptake and adopt this technology Develop targeted sensitization and awareness to empower women, traditional and low-income farmers to prepare and equip them to adopt the technology.</p> <p>Develop and implement training program for women, traditional and low-income farmers.</p>	<p>Department of Agriculture in collaboration with National Bureau of Statistics (NBS), Ministry of Employment and Social Affairs, Ministry of Youth, Sports and Family, CEPS and relevant agencies</p>	<p>6 months after the technology is available</p>

Policy Recommendations	Measures and activities	Requirements	Leading and collaborating agencies	Indicative Timeframe
<p>11. Educate and raise awareness through programs on Agrivoltaics for Controlled environment Crop Production</p>	<p>1.Sensitization and awareness programs for the target audiences.</p>	<p>Develop and implement sensitization and awareness programs on the technology to educate the general public.</p> <p>Develop and implement sensitization and awareness programs across all levels on the education system.</p> <p>Collaborate with the mainstream media for sensitization and awareness programs to educate the general public to demystify the belief that soilless crops are present health risks.</p>	<p>MACCE in collaboration with relevant MDAs and the support of media including SBC</p>	<p>Ongoing process from the cabinet approval of the report</p>



Thank You



STI for SDGs Roadmap for Seychelles



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