EO AFRICA Water Management

D4
Policy Traceability Matrix analysis

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1 Summary

This document is the “Policy Traceability Matrix analysis” and corresponds to deliverable D4 according to ESA Contract No. 4000139810/22/I-DT and the Project Proposal P22S1956-02-v0. The current version 1.1 includes some revisions in response to ESA comments received by email on the 28th of April, 2023.

It aims to discuss the potential of integrating remote sensing models as a tool for policy implementation, management, and analysis, focusing on the Egyptian context. A policy framework analysis approach is presented to identify the gaps and obstacles hindering the development of this potential and the achievement of outcomes.

1.1 Applicable documents

Ref.	Title
[AD 01]	ESA-CIP-POE-DT-sp-LE-2021-882 Letter of Invitation to Tender
[AD 02]	ESA-EOP-SD-SOW-0250 Statement of Work
[AD 03]	Appendix 2 to ESA-CIP-POE-DT-sp-LE-2021-882 Letter of Invitation to Tender: Draft Contract
[AD 04]	Appendix 3 to ESA-CIP-POE-DT-sp-LE-2021-882 Letter of Invitation to Tender: EXPRO Tendering Conditions (EXPRO/TC)
[AD 05]	Appendix 4 to ESA-CIP-POE-DT-sp-LE-2021-882 Letter of Invitation to Tender: Proposal Template (including Cover Letter and Detailed Proposal)

1.2 Acronyms

Acronym	
RS	Remote Sensing
ETa	Actual Evapotranspiration
ETc	Crop Evapotranspiration
EO	Earth Observation
Kc	Crop Coefficient
Ks	Water Stress Coefficient
BCM	Billion Cubic Meter
LE	Egyptian pounds
MWRI	Ministry of Water Resources and Irrigation
CWSI	Crop Water Stress Index
Sqm	Square meters
NARSS	National Authority for Remote Sensing & Space Sciences
NRC	National Research Center
DRC	Desert Research Center
ASRT	Academy of Scientific Research and Technology
WUA	Water User Association

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2 Introduction

Water is key for sustainable development. It is integrated in all economic, socio-political, and ecological/environmental aspects of human's lives. Yet, water scarcity, exacerbated by climate change, is becoming a fast-spreading threat impacting livelihood, food security, sustainable economic development, and social stability (Abdelmoneim et al., 2023). Approximately, one-fifth of the world's population lives in water-stressed areas, and this trend is likely to worsen in the near future if the current trends, threats, and pressures, are not fully understood and appropriately managed (Bhaga et al., 2021).

Globally, 70% of the fresh water consumption is directed to irrigated agriculture (Wu et al., 2022). Water scarcity is the main limiting factor for agricultural expansion, especially in arid and semi-arid regions, where crop water consumption exceeds precipitation. In such regions, the water crisis could have severe impacts beyond agricultural production and food security, as it could prone the region to social and political instability.

To overcome such challenges, good governance, thus effective and efficient policy is required. In turn, information is required to assess the need and urgency to develop a policy, to mobilize instruments for implementation, to control and enforce proper execution, and to monitor and evaluate its impacts (De Leeuw et al., 2010). Thus, data channels, and reliable available information, are essential for an efficient policy cycle. However, even though some data are available, access to these sources is a problem. Data are often stored somewhere obscured from the sight of the people who may need to be informed. The available data instead, through the internet for instance, are usually sectoral, and there are great difficulties when one wishes to combine two or more datasets (Awad et al., 2009). Data availability and reliability challenges become significantly vital when discussing water resources management. As a scarce, precious resource, poor policy design and implementation resulted from data scarcity and/or scatteredness could lead to social instability and even international conflicts (Awad et al., 2009).

On the other hand, remotely sensed (RS) models could play a major role in bridging the spatial and temporal data gap. As a relatively reliable channel of data, RS models could be used to sustainably feed information to water resources policy design/management at regional/national scale, especially for agricultural water management. This could be achieved through their capability of determining two key agronomic information, namely: actual evapotranspiration (ETa) and crop evapotranspiration (ETc). Temporal mapping of such data allows for managing crop water demand and consumption, water accounting, water allocation, and regional water use efficiency. Thus, RS models provide an attractive and scalable alternative to conventional ground data collection methods (Bastiaanssen et al., 2009).

The proposed earth observation (EO) based solution is an open access tool capable of estimating and mapping potential and actual crop evapotranspiration using crop coefficient (Kc) and water stress coefficient (Ks), by analyzing the available data from PRISMA and ECOSTRESS missions.

Awareness of the RS potential - such as the model in hands - to support water resources policies, is an essential step towards the integration of EO models into the policy cycles. In a region where water resources are the main limitation for agricultural land expansion, the need for a reliable water resources management tool to guide the decision maker and the end user is crucial, and Egypt is no exception.

Although, the policy objectives may differ, both, the private sector and the national governmental investments in Egypt are potential users of such a solution.

As a matter of fact, the Egyptian government is heavily investing in national projects and initiatives based on multiple policies, in order to meet the increasing demand, and to face the limited water availability challenges.

On the other hand - in the Egyptian context - the private sector is always the first candidate when agricultural investment in large open areas, suitable for remote sensing applications, is concerned. For instance, the early adopter of the proposed solution manages a total area of 14,070 ha, out of which 13,800 ha are farming area, and where irrigation with central pivots (63 ha/pivot approximately) annually consumes 140 million m^3 of water. Though, the infrastructure is old, and a reliable tool is needed to assess the water application efficiency, enhance the water resources management, and help the decision maker to assess the potential savings.

The deliverable in hands tries to underline the challenges related to water resources management in Egypt, and the potential of EO based models to contribute to the solution. Furthermore, it introduces the policy framework analysis approach that will be followed during the project, to ensure the fulfillment of the requirements and gaps in the final developed solution. The analysis will target both categories of potential users: i) governmental decision makers, ii) large-scale private sector, along with iii) research centers and university networks. The last category is targeted to foster dissemination and awareness of the final product, and to ensure its sustainable integration into the capacity building programs and processes. The analysis aims to bring out the distortions and inefficacies of the current policies and to ensure that the proposed model meets the requirements of the potential early adopters. Finally, the data collection materials relevant to the policy framework analysis are illustrated.

3 Basic definitions: Policy and Policy cycles

Before initiating a policy framework analysis, it important to define some basic concepts regarding policy and decision-making processes.

A policy in general is defined as a set of ideas or a plan of what to do in situations that has been agreed to officially by a group of people, a business organization, a government, or a political party (Turner, 2006). According to the reasons of development, policies could be categorized into two main groups:

- **Re-active Policy**: a policy that was designed to remedy an existing challenge.
- **Pro-active Policy:** a policy that is designed to prevent a concern, problem, or emergency from occurring.

Policy making and dynamics on other hand could be understood using the policy cycle proposed by (Lasswell, 1956) the founder of modern policy analysis.

Policy cycle is a heuristic tool through which different stages of the ongoing and never-ending dynamics of policy processes can be segmented and then analyzed (Capano and Pritoni, 2020). This segmentation allows for grasping specific dynamics occurring in any given stage along with defining the relevance/potential of the proposed tools - such as remote sensing models - at each stage of the policy cycle (Figure 1).

In its simplest form, policy cycle consists of five main stages:

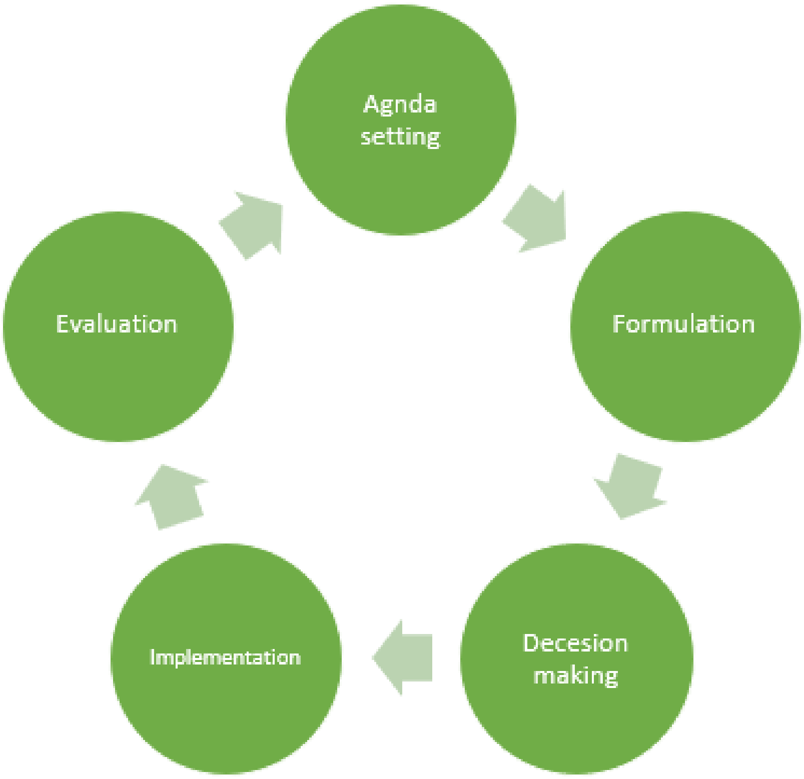

Figure 1: Policy cycle

- **Agenda setting:** It is the stage where the problems are defined and prioritized according to the main actors and stakeholders. It is worth to mention that this prioritization is a strategic phase to pre-structure the following stages and is mainly associated with other concepts such as: power, conflict management, lobbying etc. However, as the main objective of this deliverable is to discuss the potential of integrating RS models for policy implementation and management, it will not deeply discuss these concepts.

- **Formulation:** in this stage the available solutions are characterized and assessed. While stakeholders were the main actors in the previous stage, experts and professionals are the main contributors in this one (Dunlop, 2013). Also, interest groups have to be included in this stage as bearer of information and data for the professional and policy maker (De Bruycker, 2016).

- **Decision-making**: it is the stage where the final solution is to be selected and pursued, including the process of its legitimation. It is the stage where the politicians/decision makers can exercise their sovereignty, nevertheless, other actors can influence the outputs of the decision-making process and tradeoffs must be assessed.

- **Implementation**: this stage was being considered a simple mere execution of what has been agreed upon in the previous one, however it was proven that implementation stage has its own autonomous logic, dynamics and characteristics (Bardach, 1977; Pressman and Wildavsky, 1973). This notion means that implementation is structurally characterized by a tendency to distort goals. As, it is a different arena, other factors including stakeholders themselves could influence the implementation approach and outcomes according to their interests (Capano and Pritoni, 2020). Yackee and Yackee (2006) noticed that implementation is the stage where the stakeholders excluded from the discussion in the agenda setting stage (the first stage) can exercise their influence on the final outcomes.

  Thus, Implementation is a strategic stage of the policy cycle as it represents the link between the established goals and the actual outcome of a policy. It is believed by the authors to be the main arena for RS models integration in the water resources policy cycle (along with the coming stage).

- **Evaluation**: as the last stage of policy cycle, it implies periodical assessment of the policy outcomes and impacts. It facilitates evidence-based policy design and implementation, increasing the policy's accountability and transparency, demonstrating achievements towards policy objectives, and assessing the policies effectiveness, efficiency, results and impacts. However, periodical evaluation demands systematic monitoring tools, another area where RS models and tools excel. This will be further illustrated when discussing examples from Egyptian context.

4 Water resources management in Egypt: Background and policy challenges

Egypt is characterized by its dependability on one main water resource that accounts for around 85% of total fresh water supply as shown in Table 1 (Mohie El Din and Moussa, 2016). The annual water deficit estimated to be 13.5 BCM is the gap between the total annual water supply (66 BCM) and the annual demand (79.5 BCM) (Mohie El Din and Moussa, 2016). This gap is compensated by recycling drainage water either officially or unofficially.

Table 2 Water resources in Egypt

Water resource	Annual supply in BCM
The Nile River	55.5
Effective rainfall on the northern strip of the Mediterranean Sea	1.6
non-renewable deep groundwater in western desert	2.4
non-renewable deep groundwater in western desert	2.4
Shallow ground water	6.5

Aside from the obvious limited availability, the water resources management in Egypt faces numerous challenges. In the coming section some of the most important challenges that triggered policy cycles or national projects are pinpointed, focusing on the ones where the developed solution (ETa-EO based model) is expected to be more relevant.

4.1 Seepage losses from canals/drains: The national lining project

In the Nile valley and delta (known also as old lands), open canals are the main conveyance system for irrigation. Water is conveyed from the Nile through an extensive network of earthen channels exceeding 32000 km (Ashour et al., 2021). This ramified delivery system consists of three levels of channels i) main canals, ii) secondary canals (branches and sub-branches), iii) tertiary canals (Mesqas and Marwas). Main canals run continuously, while the distribution at the secondary level follows a rotational schedule that applies also to the tertiary canals that reach the farms i.e. end users.

As most of the distribution network is formed by earthen secondary and tertiary canals, a huge amount of water is lost by seepage. Furthermore, weeds, sedimentation, and bad governance led to consistent failure of service at the tail of the canals.

To face such challenge the Egyptian government launched an ambitious national project (2022-2024) to line 20,000 km of channels claiming to save up to 5 BCM of fresh water annually.

The first phase of the project is valued 18 billion LE (590 million USD) to line 7,000 kilometers of canals. The government expects to enhance water management and distribution and ensuring the delivery to the canals' tails. Yet, no scientific evaluation of such policy is available.

The developed EO based solution will enable mapping the actual water consumption (ETa) and the Crop Water Stress Index (CWSI). Accordingly, the quality of the service along the ramified network of tertiary canals in terms of the reliability of the delivery may be tracked. Highly stressed areas will necessitate of a closer investigation. Consequently, monitoring and periodically evaluating the impacts of such policy is rendered feasible.

4.2 Restricting high water consumption crops: Modifying the cropping pattern policies

Egypt is the largest rice producer in the middle east. Rice is one of the grain crops in which Egypt enjoys self-sufficiency and realizes a surplus for exports. One of the overlooked advantages of rice cultivation is its suitability with the saline conditions in the North Delta regions (Eliw et al., 2022). Approximately 650,000 ha from the whole cultivated area in Egypt (3.3 million ha) is cultivated by rice (around 20% of the total) (Elbasiouny and Elbehiry, 2020). Yet, it is one of the most water consuming crops, especially under the Egyptian conditions, where rice varieties produce higher grain yields when soil water content is kept near saturation throughout the season (Elmoghazy and Elshenawy, 2019).

One of the main reasons of the remarkable position of the Egyptian rice in the cropping pattern is the governmental policies form the early 90's to the 2000's. To boost rice cultivation as an exported good, the Egyptian government adopted serious programs to develop and distribute certified high yielding resistant seeds; in fact, the Egyptian varieties can produce up to 10 tons/ha while the worldwide average is between 3-6 tons/ha (Elmoghazy and Elshenawy, 2019). In addition, the government promoted cultivation area extension and technology transfer, as well as adopting a free market policy, thus abandoning compulsory delivery of crops in the framework of economic reform programs, which resulted in a significant increase in total production (Eliw et al., 2022).

Such policies were usually faced by the concerns of the Ministry of Water Resources and Irrigation (MWRI) about the elevated water demands . The red flags were raised starting early 90's to confine the areas cultivated with rice to a maximum of 300,000 ha. Notwithstanding these concerns, the average annual rice area reached about 583,000 ha (1.4 million feddans) during 1994-1996 (Sabaa and Sharaf, 2000), registering an increase of 163,000 ha as compared to the year 1986 (Elmoghazy and Elshenawy, 2019) .

The incremental trend continued through the 2000's The boost, driven by the release of promising rice varieties in the late 80's, significantly increased the average yield per unit area. This increase corresponded to 27% and 66% as compared to the periods 1987-1997 and 1975-1986 respectively. In recent years, to address the expanding water resources challenges, the Egyptian government adopted a more restrictive policy toward the highly water demanding crops.

The Ministerial Decree (No. 305 of 2020) by MWRI, published in January 27, 2021, indicated the Delta provinces allowed to plant rice in the calendar year 2021. The allotted rice cultivated area was set to 451,164 ha in nine governorates. This includes 304,164 ha to be planted with current early maturing varieties (Table 2), 84,000 ha with drought tolerant varieties, and 63,000 ha with soil salinity tolerant varieties .

Table 3 Areas allocated for rice cultivation in 2021using early maturing varieties.

Governorate	Allotted Rice Areas in 2021 (ha)
Alexandria	840
Beheira	44,793
Gharbia	17,052
Kafr El Sheikh	79,716
Dakahlia	76,671
Damietta	17,640
Sharkia	53,697
Ismaelia	1,155
Port Said	12,600
Total	**304,164**

On March 30, 2021, the Egyptian parliament approved a new water resources and irrigation law to curb illegal rice cultivation. Article 31 of the new law demanded that the allotment of rice areas had to be in accordance with a ministerial decree issued by the Ministry of Water Resources and Irrigation in consultation with the Ministry of Agriculture and Land Reclamation. Article 124 stipulates that farmers who do not adhere to the allotted rice areas according to Article 31 will either face fines ranging between 3000 – 10,000 LE ($100 – $330) per feddan (4,200 sqm) or receive a prison sentence not to exceed six months. The law left the court with the power to determine the penalty between a sentence or a fine for violators of rice cultivation outside specified areas set by the government.

The new policy defined rice cultivated areas and banned exports to address the problem of limited irrigation water, resulting in negative impacts on Egypt's rice exports.

The above reported shows one of the most relevant cases about the failure of a policy to achieve its expected results. Although the policies adopted in the 90's and 2000's were presumed to boost rice cultivation, the lack of policy cycle assessment tools - among other reasons – led to the defective management of rice cropping pattern in the last five decades.

An EO-based model may contribute to the interplay as it offers the required support for the implementation, monitoring and evaluation of the rice cultivation policy approved by the Egyptian parliament in 2021, and its enforcement as stated in Articles 31 and 124 of the same.

As a matter of fact, the developed solution will allow to map ETa and consequently the actual water consumption of the cultivated crops are well defined, with a clear distinction of rice cultivations. Coupled with water supply data, it enables to estimate the irrigation efficiency at regional scale, and to evaluate the impact of introducing low water consumption rice varieties or innovative irrigation practices.

4.3 Raising on farm irrigation efficiency policies: Initiatives and subsidies to switch to pressurized irrigation systems

One of the main challenges faced in the water resources management in Egypt is low on-farm irrigation efficiency for most of the irrigated lands. Only 6% of total irrigated areas use pressurized irrigation while it is estimated that most of Egypt's irrigation systems (surface irrigation) operate at only 50% efficiency (El-Gendy, 2011).

Yet, some studies contradict the mentioned assumptions by estimating the overall quantitative efficiency. In that case, the overall efficiency is expected to be much higher due to legal and illegal reuse of drainage water thus it might even reach 93% (Molle et al., 2018). However, it's worth mentioning that existing data on water use and thus the estimation of the efficiency is rough estimates and not based on field observations (Ayyad et al., 2019).

Nonetheless, the Egyptian government adopted an ambitious policy to boost converting from surface to pressurized irrigation from 2022-2025. With a total value of 55 billion LE (1.8 billion USD), the initiative allows financing agricultural cooperative societies for the purpose of switching to modern irrigation methods through the National Bank of Egypt and the Agricultural Bank of Egypt.

The aim of the initiative is to rationalize the use of water resources and maximize its productivity. This will be achieved by financing the conversion of 4 million feddans (840,000 ha) from surface to pressurized irrigation.

The farmers benefiting from the initiative will pay the cost of switching to modern irrigation systems to the banks in installments over ten years without bearing any interest, provided that the first installment is paid one year after the completion of implementation. This constitutes an important term as the initiative expects a growth of 25-30% in farmers' income while saving 30-40% of water use.

The central bank will compensate the banks in partnership with the Ministry of Finance. According to the plan, within 3 years, all agricultural lands will eventually shift to smart irrigation methods.

As most of the pressurized irrigation systems are equipped with flowmeters, seasonal supplies could be assessed. With the EO-based ETa, actual consumption is estimated, which means that the EO developed solution is able to play a major role in estimating and mapping on-farm irrigation efficiency on a periodical basis. This information is necessary to monitor and evaluate the impact of the subsidisation policy on the irrigation modernization.

4.4 The potential of the developed solution in the policy cycle assessment

Hyperspectral imaging is more capable of identifying and discriminating the targeted features of certain objects making them more informative in a policy cycle assessment. By using the data from PRISMA and ECOSTRESS missions, the developed solution will be capable of estimating and mapping potential and actual crop evapotranspiration, using crop coefficient (Kc) and water stress coefficient (Ks). Consequently, two main applications could be developed: i) monitoring of crops'vegetative growth ii) monitoring of crops' water consumption.

Policy cycles necessitate of non destructive tools for periodical monitoring and evaluation. The previously mentioned applications, will give the right flexibility to the developed model to act as a tool and be integrated in policy cycles. Yet, challenges are not limited to technical obstacles. Accordingly, analysis that allows for their identification and clustering will support the refinement of the final product features to be adapted to the stakeholders requirements.

5 Policy traceability matrix analysis

In the previous section, some of the main challenges in relation to the policies adopted and the potential role of the developed EO solution was discussed. Those challenges are based mainly on literature. They serve as a compass to identify contexts, possible stakeholders/early adopters. Yet, to ensure the fulfilment of the actual requirements of the early adopters, a Policy traceability matrix analysis had to be conducted.

The policy traceability matrix analysis is a tool that helps to correlate and trace the final user requirements and assuring its alignment with the project's objectives through its development. It's also an accountability and project management tool that helps following up with the projects team activities and provide periodical evaluation against the defined requirements.

A questionnaire was designed to define the early adopters' requirements and expectations from the EO solution under development. The questionnaire also aims to identify the current situation regarding the available tools, models, level of proficiency, along with the level of integration of EO models in policy cycles.

Even though targeting the early adopters involved in the project is fundamental, the survey was extended to include other stakeholders. Research centers and educational institutions are targeted as potential users of the developed solution as they may ensure sustainable dissemination channels and pools. Another category of stakeholders is the governmental sector, being the main player in setting and implementing national policies. Finally, other private entities – along with OSAP- will be targeted, the large-scale open field agriculture private sector being the main potential user for EO-based solutions.

5.1 Questionnaires design

Within the applied policy research, (Ritchie and Spencer, 2002) have broken down the qualitative methods of the framework analysis into four categories of questions: contextual, diagnostic, evaluative and strategic (Figure 2).

- **Contextual:** meant to identify what already exists on site including: the available models and tools, the technical know-how and the awareness about RS potential and outreach. This information is essential to draw a base line of the environment where the developed solution will be deployed.

- **Diagnostic**: This category of questions is meant to understand the reasons behind the existing situation (clarified from above). Mainly, it aims to investigate the institutional and structural challenges relevant to RS models.

- **Evaluative:** the objective is to assess the effectiveness of the existing RS models and tools and how satisfied the targeted groups are.

- **Strategic**: this is the most important part of the questionnaire where the targeted groups have to identify their requirements and expectations from the developed solution.

The questionnaire will be addressed to targeted stakeholders who significantly represent their institution/category, through direct interviews/phone calls. Their answers will be analyzed according to the post data collection phases as described by (Parkinson et al., 2016) (see below sections). The final report will include the results of the framework analysis along with the discussions in deliverable-11: policy highlights (M.3)

Stakeholder Questionnaire: requirments and expectations from Remote Sensing models, A policy tracibility matrix analysis

EO Africa Explorers is an ESA initative aims to assist African countries to overcome problems faced in the collection, analysis and use of water-related geo-information by exploiting the advantages of EO technology in providing information relevant for effective and sustainable water resources management at the national to regional scale, thus helping to mitigate the wide spread water scarcity in Africa. In this framework , an Earth Observation (EO), open source, innovative and integrated model is being developed to assess in near-real-time actual crop evapotranspiration (ETa). This information will serve as a Decision Support System (DSS) to improve irrigation water management. to ensure the integration of the final product with the expected requirments, this framework analysis is being conducted. Thanks for participation.

1. What is the nature of the organization?

☐ Education ☐ Research ☐ Private Sector ☐ Governmental Organization

2. Please tick the box that best indicates the degree of your acceptance

Questions Categories	Description	Opinion	Degree				
			Very Low	Low	Medium	High	Very High
Contextual	In your organization, what are the currently available remote sensing (RS) tools ?						
	Can you list the tools that you are aware of existence (even if they are not used in your organization)						
	How familiar are you (or the organisation staff) with such tools? (Level of experience)		☐	☐	☐	☐	☐
	What are the main applications of RS models in your organization ?						
	Does your organization or your self provide consultancy using RS solutions to any other governmental/ private body?						
	Can you give examples of challenges that could significantly benefit from EO-based solution?						
Diagnostic	Do you think that the available tools are are suitable for the challenges that you are facing? If no, then Why?		☐	☐	☐	☐	☐
	In your opinion, are remote sensing used as a tool in decision-making process? If yes, then state examples, if no, then why?						
	How well do you think such tools and models are integrated in decision support systems in the private sector?		☐	☐	☐	☐	☐
	To which degree do you think such tools and models are integrated in decision support systems in the governmental organizations?		☐	☐	☐	☐	☐
Evaluative	How effective are RS models and tools in decision support systems?		☐	☐	☐	☐	☐
	What are the main factors affecting the success (integration) of an RS model or service? Do you think they are mainly technical or institutional?	☐ Structural	☐ Inisitutional				
	Do you know about any attempt to use EO-based solutions for policy management? If yes, how do you personally assess the results?	☐ YES	☐ NO				
	What are the barriers for a full operability of these models?						
Strategic	What types of services do you expect from an EO-based tool to provide?						
	In your opinion what are the main features of an EO-based solution to be defined as "user friendly tool"?						
	Can you suggest any new applications where an EO-based solution is relevant?						
	Can you identify three important actions to foster RS models integration in the policy cycle?						

Figure 1 The prepared questionnaire for the policy framework analysis

5.2 Post Data collection

5.2.1 Familiarization

It refers to the process by which the analyst is familiarized with the transcripts of the data collected (i.e. interview or focus group transcripts, observation or field notes) and gains an overview of the existing EO solutions environment including recurrent themes, comments, challenges, and doubts.

5.2.2 Identifying a thematic framework

It is expected that the questionnaire will generate a list of recurrent emergent themes regarding RS models such as: opinions, challenges, narratives, and requirements. The main outcome from this stage is to cluster the ideas in a thematic framework.

5.2.3 Indexing

As simple as it sounds, in this stage, codes are allocated to identify portions or sections of the data that correspond to a particular theme. This process is applied to all the gathered textual data (i.e. transcripts of interviews). It is significantly important when the surveyed sample is relatively large.

5.2.4 Charting

Data is lifted from its original textual context, weighed through identified themes, and visualized on charts.

5.2.5 Mapping and interpretation:

The final stage involves the analysis of the key characteristics as laid out in the charts. This analysis should be able to provide a schematic diagram guiding the analyst in the interpretation of the data set. The main outcome is to identify the main requirements and expectations of the targeted groups regarding EO-based models and to investigate more use cases. The requirements and expectations of this stage are an input to trace the solution development and are used as evaluation criteria of the final product (developed solution) features and capabilities.

6 Listing and categorizing the main early adopters

Aside from the main two early adopters NARSS and OSAP, four main categories of possible early adopters were targeted, namely:

6.1 Research centers:

Research centers are targeted as a vessel for dissemination and to ensure the sustainability of the capacity building component of the developed solution.

Following is the list of the targeted institutions:

1- National Authority for Remote Sensing & Space Sciences (NARSS)

2- National research center – land and water department (NRC)

3- Desert research center (DRC)

4- Academy of Scientific Research and Technology (ASRT)

5- Agricultural research center

6- National water research center

7- Egyptian meteorological Authority

8- Agricultural Extension & Rural Development Research Institute

9- Agricultural Engineering Research Institute

10- Central Laboratory for Agricultural Expert Systems

6.2 University networks:

To ensure the regional perspective of the dissemination process, a network of agriculture faculties in several universities were targeted on regional basis to cover the country, namely:

1- Cairo University (Cairo)

2- Ain shams University (Cairo)

3- Assiut University (Upper Egypt)

4- Alexandria University (North coast and West delta)

5- El Zagazig University (East Delta)

6- King Salman University (Sinai)

6.3 Governmental Organizations:

Ministries are the main designers and enforcers of policies. Thus, including them is fundamental, especially as the developed solution is mainly targeting large scale applications:

1- Ministry of Water Resources and Irrigation

2- Ministry of Agriculture and Land Reclamation

3- Ministry of Planning and Economic Development

4- Ministry of Social Solidarity

6.4 Private sector

As the leading force for agricultural investment in Egypt, the private sector will be targeted in two sub – categories:

1- Large scale investors: mainly pivot irrigation systems owners in West delta and the new valley as they are the perfect candidate for the new developed solution.

2- Associations of small holders in the old lands: water user associations (WUA) can supervise irrigation rotation schedules of large collectively irrigated areas. Aside from their main role, which is irrigation management, WUA are responsible for maintenance of their systems along with other social activities. If the developed solution is friendly enough, it could be integrated into their supervision activities, especially since they are part of the governance system, directly connected to the public system scattered through the different irrigation districts.