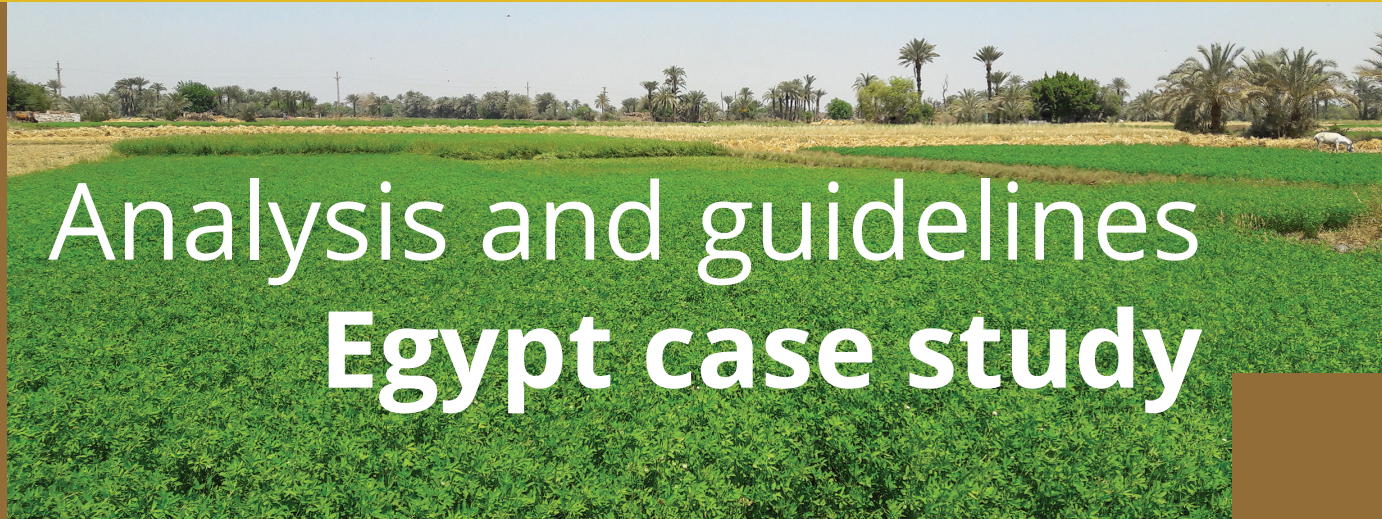
Food and Agriculture Organization of the United Nations

Comprehensive assessment of national agricultural research and extension systems with a special focus on agricultural research for development in Egypt



Analysis and guidelines

Egypt case study

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Comprehensive assessment of national agricultural research and extension systems with a special focus on agricultural research for development in Egypt

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Contents

Tables

Figures

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Dr. François Molle	Principle Scientist, Institute of Research for Development (IRD)
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Executive summary

National Agricultural Research Systems (NARS) in Egypt are facing, and will continue to face, multiple-interlinked challenges due to the dynamic nature of the drivers of change and the complexity of institutional structures and linkages. Several efforts are being exerted by Egypt's NARS in the field of agricultural research for development (AR4D) to help develop an integrated and coherent approach for research and dissemination of proven technologies and practices.

The current study was conducted in 7 phases, namely; 1) Develop methodology guidelines for the assessment, 2) Desk review analysis, 3) Compensative analysis of participatory approach, 4) Stakeholders' validation, 5) Draw lessons learned, 6) Develop technical guidelines, 7) Capacity building for national staff to enhance capacity on AR4D delivery. The current document will discuss phrases 1,2 and 3 while phases 4, 5, 6 and 7 will be demonstrated in a separate publication.

The study started by collecting new information by conducting a desk review analysis, key informant interviews (KIIs) and focus group discussions (FGDs) to capture the systemic changes overtime, both drivers and solutions, and to understand the resilience of the system to deal with the upcoming development challenges. Interviews were held with various key informants and focus group discussions from both NARS, extension and advisory services (EAS) in Egypt. The purpose of these participatory discussions was to obtain further knowledge and insights on the performance of the NARS in Egypt to identify the shortcomings and possible solutions to facilitate the implementation of AR4D activities in the country and thereby enhance their impact in this document, the phrases 1,2 and 3 will be discussed and phases 4, 5, 6 and 7 will be demonstrated in a separate report.

Interviews with 25 experts familiar with the NARS organization and structure were conducted. The key-individual experts have diverse professional backgrounds from different national, regional and international organizations engaged in AR4D. Additionally, three FGDs were arranged with researchers, academia, extensionists and farmer groups within the country. Discussions in each session centred on a specific theme and each section was attended by 15 participants. The main findings of the study are summarized as follows:

- Egypt's Science, Technology and Innovation (STI) System is dominated by public sector institutions that are characterized by a high degree of centralization. The Higher Council for Science and Technology is at the top of the system, with the main responsibility of identifying Egypt's developmental priorities and science and technology research strategies necessary to support them. The Ministry of Higher Education and Scientific Research is responsible for implementing the national research policy and strategy of all public universities and research institutes.

- The desk review analysis of available literature indicated that the current structure of agricultural research in Egypt is highly centralized and mostly dominated by public sector institutions. However, both public and private sector organizations carry out agricultural Research for Development (AR4D) in Egypt. The AR4D institutions include mainly the Agricultural Research Centre (ARC), the Desert Research Centre, the National Research Centre, Faculties of Agriculture at various public and private Universities, private agriculture companies, and some international AR4D organizations. These organizations, with leading roles to ARC, form the NARS in Egypt.
- The organizational set-up and linkage between the ARC and other national agricultural research institutions indicated the existence of venues for interactions through the Regional Council for Research and Extension that was established to coordinate actors in Egypt's NARS. However, linkages between NARS still need improvement to effectively promote the coordination between different actors including decision-makers, scientists, researchers, extension officers, private sector, and farmers.
- Although extension officers act as a vital link between researchers and farmers, analysis of the desk review and participatory discussions revealed that weak means of communication represent a real constraint to the delivery of extension services. In addition, shortages in agricultural extension personnel, lack of financial support and the lack of trained and up-to-date informed extension officers are all limiting factors to the proper functioning of extension and advisory services, and their links to researchers and farmers.
- There are several challenges limiting the performance of AR4D organizations, planning, and implementation mechanisms in the country. These challenges are limited financial resources, low capacity of AR4D staff, weak institutional coordination and weak linkages between research and extension. The performances of various key players, including decision makers, researchers, project managers, farmers and extension officers, were limited by several related problems that negatively affected the implementation and impact of AR4D during the last ten years. In addition, extension officers lack the adequate logistics to enhance their mobility to work with farmers, and farmers could not fully benefit from AR4D because they lacked knowledge about, and access to new farming technologies and improved practices.
- Absence of Monitoring, Evaluation and Learning (MEL) systems in implemented AR4D programs negatively affected the projects. MEL systems are essential for successful implementation of AR4D projects. Discussions revealed that this was due to weak capacities of researchers and extension officers to incorporate and adopt proper MEL mechanisms in AR4D projects. Weaknesses in how to design and implement sustainability and exit plans were also identified. These resulted in services being stopped after projects were terminated. In addition, mechanisms to ensure accountability for AR4D deliverables are not clear.
- Although AR4D projects in Egypt were aligned with the national strategy, there are challenges that need to be addressed through new technologies and improved practices and innovations developed by scientific research. The participatory discussions indicated that, although the impacts of AR4D projects implemented

in Egypt over the last ten years are good, they are still rated as unsatisfactory. The main factor for this unsatisfactory rating was mainly driven by limited financial support for agricultural research in Egypt. Egyptian NARS have been doing their best to create, promote and disseminate improved technologies and research findings, but there is still room for improvement. In addition, the EAS needs to be fully supported and empowered to help the NARS achieve the targeted impact.

- The results of the assessment showed that the technical, administrative, and financial support from the government to the main AR4D institution in the country (ARC) was limited. Collaboration among the various NARS institutions and linkages with the agricultural extension services (AES) were also found to be weak and ineffective. A majority of respondents thought that most of the AR4D projects implemented in the country over the past ten years were linked to the national priorities of the country; however, a majority of farmers and extension workers interviewed indicated that they had little or no opportunities to participate in AR4D processes, including decision-making during research planning and project implementation.
- In addition to monitoring and evaluating systems, the need for an effective accountability mechanism was highlighted as a mean to assure proper implementation and financial accountability of projects to ensure good return on investment dollars.
- Decision makers, researchers, project managers, farmers, extension workers, local communities and input suppliers all are facing various challenges that limited end-users benefiting from the results of AR4D. The need to improve research and extension staff capacity and the need for enough funding for AR4D, were consequently highlighted as the key areas of consideration for the improvement of AR4D in Egypt.
- The study also revealed that the NARS still lacks the requisite organizational frameworks or institutional mechanisms to encourage cost effectiveness and inter-agency partnerships in research. To enable the NARS to contribute effectively to the growth and development of agriculture, appropriate organizational measures and steps should be considered to facilitate collaboration among various actors. As an initial step, organizations conducting research on agriculture related issues should adopt a nature of networking and collaboration between and among themselves, by seeking to reach out to others on every matter of common purpose. In this connection, ARC could take the lead in coordinating AR4D activities of the NARS by establishing research alliances among NARS actors. The coordination between NARS organization could be enhanced through developing and implementing joint projects.
- Several lessons learned and recommendations were drawn from the literature analysis and participatory discussion that would be helpful in decision making within AR4D and improve the institutional linkages among NARS actors in Egypt. The main outputs of the study will be supportive of guidelines to help researchers and project managers to properly and successfully design and implement their project to achieve targeted impacts. These lessons learned and supportive technical guidelines will be discussed in a separate upcoming publication.


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CHAPTER 1
Introduction

Agriculture is a major sector in Egypt's economy providing food for domestic consumption, in addition to contributing to foreign trade. Although industrialization has received greater attention in recent years, the country continues to depend largely on agricultural production. The agriculture sector represents 15 percent of Egypt's GDP and 25 percent of its workforce. Gender wise, agriculture employs around 45 percent of the female workforce. It is worth noting that most of the farming activities in Egypt are dominated by small-scale farmers who account for 25 million of those working in the agriculture sector, representing around 60 percent of the rural population. The main goals of sustainable agriculture and rural development is to increase food production in a sustainable manner and to reduce food loss and waste. These goals would be used to curb, or even bridge, the growing food gap and ensure stable supplies of nutritionally adequate food to achieve food and nutrition security and improve the standards of living in rural areas. Additionally, these goals could increase employment opportunities, generate income for poverty alleviation, and conserve and rehabilitate natural resources and the environment in marginal lands to maintain sustainable production system.

The Government of Egypt (GOE) ambition is to enhance the performance of the agricultural sector and create jobs for young graduates through expansion of cultivated lands by reclaiming new areas in the desert to meet the food demands of an increasing population. Despite the importance of the sector, the level of investments in agricultural research, which is critical to driving its growth and development, has been very low over the last 20 years.

NARS organizations in Egypt have a deeper understanding of the challenges both at the farm and system level, but they still need technical and financial support to increase their efficiency to sustainably enhance the impacts of agricultural research for development projects (AR4D) and achieve national food and nutrition security. Building the capacities of these institutions, expanding, and strengthening their abilities to respond to growing challenges is critically important for the achievement of national food and nutritional security for the country. Technical support, in the form of national guidelines and capacity enhancement can provide NARS with essential tools to streamline their efforts, increase their efficiency, and achieve better outcomes and impacts.

NARS in Egypt face multiple interlinked challenges due to the dynamic nature of the drivers of change and the complexity of the institutional structures and linkages

within the country. Institutional linkages between actors in the NARS represent an important factor where cooperation allows for the integration of efforts, which saves time, effort and financial resources and enriches the exchange of knowledge for better implementation of applied research to achieve sizable impact. Weak linkages between the NARS and stakeholders (either the government, farmers, extension agents, private and public investors, or national and international entities) usually leads to failure of decision-making to adopt the benefits from the scientific knowledge produced by researchers and innovators. Another major challenge for NARS is the insufficient financial support for agricultural research, extension, cooperative services. The Global Innovation Index issued by the Academy of Scientific Research and Technology in 2018 ranked Egypt 53rd in terms of R&D expenditures. However the average value of expenditures on Research and Development as a percentage of GDP in Egypt increased from 0.68 percent in 2017 to 0.72 percent in 2018. This is still well below the 1 percent targeted in the 2014 Egyptian Constitution and far below the world average of 1.17 percent in 2018.

This case study was conducted to provide a good understanding of the challenges and opportunities related to Egypt's agricultural research and organizational development to draw lessons and develop supporting guidelines. This study aimed to enhance efforts exerted by Egypt's NARS in the field of developmental research by formulating an integrated and coherent approach for research and dissemination of proven technologies and practices. Such approaches are expected to address key bottlenecks and provide the needed direction and means for sustainable improved implementation of AR4D. This can ultimately lead to enhancing and empowering the capacity of Egypt's NARS to better inform and influence policies and facilitate institutional changes required in the agricultural sector.

As part of the efforts of the Food and Agriculture Organization (FAO) to support and strengthen NARS' research impact and their links to extension service systems, the present assessment was carried out to establish a deeper insight into challenges and opportunities that are facing NARS in Egypt. The direct outputs of this study included:

(i) clear understanding of the organization and management of NARS;

(ii) developed guidelines that can be followed to effectively help AR4D implementation including assessing problem identification, research needs, demonstration, and out-scaling of proven agricultural technologies;

(iii) assessment of the institutional linkages and collaboration within and between NARS actors and extension systems;

(iv) a policy brief that offers specific recommendations to ensure effective adoption of proposed methodologies for enhanced impact of NARS's AR4D efforts.

CHAPTER 2
Methodology

National Agricultural Research Systems (NARS) including universities, public and private research organizations play a very important role in advancing research on agricultural productivity. Though NARS have a deeper understanding of the challenges both at a farm and system level, they need the technical and financial support to increase their effectiveness to sustainably enhance the impacts of research for development projects (AR4D) and achieve national food and nutrition security. Technical support, in the form of national guidelines can provide NARS with essential tools to streamline their efforts, increase their efficiency, and achieve better outcomes and impacts. This assessment was conducted as part of the efforts of the Food and Agriculture Organization (FAO) to support and strengthen NARS' research impacts and their links to extension service systems.

The guidelines, methodologies and policy brief were based on a good understanding of the challenges, opportunities, weakness and strengths related to agricultural research and their organizational development. The case study was used to document relevant examples that can be adopted for other similar systems. Such approaches will ensure that the guideline and policy brief are context-sensitive, address key bottlenecks and provide the needed direction and means for sustainable improved implementation of AR4D to further enhance the capacity and empower the NARS to better inform and influence policies and ease institutional changes required in the agricultural sector. The deliverables of the assessment were:

1. Develop a guideline for assessment of impacts of AR4D projects based on literature review and participatory discussions.
2. Prepare a case study report based on the comprehensive analysis of AR4D projects in Egypt.
3. Develop a policy brief to support NARS for better implementation of AR4D projects by engagement of various actors including beneficiaries/farmers.
4. Analyse the institutional linkages among national agricultural research systems/ institutions, including universities and relevant stakeholders with particular focus on research-extension-farmers' pathways/linkages.
5. Develop criteria and check list to ensure better research and development linkages for sustainable agriculture and food security.
6. Organize virtual training programs at country level focusing on AR4D with emphasis on participatory research.

7. Draw lessons learned and prepare key recommendations for further improvement of AR4D.

1. Assessment approach

The assessment utilized various methods based on different information sources and approaches. The assessment consisted of two sub-assessments:

1. Assessing the current overall methodology used in undertaking AR4D for sustainable impact in developing countries as a case study. There is greater diversity of NARS in developing countries, and each institution has its own mandate and research agenda, which also lead to diversity of implementation modalities of AR4D. To develop an applicable guideline for NARS in AR4D for developing countries, the present status of AR4D implementation must be carefully assessed.
2. Within the same country, a NARS's institutional setup of the agricultural research organizations' vision, mandates, priorities, policies, governance, funding, and investment portfolio vary from institution to institution which make the integration and collaboration, at a national level, a complex and challenging process. Therefore, assessing the current institutional linkages and collaboration between key-NARS and extension systems in the country is very important to develop a multi-criteria checklist to improve the linkages between NARS actors.

The assessment methodology included several steps:

1. Identification and interviews with key-informant individual experts to get an overview of the AR4D efforts in the country through open-ended questions.
2. Identify key NARS for an in-depth understanding of their roles, responsibilities, and institutional linkages.
3. Assessment of project design, inception, implementation, monitoring and evaluation procedures, impacts, and sustainability plans. This was done through an extensive desk review, interview with key project stakeholders and focus group discussions.
4. In-depth and comprehensive desk review analysis of documents that established the modalities for institutional linkages within and between NARS and extension services.
5. Develop key lessons learned through a systematic analysis of challenges and opportunities in AR4D efforts implemented by NARS including institutional linkages to explore gaps for further improvement.
6. Develop guideline that will support NARS to improve the efficiency in delivering sustainable impact of AR4D efforts.

7. Organize validation workshops to present, discuss and validate the outputs and get feedback from relevant stakeholders.

The assessment included two phases:

1. *Implementation phase:* This assessment commenced with a comprehensive desk review to understand the function and performance of current national research systems to identify the potential opportunities for improvement and to address the gaps in AR4D implementation based on the country's context. Afterwards, data collection activities through FGD and KII were carried out to acquire the required datasets for a systemic analysis to develop supporting guidelines for NARS after implementing the whole set of activities listed in Table 1.
2. *Validation phase:* After completing the analysis, the lessons learned, the developed guidelines, and other outputs were shared with relevant stakeholders and decision makers for consultation and feedback before validation in order to finalize and formulate the final version of the guideline. The revised guidelines were formulated and widely shared with stakeholders in Egypt with possible scaling out to other countries.

2. Data collection procedure

Data required to achieve the objectives of the current project were collected through desk reviews of secondary data, focus group discussion with key stakeholders and Key-informants' interviews held with selected individual experts or persons of positions.

a) ***Desk review***
The consultant gained a good understanding of the national AR4D strategy and its impact on food security at a national level. This included collecting available secondary data and information related to performance of national agricultural research actors and their institutional linkages as well as the relationships between research and extension authorities. The sources of information were projects design documents, progress reports, fact sheets, technical reports, evaluation reports, published manuscripts, etc. In addition, the main information about each project was collected using a specific template outlined in Annex 1.

b) ***Focus Group Discussion (FGDs)***
FGDs were held with researchers, academia, extensionists, relevant community -based organizations (CBOs) and farmers groups. Gender dimensions were guided by very specific questions to generate concise and precise data as much as possible. Individual bias was avoided to ensure the quality of responses of individuals within the group discussion. To facilitate the focus group discussions

and individual research staff interviews, a particular set of questions were asked (see Annex 2). The FGD was conducted in three sessions (AR4D, EAS, linkages between NARS actors) and each group was composed of 10-15 participants as shown in Annex 4.

c) ***Key-Informant Interviews (KIIs)***
Key informant interviews were held with selected individual experts who have extensive knowledge/insights of the NARS and its research for development impact on agricultural development. The key individuals were from different national, regional, and international research organizations which provided different insights on shortcomings and solutions to remove the potential bottlenecks in the research-to-policy action cycle. The Questionnaire in Annex 3 was used to facilitate the key-informant interviews with necessary adjustment as needed. The KII was conducted for different levels of experts (national regional and international experts). The experts also represented different agricultural research areas as shown in Annex 5.

Both focus groups and individual experts/key-informants were asked open-ended questions (Annexes 1, 2, 3 and Annex 4) to obtain data used in the assessment. The following key-questions offer an example of questions that were used to solicit information:

- how do you think about the importance of the NARS roles in food security in the country?
- how and to what extend do NARS identify their research agenda and priorities?
- how do priorities link with national and international research agendas?
- how and on what basis do researchers design AR4D projects?
- what are the modalities of implementing the AR4D?
- how much influence do AR4D projects have in agricultural policy and decision-making processes at a national level?
- what are the available resources and facilities (updated/upgraded) that NARS depend on in their research?
- how is research within NARS organized? Is it a commodity-based or system-based approach with integrated multi-disciplinary research agendas?
- how effective are the national extension services in delivering advisory services? and how are they linked to research organizations at a national level?
- what is your opinion of the NARS performance? Are you satisfied from their efforts on implementing AR4D? and why?
- what are the key weakness and opportunities of NARS in AR4D?
- how do you assess Intra/Inter-institutional coordination, integration, and collaboration between NARS actors in the country?

- what accountability mechanisms for deliverables are in place (if any)? Who is held responsible for the efficient use of resource and value for money?
- what are the key areas for improvement in AR4D?
- are there other recommendations that you have, or suggestions you would like to mention?

3. Data analysis and reporting

Preliminary analysis of the data took place parallel to the data collection process. The final analysis was made immediately after all required data was completed. After data analysis was completed, qualitative descriptions and interpretations were carried out to draw lessons learned as an introduction to develop the NARS assessment guidelines and policy briefs.

4. Consultation and validation of the developed guideline

The developed documents will be shared through consultation with key-stakeholders and decision makers before its validation in a roundtable discussion and dialogue with relevant stakeholders and decision makers; and before globally publishing the assessment key-findings and the developed guidelines.

Experts from a variety of disciplines will be invited for a roundtable discussion. The assessment components and its results, a developed guideline and a case study will be presented to the audiences followed by facilitated discussions by small groups to gather their feedback. Then the final revised version of the guidelines and case study documents will be widely disseminated.


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CHAPTER 3
Literature review analysis

1. Introduction

Agriculture is a major sector in Egypt's economy. It is a major source of food for domestic consumption, in addition to contributing to foreign trade. The agriculture sector contributes 15 percent of Egypt's GDP and makes up to 25 percent of total employment within the country. Gender wise, agriculture employs around 45 percent of the total female workforce. It is worth noting that most of farming activities in Egypt are dominated by small-scale farmers who account for 25 million workers in the agriculture sector, representing around 60 percent of the rural population. Agriculture is closely linked to rural development and has long been a core priority of successive government administrations. Thus, there have been several presidential initiatives aimed at promoting and investing in agriculture. The Government of Egypt (GOE) currently has an ambitious plan to enhance the performance of the agricultural sector through increasing cultivated lands in the desert. It is worth noting that irrigation of new lands will depend on groundwater wells. GOE also plans to promote vertical agricultural expansion by enhancing land and water productivity through specific agricultural research programs. Accordingly, GOE has started to largely investment in agriculture through adopting several presidential initiatives, such as the "One and Half Million Feddan Project", "El-Reef El-Masry", "the New Delta", and others.

In the coming years, the agricultural sector may face many challenges in achieving food security. Amongst these challenges, rapid population growth, climate change, low adoption of technical innovations, water shortage and scarcity and land degradation and salinization are some of the issues facing Egyptian agriculture. These challenges will lead to a significant decrease in farm productivity and incomes, subsequently leading to a decline in the agricultural sector's contribution to the GDP. Therefore, investing in agricultural research is one of the fastest ways to overcome these challenges ensuring an enhanced food production system and protecting vulnerable communities and ecosystems.

Agricultural research encompasses all the different activities that develop and generate the technologies and information that are needed and demanded by farmers and others to enable them to know about and make informed decisions regarding agricultural practices that improve their livelihood and well-being. The NARS comprise all institutions carrying out agricultural research in the public, private, governmental, non-government, university, and other national and international agencies. These organizations play a very important role in advancing

research on sustainable agricultural productivity. It is therefore important to review the past and current structure of the NARS to evaluate the capacity of the system to effectively respond to the AR4D needs of the country.

The present review aims to develop an understanding of the current situation of AR4D in Egypt through reviewing the organization, structure, coordination, and management of the NARS organizations to identify their strengths and weaknesses. Key findings will highlight areas in which their strengths can be developed or reformed to enable them to contribute effectively to agricultural development.

2. Overview of the Egyptian Research, Technology and Innovation (RTI) system

Research is the centre-point for achieving sustainable development goals in Agriculture and in all sectors of the economy. Science and technology play a leading role in the advancement of countries and societies in the world. As an agriculture-based economy, agricultural research and innovation play a significant role in improving sustainable food production and enhancing farming system productivity. New applied agronomic practices, high yielding varieties, improved animal breeds, proper modern machinery, and improved soil and water management practices, etc., all contribute to efforts to support small-scale farmers to alleviate poverty, combat hunger, improve food systems and increase farmers' income. However, several factors hamper the efforts to realize such important goals such as land fragmentation, lack of access to good agricultural and irrigation practices, absence of collective actions among farmers, water shortage and proper fertilizers application. One of the main factors that affect agricultural research in Egypt at the macro level relates to the set-up of the National Agricultural Research System (NARS) that is highly dominated by the public sector. R4D activities are mostly carried out by governmental institutions, including universities and research centres affiliated to different Ministries like the Ministry of Higher Education, the Ministry of Agriculture and Land Reclamation, the Ministry of Water Resources and Irrigation and the Academy of Scientific Research and Technology.

Another macro-level factor impacting agricultural research is related to the investment and budget allocations within agriculture. Agricultural services such as extension, research, cooperative organizations and other activities receive only small budgets. The Global Innovation Index issued by the Academy of Scientific Research and Technology in 2018 reported that Egypt ranked 53rd in terms of R4D.[1] The average value of funding spent on Research and Development as a percentage

[1] Academy of Scientific Research and Technology Website, http://asrt.sci.eg/ar/index.php/news/item/484-53

of GDP for Egypt increased from 0.68 percent in 2017 to 0.72 percent in 2018, which is still below the 1 percent targeted in the Egyptian Constitution, and far below the world average of 1.17 percent in 2018 (based on 72 countries).[2]

Institutional linkages between actors in the National Agricultural Research System also represent an important factor influencing agricultural research. Cooperation allows for the integration of efforts which saves time by eliminating duplication of research and enriches the exchange of ideas and knowledge, thus improving the implementation of research and outcomes. Weak linkages between NARS and stakeholders (either the government, farmers, extension agents, private and public investors, or national and international entities) can lead to decision makers' failure to benefit from the scientific knowledge produced by researchers and innovators. This can result in negative impacts on integrating global and local knowledge with actions for development and consequently impacting decisions made to investment in research for development. This lack of sufficient funds for development can have an impact over several decades, obstructing sustainable development goals.

The current review aims to understand the current situation of agricultural research for development (AR4D) in Egypt, which helps in developing an integrated and coherent approach for research and dissemination of proven technologies and practices to link it with small-scale farmers' needs. It is worth noting that reviewing literature available on research for sustainable agricultural development in Egypt revealed very little work on the subject. Therefore, the desk review analysis covered literature found on Egypt and other similar countries in the NENA region.

The Ministry of Higher Education and Scientific Research (MOHESR) has issued a strategy update report assessing the status of Science, Technology and Innovation (STI) in Egypt (2019)[3] based on reports issued by the Egyptian Science, Technology and Innovation Observatory at the Academy of Scientific Research and Technology. According to the report, Egypt has developed the National Sustainable Development Strategy (Egypt Vision 2030) in which several goals are targeted to be achieved by 2030 including goals related to the scientific research sector to support the Government's track towards achieving a knowledge-based economy that ensures the progress, prosperity and welfare of Egyptian society. The report emphasized the fact that Egypt Vision 2030 represents the main pillar of the national vision regarding the production and localization of science and knowledge.

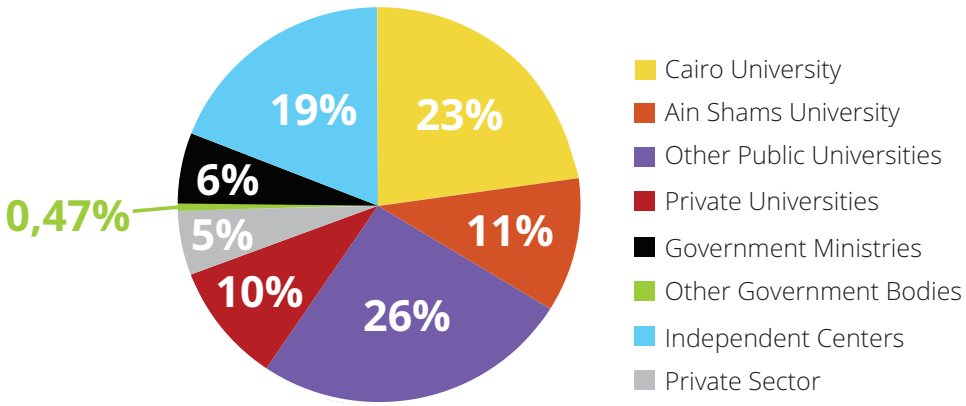
[2] The Global Economy Website, https://www.theglobaleconomy.com/Egypt/Research_and_development/

[3] The Ministry of Higher Education and Scientific Research (2019); "Strategy Update Report on the National Strategy for Science, Technology and Innovation".

2.1 Key actors of the national research system in Egypt

The Brief on Science, Technology and Innovation in Egypt (2014)[4] issued by the Egyptian Centre for the Advancement of Science, Technology and Innovation (ECASTI) revealed that Egypt's Science, Technology and Innovation (STI) System is dominated by the public sector and is characterized by a high degree of centralization. The Higher Council for Science and Technology is at the top of the system. The higher council is responsible for identifying Egypt's developmental priorities and science and technology research strategy necessary to support them. The Ministry of Higher Education and Scientific Research is responsible for implementing the national research policy and strategy of all public universities and research institutes. According to the Scientific Research Institutions Map issued by the Ministry of Scientific Research and Higher Education in 2010, there are 13 research centres and 56 public and private universities affiliated with the Ministry, in addition to other research centres affiliated with other ministries. Figure 1 presents various R4D centres' affiliations. Public universities account for the largest share of research affiliations. Cairo University ranks first in terms of affiliated R4D centres (23 percent), followed by Ain shams University (11 percent), and other public universities (26 percent). R4D centres affiliated to private universities account for 10 percent of the total number of R4D centres. As for R4D centres affiliated to Ministries, they account for 6 percent, while those affiliated to other governmental bodies account for only 0.47 percent. Finally, independent R4D centres account for 19 percent, while those affiliated to the private sector account for 5 percent of the total number of R4D centres at the country level.

Figure 1. Affiliation of identified R4D centres



Source: Status Brief on Science, Technology and Innovation in Egypt, the Egyptian Centre for the Advancement of Science, Technology and Innovation

[4] Technology and Innovation in Egypt Status Brief; The Egyptian Center for the Advancement of Science, Technology and Innovation (ECASTI), June, 2014.

The number of research centres affiliated under different ministries:

- Ministry of Communication and Information Technology (1 research centre).
- Ministry of Investment (1 research centre).
- Ministry of Housing (3 research centres).
- Ministry of Petroleum (6 research centres).
- Ministry of Trade and Industry (3 research centres).
- Ministry of Education (2 research centres).
- Ministry of Agriculture (24 research centres).
- Ministry of Health and Population (7 research centres).
- Ministry of Civil Aviation (1 research centre).
- Ministry of Energy and Electricity (6 research centres).
- Ministry of Water Resources and Irrigation (15 research centres).
- Ministry of Transportation (2 research centres).

The Ministry of Agriculture and Land Reclamation tops all the other ministries with 24 affiliated research centres. More details are presented in Annex 1.

MOHESR's strategy update report presented an analysis of specializations in governmental universities. Their analysis revealed that scientific specializations (natural, engineering, medical and agricultural sciences) represented 51.6 percent while theoretical specializations (social sciences and humanities) account for 48.4 percent of the total number of colleges. Students enrolled in the study of agricultural and veterinary sciences represent only 3.4 percent of the total number of students enrolled in governmental and private universities, with the majority of this percentage enrolled in governmental universities indicating the low importance of agricultural education and research in private sector's investment portfolio.

In regard to the performance of R4D centres, ECASTI's status brief pointed out that, while significant efforts have attempted to build a technology-driven economy, they did not achieve the anticipated success due to several reasons. The major issue is the absence of an integrated ecosystem serving a clearly defined national vision. In addition, the lack of coordination and collaboration between and among these research centres plays a significant role. This made Egypt a consumer of and not a producer of technology, like most developing countries. Consequently, it is essential to recognize key existing components in the ecosystem and Egypt's current performance, and the importance of local production of new technologies and associated impacts on Egypt's national sovereignty and security as a first step to identifying a way forward.

2.2 Institutional capacity for agricultural research in Egypt

Data extracted from MOHESR's report on research capacities are presented in Table (1) and indicate that the total number of researchers working in the field of research and development reached 138 270 in 2018. They work within the public, higher education, or private sectors. The Agricultural Research Centre of the Ministry of Agriculture and Land Reclamation is the largest employer of researchers accounting for 41 percent of the total number of researchers working in the public sector (estimated at 24 255 in 2018). Concerning agricultural sciences papers published at the international level between 2015 and 2018, Egyptian manuscripts accounted for only 6.3 percent of the total number of specialized scientific publications.

MOHESR's report further provided the results of a SWOT analysis applied to R4D inputs and outputs based on data obtained from case studies and published research papers. The identified strengths and weaknesses are illustrated in Table 2 and opportunities and threats are illustrated in Table 3 regarding Egypt's scientific research system. The SWOT analysis was based on the following factors: human resources, infrastructure, funding, regulations and legislative system, supportive local environment of innovation and scientific research, intellectual property investment, and maximization of economic return and scientific research.

Table 1. Egypt's research capacities

Type of entity	No. of institutions	No. of employed researchers		Full-Time Equivalent (FTEs)	Total number of researchers per million people		GDE on R4D (LE billion)		R4D share of expenditure out of GNP	
		2017	2018	2018	2015	2018	2012	2018	2010	2017
Public sector	- (11) Research centres and institutes affiliated to the Ministry of Scientific Research. - (14) Research centres, institutes and entities affiliated to other ministries.	21 843	24 255	22 713.4	1 362.5	1 393.6	8.52	23.6	0.43	0.7
Higher education sector	Fifty two (52) Universities: - (26) Governmental - (26) Private	45 281	108 675	40 408.9						
Private sector	- Comprises the Business Sector Institutions	-	5 340	4 272						

Source: Ministry of Higher Education and Scientific Research, Science and Technology Innovation's Report, 2019.

Table 2. Strengths and weaknesses in Egypt's scientific research system

	Strengths	Weaknesses
Human resources	- Availability of good scientific base consisting of more than 138.5 thousand researchers in 56 public and private universities and 25 research centres institutes and entities affiliated to ministries as well as civil society institutions concerned with research and development. - Egypt has the largest amount of production of a research society of scientific researchers in the Middle East over the last ten years. - There are more than 500 thousand students enrolled in science, medicine, and technology colleges. - Graduation of thousands of higher studies students (doctorate and master) from Egyptian universities. - Further growth in the number of researchers from different research entities. - Increased number of young researchers. - There is a group of national young experts in the management of scientific research finance, science and technology indexes and evaluation of scientific research institution performance.	- Absence of good distribution of researchers in proportion to distinguished capacities on national scale. - The number of full-time scientific researcher does not exceed 50 percent of the total number of researchers in Egypt. - Lack of expertise in some rare specializations (nuclear physics). - Absence of a sufficient number of engineers and assistant technicians (lab assistants) in scientific research institutions and their low capacities and incomes. - Not empowering young people and marginalizing their role in planning and management of science, technology, and innovation system. - Reluctance of students to enrol in the scientific section in secondary school. - Low number of the scientists in physics and mathematics. - Most private universities focus only on education, without developing research and innovation capacities of faculty members.
Supportive local environment of innovation and scientific research	- Rapid growth of a young and mature environment that supports innovation and scientific research development, including civil society organizations, technology incubators, capital investment organizations, business plan contests, initial model support programs.	
International visions	- Egypt has achieved advanced positions in the productivity of scientific research in fields of chemistry, medicine, materials science, and advanced positions in terms of influence within the research fields of computer science, mathematics, and physics. - Egypt achieved a high rank in international publishing, ranking 38th out of 230 countries. - The scientific production of some scientific schools in Egypt is higher than the world average.	- Egypt ranked low in the global innovation index (95th out of 126 countries) and the emergence of an advanced ranking of Egypt in indicators of plagiarism. - Lack of funding opportunities, opportunities of international partnership and opportunities to support the capacities available to Egypt and North African countries from many intergovernmental institutions. - There is no clear and unified mechanism for marketing scientific research results for investors and businesspersons.

Intellectual property investment and maximizing economic revenue	- Existence of networks of technology, innovation and commercialization offices (TICOs) in universities, research centres and sub-offices of the Egyptian patent Office. - Existence of a network of technological incubators and increased support in the establishment of technology companies - Initiating initiatives to support graduation projects and transform them into services and products.	- Poor economic returns and tangible (measurable) returns gained from scientific research. - The low number of patents registered annually for Egyptians, as well as the low number of patents registered by universities and research centres , amounting for no more than 10 percent per annum of total patents - Deteriorating culture of science, technology, innovation, and intellectual property rights (IPRS) - Existence of some regulations that impede the holders of intellectual property.
Scientific research	- Scientific publication based on international cooperation is on the rise. - Increase of the rate of international publication in ascending order. - Integration of a large number of local scientific journals into international databases	- Lack of clear priorities for scientific research across schools and departments. - Lack of interest in interdisciplinary departments. - Poor impact of international scientific publication in many disciplines. - Poor quality of scientific publications of institutions. - Lack of Scientific publication of social and human research in international journals.

Source: Ministry of Higher Education and Scientific Research, Science and Technology Innovation Report, 2019.

Table 3. Opportunities and threats to Egypt's scientific research system

	Opportunities	**Threats**
Human resources	- Several thousand Egyptian scientists in all disciplines who immigrated abroad and a large number of them take leadership positions in their destinations.	- A continuous drain human intellect due to strong material attraction factors in the West and the Gulf (selective immigration).
Funding	- An Article in the Constitution allocates at least 1 percent of the national income to support scientific research.	- Lack of coordination between different donors leads to recurrent funding for the same research objectives. - Lack of coordination between scientific research institutions leads to the repetition of research topics. - Scarcity of specialized research institutions in a specific field.

Regulations legislative regime	- Political and national will in support of scientific research and innovation - Existence of a law for incentives for scientific research.	- More continuous changes in the science and technology system. - Absence of a binding mechanism to follow up the implementation of strategic plans and follow up research performances of universities and research centre. - Emergence of some restrictions on the localization of advanced technologies and the ownership of their tools by developed countries.
International visions	- Equal international cooperation with all developed countries in scientific research. - Good reputation of the Egyptian school of medicine in the Arab and Islamic worlds.	- Emerging changes in the Middle East and North Africa region and change in international relations with the donor countries.
Intellectual property and maximizing economic revenue	- Launch some major national projects such as the New Suez Canal, the Grain Stock Market, and the expansion outside the valley of a project covering an area of 1.5 million acres. - Establishment of investments in the fields of new energy and transportation. - The State aims to deepen local deserialization and support national industries such as spinning, weaving ,medication, and petrochemicals.	- Dependence of the national industry on foreign expertise (lack of trust). - Difficulty of competition with imported technologies after full liberalization of trade. - Lack of coordination on the national side with government agencies supporting the investment and marketing of the outputs of scientific research.

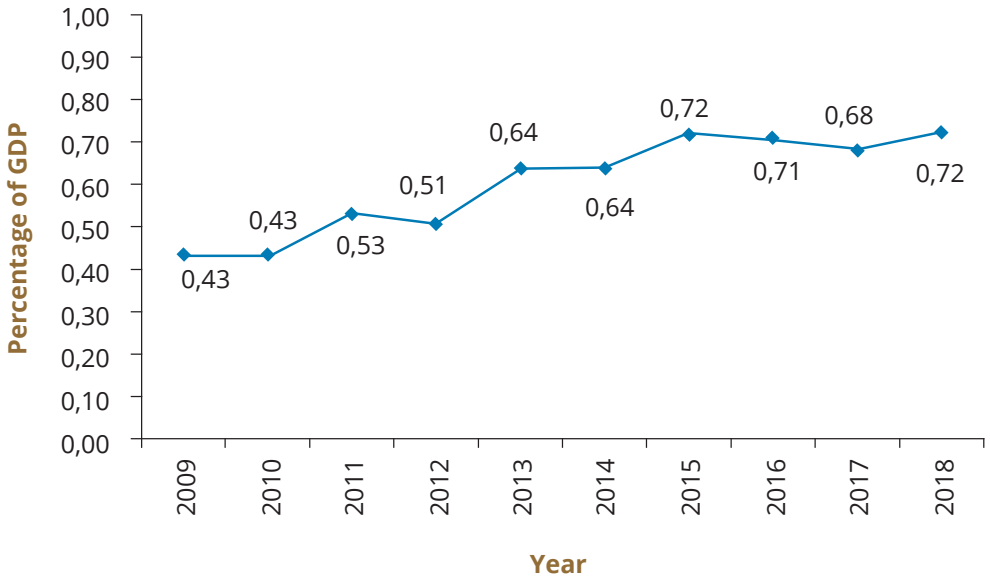
Source: Ministry of Higher Education and Scientific Research, Science and Technology Innovation Report, 2019.

3. Investment in research for development

Most research for development efforts in Egypt are mainly funded by governmental research centres and public universities, while private sector has a minor role in R4D. In regard to R4D expenditures, data indicate that funding for R4D as a percentage of the Gross Domestic Product (GDP) increased from 0.43 percent in 2009 to 0.72 percent in 2018, as shown in Figure 2. This share is below the 1 percent designated expenditure in the Egyptian Constitution, which puts the country in a challenging situation to achieve its' Sustainable Development Goals. According to the country ranking by research and development expenditures,[5] Egypt was 38th. The highest ranking was in Israel at 4.95 percent while the lowest value was in Mauritania at 0.01 percent (World Bank 2021).

[5] The Global Economy, Research and development expenditure, country ranking, https://www.theglobaleconomy.com/rankings/research_and_development/

Figure 2. Research for development expenditure in Egypt (% of GDP) over the period 2005-2018



Source: World Bank Indicators https://data.worldbank.org/indicator/GB.XPD.RSDV.GD.ZS?locations=EG

The Agricultural Science and Technology Indicators (ASTI) Egypt Factsheet (2015) pointed out that recent initiatives have been established to address research funding problems in Egypt, including the creation of the Higher Council for Science and Technology (HCST) and the establishment of the Science and Technological Development Fund (STDF) in 2007. This competitive research fund issues around 200 million Egyptian Pounds (USD 13 million) per year to agricultural and non-agricultural research programs and is a good sign of increased government commitment to science and technology. However, significantly more funds are required to address the challenges facing Egypt's agricultural sector.

4. Legalization of the research role

The Ministry of Higher Education and Scientific Research plays a key-role in providing the proper legislation and enabling environment to support science and technology. MOHESR targets to achieve comprehensive development by providing and encouraging:

- distinct human capabilities in the different fields of science and technology;
- advanced research capabilities;
- developing national expertise;

- solutions to problems in the production and services sectors;
- distinctness and competitiveness.

Several positive changes in the Egyptian government's policies on science, technology, and innovation (STI) have recently been highlighted by several initiatives with the revival of some public model examples such as the Zewail City for Science and Technology, which includes Egypt's first Research University. The policy of Scientific Research and Technology aims to:

- link the scientific sector to the production and services sectors;
- establish coordination and integration between research institutes;
- achieve integration between scientific culture and the culture of the society;
- encourage technology transfer, adaptation and development;
- increase the governmental funds assigned to scientific research and technology development;
- improve international cooperation;
- develop human resources;
- upgrading laboratories infrastructure;
- developing R&D management tools.

In order to achieve the designated targets and goals, a package of legislations supporting science, technology and invention were completed in 2018 and the beginning of 2019. In October 2018, the Parliament initially approved the government-drafted law to establish a fund supporting innovators.[6] The draft law aims to support research, innovation and development carried out at national small and micro-technology enterprises to raise their competitiveness and encourage innovators who face many problems in funding their projects. Under the draft law, finances will not pose a burden on the state's budget, as it will depend on donations, cash and in-kind grants offered by individuals, in addition to loans offered by the state's concerned bodies. Finances will also be obtained through the services provided by the fund to support research and innovation projects, in addition to obtaining 1 percent of the profits from the private units of public universities, institutes and research bodies.

The draft law grants innovator students scholarships to pursue their education and establishes partnership opportunities between young innovators and funding entities to put their research ideas into action. Article 7 reads that the fund will be exempted from paying tax, while Article 8 suggests that a board of directors should be

[6] Egypt Today, Parliament approves draft law to establish fund for innovators, https://www.egypttoday.com/Article/1/59390/Parliament-approves-draft-law-to-establish-fund-for-innovators

formed to submit a report to the prime minister on the fund's achievements. Based on approval of the draft Law, MOHESR reviewed the priorities upon which scientific research should focus in Egypt to place then within the framework of the national unified strategies for science, technology, innovation, and Egypt's sustainable development vision 2030. In this regard, the Governor of the Central Bank of Egypt (CBE) said that launching a LE one billion fund would support innovation.

5. Challenges facing Research for Development (R4D) in Egypt

There are several examples of research for development (R4D) projects in Egypt that highlighted the critical issues and challenges needed to be considered when planning R4D projects. Noha El Tawil (2019)[7] pointed out the critical status of Egypt's R4D in which she indicated that Egypt's investment in R4D remains quite low despite the fact that the deficit in the country's balance of payments (BOP) would gradually decrease, or even be eliminated. Different goods would be available at reasonable prices for consumers if investment in R4D increased. The United States of America National Science Foundation (NSF, 2018)[8] defined R4D as three types of research: basic research, applied research and developmental research. El Tawil stated that, although Egypt is lacking on all of these fronts, there is generous room for improvement. One of the main challenges is the gap between sectors serving market needs and the outstanding academic research that the country produces. A second challenge is the unwillingness to amend the incentive packages for highly qualified researchers to conduct proper R4D and train others. In addition, the government does not provide sufficient incentives for manufacturers running R4D departments as they do for those provided to export manufacturers.

The national research system of Egypt lagged behind many countries of the world. Amr Radwan and Mahmoud M. Sakr (2017)[9] conducted a SWOT analysis of Egypt's Science and Technology System. They mentioned that Egypt's Science and Technology System was built a few decades ago as a static and linear system that does not allow quick adaptation to current dynamics. During their review, they assumed that some authors indicated that the non-linear and dynamic national systems could facilitate technological development and allow for a better market uptake of research results, as well as boosting product innovation capabilities. Their recommendation emphasized the importance of promoting evidence based strategic planning at

[7] Noha El Tawil (2019); "The Critical Status of Egypt's R4D"; Egypt Today, https://www.egypttoday.com/Article/3/70585/The-Critical-Status-of-Egypt's-R-D

[8] National Science Foundation (2018); Definitions of Research and Development: An Annotated Compilation of Official Sources

[9] Amr Radwan and Mahmoud M. Sakr (2017); "Review of the Egypt Science and Technology System; Swot Analysis"; The International Journal ENTREPRENEURSHIP AND SUSTAINABILITY ISSUES ISSN 2345-0282 V(5), N(2).

the level of research institutions in Egypt. Many previous studies underscored the importance of evaluation and monitoring systems of science and technology as an essential component of the development process. Having a continuous and effective evaluation and monitoring mechanism embedded in the national system of science and technology is crucial for effective and efficient utilization of the existing capacities and resources. Findings of such SWOT analysis of national research systems would contribute to building the conceptual framework needed to further develop policies and institutional reforms. Four major problems pertaining to the production, access and use of knowledge have been identified; these are:

1. Lack of research visions and strategies: the ongoing research in Egypt is scattered, redundant, and lacks serious and effective coordination.
2. Weak performance and management of research: research activities suffer serious drawback in terms of qualitative performance, and the poor links between research and practices of scientific, social, and economic development is very weak. Although private sector's role in knowledge production has been increasing, it did not achieve its full potential and lacked coordination with national institutions.
3. Instability in providing funds: public research institutions and higher education institutions suffer from insufficient funds.
4. Lack of an independent and liberal research environment: conducting research is constrained by data accessing, collection, exchange and dissemination.

6. Challenges facing Agricultural Research for Development (AR4D) in Egypt

Studying the challenges facing the agricultural sector in Egypt[10] indicated that, despite the fact that Egypt is an agricultural-based country and agriculture contributes significantly to food security, the economy, employment, export earnings and ecological balance, the sector faces many threats that hamper the positive impacts of rural development initiatives. Prominent challenges include soil and water issues, land fragmentation, conventional agronomic practices, lack of marketing information, poverty, rapid population growth, inadequate support services, institutional constraints, and lack of proper agricultural and rural development policies.

In addition, small landholdings represent a major obstacle for agricultural development in Egypt, where 80 percent of landholdings in old lands are less than five acres. Initiatives are needed to increase agricultural production while reducing

[10] Shalaby *et al.* (2011), Threats and Challenges to Sustainable Agriculture and Rural Development inEgypt: Implications for agricultural Extension", J. Anim. Plant Sci., 21(3).

land fragmentation. Policy makers need to design policies that address issues to develop farming practices and technologies to increase agricultural production and combat poverty. Agricultural extension and advisory services can also help in realizing higher yields and resilience of rural communities. There is an urgent need to move from supply-driven information to demand-driven information customized to farmers' actual needs. There is also a dire need to develop capacity building programs for extension agents to improve their knowledge and skills. Strong ties bind agriculture research and extension services which can have a significant and positive role in achieving sustainable rural development. Putting in place science-based programs on sustainable agricultural development is strongly recommended for rural livelihood improvements.

7. Egypt's National Agricultural Research System (NARS)

To better understand the underlying dimensions and facts influencing the overall performance of the National Agricultural Research System (NARS) in Egypt, it is important to review the current situation of AR4D and the setup and structural organization of NARS.

7.1 Current situation of Agricultural Research for Development (AR4D)

Linkages between agricultural research and rural development forms a complex point of view that considers the social, political and economic aspects, such as population growth, poverty and sustainable human development, were investigated by Kamel Saleh *et al.* (2013).[11] They mentioned that Egypt has been experiencing new paths in achieving human development needs through promoting new agricultural technologies and techniques in the fields of food production and processing, diversification of livestock production, agricultural production and plant protection. These outcomes were helping to maximize the revenues and improve the standards of living for Egyptians. Livestock and agricultural production were considered as the main venue for improving rural community's livelihoods and cohesion. The evolution of agricultural research for rural development was a major contributor to the development of the country's economy. They concluded that it is important to underline the need to increase the level of production and reproductive efficiency for some Egyptian livestock to secure food resources for a growing population. The authors used a program to improve Egyptian buffalos as an example of how this works. Applying scientific research techniques and a good genetic improvement program, and taking into account the environmental impacts of such a program,

[11] Kamel Saleh *et al.* (2014); Egyptian Research for Agriculture Rural development today. 1st International Conference 'Economic Scientific Research-Theoretical, Empirical and Practical Approaches', ESPERA, Procedia Economics and Finance 8 (2014), pp 683–687.

the program works to achieve superior buffalo bulls. These bulls provide higher revenues and good production for farmers and for organizations dealing with water buffalo breeding. They also confirmed the importance of research in increasing the productivity of inland cattle species by conducting experiments in breeding inland cattle with highly productive exotic breeds with the goal of improving the genetics of the hybrid cattle and increasing their economic productivity.

According to the Country Factsheet that was issued in (2015)[12] by the Agricultural Science and Technology Indicators (ASTI),[13] Egypt's AR4D System is amongst the world's leader in terms of human resource capacity. As shown in Table 4, more than 8 400 agricultural researchers have been recorded as full time equivalents (FTEs) in 2012, of whom the majority (5 692.2) are PhD holders (Figure 3a, b). Three-quarters of them are employed by the Agricultural Research Centre (ARC), which is the main entity responsible for conducting AR4D in the country. In addition, Egypt's expenditure on research for sustainable agricultural development grew by more than 30 percent over the last two decades. Unfortunately, most of the growth in expenditure was not due to investing in research activities, but to higher salary payments following the large-scale recruitment of staff by ARC and upgrading research facilities.

Table 4. Key indicators on Egypt's agricultural research for development, 2009 compared to 2012

Total public spending on agricultural research	**2009**	**Growth**	**2012**
Egyptian pounds (million in constant prices, 2005)	372.9		463.0
Overall growth		**24%**	
Total number of public agricultural researchers			
Full-time equivalents (FTEs)	6 490.3		8 419.7
Overall growth		**30%**	
Agricultural research intensity			
Spending as a share of agricultural GDP (%)	0.42%		0.44%
FTE researchers per 100,000 farmers	101.62		133.31

Source: *Agricultural R4D Indicators Factsheet, ASTI, March 2015*

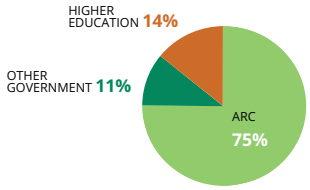
[12] Agricultural Science and Technology Indicators (2015); Agricultural R4D Indicators Factsheet on Egypt; www.asti.cgiar.org/egypt

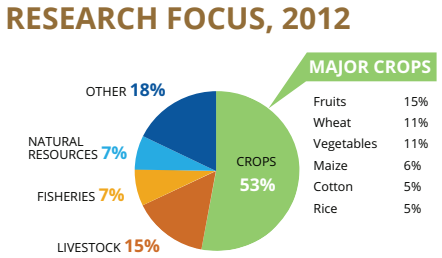
[13] Egypt Factsheet, Agricultural Science and Technology Indicators (ASTI), International Food Policy Research Institute (IFPRI), https://www.asti.cgiar.org/egypt

Figure 3a. Financial resources and institutional profiles in Egypt, 2012

Spending Allocation	
Salaries	87%
Operating and program costs	3%
Capital investments	10%
Funding Sources	
Government	62%
Donors and development banks	4%
Sales of good/services	35%

Note: Shares are based on data for ARC agencies only.

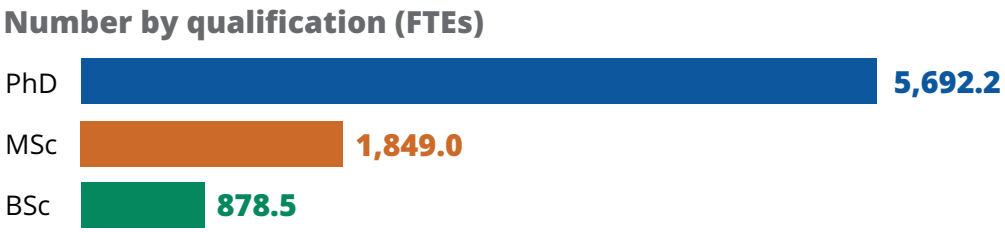




Note: Major crops include those that are the focus of at least 5 percent of all crop researchers; 47 percent of total crop researchers focused on a wide variety of other crops.

Source: Agricultural R4D Indicators Factsheet, ASTI, March 2015.

Figure 3b. Agricultural research profiles in Egypt, 2012



Notes: Major crops include those that are the focus of at least 5% of all field crop researchers; 47% of the total field crop researchers focused on a wide variety of other crops.

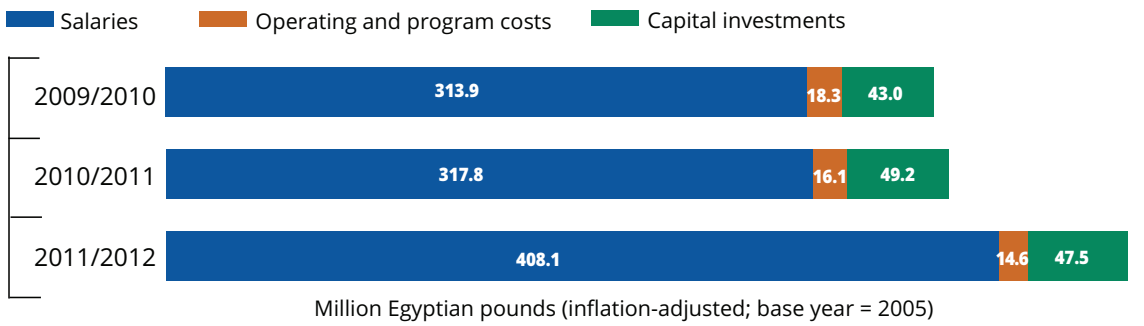
Source: Agricultural R4D Indicators Factsheet, ASTI, March 2015.

7.2 Challenges in funding the AR4D

Investigating fund-related challenges indicates that around 90 percent of ARC's total spending is allocated to salary expenses, leaving relatively limited resources to fund the costs of conducting research, or maintaining and upgrading AR4D facilities. Donors used to play a considerable role in funding such types of expenditures in the past, but issues in 2011 led to a substantial decline in donor contributions to AR4D.

According to ASTI (2015), ARC's total expenditure increased by 25 percent between 2009 and 2012, as shown in Figure 4. However, such increase was entirely due to higher salaries following the sharp increase in the number of employed researchers. ARC's research programs were severely underfunded and operating and program costs accounted for only a very small, and declining, share of the ARC's total expenditures between 2009-2012.

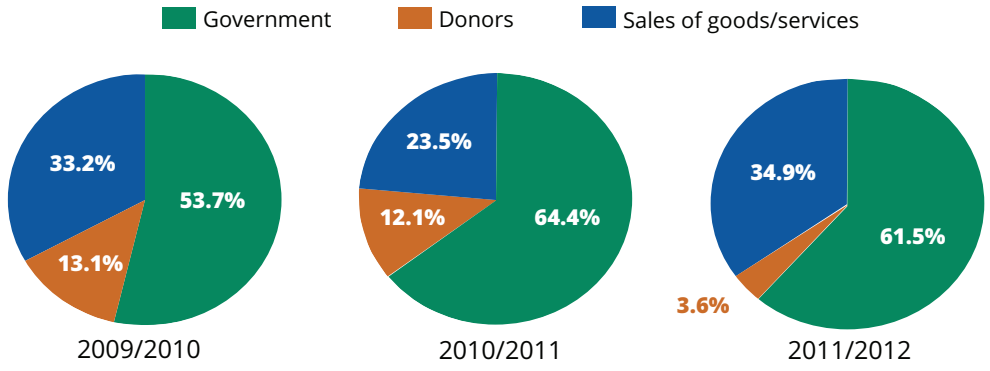
Figure 4. ARC's expenditure according to cost category, 2009-2012



Source: Agricultural R4D Indicators Factsheet, ASTI, March 2015.

ARC's salary expenditures, roughly estimated at 60 percent of all other expenses, was entirely funded by the Government of Egypt. As for non-salary expenditures, the government covers the largest share, 61.5 percent in 2011/2012, as depicted in Figure 5. It is worth mentioning that ARC generates a relatively large portion of its funding internally through the sale of seeds, vaccinations, and other services such as laboratory tests and technical assistance. In 2011/2012, sales of goods and services covered 34.9 percent of ARC's non-salary expenditures. Donors' contribution, such as the European Union, Italian Cooperation, RDF-France, JICA-Japan, USAID, the World Bank, IFAD and FAO, used to play an important role in funding ARC's research, but such funds substantially contracted after political changes in 2011. These funding sources declined from 13.1 percent in 2009/2010 to 3.6 percent in 2011/2012. Since 2014, donors gradually started increasing their investment in Egypt's agricultural research and extension systems once again.

Figure 5. Sources of funding for ARC's non-salary expenditure, 2009-2012



Source: Agricultural R4D Indicators Factsheet, ASTI, March 2015.

Exploring agricultural research capacity in Egypt and other large developing countries shows that Egypt has an extremely large pool of agricultural researchers, with FTE researchers per million farmers estimated at 8 420, roughly four times that of Brazil or Turkey, and more than 30 times higher than India (Table 5). The ASTI Egypt Factsheet (2015) highlighted that Egypt's disproportionately high number of researchers raises concerns, especially with the limited number of outputs produced relative to comparison countries.

Table 5. FTE researchers per million farmers in Egypt and other large developing countries

Country	FTE agricultural researchers	FTE researchers per million population	FTE researchers per 100,000 farmers
Egypt	8 420	104.4	133.3
Turkey	3 009	40.7	38.5
India	11 217	9.4	4.2
Brazil	5 376	28.6	44.1
Nigeria	2 688	16.4	21.9

Source: Agricultural R4D Indicators Factsheet, ASTI, March 2015

Note: Data for Egypt and Turkey are for 2012; data for Nigeria are for 2011; data for India are for 2009; and data for Brazil are for 2006. It is important to note that countries like Brazil and India employ a large number of degree-qualified technicians, who are not included in these data because they are not officially classified as researchers.

Although 68 percent of the total number of employed researchers in Egypt, around 5 700, are PhD-qualified agricultural researchers (in FTEs), they are not well-distributed across the country or across disciplines and they lack sufficient fund to conduct viable research programs, which represents a serious challenge

in AR4D in the country (Table 6). In addition, a large number of researchers are approaching retirement. To overcome such challenges, the Ministry of Agriculture's Sustainable Agricultural Development Strategy towards 2030 has adopted a new policy for human resource development in the field of AR4D. ARC is currently in the process of establishing systematic on-job training programs for all research staff. In addition, the government recently approved salary increases and performance bonuses for both ARC and university-based scientists, which is expected to have a positive impact on staff motivation.

Table 6. Cross-country comparisons of researchers

Country	Total number of researchers, (FTEs), 2012	Growth in the number of researchers, 2009–2012	Share of PhD researchers, (FTEs), 2012
Egypt	8 419.7	30%	68%
Algeria	593.4	16%	23%
Jordan	272.3	1%	35%
Turkey	3 009.4	17%	42%

Source: Agricultural R4D Indicators Factsheet, ASTI, March 2015.

It is worth mentioning that Egypt's national agricultural research system employs PhD-qualified agricultural researchers more than other countries in Africa. Obtaining a PhD degree is the basis of promotion in the country's civil service system. Therefore, it was seen as necessary to improve the quality of domestic PhD academic programs to match international standards. Accordingly, GOE started implementing a USD 50 million World Bank-funded "Higher Education Enhancement Project" between 2000–2017 to lay the foundations for a new education system through implementation of legislative reforms, institutional restructuring, and the establishment of independent quality-assurance mechanisms and monitoring systems. The key objectives were to enhance the country's agricultural science capacity and amend the current promotion system based on scientific merit. It will remain a challenge to attract and maintain qualified agricultural researchers without competitive remuneration, as most talented professors and researchers are working in the Gulf States, Europe, and North America. The following section highlights the institutional setup and structure of existing Agricultural Research for Development Institutions in Egypt

7.3 Institutional setup

Institutional setup refers to institutions that form the country's National Agricultural Research System (NARS). It comprises all entities that carry out agricultural research in various fields. Historically, agricultural research services were initiated by private or semi-independent agricultural societies in Egypt in 1897 to focus on a relatively small number of export crops like cotton. The former Royal Agricultural Society

commenced its first research work on pest management problems related to cotton in 1897 at Giza. Nowadays NARS stands on four pillars, of which three are inputs for research and development activities (research entities, research staff and expenditure), and a fourth which is output (research products). Agricultural research entities are governmental, including research centres, research institutes, and universities, while some are privately-owned institutions. There are also foreign institutions that carryout agricultural research, including regional and country offices of international research institutions and organizations engaged in agricultural development.

7.4 Structural organization of the National Agricultural Research Systems (NARS) in Egypt

This part focuses on the structure of the main institutions implementing agricultural research for development in Egypt. The structure of NARS in Egypt includes a long list of agricultural research institutions in Egypt involved in AR4D. Ministry of Agriculture has two large agricultural research centres with two different research technical mandates and geographical coverages. The ARC is the primary entity responsible for all fields of agricultural research, including agricultural development and scaling out of technology and innovations in irrigated ecosystems in Egypt while The Desert Research Centre (DRC) is responsible for conducting research work related to rain-fed, rangeland, and desert farming systems.

In a complementary role, the Ministry of Water Resources and Irrigation has a large national research centre that deals with a full spectrum of research on water resources management and use. The National Water Research Centre (NWRC) is responsible for conducting research on water resources, irrigation and drainage in agriculture.

The third entity in NARS is the National Academy of Scientific Research and Technology and its National Research Centre (NRC), which are affiliated to the Ministry of Scientific Research and Technology. They include division responsible for conducting agricultural research in all its topics.

In addition to the agricultural and water research centres, universities and higher technical institutes affiliated to the Ministry of Higher Education also play a significant role in advancing agricultural research in Egypt. There are roughly 30 faculties of agriculture and technical institutes which are distributed all over the country and heavily involved in large projects in agricultural development. The private sector is increasingly involved in agricultural research, particularly in seed production, tissue culture and micro-propagation and agrochemicals.

The ARC is the main agricultural research organization in Egypt and a study of linkages between the ARC and other national agricultural research institutions is essential for strengthening collaborations and cooperation protocols. One example of these protocols is the Regional Councils for Research and Extension which is comprised of

four regional councils that established the goal of promoting coordination between decision-makers, scientists, researchers, extension officers, private sector and farmers to enhance agricultural development in Egypt. Following is the list of all relevant institutions involved in agricultural research for development in Egypt:

1. Ministries

- Ministry of Agriculture and Land Reclamation:
  - Agricultural Research Centre (ARC);
  - Desert Research Centre (DRC).
- Ministry of Water Resources and Irrigation:
  - National Water Research Institute.
- Ministry of Higher Education and Scientific Research:
  - Academy of Scientific Research and Technology (ASRT);
  - National Research Centre (NRC), Division of Agriculture and Biology Research;
  - Institute of Oceanography and Fisheries (IOF).

2. Universities

- Faculty of Agriculture and Veterinary Medicine in the following 26 universities: Cairo University, Ain Shams University, Alexandria University, Mansoura University, Benha University, Tanta University, Helwan University, Azhar University, Zagazig University, Menofia University, Assiut University, Kafr El-Sheikh University, Menia University, Suez Canal University, Fayoum University, Heliopolis University, King Soliman University, New Valley University, Sohag University, Aswan University, Damietta University, Behera University, Beni Swief University, Port-Said University, Suez University.
- Faculty of Cotton Sciences, Helwan University.
- Faculty of Fisheries, Kafr El-Sheikh University.
- Faculty of Fish and Fisheries Technology, Aswan University.

3. Private institutions

- Arab Academy for Science, Technology and Maritime Transport (AASTMT).
- College of Fisheries and Aquaculture Technology (CFAT).
- The Higher Institute for Agricultural Cooperation, Ain Shams University.
- The Higher Institute for Agricultural Cooperation and Extension.

4. Regional and international organizations

- Food and Agriculture Organization of the United Nations (FAO).
- Arab Organization for Agricultural Development of the League of Arab States (AOAD).

- Arab Centre for the Studies of Arid Zones and Dry Land of the League of Arab States (ACSAD).
- International Centre for Agricultural Research in the Dry Areas (ICARDA).
- International Centre for Rural Development (ICRD).
- International Development Research Centre of Canada (IDRC).
- International Water Management Institute (IWMI).
- International Food Policy Institute (IFPRI).
- International Rice Research Institute (IRRI).
- International Fund for Agricultural Development (IFAD).
- International Italian Cooperation Program.
- European Union.
- U.S. Agency for International Development (USAID).
- German Federal Ministry for Economic Cooperation and Development (BMZ).
- Japan International Cooperation Agency (JICA).

7.5 Challenges facing Egypt's National Agriculture Research System (NARS)

- Most of the growth in ARC's expenditure is not due to investing in research activities, but to higher salary expenses following the large-scale recruitment of research staff. Around 90 percent of ARC's total spending is allocated to salary expenses, leaving relatively limited resources to fund the costs of conducting research and maintaining and upgrading the infrastructure and equipment required to serve AR4D activities.
- Agricultural researchers lack sufficient funds to conduct viable research programs. Donors used to play a considerable role in funding such types of expenditures, but issues in 2011 led to a substantial decline in donor contributions.
- Although Egypt employs around 5,700 PhD-qualified agricultural researchers (FTEs), they are not efficiently distributed across the country or across disciplines.
- A large number of the recruited researchers are approaching retirement age.
- The number of FTE researchers per million farmers in Egypt is roughly four times that of Brazil or Turkey, and more than 30 times higher than India's. Such facts raise concerns, especially with the limited number of outputs produced by Egyptian FTEs.
- Local academic programs leading to PhD degrees in various branches of agricultural sciences needs improvements to match international standards.
- Despite salary increases, attracting and maintaining qualified agricultural researchers without competitive remuneration is still challenging. Egypt's most

talented professors and researchers are working in the Gulf States, Europe, and North America.

Measures taken to overcome challenges to NARS in Egypt

The Ministry of Agriculture's Sustainable Agricultural Development Strategy towards 2030 adopted the following new policy for human resource development in the field of AR4D in agriculture and extension:

- the ARC is currently implementing a systematic training program for all of its research staff;
- the GOE has recently approved salary increases and performance bonuses for both ARC and university-based scientists, which is expected to have positive impacts on staff motivation;
- to improve the PhD academic programs in agricultural sciences, the GOE implemented a USD 50 million Higher Education Enhancement Project (2000–2017) funded by the World Bank. Its aim is to lay the foundation for a new education system for strengthening the country's agricultural science capacity and to modify the current system of promotions from one that is based on seniority to a one that is based on merit.

8. Conclusion

The literature review and analysis of Egypt's agricultural systems revealed that it would be important for all agricultural research organizations to develop structured programs to enhance their visibility to attract potential partners for collaboration. The NARS still lacks the requisite organizational frameworks or institutional mechanisms to encourage cost effectiveness and inter-agency partnerships in research. To enable the NARS to contribute effectively to the growth and development of agriculture in Egypt, appropriate steps should be considered to facilitate collaboration. This should help to fully integrate and better utilize the scarce scientific resources of the country. As an initial step, organizations conducting research on agriculture related issues, particularly for the good of the public, should adopt a culture of networking and collaboration between and among themselves, by seeking to reach out to others on every matter of common purpose.

The ARC should take the lead in coordinating the activities of the NARS in Egypt, but to do this, the present institutional governance issues faced by the institute must be resolved. Through established MoUs, research activities can be organized with universities and other institutions of higher learning to replicate experiments on research projects, activities, and experiments at their respective facilities in a coordinated manner. ARC could organize and form various research clusters with other NARS organizations, wherein each cluster would jointly develop proposals and seek competitive grant funding. In addition, ARC should activate and enforce the

Regional Centre for Agricultural Research and Extension coordination platform for bringing all NARS related organizations together on a quarterly basis to exchange ideas and review progress. Additionally, ARC could establish and convene an annual agricultural research congress and publish the proceedings accordingly.

9. References

Academy of Scientific Research and Technology Website, http://asrt.sci.eg/ar/index.php/news/item/484-53.

The Global Economy Website, https://www.theglobaleconomy.com/Egypt/Research_and_development/.

The Ministry of Higher Education and Scientific Research (2019); "Strategy Update Report on the National Strategy for Science, Technology and Innovation".

Technology and Innovation in Egypt Status Brief; The Egyptian Centre for the Advancement of Science, Technology and Innovation (ECASTI), June, 2014.

The Global Economy, Research and development expenditure, country ranking, https://www.theglobaleconomy.com/rankings/research_and_development/.

Egypt Today, Parliament approves draft law to establish fund for innovators, https://www.egypttoday.com/Article/1/59390/Parliament-approves-draft-law-to-establish-fund-for-innovators.

Noha El Tawil (2019); "The Critical Status of Egypt's R4D"; Egypt Today, https://www.egypttoday.com/Article/3/70585/The-Critical-Status-of-Egypt's-R-D.

National Science Foundation (2018); Definitions of Research and Development: An Annotated Compilation of Official Sources.

Amr Radwan and Mahmoud M. Sakr (2017); "Review of the Egypt Science and Technology System; Swot Analysis"; The International Journal ENTREPRENEURSHIP AND SUSTAINABILITY ISSUES ISSN 2345-0282 V(5), N(2).

Shalaby *et al.* (2011), Threats and Challenges to Sustainable Agriculture and Rural Development in Egypt: Implications for agricultural Extension", J. Anim. Plant Sci., 21(3).

Kamel Saleh *et al.* (2014); Egyptian Research for Agriculture Rural development today. 1st International Conference 'Economic Scientific Research -Theoretical, Empirical and Practical Approaches', ESPERA, Procedia Economics and Finance 8 (2014), pp 683–687.

Agricultural Science and Technology Indicators (2015); Agricultural R4D Indicators Factsheet on Egypt; www.asti.cgiar.org/egypt.

Egypt Factsheet, Agricultural Science and Technology Indicators (ASTI), International Food Policy Research Institute (IFPRI), https://www.asti.cgiar.org/egypt.

Agricultural Research Centre' Website; http://www.arc.sci.eg/AboutARC.aspx?TabId=&NavId=&lang=en.

Water and Livelihoods Initiative (WLI) (2017); Research and Extension in Egypt; Socio-economic Report.

Desert Research Centre's Website; https://drc.gov.eg/en/home/.

Water and Livelihoods Initiative (WLI) (2017); Research and Extension in Egypt; Socio-economic Report.

National Research Centre's Website, https://www.nrc.sci.eg/.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CHAPTER 4
Comprehensive analysis of participatory-discussion

1. Introduction

The NARS in Egypt are facing, and will continue to face, multiple-interlinked challenges due to the dynamic nature of the drivers of change and the complexity of its institutional structures and linkages. Several efforts are being exerted by Egypt-NARS in the field of agricultural research for development to help formulate an integrated and coherent approach for research and dissemination of proven technologies and practices. In order to support such efforts, the study strived to collect new information on agricultural research through the organization of focus group discussions (FGDs) to capture the systemic changes overtime, both drivers and solutions, and to better understand the resilience of the system to deal with upcoming development challenges. Accordingly, three FGDs were carried out to discuss topics on AR4D with researchers, extension agents and farmers and to collect the data required for a systemic analysis to support the creation of guideline for the NARS.

Interviews were held with various key informants and focus groups associated with both the NARS and the extension and advisory services (EAS) in Egypt. This was to obtain further knowledge and insights on the performance of the NARS and identify shortcomings and possible solutions to facilitate implementation of AR4D activities and thereby enhance their impact on economic growth, food security and nutrition. To avoid individual biases, two times of the required number of respondents were invited for both the KIIs and FGDs and only those who volunteered to provide responses were interviewed. Both individual experts/ key informants and focus groups were asked multiple choices and open-ended questions to obtain needed information.

1.1 Key-Informant Interviews (KIIs)

The KIIs were held with 24 individual experts who were well familiar with the NARS and its research for development impact on agricultural development. The key individuals were of diverse professional backgrounds and selected from different national, regional, and international organizations associated with agricultural research for development (AR4D) activities in the country. The embedded questionnaires in Annex 1 were used to facilitate the interviews with the key informants. The KIIs interviews were mostly conducted virtually through online meetings.

1.2 Focus group discussions (FGDs)

Three FGDs were arranged with researchers, academia, extensionists and farmers groups within the country. The discussions were held in three sessions with each lasting two hours. The discussions for each session were centred on a specific theme and each section was attended by 15 participants. The composition of each focus group and the themes discussed are summarized separately in this report. The questions posed to the participants of the various focus groups are contained in Annex 2. A total of 50 individuals, which included researchers, extension agents and farmers from various parts of the country were also interviewed separately, whether in-person or by phone or virtually, to obtain additional data on the sets of questions posed to the FGD participants, using the same questionnaire used for the FGD.

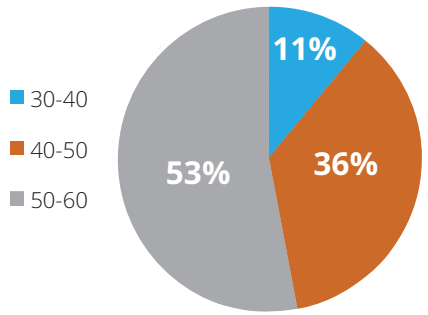
1.3 Data analysis

Preliminary analysis of the data was done parallel to the data collection process to track emerging themes and patterns from the responses and to evaluate the sufficiency of the data. The final analysis was made immediately after all the required data were completed. All quantitative data were averaged or summed and categorized using Microsoft Excel. The qualitative data were analysed by critically reviewing the transcripts of the interviews and discussions to determine and summarize the prevailing themes, patterns, contrasts and or other observations recorded.

2. Results and discussion

Questionnaires were administered to 45 participants who provided answers to questions listed in the comprehensive questionnaire specifically designed for researchers and academia (Annex 1). To enhance the feedback from participants and capture a wider picture about the current situation of AR4D in Egypt and its impact, one FGD was organized around fifteen participants while the rest of the responses were collected using the other 30 individual interviews. Females made up 38 percent of the participants and men were 62 percent. In regard to affiliation, 20 percent of the participants worked at universities, while 80 percent worked at research centres. It is worth noting that 36 percent of the participants from the research centres occupied leading positions within their institutions, such as Deputy Directors or Chiefs of Research and Studies Affairs. Classifying participants by age showed that 11 percent were between 30 and 40 years old, 36 percent fell between 40 and 50 and 53 percent belonged to the category of 50 to 60 years old (Figure 6).

Figure 6. Distribution of FGD participants by age



As for classification by academic degree and employment position, results indicated that 62 percent were PhD holders and worked as Chief Researchers, while 18 percent held PhDs and worked as Senior Researchers. Within universities, 9 percent were PhD holders and listed as Professors, another 9 percent had PhDs and worked as Associate Professors, while 2 percent held M.Sc. degree and worked as Assistant Lecturers (Table 7). Most of the respondents worked at research centres as chief researchers, who by default are older in age and have more experience on AR4D projects compared to younger researchers who work as researchers. The respondents sampling was well representative in terms of diversity in age, gender, experience, research areas, and institutions.

Table 7. Distribution of FGD participants by affiliation and position/job

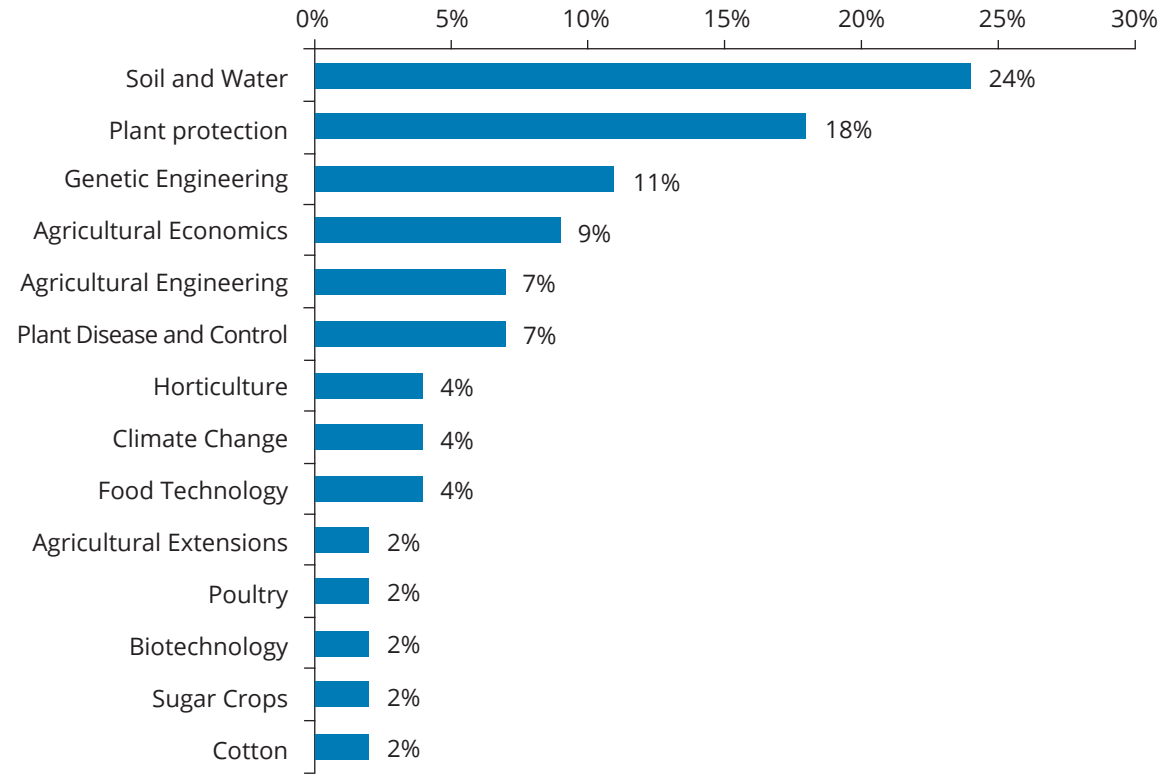
Position/job title	Affiliation	
	Research centres	Universities
Chief Researcher/Professor (PhD holders)	62%*	9%
Senior Researcher/Associate Professor (PhD holders)	18%	9%
Researcher/Assistant Lecturer (M.Sc. holders)	0%	2%
Total	80%	20%

* Includes 10 Deputy Directors of Research and Study Affairs

Agriculture is a science that encompasses a wide range of specializations directly influencing human life. Exploring the specializations of FGD participants and interviewees indicates that 24 percent specialized in Soil and Water research, which can be attributed to the fact that soil and water rank as major factors of agricultural production in Egypt. Participants specialized in Plant Protection rank second at 18 percent. Genetic Engineering (GE) specialists, also called genetic modification or genetic manipulation, represented 11 percent of the participants. About 9 percent of

the participants specialized in Agricultural Economics and they assess the economic feasibility of agricultural research programs and outcomes. Participants specializing in Agricultural Engineering accounted for 7 percent of the respondents. The importance of this specialization stems from the fact that it combines various disciplines to improve the efficiency of farms and agribusiness enterprises through new or improved engineering technologies. Another 7 percent specialized in Plant Disease and Control. These specialists are highly important for preventing and controlling plant diseases, a key factor for growing healthy crops. Participants specialized in Horticulture, Climate Change and Food Technology research accounted for another 4 percent, while Agricultural Extension, Poultry Production, and Biotechnology accounted for the last 2 percent (Figure 7).

Figure 7. Distribution of FGD participants by research field



2.1 Agricultural Research for Development (AR4D)

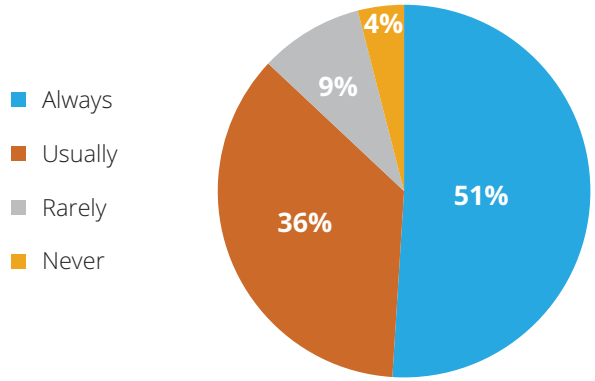
2.1.1 Research arrangement and capacity to implement AR4D

In order to identify research arrangements and the capacity to implement AR4D in Egypt, participants were asked to respond to a number of questions. Responses were then analysed and the results are presented in the following section.

Contribution to decision-making on research topics at organization and national levels

Exploring participants' responses to the question regarding their contribution to decision-making on research topics at their organizations or at the national level indicated that 51 percent said they always contributed, while 36 percent mentioned they usually contributed. However, 9 percent of the participants mentioned they rarely contributed and 4 percent mentioned they never contributed to decision-making on research topics at either the organization or national levels (Figure 8). It can be concluded that researchers mostly contributed to decision-making on research topics at their organizations and at the national level.

Figure 8. Contribution to decision-making on research topics at organization or the national level



Decision making on Agricultural Research for Development (AR4D) at the national level

Participants were asked how decisions were made on AR4D projects at the national level. Responses illustrated in Table 8 indicate that the majority of respondents (67 percent) mentioned it was demand driven, whereas 22 percent think otherwise and indicated it was supply driven. This means that decisions on AR4D at the national level are mostly demand driven. However, 11 percent of the participants mentioned that decisions made on AR4D at the national level were based on other factors, introduced in the following paragraph and illustrated in Table 9.

Table 8. Decision making on AR4D at the national level

Responses	%
Demand driven	67
Supply driven	22
Other	11

Explanations received from participants regarding other factors influencing decision indicate that 45 percent of the participants believed that AR4D projects were based on Egypt's Vision 2030 and Sustainable Agricultural Development Strategy 2030. Twenty-seven percent believed they were based on solving specific problems facing the agricultural sector, and another 27 percent believed they were based on national projects that aim at curbing the gap between production and consumption. These results suggest that other factors influencing decision making on AR4D projects at the national level mainly depend on the goals Egypt's SADS 2030.

Table 9. Researchers' explanations regarding other factors influencing decision making on AR4D at the national level

Responses	%
Based on Egypt Vision 2030 and Sustainable Agricultural Development Strategy (SADS) 2030	45%
Based on solving problems faced in agriculture	27%
Based on national projects that aim at curbing the gap between production and consumption	27%

Technical, administrative and financial support to research institutions

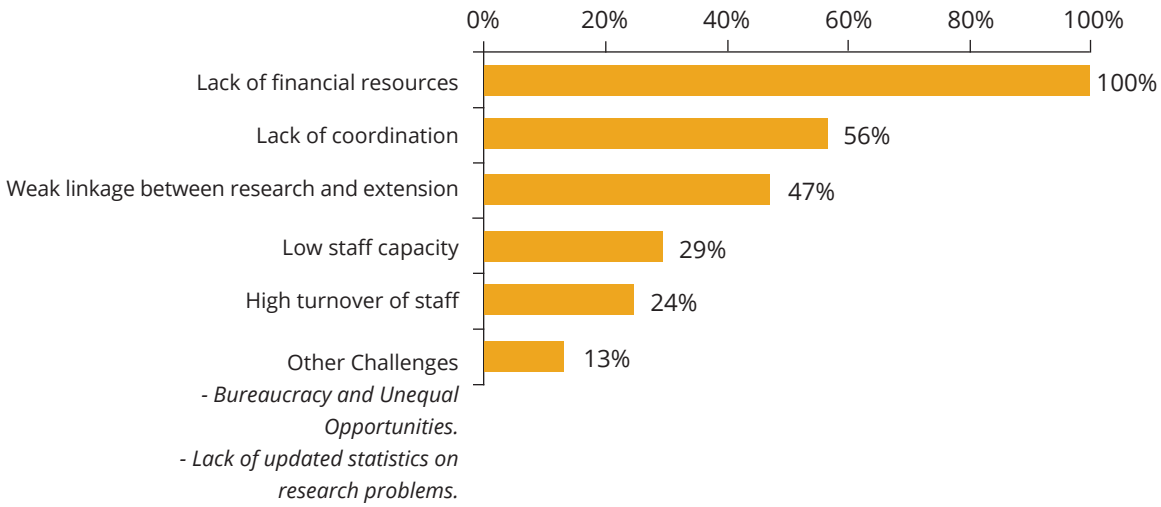
It is well known that technical, administrative, and financial support highly affect AR4D efforts. Participants were asked how they assess governmental support to their research institutions. Responses obtained indicated that only 9 percent of the participants believed that they received needed financial support while 91 percent believed that there is very long way to go and financial support was insufficient. This result was considered the major problems affecting AR4D in Egypt.

2.1.2 Main challenges facing AR4D in research organizations

Identifying the main challenges facing AR4D in research organizations is the key-driver to overcoming them and improving the performance of implementation. Responses illustrated in Figure 9, according to relative importance, suggests that all the participants (100 percent) believed that lack of financial resources ranked as the top challenge facing AR4D. Lack of coordination and collaboration ranked second, with 56 percent of the participants believing it to be one of the main challenges facing AR4D in their organizations. Almost half of the participants (47 percent) ranked weak

linkages between research and extension as the third top challenge. Low capacity of the research staff ranked fourth in terms of relative importance at 29 percent, while high turnover of management ranked fifth at 24 percent. Other challenges ranked sixth (13 percent) and included bureaucracy, unequal opportunities and lack of updated statistics impacting research problems.

Figure 9. Main challenges facing AR4D in participants' organizations



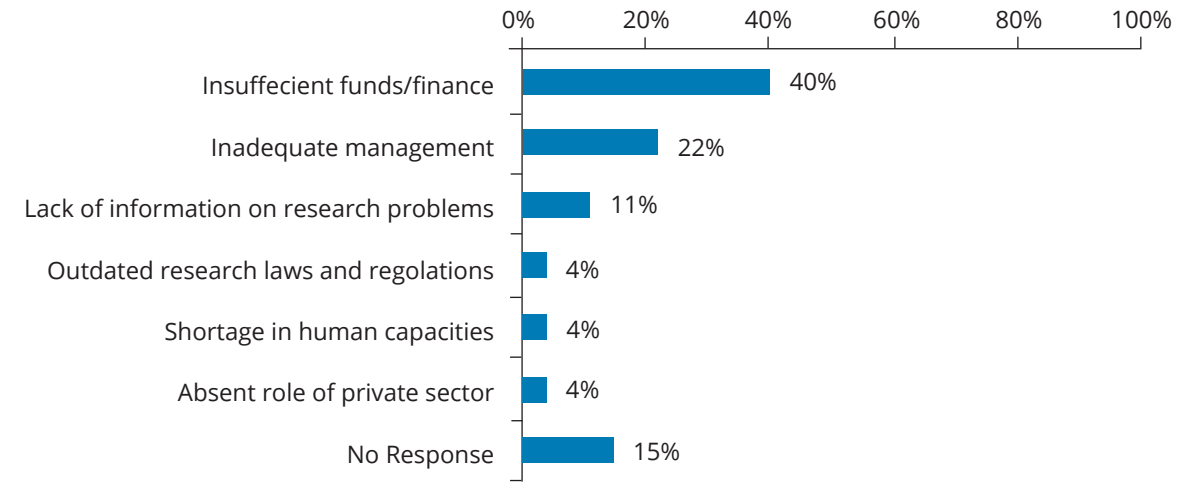
Main challenges that affect the performance of actors in AR4D project cycles

Actors in AR4D project cycles play different significant roles in the success of AR4D. The main challenges that affected their involvement, performance, and function are a crucial step towards finding ways and means to improve them. The following subsections present participants' opinions regarding the challenges that affected the performance of decision makers, researchers, project managers, farmers, extension officers, in addition to other actors such as local communities and NGOs.

Decision makers were the top actors in AR4D project cycles and their decisions highly affected the enabling environment for AR4D implementation. Researcher's and academia's opinions regarding the main challenges influencing the performance of decision makers are shown in Figure 10. Results indicated that 40 percent believed that insufficient funds was the greatest challenge influencing the performance of decision makers. The same percentage of participants believed that poor management was the most critical issue because of bureaucracy and centralized decision-making. In addition, 11 percent believed that the lack of information on

research problems was also among the main challenges facing decision makers. Only 4 percent believed that outdated research laws and regulations represented an obstacle to decision makers. Another 4 percent believed that shortages in human capacities due to inappropriate recruitment plans affected decision making. Finally, 4 percent of the participants believed that the absence of private sector's participation in research plans affected the performance of decision makers. The conclusion that can be drawn here is that there are many interlinked challenges affecting decision making at the AR4D level and insufficient funds followed by poor management lead the list of issues.

Figure 10. Main challenges that affect the performance of decision makers (enabling environment)



Main challenges that affect the performance of researchers

In order to succeed in any AR4D project, it has to be properly designed and researchers play the role of project designers. It is important to identify the main challenges influencing their performance as a means to improve their leadership role in design management. Responses received from researchers and academia presented in Table 10 indicated that 42 percent of the participants agreed that the lack of financial resources was the main challenge facing their involvement and performance. Another 33 percent believed it was modest experience and research capabilities. A small proportion of participants (13 percent) think that the problem was a lack of teamwork spirit and 7 percent identified on-job capacity building as one of the main challenges affecting their performance. As for minor challenges, 2 percent of the participants believed that poor English language skill led to misunderstanding the Terms of Reference for AR4D projects, in addition to

limited communication and collaboration with donors and international research organizations. Another 2 percent believed that a lack of coordination between various national AR4D institutions was challenging their involvement and performance in conducting AR4D. A very small percentage (2 percent) believed that limited chances for the application and adoption of results of their research work led to researchers losing their enthusiasm and motivation to improve their research capabilities, which negatively affected their performance as project designers.

Such responses confirm the previously elaborated results regarding the significant impact of insufficient fund, modest experience, and research capacities, coupled with the lack of teamwork spirit were critical challenges and need multiple significant interventions. Capacity building, joint projects implementation, inspiring and motivating research teams, resource mobilization and fund raising are needed to improve the capacity and performance of designing and conducting AR4D projects.

Table 10. Main challenges that affect researchers' performance as project designers

Challenges	%
Lack of financial resources	42
Modest experience and research capabilities	33
Lack of teamwork spirit	13
Insufficient capacity building	7
Poor English language skill leads to: • Misunderstanding TORs of AR4D Projects • Limited communication with Donors	2
Lack of coordination between national research institutions	2
Failure to apply the results of applied research leads to researchers losing the motivation to raise the efficiency of their research work	2

Main challenges that affect the performance of project managers

Project managers are responsible for proper implementation of AR4D projects to achieve their final goals and targeted impacts. Project managers need to be fully aware of the key implementation factors that ensure the success and sustainability of their projects. Accordingly, it was very important to identify the main challenges that affected their performance. Responses are presented in Table 11. Results indicated that 36 percent believed that inadequate management skills were the main challenge affecting the performance of project managers, while 18 percent believed a lack of financial resources impacted their performances. Another 16 percent believed it was the absence of a clear vision on the objectives and implementation plan of AR4D projects. Nine percent believed that a lack of coordination between the project manager and involved researchers represented a challenge and 9 percent believed that shortages in skilled human resources was a main challenge impacting the performance of project manages. A majority of those who responded placed inadequate management skills as the top challenges influencing the

performance of AR4D project managers. A skilled manager is capable of putting a special focus on project deliverables, encouraging teamwork, maximizing resource use and minimizing the costs and risks to ensure timely submission of the project deliverables as per the approved work plan and budget.

Table 11. Main challenges that affect the performance of project managers as project implementers

Challenges	%
Inadequate Management Skills	36
Lack of Financial Resources	18
Absence of a clear vision on the objectives and implementation plan of AR4D projects	16
Lack of coordination between the project manager and researchers	9
Shortage in skilled human resources	9

Main challenges that affect farmers' adoption of AR4D results

Farmers are the ultimate beneficiaries of AR4D projects and therefore identifying the main challenges that affect their adoption rate as service recipients is a very crucial step towards overcoming their reluctance to adopt new technologies to increase targeted impacts of AR4D. Responses received from researchers and academia, presented in Table 12, indicated that 44 percent believed that the main challenges facing farmers' adoption of AR4D technologies was the weakness of the existing agricultural extension system. A lack of trust in extension serves was noted by 16 percent and 11 percent believed that a lack of financial incentives negatively affected farmers' adoption of AR4D outputs. It can be inferred that agricultural extension services were the main factor for improving farmers' adoption rates. Investing in updating, upgrading, and empowering existing outdated extension systems by establishing good communication channels, upgrading facilities, updating knowledge and information systems, and building trust between farmers and extension agents were of high importance in achieving AR4D impacts.

Table 12. Main challenges that affect farmers' adoption of AR4D results

Challenge	%
Weakness of the existing agricultural extension system	44
Poor communication	20
Lack of trust between farmers and extension officers	16
Lack of financial incentives	11

Main Challenges that Affect the Performance of Extension Officers

Extension officers are the vital link between researchers and farmers. It is therefore highly important to identify the main challenges affecting the performance

of extension officers to keep that link efficiently active. Responses received regarding the challenges affecting extension officers' performance are presented in Table 13. The majority of responses (33 percent) believed that weak means of communication represented a real constraint to offering extension services, while 27 percent believed that shortages in agricultural extension personnel was the problem. Lack of financial support was supported by 18 percent and 9 percent believed that the main challenge was the lack of trained and up-to-date informed extension officers. Results indicated that the existence of a proper means of communication between extension officers and both researchers and farmers represented the main constraint for keeping effective and active links open, thus preventing results from sustainably being delivered to farmers. There is also a shortage of agricultural extension personnel as a result of halting the recruitment of new extension officers due to a lack of financial resources. Proper equipping and continuous on-the-job training for new extension officers was noted as a means of ensuring a well and up-to-date informed extension service.

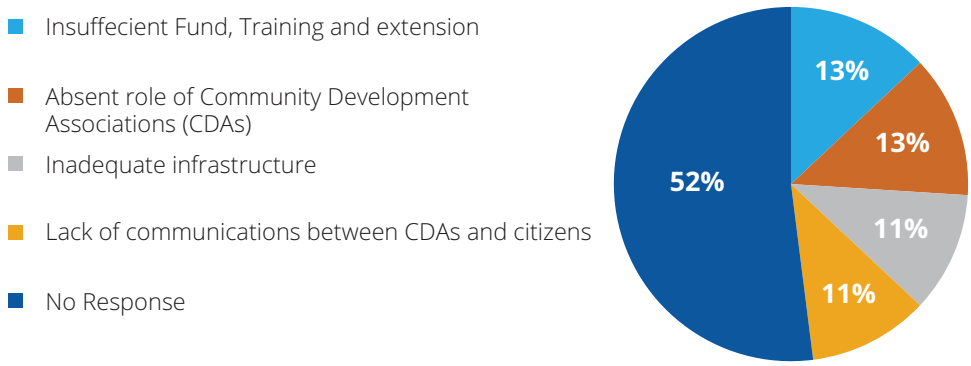
Table 13. Main challenges that affect the performance of extension officers (the link between researchers and farmers)

Challenges	%
Weak means of communication	33
Shortage in agricultural extension officers	27
Lack of financial support	18
Lack of trained and up-to-date informed extension officers	9

Main challenges affecting the performance of other actors in AR4D project cycles (local communities)

local communities play a significant role in AR4D project cycles as they ensure the sustainability of adopting the implemented interventions and project handovers. Identifying the main challenges that affect their contribution is considered of great importance. Responses received from researchers/academia regarding such challenges were presented in Figure 11. It is clear that participants believed that two challenges, insufficient funds and community awareness of extension services, coupled with the absent of a role by local Community Development Associations (CDAs), where the major issues (13 percent of the received responses). Inadequate infrastructure and lack of communication between CDAs and citizens in local communities scored 11 percent each. The results revealed that insufficient fund negatively affected required training for CDAs' staff and extension services to citizens, which clarifies the absent role of CDAs in responses given. Inadequate infrastructure and lack of communication between CDAs and Citizens can also be attributed to insufficient fund.

Figure 11. Main challenges that affect the performance of other actors in AR4D project cycle (local communities)



2.1.2 Knowledge and skill-related changes needed to improve research staff capacity to better conduct AR4D projects

Identifying skill-related changes needed to improve the capacity of research staff involved in AR4D to better conduct projects is considered highly important. Participants were asked if certain skills were missing, if the missing skills were strongly or partially needed, and if there were other missing skills they would like to recommend (Table 14).

Results indicate that 87 percent of the participants agreed that technical reporting and international publishing were the most important missing skills. About 85 percent of those who agreed believed that these skills were strongly needed, while the remaining 15 percent thought it was partially needed, as shown in Table 14. This indicates that the majority of researchers miss this important skill and strongly need to enhance it to be able to successfully implement projects. Publishing requires a series of steps and fulfilment of certain criteria set by publishers and researchers need to be aware of such steps. Knowing how to fulfil these required criteria and enhancing their standards to be able to publish their research work in peer-reviewed international journals, as well as in local newsletters, is critical to the successful implementation of AR4D results. An important explanation regarding why researchers gave priority for this skill was that it is directly related to their promotion and research staff grading systems utilized in research centres and universities. The incentives for publishing was identified as a need for their promotion rather than communication of their research results.

Project management ranked second as a missing skill (71 percent), of whom the majority (78 percent) stated that it was a strongly-needed skill and this aligns with the results obtained in section 5.3. The importance of proper management stems

from the fact that it represents a key factor for ensuring successful implementation of AR4D projects.

Table 14. Knowledge and skill-related changes needed to improve research staff and colleagues' capacity to better conduct AR4D projects

#	Skills	Missing (%)		Needed (%)		
		Yes	No	Strongly	Partially	Not Needed
1	Reporting and Publishing	87	13	85	15	0
2	Project Management	71	29	78	22	0
3	Project Proposal Writing	62	38	61	39	0
4	Planning of Project Implementation	62	38	57	43	0
5	Communication	60	40	67	33	0
6	Monitoring and Evaluation	60	40	67	30	4
7	Participatory Approaches	51	49	57	39	4
8	Conflict Management	42	58	16	53	32
9	Risk Management	40	60	39	56	6
10	Scaling-out Approaches	38	62	53	41	6
11	Other Missing Skills)					
	• Collaboration and Communication with International Research Institutions	20	80	100	0	0
	• Language, Computer and International Publishing Skills	9	91	100	0	0
	• Finance and Project Managements	9	91	100	0	0
	• Know-how of Innovations	4	96	100	0	0

Results indicated that 62 percent of the participants believed that project proposal writing was a missing skill, and that 61 percent of them believed it was strongly needed, while 39 percent believed there was a partial need for this skill. The importance of this skill is directly linked to the ability to obtain funds for AR4D projects from donors. Lacking this skill leads to losing fund opportunities.

Missing the skill of planning for project implementation also attracted the attention of 62 percent of the participants, where 57 percent of them believed that it was a strongly needed skill, while 43 percent believed it was partially needed. Such result showcases the importance of this skill for most of the researchers. Knowing the proper design and implementation of work plans for AR4D projects was one of the key factors for project successes.

AR4D projects are usually implemented to meet specific goals for specific stakeholders. Results indicated that both communication and Monitoring and Evaluation (M&E) scored equal percentages in terms of relative importance (60 percent) and 67 percent and 63 percent of those who agreed that these two skills were missing believed they were strongly needed, while 33 percent and 37 percent believed they were partially needed. It is worth mentioning that the two skills are closely linked and mutually serve each other. Both skills are considered critical

factors that needed to be highly considered, not only during the preparation and implementation stages of AR4D projects, but also post implementation to ensure the sustainability of project outcomes.

Continuous communication processes were essential to keep concerned team members well informed and to keep stakeholders well connected and informed regarding the results of the project. On the other hand, M&E is a highly critical component that helps in the follow-up and assessment of the ongoing project activities. M&E can identify and potentially rectify deviations that may occur during the execution and implementation of projects and can update projects to improve their implementation. It is worth mentioning that successful M&E systems depend on the adoption of a good communication strategy. This result highlights the needs for these two issues to be covered in the planned training sessions and proposed guidelines for implementing AR4D.

Participatory approaches are useful for achieving the goals of AR4D projects, especially when behavioural changes are targeted. Missing knowledge about participatory and community based approaches ranked seventh in terms of relative importance for participants (51 percent). In regard to the need to improve this skill, only 52 percent of those who agreed that it was missing mentioned that there was a strong need to include it in capacity building programs, while 48 percent mentioned that it was partially needed.

Conflict management ranked eighth in terms of relative importance for participants, where 42 percent of them agreed that it was a missing skill, but only 16 percent of them believed it was strongly needed, while the remaining 84 percent believe it was partially needed. One important fact to highlight here is that conflict is inevitable in a project environment. Therefore, for the project to succeed, it is necessary to bring stakeholders into alignment on all the aspects of the project management and project action plan.

The importance of risk management emanates from the fact that it allows for the confronting of negative issues or events encountered during project implementation, by either evading the possibility of their occurrence, or minimizing their negative impacts. Respondents indicated that it ranked ninth in terms of relative importance and 40 percent reported that it was a missing skill. Only 39 percent of those who mentioned it believed there was a strong need for improving this skill, while 61 percent mentioned it as partially needed. Such result sheds light on the need to draw researchers' attention to the significant weight of this skill on the full implementation and successful achievement of targeted objectives within a project.

As for outreach and scaling out approaches, responses showed that 38 percent of the participants agreed that this skill was missing and 53 percent of them believed it was strongly needed to better conduct AR4D projects. Roughly 47 percent believed it was partially needed. Knowledge about scaling out approaches relates to the skill of expansion and replication of successful projects. Enquiring if

knowledge about scaling out approaches was missing shows that only 38 percent of the respondents agreed that it was missing, and more than half of those who agreed (53 percent) believed that knowledge of this skill was strongly needed. This result means that it is important to raise researchers' awareness on the importance of scaling out approaches for AR4D projects to achieve agricultural sustainable development goals.

Participants also highlighted the need for some other skill-related changes that were essential to better conduct AR4D projects. Responses indicated that 20 percent of the participants agreed that collaboration and communication skills with international research institutions was missing and all of them believe they were strongly needed; 9 percent agreed that language, computer and international publishing skills were missing and all of them believed they were strongly needed; another 9 percent agreed that finance and project management skills were missing and all of them believe they were strongly needed. Finally, 4 percent of the participants agreed that knowledge about innovations, such as smart agricultural systems, was missing and was strongly needed. These results are useful guides for developing needed capacity building programs for researchers to enhance and improve their knowledge and skills to better conduct AR4D projects.

2.1.3 Aspects on the implementation mechanisms of AR4D

Identifying aspects related to the implementation mechanisms of AR4D was considered helpful in capturing a wider picture of this particular subject. Based on that, participants were asked to provide their opinions on several questions. The first question under this section focused on asking participant if they have managed or have been involved in AR4D projects before. As illustrated in Table 15, the answer was yes (93 percent). Their responses to questions in this questionnaire are based on their actual experience.

Table 15. Previous management/involvement in AR4D projects

Responses	%
Yes	93
N o	7

2.1.4 Motivation for implementing AR4D

Participants were also asked about their motivations for implementing AR4D projects. Answers presented in Table 16 indicated that 89 percent mentioned that they were participating to solve development problems, 67 percent said it was their field of business, 13 percent mentioned that they seek to earn extra money, and 2 percent said it was because they believe that scientific research seeks to enhance human welfare. It can be inferred that the majority of participants are well aware that there are problems hindering the achievement of sustainable development goals in the agricultural sector and need to be solved.

Table 16. Motivation for implementing AR4D projects

Responses	%
Participating to solve development problems	89
It is my business field	67
Earning extra money	13
Belief on scientific research to achieve human welfare	2

2.1.5 Challenges related to funding

Since funding is one of the major problems obstructing AR4D worldwide, participants were asked about the challenges related to funding such as sustainability, insufficient funds, fluctuations in funding, and dependency on local and/or international donors. Answers in Table 17 revealed that 62 percent believed that insufficient funding represents the main challenge. A lack of sustainability ranked second (60 percent). A fluctuation in the availability of financial support came in the third (42 percent), while a reliance on donors ranked fourth (40 percent). Only 2 percent of the participants mentioned that a lack of private sectors' participation represented a challenge or that inadequate funding from the government and the private sector represent a challenge to AR4D projects. Such result aligns with previously presented results regarding funding-related issues, challenges and associated negative impacts on implementing programs, scaling out and the sustainability of AR4D projects.

Table 17. Challenges related to funding

Responses	%
Insufficient funding	62
Lack of sustainability	60
Fluctuation in the availability of financial support	42
Reliance on donors	40
Lack of private sector's participation	2
Inadequate funding from the government and the private sector	2

2.1.6 Designing research projects

To understand the mechanisms that participants follow in implementing their AR4D projects, they were asked to describe how they design their research projects. Responses presented in Table 18 indicated that 53 percent started by defining the research problem, 20 percent mentioned that they started by defining the main objectives, 15 percent said they designed a schedule for the project implementation plan and 22 percent mentioned that data collection and analysis followed these previous three steps. One lesson to be drawn from these answers was that a large percent of the participants are lacking the skill of projects design.

Table 18. Designing research projects

Steps	%
Define the research problem	53
Define the main objectives	20
Design a schedule for the implementation plan	15
Data collection and analysis	22

2.1.7 Participation of stakeholders in research gap identification

Since AR4D mainly aims to improve the socio-economic conditions of targeted groups, it is of great importance to know if farmers, beneficiaries or Water Users Associations (WUAs) participate in the identification of research gaps in their communities. Participants provided multiple responses for this question, as illustrated in Table 19. The answers indicated that 44 percent of those who said yes mentioned that stakeholders directly participated in research gap identification, 33 percent mentioned that stakeholders participated through agricultural extension services, 22 percent indicated that stakeholders participated through the heads of associations and 16 percent mentioned that stakeholders participated through local community associations. However, a considerable percentage of responses (27 percent) indicated that stakeholders do not participate in research gap identification. It can therefore be inferred that stakeholders' participation in research gap identification was mostly indirect. These result suggest that this issue was strongly needed in training manuals and courses.

Table 19. Stakeholders responses to identification of research gaps

Responses	%
Yes, directly	44
Yes, through agriculture extension	33
Yes, through heads of associations	22
Yes, through local community associations	16
No	27

2.1.8 Participation of stakeholders in AR4D implementation

To better understand the implementation mechanism of AR4D projects, participants were asked if and how farmers/beneficiaries/WUAs participated in the implementation of AR4D projects. Answers presented in Table 20 indicated that 64 percent agreed that local stakeholders participated through adopting introduced agricultural technology packages, 44 percent participated in demonstration plots, 38 percent participated by adopting new irrigation practices and 29 percent participated by using newly developed inputs in agricultural production. However, a considerable percentage (24 percent) indicated that local stakeholders did not participate in AR4D projects. It can be noted that not all stakeholders participated

in the implementation of AR4D projects. Solutions to overcome this problem are needed to ensure full participation of all relevant stakeholders in the implementation of AR4D projects to ensure their ownership of the project outputs.

Table 20. Stakeholders' participation in implementing AR4D projects

Responses	%
Yes, adopting the introduced agricultural technology packages	64
Yes, participating in demonstration plots	44
Yes, adopting new irrigation practices	38
Yes, accept to use newly developed inputs in agricultural production	29
No	24

2.1.9 Approaches adopted in implementing AR4D projects

In order to identify the approach researchers adopted in implementing their AR4D projects, they were offered a set of multiple choice responses reported in Table 21. Responses revealed that 51 percent adopted a community-based and participatory approach involving all relevant stakeholders and beneficiaries, 51 percent adopted scaling out of Good Agricultural Practices (GAP), 31 percent adopted demonstrations and awareness raising approaches, 27 percent adopted interactive systematic innovation platform approaches, and 24 percent adopted agri-business benchmarking for farm business model approaches. However, none of the participants adopted the back-up research trials approach. The low and no adoption of approaches 4 and 6 in the table could be attributed to the limited, or lack of knowledge about such approaches and their application among researchers. Results highlight the critical need for capacity building programs that aim to cover this serious gap.

Table 21. Approach adopted to implement AR4D

#	Approaches	%
1	Community-based and participatory approach	51
2	Scaling up Good Agricultural Practices (GAPs)	51
3	Demonstrations and awareness raising	31
4	Interactive Systematic Innovation Platforms	27
5	Benchmarking for farm business model approach	24
6	back-up research trials approach	0

2.1.10 Gender Issues in AR4D Projects

Gender issues in AR4D are essential to ensure equality and equity of opportunities for all farmers regardless of their age, sex, education or culture. Therefore, participants were asked how they ensured incorporating gender issues such as women and youth participation in the implementation and the delivery of the outputs of their projects. No responses were received from participants. It is strongly suggested that this issue be supported in guidelines and capacity building programs.

2.1.11 Criteria researchers/academia consider when implementing AR4D projects

Participants were asked to choose which of the criteria listed in Table 22 they considered when implementing their AR4D projects. Applicability ranked first by almost all of the respondents (98 percent). Relevance to food security and nutrition, relevance to country research priorities and impact on environment and biodiversity ranked second with 93 percent each. Adoptability and scaling out, cost-effectiveness and affordability and gender sensitivity ranked fifth with 89 percent, and feedback mechanism ranked eighth with 73 percent of the total responses. Most researchers were fully aware of the implementation criteria to consider when implementing their AR4D projects to ensure successful implementation and achievement of targeted impacts.

Table 22. Criteria researchers consider when implementing AR4D projects

Criteria	Yes	No
	%	%
Applicability	98	2
Relevance to food security and nutrition	93	7
Relevance to country research priorities	93	7
Impact on environment and biodiversity	93	7
Adoptability and scaling out	89	11
Cost-effectiveness and affordability	89	11
Gender sensitivity	89	11
Feedback mechanism	73	27

2.1.12 Aspects on feedback, monitoring and evaluation of AR4D projects

Feedback from farmers and stakeholders is an important factor for the success of AR4D projects. It allows for the identification and rectification of issues encountered before, during and after project implementation. The feedback is also important for upgrading introduced program packages by including new elements that beneficiaries highlighted during project implementation or after project assessment. Participants were asked about the mechanisms they used to collect feedback from stakeholders. Answers presented in Table 23 indicated that 40 percent of the participants used questionnaires through individual interviews with beneficiaries, while 22 percent organized evaluation and validation workshops, field days and seminars. A high percentage of participants (38 percent) confirmed that they did not adopt any feedback mechanisms. This is an indication that a great number of researchers either ignore or miss out on one of the critical components of project monitoring, evaluation, and learning. This can lead to missing helpful lessons learned from previously implemented projects that can be considered in future implementation of AR4D projects. There is a need to provide participants with the proper knowledge and training on these mechanisms.

Table 23. Criteria researchers consider when evaluating AR4D projects

Feedback Mechanism	%
Filling Questionnaires via Personal Interviews	40
Workshops, field days and seminars	22
Nothing	38

To ensure the success of AR4D projects, feedback information must be considered when planning new research activities, especially in a similar technical area or the same ecosystem. However, when asked about this topic no answers were received from participants. This is a clear indication that this issue should be considered in the AR4D implementation guidelines and in its training manuals.

Ownership of the implemented AR4D projects by stakeholders

Ensuring stakeholders' ownership of the project outputs affects their attitudes towards the projects and their sustainability. When asked about their opinions, only 20 percent of the participants said that stakeholders felt some ownership of the implemented AR4D project, while 11 percent said that sometimes they do. However, 33 percent of the participants could not provide a specific answer, while 11 percent said stakeholders don't feel the ownership of the AR4D project (Table 24). Only a small percentage of stakeholders feel that they have ownership of the implemented AR4D projects, which could be one of the reasons that negatively affect the success and sustainability of the implemented AR4D projects limiting the project's impact.

Table 24. Stakeholders' feeling of ownership of the implemented AR4D projects

Yes	Sometimes	I don't know	No
20%	11%	33%	11%

Methods of incorporating monitoring evaluation and learning system into AR4D projects

Monitoring, evaluation and learning (MEL) is a system that should be applied along all projects phases. It helps identify lessons learned during the project life and after project closure. MEL is also needed to identify the negative and positive factors encountered during project implementation. Participants' responses in Table 25 regarding whether they have incorporated MEL system into their AR4D projects indicated that 53 percent of them organized workshops, field days and progress reports using MEL tools, while 22 percent included continuous MEL as a component in their project design phase and 9 percent cooperated with extension officers to implement MEL in their projects. However, 16 percent mentioned they know nothing about MEL systems. This result indicates the need to provide researchers with capacity building interventions on knowledge and experience about MEL systems to enhance their experience on implementing AR4D projects.

Table 25. Methods of incorporating monitoring and evaluation system into AR4D projects

Response	%
Workshops, field days and follow-up reports	53
Include continuous MEL system as a main component in the project design phase	22
Cooperate with extension officers	9
I don't know	16

2.1.13 Adoption of sustainability plan after project closure

One of the major problems that hamper the continuity of benefiting from the positive impacts of the implemented AR4D projects is the lack of a sustainability plan after project closure. Responses received from participants, presented in Table 26 indicated that 62 percent mentioned they designed and adopted a sustainability plan after project closure, while the remaining 38 percent did not. Some of the participants who adopted sustainability plans highlighted its importance for ensuring the sustainability of projects outputs. They also indicated that sustainability plans were widely implemented by farmers, which provided good evidence to demonstrate to the government and other farmers the positive economic return of research projects and persuade them to increase investments in such kind of projects.

Table 26. Adoption of sustainability plan after project closure

Reponses	%
yes	62
No	38

At the end of this section, it can be concluded that researchers do need a series of capacity building programs to help them overcome the challenges that negatively influence their performance through enhancing their capabilities for the successful planning, execution and scaling out of AR4D projects.

3. Institutional coordination between research institutions

After identifying research arrangements and capacity to implement AR4D in Egypt, participants were asked to respond to several questions regarding the institutional coordination between research institutions, which is the other side affecting the implementation and success of AR4D projects. Questions asked and responses received are presented hereinafter.

3.1 Institutional set-up of research organizations and level of decentralization

The UNDP defines institutional set-up as the policies, systems, and processes that organizations use to legislate, plan and manage their activities efficiently and to effectively coordinate with others in order to fulfil their mandate".[1] Such arrangements provide the government at all levels with a framework to formulate and implement policies. Responses in Table 27 indicated that all participants (100 percent) mentioned that the organizations they work at belong to the centralized public sector. In regard to decentralization, which refers to the transfer of control of an institution to several local authorities rather than a single entity, responses revealed that 20 percent of the participants mentioned that, there is no decentralization in their organizations.

Table 27. Institutional set-up of research organizations and level of decentralization

Question	Response	Number	%
Institutional Set-up	Public sector	45	100
Level of decentralization	Does not exist	9	20

Participants were asked about their opinions on how their research organizations should be set-up to ensure effective performance, including enhancing linkage with other research institutions. This question gave participants the chance to express their opinions regarding how their organizations should be set-up (Coordinated and Governed) for effective performance, including enhancing linkage with other research institutions. Feedback from respondents indicated that 64 percent of the researchers prefer the coordinated/decentralized form of set-up as it allows the opportunity of participatory approach in the formulation, implementation and follow up on theirs strategic research plans. Another 24 percent are also were in favour of the coordinated form of set-up as it allows decentralization in the formulation of the strategic research plans. However, 12 percent of the respondents mentioned they do not know how their organizations should be set up for effective performance, as illustrated in Table 28.

Table 28. Participants' opinions regarding how their organizations should be set-up for effective performance

Responses	%
Applying the participatory approach in the formulation, implementation and follow up of the strategic research plane	64
Decentralization of the formulation of the strategic research plane	24
I don't know	12

[1] United Nations (2017); "DEFINITION FOR NATIONAL INSTITUTIONAL ARRANGEMENTS", ggim.un-.org › ggim_20171012 › docs

The obtained results indicate that most researchers are not fully satisfied with the strategic research plans formulated by the administrations of their respective organizations. Therefore, they prefer shifting to the coordinated/decentralized set-up rather than the governed/centralized one. This also most likely means that they have ideas that they believe would improve the performance of their organizations if such ideas are adopted and implemented.

Participants shared their thoughts about the key-points to improve cooperation between their organizations and other research organizations in Egypt. The majority of participants (57 percent) think that enhanced communications and establishing partnerships and protocols for collaborative research activities are among the most important issues to be addressed and considered in institutional linkages between NARS actors. Other participants (27 percent) believe this can be achieved through holding conferences, workshops, and training programs. While 17 percent, reported that funding awarded to establishing joint research projects can help achieve this target (Table 29).

Table 29. Participants' opinions regarding the key points to improve cooperation between their organizations and other research organizations in the country

Responses	%
Enhanced communications and establishing partnerships and protocols for collaborative research activities	57
Holding Conferences, workshops and training	27
Providing funds that target joint research projects	17

3.2 Modalities of cooperation and integration with similar organization at the national and regional levels

Participants' opinions regarding the modalities to enhance cooperation and integration with other similar organization at the national and regional levels are illustrated in Table 30. Results indicate that 56 percent suggested building partnerships with other organizations; while 32 percent suggested initiating integrated coordination plans with other organizations, and the remaining 12 percent suggested to exchange technical experiences with the research staff working at other organizations.

Table 30. Participants' opinions regarding the modalities of cooperation and integration with similar organization at the national and regional levels

Responses	%
Building partnerships	56
Initiating integrated coordination plans with other organizations	32
Exchange of experiences	12

3.3 Participants' knowledge about the strategy in place to strengthen linkages between research organizations in the country

When participants were asked about their knowledge of the strategy in place to strengthen linkages between research organizations in the country, 64 percent of the them were aware of the Sustainable Development Strategy: Egypt Vision 2030, which covers all sectors of the economy, and "Sustainable Agricultural Development Strategy towards 2030 (SADS)", which targets the agricultural sector in particular, as shown in Table 31. However, a considerable percentage of participants (36 percent) did not know about cooperation strategies between research organizations in Egypt. An additional question for the question on awareness about the collaboration strategy, participants were asked about the effectiveness/efficiency of the strategy in place to strengthen linkages between research organizations in the country. The results are shown in Table 32 revealing that 32 percent of the participants believed it is effective and sufficient; 27 percent believed it is effective; while another 27 percent believed it is effective but not sufficient. The obtained result emphasizes the need to raise researchers' awareness about the "Sustainable Development Strategy: Egypt Vision 2030" and the "Sustainable Agricultural Development Strategy towards 2030", as they include the visions, plans and programs to strengthen linkages between research organizations in the country.

Table 31. Participants' knowledge about the strategy in place to strengthen linkages between research organizations in the country

Responses	%
"Sustainable Development Strategy: Egypt vision 2030" and "Sustainable Agricultural Development Strategy"	64
I have no idea	36

Table 32. Participants' opinions regarding the effectiveness/efficiency of the strategy in place to strengthen linkages between research organizations in the country

Responses	%
Effective and sufficient	32
Effective	27
Effective but not sufficient	27
I do not know	14

3.4 Challenges in linkages between NARS actors

Strong linkages between institutional actors in the National Agricultural Research System (NARS) is a key indicator of the system's performance as being essential for effective flow of technology and scientific information between research, extension, and farmers. Therefore, the study explored participants' point of view regarding the challenges affecting linkages between NARS actors.

3.4.1 Benefits and limitations of the institutional set-up as perceived by the targeted stakeholders and beneficiaries

It was important to identify the perceptions of stakeholders and beneficiaries (including private-sector, service providers and end-users) regarding the benefits and limitations of the currently standing institutional set-up of NARS in Egypt. Responses illustrated in Table 33 according to relative importance as perceived by the targeted stakeholders and beneficiaries show that, in terms of limitation, insufficient fund was ranked first as reported by 29 percent of the participants. Difficulties in communications and coordination due to lack of proper institutional structure ranked second as reported by 25 percent of the participants. Both inadequateness of the currently applied legislations and policies in addition to insufficient experience followed with equal percentages (4 percent). However, 17 percent indicated that they have no idea, which might be due to lack of experience gained from participating in AR4D projects. Such responses verify that insufficient fund and difficulties in communication and coordination due to lack of a proper institutional structure represent serious limitations to NARS in Egypt.

In regard to benefits of the currently standing institutional set-up as perceived by the targeted stakeholders and beneficiaries, responses indicated that 13 percent believed that there is sufficient number of researchers and facilities, especially laboratories and experimental stations. Both extension and training services and applying participatory approach followed with equal percentage (4 percent). These results show that stakeholders believe that the existing institutional set-up of NARS in Egypt needs strengthening to achieve the goals and meet stakeholders' expectations.

Table 33. Benefits and limitations of the institutional set-up as perceived by the targeted stakeholders and beneficiaries

Responses	%
a. Limitations	
Insufficient fund	29
Difficulties in communications and coordination due to lack of a proper institutional structure	25
Inadequate Legislations and Polices	4
Insufficient Experiences	4
I have no idea	17
b. Benefits	
Sufficient number of researchers and facilities, especially laboratories and experimental stations	13
Extension and training services	4
Applying participatory approach	4

3.4.2 Main perceived challenges of collaboration with other research organization

participants to the FGD were asked to provide their inputs regarding the challenges in linkages between NARS actors by choosing from a set of the multiple answers illustrated in Table 34. When arranged according to relative importance to shed light on the main perceived challenges, lack of financial resources ranked on top of the main perceived challenges obstructing collaboration with other research organization by accounting for 62 percent of the responses. Lack of knowledge about other organizations followed with a close percentage (60 percent). Results also indicated that lack of will to cooperate ranks third by accounting for 56 percent of the total responses, followed by inadequate policies and regulations that scored 49 percent of the total responses, while lack of trust and competition ranked fifth and sixth by scoring 38 percent and 36 percent, respectively. Socio-cultural norms scored 11 percent, and lack of coordination between research centres and lack of clear policies ranked last as perceived challenges.

Table 34. Main perceived challenges of collaboration with other research organization

#	Responses	%
1	Lack of financial and resources	62
2	Lack of knowledge about other organizations	60
3	Lack of will to collaborate	56
4	Inadequate policies and regulations	49
5	Lack of trust	38
6	Competition	36
7	Socio-cultural norms	11
8	Lack of coordination between research centres	2
9	Lack of clear policies	2

3.5 Link between research, extension, and farmers

The National Agricultural Research System in Egypt is characterized by comprising many actors. To achieve strong linkages between farmers, extension, and research, it is essential to implement agricultural innovations to establish linkages between research and extension organizations, and between actors engaged in the agricultural sector in general. The following set of questions aims to find out the status and future of existing linkages between research and extension.

3.5.1 How to improve the linkage between research and extension

In this section, we try to understand how researchers think about the existing linkages between research and extension, and how to further strengthen them to improve the efficiency of NARS performance in the country. Responses received indicated that all of the researchers are in favour of the coordinated form of set-up,

but for the different reasons illustrated in Table 35, where 55 percent are convinced that it enhances the linkage between research and extension based on solving field problems; 15 percent believe that it allows efficient management thus effective performance and better linkages between research and extension; another 15 percent mentioned that it allows for the establishment of a strong database and signing cooperation protocols for continuous communications and update of data sets and information; 11 percent believed that it allows the organization of demand-driven training programs for better performance of actors, stakeholders and beneficiaries; and finally, 4 percent stated that it allows the establishment of a real-time, results-based management system.

Table 35. Participants' opinions on how to improve the linkage between research and extension

#	Responses	%
1	Enhance linking between research and extension based on joint research-extension action plans to solve field problems	55
2	Allow efficient management thus effective performance and better linkages between research and extension	15
3	Establishing a strong database and cooperation protocols for continuous communications and update of data and information	15
4	Allow the organization of demand-driven training programs for better performance of actors, stakeholders, and beneficiaries.	11
6	Establishment of a real-time and results-based management system	4

3.5.2 The strategy in-place to strengthen the linkages between research, extension, and farmers

To explore participants' knowledge and awareness about the strategy in place to strengthen linkages between research, extension and farmers, participants responded to several related questions as presented in Table 36. The results revealed that 77 percent of them are aware about existing strategies and 23 percent of participants are unaware of any existing strategies for strengthening the linkages between research, extension, and farmers. Those who are aware about the existing strategies mentioned that the existing coordination mechanisms are the Sustainable Agricultural Development Strategy 2030 and the Agricultural Development Axis 2019 aimed to:

- shaping the relationships between the agricultural extension sector, research and scientific institutions and cooperatives;
- enhancing the legislation for agricultural extension centres to establish strong collaboration with research centres to ensure sustainable agricultural development with special focus on small and medium-scale farmers based on participatory approach;
- achieve proper utilization of extension tools and methods in establishing such linkages, including field days, farmer field schools, farmer business schools, traveling workshops, conferences, etc.;

- provide intensive capacity building programs for extension officers;
- creating a new transparent mechanism for monitoring and evaluation of the implementation of extension activities and foster private sector's participation in providing extension and advisory services to ensure proper and continuous linkages between research and extension.

The obtained result highlights the importance of organizing training sessions or raising the awareness about the existing and future initiatives in this area.

Table 36. Participants' knowledge about the strategy in place to strengthen the linkages between research and extension

#	Responses	%
1	Aware about the existing strategies	77
2	Unaware about the existing strategies	23

Regarding awareness of existing strategies that link research, extension, and farmers, participants were asked about their opinions regarding the effectiveness and efficiency of these strategies. Results listed in Table 37 show that 46 percent of the respondents mentioned that the existing strategies are effective and efficient. On the other hand, 54 percent were unable to assess these strategies, which indirectly indicates that the existing strategies are not effective in establishing strong linkages. Therefore, it is highly recommended to include this issue in the planned training sessions.

Table 37. Participants' opinions regarding the effectiveness/efficiency of existing strategies to strengthen the linkages between research, extension, and farmers

Responses	%
Sufficient and effective	46
Unable to assess	54

4. Extension officers focus group discussion analysis

Agricultural Extension Services (AES) play a fundamental role in providing a range of services to the farming communities, commercial producers, and disadvantaged and marginalized farmers. Agricultural extension officers contribute to transferring knowledge and know-how on methods and technical innovations that help in improving agricultural productivity, enhancing food self-sufficiency and national food security, improving rural livelihoods and promoting agriculture as an engine for achieving pro-poor economic growth. Extension is considered to be the vital link between researchers and farmers to achieve agricultural and rural development. Agricultural extension services in Egypt used to efficiently perform the following roles:

1. Introducing and the disseminating of modern technology practices to increase the production efficiency of rural households.

2. Raising farmers' awareness and updating knowledge of Good Agricultural Practices (GAP) and Good Handling Practices (GHP).
3. Implementation of small-scale projects in rural areas for the purpose of diversifying income sources for farmers and improving the standard of living in rural areas.
4. Introducing new extension methods such as Farmer Field Schools (FFS), Farmer Business Schools (FBS) and Farmer to Farmer (FTF) programs.
5. Enhancing the implementation of participatory approach in extension services through promoting target groups' participation in the planning of extension programs.
6. Leading preparation of technical guidelines and implementation of training programs in Old and New-lands of Egypt.
7. Raising farmers' awareness and knowledge of new variables associated with global changes such as globalization, market liberalization, privatization, etc.
8. Capacity building of extension officers through providing internal and external training opportunities.
9. Records-keeping, evaluation and lessons learned of the organized training programs with the help of audio-visual aids and video, as well as the production of visual agricultural extension programs and printed materials, and
10. Participation in local and international events to exchange experience and acquire new knowledge in the field of agricultural extension.

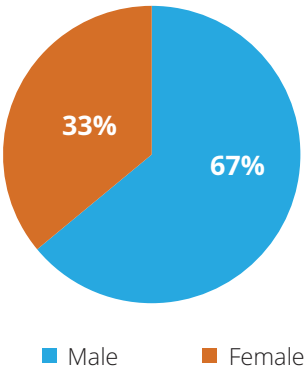
However, the fact that extension services are publicly funded and delivered by civil servants raises concern regarding their performance due to the many currently existing challenges facing agricultural extension services such as financial constraints. It is also highly important to identify other main challenges affecting the performance of extension officers to keep the linkages between research, extension and farmers efficiently active to realize the targeted impacts of the implemented AR4D projects. To achieve these objectives, the study strived to collect information through organizing a focus group discussion (FGD) with extension officers to capture the systemic changes in extension services, both drivers and solutions. The results of these discussions presented in the current FGD analysis report are expected to help in developing supporting guidelines for the NARS in Egypt.

5. Characterization of participants

A total of 15 male and female extension officers contributed to providing answers to enquiries listed in the comprehensive questionnaire specifically designed for extension officers (Annex 1). Before presenting the results of the FGD, it is useful to provide general information about the gender and educational background of the participants. The characteristics of participants illustrated in Figure 12, indicate that 67 percent of the extension officers are males and 33 percent are females; with

average age of 43 years old. Regarding the level of education, all participants are holders of B.Sc. degrees specializing in Agricultural Sciences with an of 18 years working in extension. These characteristics represent the majority of extension sector across the country.

Figure 12. Distribution of FGD participants by sex



5.1 Agricultural Research for Development (AR4D)

Extension officers play an important role in transforming the agricultural sector through active participation in the decision-making processes related to agricultural development aspects. They are key drivers for the successful achievement of the objectives of AR4D projects, including innovations in the agricultural sector. It is important to identify the obstacles and challenges they have had encountered during the implementations of these AR4D projects that they participated in during the last ten years, and whether they were able to overcome such challenges. The questionnaire designed for extension officers aimed to assess and understand their opinions regarding aspects related to research arrangements and capacity to implement AR4D programs; implementation mechanisms; monitoring and evaluation; in addition to colleting their general thoughts on AR4D.

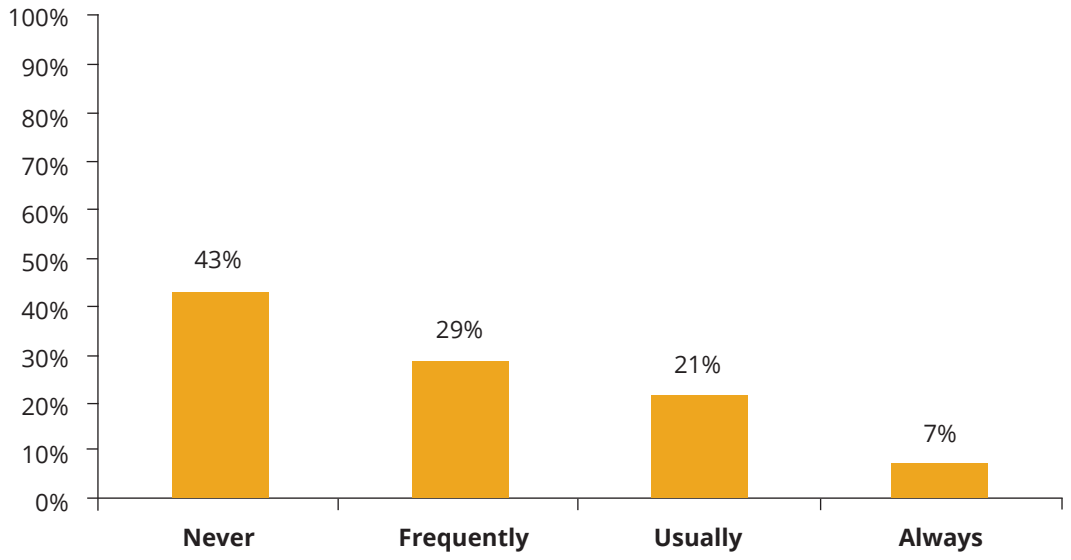
I) 3Research arrangement and capacity to implement AR4D

Extension officers contribution to decision-making on research topics at their organizations and at national level

As mentioned earlier, extension officers' contribution to decision-making on research topics is crucial for the success of AR4D projects as they act as the link between research activities and farmers who are the targeted beneficiaries of such projects

through transferring knowledge and technical innovations and the know-how to farmers and other end beneficiaries, and obtain feedback from them to researches on the priorities of topics that need to be addressed. It is worth mentioning that one of the main factors of implementing successful AR4D projects is providing solutions to problems pertinent to the existing problems as it highly encourages the active participation of beneficiaries. Extension officers' responses regarding their contribution to decision-making on research topics in their organizations are summarized in Figure 13. Almost half (43 percent) of the participants mentioned they never contributed to decision making on research topics while 57 percent of the extension officers contributed to decision-making in a way or another, and 29 percent of them frequently do; 21 percent usually contribute while only 7 percent mentioned they always contribute to the process. This result clarifies the urgent need to make extra efforts to enhance and activate linkages between extension officers and researchers to overcome this serious problem. This problem could be addressed by the planned training session on guidelines to support AR4D in Egypt.

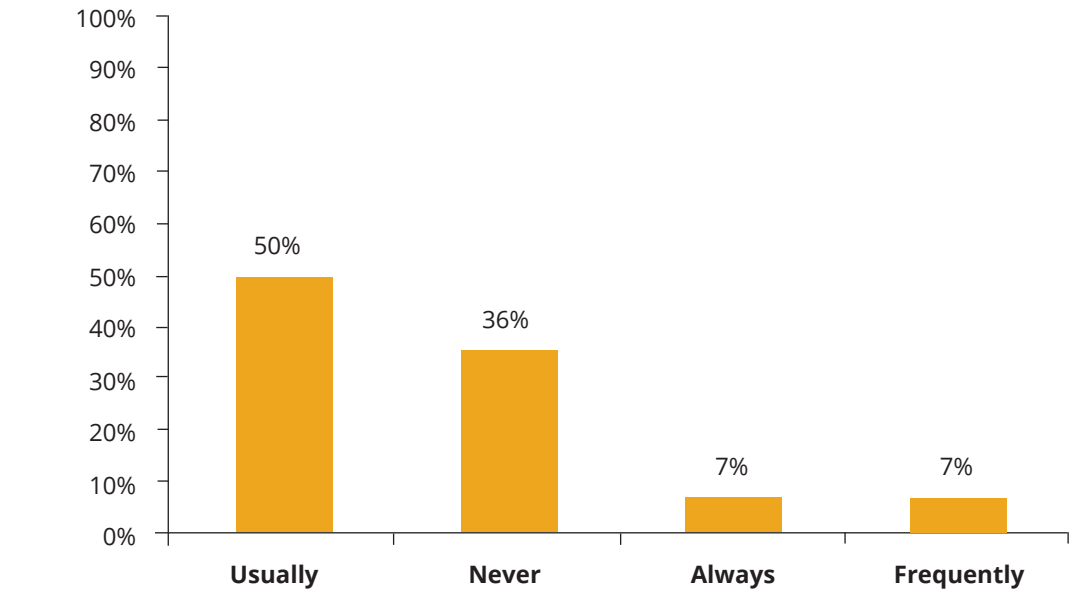
Figure 13. Extension officers' contribution to decision making on research topics in their organizations



Extension officers' contribution to decision-making on research topics at the macro level is even more crucial for the success of AR4D projects than their contribution at the micro level because decision makers at the macro level build their decisions based on priorities linked to the national development plans. Responses received from extension officers i this regard are presented in Figure 14. It can be noticed that 64 percent of extension officers contributed to decision-making on research topics at the national level in a way or another; while 36 percent mentioned they

never participated. This result emphasizes the importance of exerting extra efforts to enhance and activate linkages between extension officers and decision-makers to overcome this problem.

Figure 14. Extension officers' contribution to decision making on research topics at the national level



Challenges affect stakeholders' opportunity to benefit from AR4D

In this section, extension officers were asked to provide their responses regarding the challenges that negatively affected the opportunity to benefit from the results of agricultural research. After ranking the obtained responses according to their relative importance, challenges presented in Table 38 indicate that almost half (43 percent) of the extension officers believed that inefficient decisions regarding the agricultural sector, such as deciding to cultivate new varieties of field crops at the country level without considering the different conditions that might result in financial losses to some farmers. Another example is deciding to utilize drip irrigation on sugarcane cultivations, which cannot be practically applied, especially at later growth stages when the plants are relatively high.

One more example is deciding to adopt some technology packages containing laser levelling of soil, while farmers in several areas cannot afford to apply laser levelling on annual bases is one of the main challenges obstructing stakeholders' opportunity to benefit from the results of agricultural research. With 14 percent of extension officers reported that lack of awareness of stakeholders' needs and requirements; failure to determine the main challenges and suggest proper

solutions, and making decisions that are based on political trends considered are main challenges on benefiting from AR4D. However, only 7 percent of respondents reported that the lack of awareness of decision makers of actual problems in the agricultural is the main challenge that obstruct stakeholders' opportunities to benefit from the results of agricultural research while same percent did not respond to this question. Overall, the challenges that participants believe they are existing at the national level lead to inappropriate decisions on research plans to meet the needs of stakeholders.

Table 38. Extension officers' assessment of challenges related to decision makers that influencing opportunities to benefit from the results of AR4D

#	Response	%
1	Inefficient decisions lead to applying irrelevant methods/practices	43
2	Unawareness of stakeholders' needs and requirements	14
3	Failure to determine the main challenges and suggest proper solutions	14
4	Decisions made are based on political trends	14
5	Decision makers are not aware of diagnosing actual problems in the agri-cultural sector	7
6	Undecided	7

In regard to challenges related to researchers, results presented in Table 39 show that the majority of participants (57 percent) believed that the main challenges that affect the benefiting of stakeholders from AR4D is the lack of the required timely follow up by researchers to properly ensure the implementation of suggested solutions to address community needs in the agricultural sector a based on assessment studies. Other research officers, 14 percent reported that limiting the promotion of researchers to the number of published research articles regardless of applicability and adoptability of their research is one of the main challenges that negatively limiting the benefit of AR4D. These results indicate that redundancy of research studies due to focusing on being promoted rather than conducting demand-driven applied research. Weak linkages between research institutions also were identified by 14 percent of participants as main constrains facing AR4D impact, where it leads to replication and overlapping between research areas being conducted by different research organizations. This hinders efforts to for AR4D to achieve their goals that is similar to the previously achieved results and lessons learned from different NARS actors. The lack of good communications between researchers and extension officers was identified by 7 percent of the responses as main issue to be addressed, where extension officers believe it resulted in lack of awareness of researchers about previously achieved results and other associated problems that need to be further addressed through upcoming AR4D projects. The remaining 7 percent of the participants mentioned that they have no input regarding this issue.

Table 39. Extension officers' assessment of challenges related to researchers that influencing opportunities to benefit from the results of AR4D

#	Responses	%
1	Lack of the timely follow up required to properly link between problems in the agricultural sector and solutions suggested based on research studies	57
2	Linking the promotion of researchers to the number of research publications regardless of applicability and adoptability	14
3	Weak coordination and collaboration between research institutions lead to replication and overlapping between similar research themes	14
4	Lack of communications between researchers and extension officers	7
5	Undecided	7

The response of extension officers regarding issues related to project managers that are limiting the impact of AR4D is demonstrated in Table 40 which indicate that the majority of extension officers (57 percent) believed that lack of linkages between project managers and the agricultural research system is the reason for limiting the opportunities to benefit from the results of agricultural research, while 21 percent believed that lack of linkages between project managers and the agricultural extension system is the main reason. While 21 percent of them were unable to assess this issue.

Table 40. Extension officers' opinions regarding challenges related to project managers that affecting opportunities for other stakeholders to benefit from the results of AR4D

Responses	%
Lack of linkages between Project Managers and the Agricultural Research System	57
Lack of linkages between Project Managers and the Agricultural Extension System	21
I do not know	21

As for the challenges related to farmers, results in Table 41 indicate that 86 percent of the participant believed that continue applying traditional agricultural practices is the main challenge obstructing farmers' opportunity to benefit from the results of agricultural research, while 7 percent believe that the mistrust between farmers and extension officers is the reason for this challenge.

Table 41. Extension officers' opinions regarding farmer-related challenges negatively influencing stakeholders' opportunity to benefit from AR4D

Responses	%
Performing conventional agricultural practices	86
The lengthy period of time required to build up trust between Extension Officers and farmers	7
Undecided	7

Challenges related to extension officers themselves, listed in Table 42, revealed that 64 percent of the participants believed that lack of sufficient fund represents the top challenge. This serious challenge resulted in extension officers' inability to

benefit from the results of research studies, where it led to inability to equip them with the facilities required for them to be updated on research results thus transfer it to farmers. As of 29 percent of the participants mentioned that extension officers became engaged in tasks other than extension work due to insufficiency of funds needed to perform their original task and due to insufficient extension personnel. The last 7 percent mentioned that they do not know the answer to this question.

Table 42. Extension officers' opinions regarding extension-related challenges negatively influencing other stakeholders' opportunity to benefit from AR4D

Responses	%
Lack of sufficient fund	64
Extension Officers became engaged in tasks other than extension work	29
I do not know	7

Participants responses to the type of challenges negatively affecting Community Development Associations (CDAs) and opportunity to benefit from the results of agricultural research indicate that the majority of them (79 percent) believed that lack of linkages between CDAs and the Agricultural Extension System is the main challenge. The rest of participants (21 percent) believed that lack of linkages between CDAs and the Agricultural Research System is the challenge, as shown in Table 43.

Table 43. Extension officers' opinions regarding challenges negatively influencing community development associations' opportunity to benefit from the results of agricultural research

Responses	%
Weak linkages between Community Development Associations and the Agricultural Extension System	79
Weak linkages between Community Development Associations and the Agricultural Research System	21

The achieved results highlight the importance of providing sufficient resources to strengthen the role of agricultural extension in communicating results of agricultural research to all concerned stakeholders. In addition, there is a need to establish strong and active linkages between the agricultural extension system and involved NARS actors in AR4D projects cycle.

II) Aspects on the implementation mechanisms of AR4D

Previous involvement in AR4D projects

To understand aspects on the implementation mechanisms of AR4D projects, participated extension officers were asked a number of questions, the first of which focused on identifying if they have previously in last ten years been involved in AR4D projects and how. The responses indicated that 43 percent mentioned they did participate in AR4D projects. Out of total participants, 21 percent mentioned

they contributed by selecting and supervising the establishment of demonstration plots at AR4D project sites; 14 percent participated by communicating the problems facing farmers that need to be addressed through implementing AR4D projects. The last 7 percent contributed through transferring knowledge and expertise to lead farmers and their neighbours. However, most extension officers (57 percent) have never been involved in AR4D projects, as illustrated in Table 44 which indicate the importance of addressing this issue through training sessions and guidelines for AR4D to support the involvement of extension officers in upcoming AR4D projects.

Table 44. Previous involvement in AR4D projects

Response	Method of involvement	%
YES	Total	43
	- Selecting and supervising the establishment of a pilot plot at the targeted site	21
	- Explaining those problems facing farmers that need to be studied and tackled through implementing AR4D projects	14
	- Transferring the knowledge and know-how to pioneer farmers and their neighbours on how to apply new technology packages	7
NO	I have never been involved in AR4D projects	57

Exploring extension officers' responses regarding the motivations for their participation in AR4D projects are presented in Table 45. The results show that 88 percent of respondents participated for various reasons. Around 29 percent participated to solve irrigation problems for farmers; while 25 percent participated to help reducing losses in agricultural production; 21 percent participated to solve problems farmers face in plant, animal, and fish production. The last 13 percent mentioned they participated to receive financial gains. This result indicates that most extension officers are motivated to participate in AR4D projects to help farmers and support them to improve their farming operations.

Table 45. Extension officers' motivations to participate in AR4D projects

Response		%
Yes	Total	88
	- Solving problems farmers face in irrigation	29
	- Reducing losses in agricultural production	25
	- Solving problems farmers face in plant, animal and fish production	21
	- Receiving financial benefits	13
No	I have not been involved in AR4D Projects	12

Extension officers' participation in research gap identification

This section aimed to find out if extension officers contributed to the identification of research gaps, and how if the answer is yes. Results shown in Table 46 indicate that 79 percent of them mentioned they participated in research gap identification, while 21 percent did not. Around 29 percent participated through their employers; while

another 29 percent mentioned they participated through Water Users Associations; 14 percent contributed through Agricultural Cooperative Societies; and the last 7 percent participated through NGOs. The results emphasize the importance of providing strong support to enhance the participation of extension officers in research gap identification.

Table 46. Extension officers' participation in research gap identification

Responses		%
Yes	Total	79
	- Through the organization I work for	29
	- Through Water Users Associations	29
	- Through Agricultural Cooperatives	14
	- Through NGOs	7
	- Direct contact with researchers	0
No	I have never participated in research gap identification	21

III) Feedback mechanisms of AR4D

Under this section, participants were asked a set of questions to identify aspects related to the feedback and learning process of AR4D in Egypt.

Feedback mechanism used to report problems stakeholders face during and after the implementation of AR4D projects

Enquiring about the feedback mechanism participants used to report problems that stakeholders encountered during and after the implementation of AR4D projects indicate that 43 percent of the participants mentioned they document problems by writing reports and notifying research institutes or the authority in charge of the most important problems encountered. Another 36 percent mentioned they provided feedback through regular meetings at the Agricultural Research Centre, Agricultural Extension Sector and Agricultural Extension Institute. The last 7 percent of those who provided feedback mentioned they do that by assessing the value added of project and sending the report to concerned authorities. The remaining 14 percent do not follow any feedback mechanism. Such result is a good indication of the important role extension officers play in achieving the impact of implemented AR4D projects, as illustrated in Table 47.

Table 47. Feedback mechanism adopted to report problems stakeholders face during and after the implementation of AR4D projects

Response	%
Writing reports and notifying research institutes or the authority in charge of the most important problems faced	43
Through regular meetings at the Agricultural Research centre, Agric. Extension Sector and Agric. Extension Institute	36
Assessing the value added of project and sending the report to concerned authorities	7
No feedback mechanism followed	14

5.2 Farmers participants in FGD

Farmers are the ultimate beneficiaries of AR4D projects. Therefore, identifying the main challenges that impact their adoption rates as service recipients is a very crucial step towards improving the adoption rate and achieving the targeted impacts of the implemented AR4D projects. To support efforts exerted by Egypt-NARS in the field of AR4D to help develop an integrated and coherent approach for research and dissemination of proven technologies and practices, the study strived to collect new information through organizing focus group discussions (FGDs) with farmers to capture the systemic changes overtime, both drivers and solutions, and understand the resilience of the system to deal with the upcoming development challenges. The current FGD analysis report presents the results of the FGD that was carried out to discuss topics on AR4D with farmers and to collect the data required to cover this part of the systemic analysis to develop the supporting guideline for NARS.

5.3 Characterization of farmers participants in FGD

Fifteen farmers contributed to providing answers to enquiries listed in the comprehensive questionnaire specifically designed for farmers (Annex 1). Before presenting the results, it is useful to describe the characteristics of participants in the FGD. The characteristics of participants, described in Figures 15 and 16, indicate that 67 percent of the farmers are males and 33 percent are females; with average age of 55 years old. In regard to level of education, 40 percent of the participant farmers are illiterate; 27 percent can only read and write while 33 percent are literate.

Figure 15. Distribution of FGD participants by sex

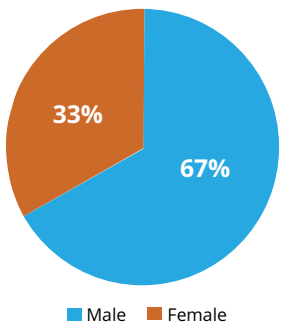
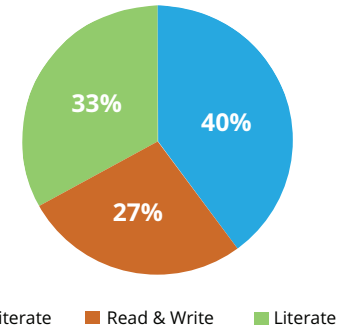


Figure 16. Distribution of participant farmers by level of education



Farmers are key players in the sustainability of any implemented AR4D if they are involved in the final outcomes of AR4D projects. Therefore, their involvement is critically important. It is important to identify the obstacles and challenges they encountered during the implementations of those AR4D projects during the last ten years. The questionnaire designed for farmers aimed to understand farmers'

opinions regarding aspects related to research arrangement and capacity to implement AR4D projects; implementation mechanisms; feedback protocol; and collection of general thoughts about AR4D.

5.4 Agricultural Research for Development (AR4D)

This section targets assessing farmers' beliefs regarding AR4D through identifying their opinions on contributing to decision-making on research topics and the challenges obstructing their opportunities to benefit from the results of agricultural research and the reasons from their perspectives.

5.5 Research arrangement and capacity to implement AR4D

Farmers' contribution to decision-making on research topics

As mentioned earlier, famers' contribution to decision-making on research topics is very important for the success of AR4D projects as they are the final targeted beneficiaries of such projects. This is simply because they are the ones who face real problems on the ground, if any, and when they implement the introduced interventions. Thus, knowing exactly what topics are need to be addressed is essential. Therefore, they prefer and acknowledge those AR4D projects that help them in addressing their needs and providing solutions to their problems. Unfortunately, results reveal that all the participant farmers (100 percent) mentioned that they did not have the opportunity to contribute to decision-making on research topics, which means that there is a need to enhance and activate linkages between farmers and researchers to address this issue to ensure that all concerned farmers are involved in the process.

Actors-related challenges obstructing their opportunity to benefit from the results of agricultural research

Under this question, farmers were asked to respond to a set of choices regarding actors-related challenges obstructing their opportunities to benefit from the results of agricultural research, and to mention the reason(s) in case challenges exist.

Responses obtained from participating farmers based on their relative importance are presented in Table 48. It is noticed that issues associated with extension services ranked as the top (67 percent) challenge obstructing farmers from benefiting from results of agricultural research. They indicated that the reason for this is the lack of sufficient fund for extension services, which lead to the declining role of extension officers in communicating properly the research results to farmers and providing researchers with feedback on the achieved results and other problems farmers faced.

Participant confirmed themselves as the second challenge (53 percent). They explained that the reason is the lack of trust between farmers and actors in the field of AR4D, which leads to farmers' unwillingness to apply research results unless they are successful implementation of recommended packages. Issues linked to decision makers represented 33 percent of the total responses. Participants attributed the reason to lack of communication channels between farmers and decision makers, which affected the research plans that should include topics to address farmers concerns and needs. Therefore, farmers could not, and still cannot, fully benefit from the results of such research studies.

Challenges related to project managers represented 20 percent of responses based on farmers' opinions. They mentioned that the reason is the lack of communication channels with project managers who usually come from outside the local community and thus are not well-aware of all of the real problems that farmers are facing or how to reach to farmers and convince them to adopt the introduced packages that have been designed based on the results of agricultural research.

In regard to challenges related to researchers, it ranked fifth by accounting for 13 percent of the responses received from farmers. Participants believed that lack of sufficient funding to conduct relevant field research studies is the reason which resulted in lack of direct contact between researchers and farmers. Therefore, researchers are not well-aware of all the problems farmers are facing on the ground, which resulted in diversion of their research studies rather than addressing farmers' practical concerns. Farmers did not recognize any role that Community Development Associations (CDAs) play in communicating the results of agricultural research.

When asked about other actor-related challenges, 33 percent of the participating farmers mentioned that the absence of strong and effective official channels between farmers and other actors in the AR4D system, in addition to lack of extension service providers, resulted in "Input Suppliers" interfering in the system, thus becoming the only source through which farmers can get information on newly achieved results of agricultural research. Since the input suppliers are by default unable to properly communicate the results and how to successfully apply them, resulting in farmers not being able to benefit from the results of agricultural research.

The results of this section give an indication of the importance of reactivating the role of extension services in terms of communicating and benefiting from the results of AR4D projects. This can be attributed to the trust extension officers succeeded in building with farmers during years when extension services were strong and active. This fact is confirmed by farmers who ranked themselves right after extension officers in terms of challenges due to lack of trust in other actors along the chain of AR4D system. When combined with the results regarding challenges related to other actors, we conclude that insufficient fund is the main reason for such challenges. In addition, it is important to establish a system that links all actors along the chain of AR4D together including farmers.

Table 48. Farmers' opinions regarding AR4D actors-related challenges obstructing their opportunity to benefit from the results of agricultural research

Rank	Actor	Yes (%)	Reasons
1	Extension services	67	Lack of sufficient fund for extension services.
2	Farmers themselves	53	Lack of trust between farmers and actors other than extension officers in the field of AR4D.
3	Decision Makers	33	Lack of communication channels between farmers and decision makers.
4	Project Managers	20	Lack of communication channels with project managers.
5	Researchers	13	Lack of sufficient fund to conduct field research studies
6	CDAs	0	No recognized role in communicating the results of agricultural research
7	Others: Input Suppliers	33	Input Suppliers interfering in the system as providers of newly achieved results of agricultural research.

I) Aspects on the implementation mechanisms of AR4D

Previous involvement in agricultural research for development projects

to understand aspects on the implementation mechanisms of AR4D projects, participant farmers were asked a number of questions, the first of which focused on identifying their previous involvement in AR4D projects and how. The obtained responses indicate that 47 percent have been involved by agreeing to adopt modern irrigation methods; 40 percent have agreed to adopt new technology packages; and 13 percent have agreed to establish pilot plots in their farms, as shown in Table 49. Such results mean that irrigation problems come on top of the reasons why farmers accept to participate in AR4D projects, as it is a critical issue farmers seek to solve. In addition, a good percentages of farmers are willing to adopt new technology packages in order to improve crop production thus income and livelihood. In regard to establishing pilot plots, the low percent is a logical result, where farmers with leadership characteristics who agree to take the lead in testing new farming technology packages are not usually many in any community.

Table 49. Previous involvement in AR4D projects

Items	Yes (%)
Agreed to adopt modern irrigation methods	47
Agreed to apply new technology packages	40
Agreed to establish pilot plots in their farms	13
Other	0

Farmers' motivations to participate in AR4D projects

Exploring farmers' responses regarding the motivations for participation in AR4D projects presented in Table 50, show that 80 percent of the farmers participated to increase farm income and profitability; while other farmers participated to solve problems encountered in the production process, either irrigation problems (67 percent), soil-related problems (40 percent), or plant production issues (40 percent).

Table 50. Farmers' motivations for participation in AR4D projects

Motivations	Yes (%)
Increasing farm income and profitability	80
Solving irrigation problems	67
Solving soil-related problems	40
Solving plant production problems	40

Farmers' participation in research gap identification

To find how did farmers contribute to decision-making, farmers were asked question on how they contributed to identifying research gaps. Results in Table 51 indicate that all of them participated only through extension officers, which emphasizes the importance of reactivating and enhancing the role of agricultural extension services in AR4D projects.

II) Aspects on the monitoring and evaluation of AR4D

Under this section, participant farmers were asked a set of questions to identify aspects related to the feedback mechanism adopted on AR4D projects. The results indicated that all participant farmers (100 percent) had the chance to make their feedback on AR4D projects and reported problems that occurred during and after the implementation of project activities. However, farmers indicated that their feedback and suggestions were not taken into consideration. Farmers were asked about the sustainability of the project outputs after the project completion. All of them (100 percent) confirmed that there was no sustainability in terms of providing services after the project completion.

When asked farmers to evaluate the achieved impacts, all farmers indicated that they got high positive impacts through increasing household income by solving irrigation problems and improved productivity as a result of AR4D projects. Farmers were asked about their opinion on addressing the main challenges associated with AR4D from their perspective. They indicated the following:

1. The main action that could help in overcoming the encountered challenges is providing sufficient funds for:
   - reactivating and enhancing the role of agricultural extension service;
   - conducting on-farm research studies relevant to their needs.
2. Establishing an official entity responsible for ensuring the sustainability of the implemented AR4D projects through designing a post-implementation plan for implemented projects.
3. Establishing a communication system that provides linkages between all actors in the AR4D system including farmers.

5.6 Key informant interviews (KII) analysis report

Key informant interviews (KIIs) are qualitative in-depth interviews that help in obtaining direct knowledge about topic of interests. This method is useful in all the phases of AR4D implementation, including identification of existing problems, research planning, project design, monitoring and evaluation, feedback mechanisms, and impact assessment of the AR4D projects. KIIs are useful in collecting qualitative and descriptive information required to better understand aspects related to the successes and shortcomings of the subject of interest for further improvements.

5.7 Characterization of participants

Twenty-five (25) interviews were conducted with key informants at various locations in Egypt including national, regional, and international experts working at different institutions and organizations. The interviewed experts included 84 percent males and 16 percent females as illustrated in Figure 17. Regarding affiliation, as shown in Figure 18 the interviews were diverse in institutions and technical backgrounds where 22 percent of the KIs work at universities, 38 percent work at research centres and 40 percent work for regional and international organizations.

Figure 17. Distribution of key informants by sex

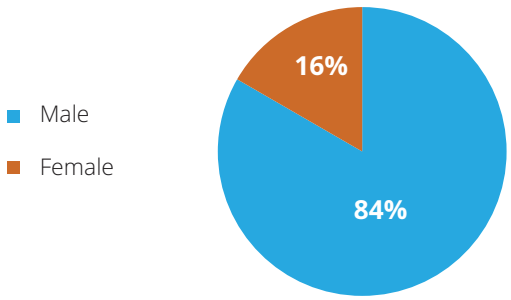
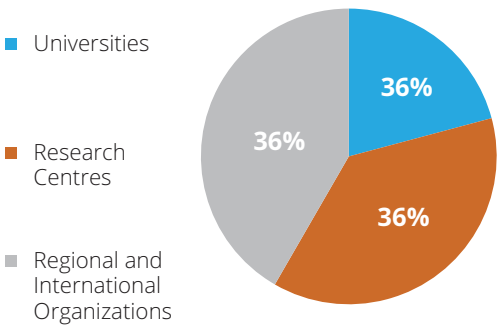


Figure 18. Distribution of key informants by affiliation



During the interviews, KIIs were asked to contribute to this assessment by providing their thoughts through a particular set of questions listed in the comprehensive questionnaire specifically designed for that purpose (Annex 3). This section highlights details of Key Informants' opinions regarding the topics discussed during the interviews.

I) Implementation of AR4D

Identification of research agenda and priorities

The experts were asked about the research agenda and priorities identified by NARS. All of the interviewed KIIs mentioned that NARS in Egypt identifies the country's research agenda and priorities based on national development goals. However, 57 percent of them mentioned that in some cases, the NARS agenda is affected by donor's interests, driven by specific funding opportunities. An example in this regard is the case of the Science, Technology and Innovation Funding Authority (STDF) that announces calls for research proposals without the alignment with the country's strategies. Another 43 percent mentioned that NARS's research agenda is mainly informed by national strategies that properly based on the country's priorities. While some topics in the research agenda, such as food security situation, remain unchanged significantly for several years, specific research topics can also be identified in response to urgent needs, e.g. change in global markets, pandemics as the case with COVID-19, etc.

Identification of AR4D topics

Focusing on how and to what extent topics on AR4D priority list are identified, 43 percent of the interviewed KIIs mentioned that AR4D topics are aligned with Egypt's Sustainable Agricultural Development Strategy 2030, and that they are well identified; while 29 percent mentioned that despite AR4D topics are linked to national strategies that set priorities for the country based on national development goals, in some cases the agenda is influenced by donor interests. Moreover, 14 percent of them mentioned that the high technical council inside the NARS identifies and decides on the AR4D topics, while another 14 percent said that in the past, the technical councils used to select the research topics, but nowadays, researchers present their ideas, and the technical councils approves them. Accordingly, part of the conducted research studies does not serve the national targets of the country. In addition, lack of coordination between research institutions and exchange information on research plans during the ten years led to redundancy in research projects and subsequently inefficient use of available resources.

Relevance of AR4D projects to country priorities

This question focused on getting KIIs' views regarding the relevance of AR4D projects to the country's priorities. Answers revealed that most of the KIIs believed that the implemented AR4D projects are mostly relevant to the country's priorities. The main reason for their opinion is that most of the AR4D projects are demand-driven aiming to address prevalent and key development issues in the country. An example of AR4D projects relevant to the country's priorities is a Project titled "Improving on-farm Irrigation" that was funded by IFAD and the World Bank based on the country's request. Although this is relevant to the broader area of research, specific supply-

driven AR4D projects could be demand or supply-driven based on the level of effort invested to understand the specific needs of the communities or institutions they intend to benefit. Another reason they mentioned is that Egypt's National Strategy 2030 comprises of main programs in which research projects during the ten years were based on the Sustainable Agricultural Development Strategy 2030 to achieve priorities of the country's sustainable development goals. However, 25 percent of the interviewed KIIs believed that the implemented AR4D projects during the last ten years were not relevant to the country's priorities due to the fact that Higher Technical Research Councils at the research institutions granted approvals for AR4D projects regardless of the country's development strategies or priorities.

AR4D projects demand-driven vs supply-driven

It was important to understand whether the existing research structure is supply-driven or demand-driven. Answers received from the interviewed KIIs indicate that 58 percent of them believed that AR4D projects during the last ten years were supply-driven and linked to research priorities targeted in the country's national development strategies. They provided the following explanations:

- during the last ten years, AR4D topics are supply-driven and not reflecting community needs, unless donors request pre-assessment as initial phase of the project;
- most of researchers did not conduct their research based on actual problems; it is rarely to find someone who did. That is why AR4D projects were designed based on researchers' interest or on donors' guidance, not according to research priorities of the country's development strategies, which means AR4D projects were mostly supply-driven;
- AR4D projects were mostly from a top-down approach which affected accountability because decisions came from top and were centralized;
- AR4D research topics should be identified by national priorities to support the national development plans or solve problems facing implementation of development projects or serve goals of increasing productivity, water and food security, natural resources protection, environment, etc.

Another part of the interviewed KIIs (25 percent) think that AR4D projects are mostly demand-driven, providing the following explanations to support their argument:

- AR4D topics are set based on combination of the mandate of the institutions and national policy and strategy. In some cases the AR4D topics might sometimes deviate when funds are provided by donors for specific topics that are not identified in national priorities;
- AR4D projects were set to meet policy demands that seek to respond to the country's needs and therefore they are demand-driven;
- AR4D projects in the country are designed to solve prevalent and key development issues thus they were demand-driven. Though this is true for the broader area

of research, specific AR4D projects could be demand or supply driven based on the level of effort invested to understand the specific needs of communities or institutions they intend to benefit. However, in some cases the projects can also be supply driven when led by donor interest. In the latter case, though the donor agenda are often aligned with national strategies, the topic may not be a priority at the national or community level.

The remaining 17 percent of the interviewed KIIs believed that AR4D projects during the last ten years were mix between supply-driven and demand-driven for the following reasons:

- most of the projects funded by external donors were designed based on donors' interests regardless of the country's research priorities. Additionally, the fund continuity conditioned by their policy's implementation. Some of the donors request to adjust the country's policy as a condition for granting the fund such as the economic reforms dictated by the World Bank as conditions for granting loans to Egypt, including waving of inputs' subsidy to farmers, floating exchange rate, etc.;
- lack of connection between research and industry. This link might appear if individual research institutes want to invest in the industry but there is no clear national policy in this regard.

AR4D projects implementation in last ten years

Half of the interviewed KIIs agree that AR4D projects implemented during the last ten years have considered or addressed applicability, adoptability, affordability, gender sensitivity and environmental impacts of the implemented interventions or introduced technologies. Experts provided the following explanations on how that was addressed:

- AR4D projects when they are demand-driven and have produced good results that either solve or reduce the extent and scope of the challenge faced, or provide greater benefit and improved livelihoods, can be considered applicable and tend to have greater chances of generating interest for outcomes and wider adoption. However, sustainable adoptability of introduced technologies and innovative practices will depend on its scale of accessibility and affordability by farmers;
- donors' and governments' increasing focus on sustainability and impact over the past ten years, has also pushed AR4D projects to have well defined impact pathways and theories of change that consider key factors including applicability, adoptability, and affordability of introduced solutions. While the same driver applies for AR4D projects to consider gender integration and potential environmental impacts of project interventions, these have not been embraced as much. This is because understanding of gender considerations is still lacking and is heavily influenced by cultural and religious perspectives that supersede recommended research outputs. Moreover, environmental impacts take time to

demonstrate and are often unattainable within the scope and duration of many AR4D projects;

- there is a trend to consider impact, inclusiveness and sustainability of technologies and their impact but the sustainability of this trend depends on the AR4D national context;
- most of donor funded AR4D projects considered these aspects in their projects' cycles;
- the implementation of AR4D projects mainly depends on the technical personnel responsible for the project.

However, 40 percent of the interviewed KIs disagree and reported that the AR4D projects implemented during the last ten years have not considered or addressed applicability, adoptability, affordability, gender sensitivity and environmental impacts of the implemented interventions and introduced technologies. They provided the following explanations on how that occurred:

- scaling out/up at scale in Egypt is not an easy process because aspects regarding applicability, adoptability, affordability, gender sensitivity and environmental impacts are not usually taken into consideration during the implementation phases;
- there should be a prototype, trials, and preliminary studies before implementation. For example, the wastewater treatment plant in Elgabal Alasfar has a very big capacity in one station in one place. The problem here is, if something went wrong in the station, all the treated wastewater will be affected. In addition to that, when plans were made during building this station was carried out, the land uses around the station was not taken into consideration. Accordingly, the only option was to discharge the treated wastewater back to the drains instead of safe reuse in agriculture.

Few experts (10 percent) think that this is a difficult question to answer, since it is impossible to generalize, or to be aware of the status of every single project implemented during the past ten years. However, they believe that most of the externally funded research projects or those funded by the Academy of Scientific Research and Technology must be identified, selected and evaluated against these parameters.

Beneficiaries' ownership and sustainability of AR4D projects outputs

The majorly of interviewed KIIs (75 percent) agreed that AR4D projects implemented during the last ten years have considered or addressed the beneficiaries' ownership and sustainability of the introduced solutions through participatory or community-based approach and they supported their conclusions based on the following observations:

- although it is difficult to generalize, the efforts to engage farmers have increased over time in last ten years where their participation takes different forms and in some cases it is facilitated through structured discussions while in other cases it

happens through various occasions such FFS, field days or training workshops. As compared to ten years ago, farmers are currently more aware of the challenges they are facing and the need to address them through seeking support from extension and advisory services. Both male and female farmers became more open to freely express their opinions, concerns and feedback on technologies promoted to them, thus increasing opportunities to have their voices heard and considered in further AR4D projects;

- another factor for increased engagement of farmers in AR4D projects is based on the expectations of donor for farmers to be included in the project design and implementation to deliver targeted impact and access their financial support. This has increased the need to involve farmers in training and open discussions facilitated through field days, FFS and focus group discussion and other opportunities for individual or group engagements. However, more work needs to be done to encourage this trend though formal channels of communication that can inform research agenda and provide feedback on promoted technologies and agricultural practices:
- beneficiaries' ownership depends on the scale and nature of the problem. For example, when it comes to food security it becomes ever one business. It is then easy to get beneficiaries involved and transfer research ownership to them. It is sought also through user participation in planning and implementation of research, especially when it is carried out in research stations and pilot fields with beneficiaries' participation and farming community involvement. Sustainability of solutions is not always the case because it needs more than just the participatory or community-based approach. But it needs a strong communication strategy combined with a good handover of the project to local communities.

The real needs should be collected from the farmers themselves. Because farmers are usually clear in determining their needs and most of them have common needs. Farmers need responsive extension services that provide them with reliable and updated information about their farming practices. The problem here is the lack of coordination and communication between end users and decision makers therefore the concerns of farmers are not properly addressed and as a result the adoption and sustainability of the AR4D outputs are not at the expected level.

Monitoring and evaluation system in implemented AR4D projects

Enquiring from KIs if they think that AR4D projects implemented in last ten years had a proper and reliable monitoring and evaluation system that ensured the proper implementation as planned. The responses indicated that 36 percent of experts believed that the implementation included a good monitoring and evaluation system while the majority (64 percent) of the experts reported otherwise and the following points support their conclusion:

- while monitoring and evaluation is a key part of a successful AR4D project, it is often the part of the implementation process that is less prioritized. In

most cases funds for monitoring and evaluation are rarely included and/or underestimated. Therefore, problems occurred during the implementation are not timely addressed and not documented at the end of the project. In addition, the absence of M&E in the project cycle led to insufficiently documenting the project outputs and lessons learned. Projects final evaluation was also missing in many projects. It is, however, possible to have an effective M&E system in place when it is part of the initial design of the project with sufficient budget allocation and implemented by well-equipped monitoring and evaluation experts;

- donor funded projects include M&E as main part of the project design while local funded projects are sporadic and may or may not include M&E thus many AR4D programs have ended up with limited results due to poor or absence of M&E system. Therefore, global and regional ranking systems of research institutes forced several research centres to improve research quality through proper implementation of M&E system to comply with international standards;
- in many of the projects, there was no real evaluation for how well the project activities have been implemented. The focus is only on financial auditing, which only targets money spending on each activity.

It is worth mentioning that even the experts who think that AR4D projects implemented in last ten years had a good and reliable monitoring and evaluation system, they also indicated that these M&E systems were irregularly implemented. In addition, most of implemented M&E systems were for donors' funded projects and ends with project closure.

Stakeholders' feedback in implemented AR4D projects

Another important aspect to cover in this section is exploring the interviewed KIIs reflections on how the stakeholders' feedback was considered in the implemented AR4D projects over the last ten years. Responses revealed that considerable number of experts (21 percent) confirmed that there was no feedback mechanisms, about half of experts reported that the stakeholders' feedback was considered providing the following justification:

- there is a trend with incremental adoption of stakeholders' inclusiveness and feedback with some emerging good practices, not only in the implementation of AR4D projects, but also during the design and inception phases;
- some of the implemented AR4D projects considered feedback mechanisms through questionnaires, field days, stakeholders' validation workshops, FGDs, media, etc.

Accountability mechanisms for delivering efficient AR4D projects

Responses received from KIs regarding the existence and implementation of accountability mechanism was not clear. However, respondents reported that there is a room for improvement through providing (1) special training on project

management, (2) incentive to take more responsibilities in managing AR4D projects, (3) technical guidance, especially in projects across multiple disciplines, (4) training on monitoring and evaluation systems to ensure timely and efficient delivery of research outputs, assure quality in research and output generated, etc.

Others explained that accountability and good governance are not specific to AR4D's achievement of defined target against dedicated resources. The overall transparency and accountability of public policies for the public sector is tributary of the accountability mechanisms in the public sector with their limitations. Review committees, formal auditing, evidence of deliverables are often in place but the efficiency of such mechanisms raises many questions. In many cases, these measures are just administrative and bureaucratic activities to conclude projects and programs with limited or no follow up on the value of money or financial efficiency. Due diligence is not part of the accountability process all the time.

Sustainability and exit plans of implemented AR4D projects

The goal here was to determine KIIs opinions regarding sustainability and exit plans in implemented AR4D projects during the last ten years. Most of experts who answered this question partially agreed that sustainability and exit plans are conducted for the implemented projects if the project was externally funded or the project was planning to establish a small farm or farm business that sustain after project completion such as diary or processing plant, greenhouses agriculture, aquaculture activities, etc. Individual experts indicated that developing exit plans is increasing particularly in co-financed program with public and external funding. Based on this, they emphasized the need for incorporating a strategy that focuses on defining the problem, the solution, pilot, and testing of AR4D projects. Some of the interviewed experts confirmed that there was no sustainability of the implemented projects and indicated that when the project was initiated, there were sufficient capabilities, either financial or institutional, but at the conclusion of the project, there were no funds allocated for continuity or follow up.

5.8 Challenges in AR4D

This section aimed to identify Key Informants' perspectives regarding challenges related to AR4D in Egypt through responding to a specific set of questions.

Challenges related to funding

This section focuses on fund-related challenges. The results indicated that insufficient funding is the main challenge for AR4D as reported by 75 percent of the interviewed KIIs, particularly when the project depends on public funds, where national budget allocation for research is very small fraction of the country's GDP. Dependency on donors and the associated fluctuations in fund availability accounted for 25 percent of the responses regarding fund-related challenges. KIIs explained that AR4D projects

have higher chances of success when external funds from international or bi-lateral agreements are available. Fund fluctuations due to dependency on the flow of external funding may result in disabling the national research organization to design and implement long-term research plan or to fully address the research gaps based on community needs. They further explained that the main reason for such fluctuations is the instability in terms of policymaking Egypt has faced during the political instability after January 25, 2011, where it resulted in a decline in the total available fund. Some of the interviewed KIIs (13 percent) believed that there is no issue in fund availability, but the lack of a clear vision is the challenge that affects fund allocation and management.

Updated AR4D facilities in Egypt

Investigating KIIs' views regarding continuous update and upgrade of available resources and facilities the NARS depend on in conducting their AR4D. The results indicate that 60 percent of them believe that the NARS's facilities are up to date. They expressed the following:

- NARS's resources and facilities are adequate, but still need enhancement and accreditation. Some of the large projects such as The National Agricultural Research Project (NARB) and Agricultural Technology Utilization and Transfer (ATUT) contributed significantly to upgrade the facilities of Agricultural Research Centre (ARC);
- facilities are up to date, but they are scattered over a range of institutes. This may result in challenges if there is a project that needs a given technology and this technology is divided between institutes. In addition, there is no inventory and mapping of facilities and their accessibility and use protocols, i.e. if a researcher wants to perform a certain test using certain instrument, they good not have access to such instrument. Moreover, most of the expensive equipment needs high maintenance and operational skills. There is no link or collaboration between those institutions that operate different research facilities;
- some of research facilities are well equipped with advanced laboratories, while most are in dire needs for upgrades. However, such upgrades require high cost that is not considered in most AR4D projects.

I) Impact of AR4D

AR4D link to research priorities of the country

We designed this section to determine KIIs' opinions regarding the link of implemented AR4D to the country's research priorities. The key informants' opinions indicated that the majority of them (86 percent) believed that AR4D projects in the last ten years were somewhat linked to the country's research priorities and they provided the following points to support their conclusion:

- in general, AR4D are determined according to the country's National Strategy that contains the research priorities where donors sometimes respond to countries

requirements in agricultural development. For example, Improving On-farm Irrigation is a national project, where IFAD and World Bank provided funds for implementing the project based on the country's request. However sometimes AR4D projects do not match with donor's interest and priorities whether the donor is local or foreign. For example, the STDF announced a certain call for research without considering the country's strategy or priorities of research areas;

- in theory, as the AR4D is executed using public money, and therefore each AR4D should be aligned with the national strategy in their domain of expertise. However, in realty this is not the case in most projects;
- AR4D projects depends on the agriculture investment plan. The agriculture investment plan constitutes of both public and private investments. The public investment, focuses on the infrastructure such roads, networks grids of water and electricity, agriculture research institutes core facilities, and extension service structure. While private investment, depends mainly on public investment, and it cannot operate without it as they provide software facilities such as capacity building, technologies, technical expertise and innovations;
- most of the national priorities are already aligned with global development goals, which create common grounds for interest and collaboration. National research priorities could link with regional goals as well as the goals of other international actors outside the region. In this connection, AR4D efforts are linked to the international research agenda through the country's commitments to international initiatives such as MDGs and SDGs as well as food security and rural development programs of international and regional agencies such as FAO, IFAD, ICARDA, World Bank, AOAD, USAID, CIDA, JICA, etc.;
- in countries with a national strategy (agriculture, water, rural development, etc.), the research agenda is set by the mandate of the research institutions and then by the objectives and targets of the various strategies. Yet with lack of sustainable funds, externally funded project might force some component to be dropped off from the research agenda;
- in principle, NARS are often committed to meet agricultural development challenges in different sectors such as water, land, technologies, extension services and food systems. AR4D projects and programs funded by the public sector are expected to address defined priorities within a strategic plan (usually five years) and the long-term strategy is based on annual work plans and defined set of deliverables;
- AR4D does not always meet the needs of the community. However, the updated version of the 2030 strategy has been released recently and therefore AR4D projects have been incorporated to serve the country's strategy and sustainable development goals.

Impact of implemented AR4D projects

To explore if implemented AR4D projects during the last ten years have achieved the targeted impacts on small-scale farmers, KIIs were invited to express their opinions

regarding this issue. Based on the received responses, it was noticed that only 20 percent of AR4D projects have achieved the targeted impacts, one example of these projects was the long term investment in AR4D on mechanized raised bed (MRB) technology from 2005-2020, where it resulted in significant increase in crop yield by 20 percent-30 percent and at the same time reduced crop water use by 25 percent. The following reflections this regarding impacts were observed:

- it is not a common practice that the project team measures the impacts after the project closed;
- most of the projects had short duration (e.g. 1.5-3 years) which makes it difficult to measure the impact at the local level;
- during the past ten years, AR4D projects have made incremental advances to achieve impacts in some areas e.g. development of improved crop varieties, improvements in water-use efficiency, etc. However, it is important to note that the challenges faced by small-scale farmers are very complex and include socio-economic (e.g. alternative sources of income, education, access to credit, policies and enabling environments, etc.) as well as bio-physical challenges (e.g. scarcity of natural resources, climate change, etc.) that all are inter-related. The desired impact of improving the livelihoods of small-scale farmers requires continued investment in research and large-scale technology dissemination efforts to achieve the set targets sustainably and equitably.

Influence of AR4D projects on policy and decision-making

The key informants' opinions on the reflections of the AR4D outcomes on decision making at national level were assessed. The respondents indicated that all of them believe that it depends on the potential scalability of the outcomes and outputs and their alignment with national strategies, then their chances of being up scaled to influence policy and decision-making. In other words, the leading projects with large evidence of impact at large scale are often expanded and replicated. Yet many projects with quite interesting results end up in final reports or at best in a peer reviewed journal paper with no real impact to small scale farmers. An example of one of these projects that showed desirable impacts is adopting the mechanized raised bed technology implemented across the country, which led to a sizable impact on farmers' livelihoods and resulted in irrigation water saving. The great outcome of this large impact is the attraction of both local and foreign donors to largely invest on this technology to cover more areas. The government of Egypt invested in this technology to scale it by targeting to cover 800 000 ha by 2023.

II) General thoughts on AR4D

NARS performance in implementing AR4D

The section aims collect general thoughts from KIIs' regarding the performance of NARS, level of satisfaction with the NARS's efforts in implementing AR4D,

reasons behind the expressed opinions and key areas for improvement. In regard to NARS performance, some of the interviewed KIIs see that performance of the NARS in Egypt is good and efforts in the implementation of AR4D last ten years are satisfactory due to the fact that the NARS works with all development stakeholders. Others explained that the NARS closely work with policy makers and with key government, ministries engaged in AR4D activities, including the Ministry of Water and Irrigation, Ministry of Agriculture, and other entities as well as international research institutions focusing on different areas of AR4D. These connections positioned them as a strategic link between research and development, and resulted in the establishment of policies and institutions that can facilitate technology scaling initiatives.

Others believed that the NARS is comprises of a large number of research institutes in Egypt. However, the enabling environment and regulations need to be improved for better performance and satisfactory implementation. Also, self-guidance and motivation need to be enhanced to change from being dependent to be independent. They added that many efforts and funds are exerted but the return is not proportionate to the value of investment. One of the problems faced in this regard is that there is no proper documentation of the conducted research studies, thus the results were not publicized and recognized as needed. Documentation and communication system should be established, empowered, and enhanced to properly document all implemented efforts whether it was a success or not.

The interviewed KIIs from international organizations mentioned that, as one of the strong collaborators in AR4D efforts, ICARDA views the contribution of NARS as invaluable. NARS are well connected and have an established network of offices across the country, which allows them the opportunity and flexibility to implement and manage projects. They are also equipped with large experimental sites and a large spectrum of disciplines that can be harnessed to effectively implement AR4D activities. However, the cumbersomeness of the institutions and the bureaucracy associated with running public offices, which requires several formal approvals, can delay implementation and deny researchers the flexibility needed to steer research agenda and make quick decisions. Other challenges include the lack of engagement of young researchers and scientists, and insufficient and inefficient flow of information between research and extension (even though NARS are closely linked with extension services).

Other KIIs believe that lack of innovation in research at some institutes and lack of opening for competition reduced their less-than-satisfactory performance, compared with the situation in the 1980s and 1990s. It is mainly due to lack of interest and support from the government. They now prefer readily available rather than building their capacity to innovate and adapt technologies as needed.

Key areas for improvement in AR4D implementation

This section focuses on collecting ideas about the key areas for improvement in the implementation of AD4R, which helps in setting the recommendations and supporting guidelines for better implementation of AR4D. The following responses were obtained:

- regular and sufficient funds for AR4D projects should be secured;
- it is essential that research institutes start incorporating a strict and efficient M&E system with proper fund in the implemented AR4D projects, in addition to proper documentation of the project achievements and lessons learned;
- engaging the NARS with private sector is important to drive innovation to industry and create wealth for NARS to explore and involve new areas of research and topics;
- strengthening the extension system considered essential to link research to development and realize the desired impact. The extension system should also be expanded to include other players such as NGOs and the private sector for a broader and more pluralistic extension system that is flexible and can inclusively reach different beneficiary groups;
- effectiveness of AR4D projects could also be enhanced by creating an enabling environment that facilitates sustainable adoption of proven technologies. These include financial institutions that provide credit, reliable input and output markets, policies on land tenure, etc.;
- raise the political will to incentive the AR4D sector;
- the country should allow end-users to express their needs and match its strategy with the needs assessment developed by stakeholders. Thereafter, the country should support those research projects as priority that match both the strategy and the needs assessment. In addition, feedback should be performed in every step of AR4D implementation;
- it is crucial to strengthening the link between research outcomes and policy makers to ensure results-based decision making where research is necessary to generate evidence needed for policy makers and development agencies to bring results-based effective and sustainable change;
- it is highly important to encourage the involvement in AR4D through linking researchers' promotion and upgrading to AR4D that the research staff achieved over a certain period based on clear criteria and guidelines;
- capacity building and continuous training for the research staff to overcome the skill gaps that identified through this assessment or any other training needs assessment;
- strengthening the coordination between research entities engaged in AR4D, including private sector is critical to achieve the targeted impacts.

Key-recommendations to improve AR4D in Egypt

Interviewed KIIs provided a variety of recommendations and suggestions on various aspects related to implementation of AR4D. The provided recommendations hereafter are listed based on its relative importance as indicated by the key informants:

- establishing and enhancing linkages (partnership, twinning, coordination, alliances, etc.) between institutions engaged in agricultural research, including those inside the National Agricultural Research System (universities and research institutions) and those outside the NARS (international organizations, private sector, and industry) in order to co-create innovation and knowledge through mutual interests to fill in the knowledge gaps;
- improve agricultural education system; including upgrading the education curriculums and syllabus at college's level and continuous on-the job training for research staff to meet the local and international standards;
- strengthening stakeholders' participation including small-scale farmers and other end users to ensure that they have a prominent role in the development plans via contributing financially and technically in the full cycle of AR4D projects. Private sector should also have a role in AR4D activities whenever and wherever applicable, where it can help increase impacts of the implemented projects and share with the government the cost of implementation;
- as an invaluable integral component of the NARS, it is very important to strengthen the agricultural extension system to capitalize and utilize the results achieved from successful AR4D projects;
- there should be a mechanism for strategy development that avoids redundancy and provides for all stakeholders to contribute to one national target;
- establishing a strong documentation strategy that includes portfolio of implemented projects, success and failure stories, lessons learned, policy briefs and technical reports;
- establish a technical database that contains all fields of agricultural resources and lists of technical experts with their level of expertise from different national research centres, universities and private sectors in order to be easy approached whenever needed to design a national research plan;
- decentralization and down-up approaches should be promoted so the research organization work independently within the strategic framework of agricultural development with a democratic system where decentralization enables the institutions to seek what benefits them without going through bureaucratic regimes which in many cases cause delays in implementing AR4D projects:
- ensure a multidisciplinary vision in the pre-implementation phase of AR4D projects, in which applicability, adaptability, affordability, gender sensitivity, and the environmental impacts are all well considered;

- there should be clear coordination mechanisms between donors and national research partners including coordination between donors themselves and coordination between research partners themselves. Such coordination mechanism will ensure that the donors' agenda alignment with country national priorities in agricultural research and will avoid possible conflict, overlaps and duplications of areas of intersection between different NARS actors;
- establish an AR4D unit overseeing and mapping all projects and work as link between industry and relevant research units or divisions to provide appropriate solutions. The unit also act as a central audit mechanism to ensure commitment of government implementation agencies to apply proven research findings in practice at the large scale.

III) Institutional coordination between NARS actors

Institutional set up in the research organizations in Egypt

Most of research organizations in Egypt are mainly public and centralized institutions belong to different ministries. The key informants explained that many research institutions and universities that work on agriculture related issues are often operate as silos, and in many cases, there is a redundancy in functions and overlap in mandates between different institutions belonging to different ministries with low or no functional operationalized coordination protocols. For example, the case of Soil, Water and Environment Research Institute under Ministry of Agriculture and Water Managements Research Institute under Ministry of Water Resources and Irrigation where both have very similar functions and mandates. This discoordination resulting in duplication of efforts and inefficiency in resource utilization. They also believe there is heavy bureaucracy that hampers competitiveness and complicates achieving the desired outputs. Strengthened collaboration among these institutions could create great opportunities for more integrated and system-level research that addresses the complexity, inter-connectedness, and multi-disciplinary nature of the dynamic challenges in the agriculture sector and hence the solutions that are sought. Improvements in intra-department collaborations within the research institutions could also create integration of research themes and disciplines.

However, few key informants disagreed with the above conclusions as they mentioned that the coordination between research organizations in Egypt is satisfactory to a reasonable extent at the planning and decision-making level. Although there is a coordination between research centres at higher management level, there is less or no coordination at the operational level. However, there were some successful examples of cooperation and coordination, e.g. the management of water and salinity of the Nile delta project, another successful example is the national project on-farm irrigation management.

Intra/Inter-institutional coordination, integration and collaboration between NARS actors in Egypt

Assessing intra/Inter-institutional coordination, integration and collaboration between NARS actors is somewhat a complex task therefore; the interviewed KIIs did not give specific responses to this part. However, one-third of the key informants assessed intra/Inter-institutional coordination, integration and collaboration between NARS actors as weak and needs major improvements. They explained that this matter relates to the implementation process, because collaboration policies between different NARS organizations in Egypt theoretically exist but not enforced in the ground.

For different actors to collaborate there should be mutual interest and trust, but unfortunately in reality there is lack of trust because the intellectual property laws are not yet strengthened and enforced in Egypt. Another reason explained is the low coordination between research organizations and the weak link between senior managements in actors' institutions. Therefore, decision makers should enhance investment in integrated joined projects that bring all different and relevant stakeholders together to address one common goal.

Existing strategy to strengthen the linkages between research organizations in Egypt

Responses received regarding the existence of a strategy to strengthen linkages between research organizations in Egypt revealed that the majority (80 percent) of key-informants mentioned that there is a collaboration program in the Egypt Vision 2030 but this program still limited to committees meetings held periodically within theoretical collaboration frameworks with very little reflections on the ground. The high-level Research Councils in general are more focused on administrative management than institutional technical performance within coherent and clear policy where NARS needs to effectively communicate with each other and work together to address common challenges and achieve common goal. Few KIIs (20 percent) reported that there is a main program in Egypt's Strategy in which research projects that serve the country's strategy and sustainable development goals is incorporated.

Perceived challenges for collaboration between research organizations

Under this section, the interviewed KIIs were asked to select which of the listed main perceived challenges for collaboration between research organizations they believed is most important from their points of view. Responses illustrated in Table 51 indicate that lack of will to collaborate come on top of the perceived challenges, followed by lack of resources, lack of knowledge about other organizations, inadequate policies and regulations, competition, socio-culture norms and finally lack of trust.

Table 51. Main perceived challenges for collaboration between research organizations

#	Main perceived challenges	Rank
1	Lack of will to collaborate	1
2	Lack of resources	2
3	Lack of knowledge about other organizations	2
4	Inadequate policies and regulations	3
5	Competition	4
6	Socio-cultural norms	5
7	Lack of trust	6

Key-points to improve cooperation among NARS in Egypt

Reviewing opinions that KIIs expressed with respect to the key-points to improve cooperation between agricultural research organizations in Egypt, indicate that enhancing collaboration between different actors could be through research alliances and implementing joint projects and introducing collaboration polices regarding data sharing and incentives for collaborative research. The KIIs also reported that improving and enforcing the existing cooperation mechanisms is the way to improve the linkages among NARS actors. Other points expressed by the KIs is to improve the high-level leadership capacities in NARS and upgrade the structural role of the Ministry of Higher Education and Scientific Research with more inclusiveness of AR4D with wider scope aligned with the national research priorities.

Link between extension and advisory services and research at national level

In this section, the national agricultural extension system in Egypt is already a core component of the agricultural sector and the agricultural research centre. However, all of the interviewed key-informants indicated that the current extension system is weak in terms of delivering advisory services for several reasons. The main reason is the inadequacy of fund thus the extension officers are outdated and unequipped with proper facilities. In addition, the system is currently facing structural challenges that require a long-term reform strategy including the recruitment process and long-term capacity building of extension officers.

Regarding the effectiveness and performance of the current linkage between research and extension, most of the KIIs believe that the current linkage is weak and needs major improvement in many areas of improvement. They explained that the link between research and extension in the past used to be strong when sufficient funds were available, but currently it is deteriorated because resources required for extension services to perform effectively are insufficient and declining. One of the reasons for this situation is that research institutions engaged in agricultural-related issues often operate separately, resulting in inefficiency in resource allocation and utilization.

Strengthening the linkages between research and extension

Agricultural research and extension systems are interrelated systems and both functioning under the Ministry of Agriculture and Land Reclamation. However, declining the annual budgets for research and extension in the last ten years resulted in barely covering the wages and salaries with insufficient allocation for research programs and activities, and the associated extension services. To overcome this challenge, Egypt's new constitution set the target of raising the share of expenditures on research and development as percent of Gross Domestic Product (GDP) to at least 1 percent, which is expected to have positive impacts on improving agricultural research and extension sectors, subsequently in the linkage between both.

In addition, Egypt's Sustainable Agricultural Development Strategy towards 2030 (SADS 2030) comprises a number of development programs and projects to achieve agricultural development, of which the "National program for agricultural research, extension and technology transfer" was designed to strengthen the linkages between research and extension through the following six sub-programs:

- developing agricultural extension modalities and approaches, through technology transfer;
- maximizing the sustainable levels of human resources and the productivity of both land and water;
- protecting the qualitative and quantitative characteristics of agricultural natural resources;
- applying modern technology to the development of disease and pest-resistant crop varieties, and climatic and environmental adverse conditions tolerant varieties, as well as reducing the period needed to develop new varieties using modern approved biotechnology tools;
- promoting the productive efficiency of livestock, poultry and fisheries;
- positively responding to the probable adverse effects of the climate change on agricultural production;
- keeping abreast of global scientific research developments in the field of nanotechnology;
- evaluating generated technology packages based on economic return.

Moreover, the Agricultural Development Axis 2019 is comprised of a number of programs, initiatives and action plan, the 10th of which is "Research, Extension and Technology Transfer", which aims to:

- continuous development of agricultural extension and technology transfer techniques and methodologies;
- use modern technologies in the production of resilient varieties to diseases, pests, and inadequate climatic conditions;

- contribute to addressing the impact of expected climate changes on agricultural production;
- support and develop the required organs to enforce the agricultural ITC efficiency.

Strengthening the linkages between extension system and farmers

The strategy in place to strengthen the linkages between extension and advisory system and farmers is one of the main targets of the SADS 2030 through adopting an "Agricultural Extension System Development Policy" that aims to:

- restructure the agricultural extension system and laying down a detailed business plan for its reform;
- design and executing intensive programs for the training of extension officers in the different specializations needed;
- reviewing working procedures with a view to their development and for exercising coordination within the extension system, as well as with research;
- introducing a transparent mechanism for monitoring and evaluating extension activities, with the participation of concerned stakeholders;
- integrating private sector participation in extension activities; and
- incentives to extension officers based on their achievements.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CHAPTER 5
Annexes

1. Annex 1

Developing a guideline to support NARS' AR4D impact and strengthen the institutional linkages between NARS actors in Egypt

Questionnaire for Individual Research Staff and focus group discussion

Biodata

Name of research organization: .....

Name of interviewee: .....

Position: .....

Sex: Male ( ) Female ( )

Age: Years ( )

Educational level: BSc ( ) MSc ( ) PhD ( )

Phone number: ..... Email address: .....

Research areas:

.....

.....

.....

1. Research for Development

I) **Research arrangement and capacity to implement AR4D:**

1. Do you contribute in decisions making on research topics at your organization or national level? Always ( ) Usually ( ) Rarely ( ) Never ( )

2. How are decisions made on research for development (AR4D) at national level?

   Demand driven ( ) Supply driven ( )

   please explain how

3. How do you see the technical, administrative and financial support of the government to your research institution?

.....
.....

4. What are the main challenges facing R4D in your organization?

Lack of financial resources ( ) High turnover of staff ( )
Low staff capacity ( ) Lack of coordination ( )
Weak linkage between research and extension ( ) Other (please specify):

.....
.....
.....

5. In your opinion, what are the main challenges that affects the performance of:

#	Actors in R4D project cycle	Challenges
1	Decision makers (for enabling environment)	
2	Researchers (as project designers)	
3	Project managers (as project implementers)	
4	Farmers (as service recipient)	
5	Extension officers (the link between researchers and farmers)	
6	Others (local communities)	

6. What are the knowledge and skill related changes needed to improve your own and your staff/colleagues capacity to better conduct AR4D projects?

#	Skills	Missing		Needed	
		Yes	No	Strongly	Partially
1	Project proposal writing				
2	Project implementation planning				
3	Participatory approaches				
4	Project management				
5	Communication				
6	Risk management				
7	Conflict management				
8	Mentoring and evaluation				
9	Scaling out approaches				
10	Reporting and publishing				
11	Others (please specify)				

II) **Aspects on implementation mechanisms of AR4D:**

1. Have you managed/involved in research for development projects before?
   Yes ( ) No ( )
2. What was the motivation for you to implement R4D?
3. What are the challenges related to funding e.g. sustainability, insufficiency of funds, fluctuations, dependency on donors, etc.?

   .....
   .....
   .....
4. How did you design your research projects? (Specify the steps)

   .....
   .....
   .....
5. Did farmers/beneficiaries/WUAs participate in research gap identification?
   how?.....

   .....
   .....
6. Did farmers/beneficiaries/WUAs participate in implementation of AR4D?
   how?.....

   .....
   .....
7. What was the approach you adopted to implement AR4D?
   Community-based approach ( ) Benchmarking for farm business model ( )
   Scaling out GAPs ( ) Interactive systemic innovation platforms ( )
   Demonstration and awareness raising ( ) Participatory of stakeholders and beneficiaries ( ) Back-up research trials ( ) Other (please specify)

   .....
   .....
   .....
8. How did you ensure gender issues (including women and youth) in your projects from participation and delivery of the outputs?

   .....
   .....
   .....
9. Which of the followings you considered when you implement your AR4D projects?

#	Criteria	Responds		Remarks
		Yes	No	
1	Relevance to country research priorities			
2	Relevance to food security and nutrition			
3	Applicability			
4	Adoptability and scaling out			
5	Cost-effectiveness and affordability			
6	Gender sensitivity			
7	Impact on environment and biodiversity			
8	Feedback mechanism			
9	Others (Please specify)			

III) **Aspects on monitoring and evaluation of R4D:**

1. What was the feedback mechanism you used to collected from the farmers or stakeholders before, during and after implementation of your R4D projects?

   .....
   .....
   .....

2. How is feedback taken into account when planning new research activities?

   .....
   .....
   .....

3. Do the stakeholders feel the ownership of the implemented R4D projects?

   .....
   .....
   .....

4. How is monitoring and evaluation system for R4D incorporated into projects?

   .....
   .....
   .....

5. Was there a sustainability plan adopted after project closure?please describe

   .....
   .....
   .....

IV) **General thoughts on R4D**

1. How do you evaluate the impact of AR4D in your organization?
   Low ( ) Medium ( ) High ( )
2. What were the main challenges in implementing AR4D?

   .....
   .....
   .....
3. What were your action to overcome these challenges?

   .....
   .....
   .....

2. Institutional coordination between research institutions

I) **Institutional coordination**

1. What is the institutional set-up in your organization? level of decentralization? roles at different levels?
2. In your opinion how the organization should be set-up (coordinated and governed) for its effective performance including enhancing linkage with other research institutions?

   .....
   .....
   .....
3. What is the modality of cooperation and integration with other similar organization at national and regional level?

   .....
   .....
   .....
4. What is the strategy in place to strengthen the linkages between research organizations in the country?

   .....
   .....
   .....
5. Is this strategy effective/efficient?

   .....
   .....
   .....

II) Challenges in linkages between NARs actors

1. What are the benefits and limitations of this institutional set up, as perceived by the target stakeholders and beneficiaries?

   .....
   .....
   .....

2. What are the main perceived challenges of collaboration with other research organization?

   Lack of will to collaborate ( ) Lack of trust ( )
   Socio-cultural norms ( ) Competition ( )
   Lack of and resources ( ) Lack of knowledge about other organization ( )
   Inadequate policies and regulations ( )
   Other negative experiences (please specify): .....
   .....
   .....

III) Link between research and extension

1. In your opinion how the organization should be set-up (coordinated and governed) for its effective performance including enhancing linkage between research and extension?

   .....
   .....
   .....

2. What is the strategy in place to strengthen the linkages between Research and extension?

   .....
   .....
   .....

3. What is the strategy in place to strengthen the linkages between extension and farmers?

   .....
   .....
   .....

4. Are these strategies effective/efficient?

   .....
   .....
   .....

IV) **General Thoughts:**

1. In your opinion, what are the key-points to improve cooperation between your organization and other research organizations in the country?

   .....
   .....
   .....

2. Do you have any other relevant information or relevant published documents that you think would be helpful for this assessment?

   .....
   .....
   .....

2. Annex 2

Developing a guideline to support NARS' AR4D impact and strengthen the institutional linkages between NARS actors in Egypt

Questionnaire for Extension Agents

Biodata

Name of interviewee: .....

Sex: Male ( ) Female ( )

Age: Years ( )

Educational level:

Specialization: Agricultural Extension ( ) Water Extension ( )

Years of Experience: ( )

Phone number: .....

1. Agricultural Research for Development (AR4D)

I) Research arrangement and capacity to implement AR4D:

1. Do you contribute to decisions making on research topics in your organization?
   Always ( ) Usually ( ) Rarely ( ) Never ( )

2. In your opinion, what are the challenges negatively influencing stakeholders' benefiting from the results of agricultural research? In case you answer is yes, please mention the reasons:

- Decision makers: Yes ( ) No ( ) Reason: .....
- Researchers: Yes ( ) No ( ) Reason: .....
- Project managers: Yes ( ) No ( ) Reason: .....
- Farmers: Yes ( ) No ( ) Reason: .....
- ExtensionAgents: Yes ( ) No ( ) Reason: .....
- Local communities: Yes ( ) No ( ) Reason: .....
- Others, please mention: (.....) Reason: .....

II) Aspects on implementation mechanisms of AR4D:

1. Did you participate in research gap identification?

   Yes ( ) No ( )

   If yes, how?

   - Direct contact with the researcher
   - Through the organization I work for
   - Through Agricultural Cooperatives
   - Through Water Users Associations
   - Through NGOs
   - Other, please specify: .....

2. Have you been involved in agricultural research for development activities/ projects before?

   Yes ( ) No ( )

   If yes, how?

   - Explaining those problems facing farmers that need to be studied and tackled through research
   - Selecting and supervising the establishment of a pilot plot at the targeted site
   - Transferring knowledge to the farmer and his neighbours on how to apply new production methods of technology packages
   - Developing traditional irrigation methods
   - Implementing modern irrigation methods
   - Other, please mention: .....

3. What was the motivation for your participation in AR4D projects?

   - Is it contribution to the efforts exerted to realize sustainable development goals?

     Yes ( ) No ( )

If yes, how?

- Solving problems farmers face in plant, animal and fish production
- Reducing losses in agricultural production
- Solving problems farmers face in irrigation
- Receiving financial benefits
- Other, please mention: .....

- If your answer is No, please mention the motivation for your participation in R4D projects:

.....

III) Aspects on monitoring and evaluation of AR4D:

1. What was the feedback mechanism you used to report problems stakeholders face during and after the implementation of AR4D project?

.....

2. Was feedback taken into account when planning for new research activities?

If Yes ( ); how?

.....

If No ( ); why?

.....

3. Did you record positive impacts from implementing the AR4D project?

If Yes ( ); how?

- Learning new/modern methods that lead to:
  - Solving soil-related problems
  - Improve in plant, animal and fish productivities
  - Solving irrigation problems
  - Other, please mention: .....

If No ( ), Why?

.....

4. Was there sustainability in providing the same services after project closure?

If Yes ( ); Please describe how:

.....If No ( ); Why

2. Institutional coordination between research and Extension Institutions

I) Link between research and extension

1. In your opinion how the organization should be set-up (coordinated and governed) for its effective performance including enhancing linkage between research and extension?

.....

2. What is the strategy in place to strengthen the linkages between Research and extension?

.....

3. What is the strategy in place to strengthen the linkages between extension and farmers?

.....

4. Are these strategies effective/efficient?

   If Yes; How?

.....If No; Why?

.....

II) General thoughts on farmers' opinions regarding R4D

1. How do you evaluate the impact of AR4D?

   Low ( ) Medium ( ) High ( )

2. In your opinion, what are the main challenges in implementing AR4D?

   .....

   .....

3. In your opinion, what are the actions that could help overcome these challenges?

   .....

III) General Thoughts:

1. In your opinion, what are the key-points to improve cooperation between your organization and other research organizations in the country?

.....

2. Do you have any other relevant information or relevant published documents that you think would be helpful for this assessment?

.....

3. Annex 3

Developing a guideline to support NARS' AR4D impact and strengthen the institutional linkages between NARS actors in Egypt

Questionnaire for Farmers

Biodata

Name of interviewee: .....

Sex: Male ( ) Female ( )

Age: Years ( )

Educational level:

Illiterate ( )

Read and Write ( )

Educational level:

Phone number: .....

1. Agricultural Research for Development (AR4D)

I) Research arrangement and capacity to implement AR4D:

1. Do you contribute to decision making regarding research topics?
   Always ( ) Usually ( ) Rarely ( ) Never ( )
   If yes, how?
   - Through Unions of Producers ( )
   - Through Agricultural Cooperatives ( )
   - Through Water Users Associations ( )
   - Other, Please Mention: .....

2. Do you contribute implementing research activities at the community level?
   Always ( ) Usually ( ) Rarely ( ) Never ( )
   If yes, how?
   - Through Unions of Producers ( )
   - Through Agricultural Cooperatives ( )
   - Through Water Users Associations ( )
   - Other, Please Mention: .....

3. In your opinion, which of the following represents a challenge obstructing your opportunity to benefit from the results of agricultural researches? In case your answer is yes, please mention the reasons:
   - Decision makers: Yes ( ) No ( ) Reason: .....
   - Researchers: Yes ( ) No ( ) Reason: .....
   - Project managers: Yes ( ) No ( ) Reason: .....
   - Farmers: Yes ( ) No ( ) Reason: .....
   - Extension Agents: Yes ( ) No ( ) Reason: .....
   - Local communities: Yes ( ) No ( ) Reason: .....
   - Others, please mention: (.....) Reason: .....

II. **Aspects on implementation mechanisms of AR4D:**

1. Did you participate in research gap identification?
   Yes ( ) No ( )
   If yes, how?
   - Direct contact with the researcher
   - Through Extension Agents
   - Through Agricultural Cooperatives
   - Through Water Users Associations
   - Through NGOs
   - Other, please specify: .....
2. Have you been involved in agricultural research for development projects before?
   Yes ( ) No ( )
   If yes, how?
   - Agreed to establish a pilot plot in your farm?
   - Agreed to apply new technologies packages?
   - Agreed to adopt modern irrigation methods?
   - Other (please mention): .....
3. What was the motivation for your participation in AR4D projects?
   - Solving problems in your land
   - Solving problems in plant production
   - Solving problems in animal production
   - Solving problems in fish production

- Solving problems in irrigation
- Learning new farming methods/practices that boosts production
- Increasing farm income and profitability
- Receiving financial benefits
- Other, please specify: .....

III) Aspects on monitoring and evaluation of AR4D:

1. Did you have the chance to give your feedback regarding those AR4D projects in which you participated?
   If Yes ( ); What was the feedback mechanism you used during and after implementation of project?
   .....
   If No ( ); why?
   .....

2. How is feedback taken into account when planning new research activities?
   .....

3. Did you obtain positive impacts from participating in the R4D project?
   If Yes ( ); how?
   - Learning farming or irrigation methods that lead to:
     - Solving soil-related problems
     - Improve in productivity
     - Solving irrigation problems
     - Other, please mention

   .....
   If No ( ), Why?
   .....

4. Was there sustainability in receiving the same services after project closure?
   If Yes ( ); Please describe
   .....If No ( ); Why?

IV) General thoughts on farmers' opinions regarding AR4D

1. How do you evaluate the impact of AR4D?
   Low ( ) Medium ( ) High ( )

2. In your opinion, what are the main challenges in implementing AR4D?

.....

.....

3. In your opinion, what are the actions that could help overcome these challenges?

.....

.....

4. Annex 4

Developing a guideline to support NARS' AR4D impact and strengthen the institutional linkages between NARS actors in Egypt

Questionnaire for Key-informants/Individual experts

Biodata

Name: .....

Country: .....

Organization.....

Position:.....

Phone number: ..... Email address: .....

Area of expertise:

.....

.....

.....

1. Implementation of AR4D

1. How and to what extent do NARS identify their research agenda and priorities?

.....

.....

.....

2. How and to what extent are AR4D's topics identified?

.....

.....

.....

3. Do you think that the AR4D projects are mostly relevant to country priorities? Why?

   .....
   .....
   .....

4. Do you think the AR4D projects in the country are mostly demand or supply driven? And how?

   .....
   .....
   .....

5. Do you think that AR4D projects implemented in last ten years have considered/addressed (applicability, adoptability, affordability, gender sensitivity and environmental impact) of the implemented interventions/ introduced technologies? How?

   .....
   .....
   .....

6. Do you think that AR4D projects implemented in last ten years have considered/addressed the beneficiaries' ownership of the introduced solutions through participatory or community-based approaches? How?

   .....
   .....
   .....

7. Do you think that AR4D projects implemented in last ten years had a good and reliable monitoring and evaluation system that ensured the proper implementation as planned?

   .....
   .....
   .....

8. Do you think that AR4D projects implemented in last ten years have considered the stakeholders' feedback mechanism? How?

   .....
   .....
   .....

9. What accountability mechanisms for deliverables are in place (if any)? Who is held responsibility for the efficiency in resource use and value for money?

10. Have AR4D projects in last ten years had proper sustainability and exit plans?

.....

.....

.....

I) Challenges in AR4D

1. What are the challenges related to funding e.g. *sustainability*, *insufficiency of funds*, *fluctuations*, *dependency on donors*, etc.?

.....

.....

.....

2. Do you think the available resources and facilities that NARS depend on in their AR4D are always updated/upgraded?

.....

.....

.....

II) Impact of AR4D

1. To what extent the AR4D linked to research priorities of the country?

.....

.....

.....

2. Do you think that the AR4D projects implemented in last ten years have achieved the targeted impact on small-scale farmers or end users? How?

.....

.....

.....

3. How much influence do AR4D projects have in agricultural policy and decision-making processes at national level?

.....

.....

.....

III) General Thoughts in AR4D

1. In general, what is your opinion on the NARS performance? Are you satisfied from their efforts on implementing AR4D? and why?

.....

.....

.....

2. What are the key areas for improvement in implementation of AR4D?
   .....
   .....
   .....
3. Are there other recommendations that you have, or suggestions you would like to mention to improve implementation of AR4D?
   .....
   .....
   .....

2. Institutional coordination between research intuitions

1. What do you think about the institutional set up in the research organizations in your country? And how it should be? e.g. level of decentralization, roles at different levels etc.
   .....
   .....
   .....
2. How do you assess Intra/Inter-institutional coordination, integration and collaboration between NARS actors in the country?
   .....
   .....
   .....
3. What is the modality of collaboration and integration between research organization in the country?
   .....
   .....
   .....
4. Is there a strategy in place to strengthen the linkages between research organizations in the country?
   .....
   .....
   .....
5. What are the main perceived challenges of collaboration between research organizations?
   Lack of will to collaborate ( ) Lack of trust ( )
   Socio-cultural norms ( ) Competition ( ) Lack of and resources ( )
   Lack of knowledge about other organization ( )
   Inadequate policies and regulations ( ) Other negative experiences (please specify): .....
   .....
   .....

6. In your opinion, what are the key-points to improve cooperation between agricultural research organizations in the country?

.....
.....
.....

7. How effective are the national extension in delivering advisory services? and how are they linked to research organizations at national level?

.....
.....
.....

8. How do you evaluate effectiveness and performance of current linkage between research and extension?

.....
.....
.....

9. Are there any strategies in place to strengthen the linkages between Research and extension? Please describe in details

.....
.....
.....

10. What is the strategy in place to strengthen the linkages between extension and farmers?

.....
.....

11. How do you evaluate these strategies? Low ( ) Medium ( ) High ( ) Please explain below

.....
.....

Do you have any other relevant information or relevant published documents that you think would be helpful for this assessment?

.....
.....
.....

5. Annex 5: Structures of NARS organizations in Egypt

5.1 Agricultural Research Centre (ARC)[1]

In 1971, the Presidential Decree No. 2425 issued to establish the General Authority for Agricultural Research (GAAR) with the main purpose of achieving agricultural development goals. Later, in 1983, the Presidential Decree No.19 issued to transform GAAR to the Agricultural Research Centre (ARC), the main institution responsible for applied research in agriculture and extension.

ARC's mandate is to carry agriculture research at the country level in collaboration with the existing colleges of agriculture and other research institutions related to agriculture. It is a semi-autonomous research institution governed by a board of directors chaired by the Minister of Agriculture and Land Reclamation. ARC's policy framework based on active communication and interaction between three major activities: research, extension, and training.

5.1.1 Vision

A comprehensive agricultural renaissance of a New Egypt by 2030 that is capable of sustained rapid growth and dependent on innovation and knowledge intensification.

5.1.2 Mission

The overarching goal of ARC is to maximize economic return per unit of land and water. Within the national agricultural development strategies, ARC assumes the following major functions:

- conducting applied and basic research to generate a continuous flow of technologies that help increase productivity and reduce production cost;
- transfer of new technologies to the farming community through extension service; and monitoring their adoption by the end users;
- continuous development of Human capital.

5.2 Organizational structure

Currently, ARC comprises 16 research institutes; 13 central laboratories; 10 regional stations; 53 specific research stations; 23 administrations conducting agricultural experiments across Egypt; three information centres; and four highly equipped research, extension and training centres.

[1] Agricultural Research Center' Website; http://www.arc.sci.eg/AboutARC.aspx?TabId=&NavId=&lang=en

5.3 Human resources[2]

Human resources working at ARC comprise 10238 researchers, either holders of PhD, MSc or BSc degrees in different agricultural specializations and branches, in addition to 41.7 thousand technician and administrative staff.

5.4 Institutes affiliated to ARC

- Animal Health Research Institute (AHRI).
- Animal Production Research Institute (APRI).
- Animal Reproduction Research Institute (ARRI).
- Agricultural Economics Research Institute (AERI).
- Agricultural Extension and Rural Development Research Institute (AERDRI).
- Agricultural Engineering Research Institute (AENRI).
- Agricultural Genetic Engineering Research Institute (AGERI).
- Cotton Research Institute (CRI).
- Field Crops Research Institute (FCRI).
- Food Technology Research Institute (FTRI).
- Horticulture Research Institute (HRI).
- Horticulture Research Institute (HRI).
- Plant Protection Research Institute (PPRI).
- Soil, Water and Environment Research Institute (SWERI).
- Sugar Crops Research Institute (SCRI).
- Veterinary Serum and Vaccine Research Institute (VSVRI).

5.5 Central laboratories

- The Central Laboratory for Evaluation of Veterinary Biologics (CLEVB).
- The Central Agricultural Pesticide Laboratory (CAPL).
- The Central Lab. for Agricultural Climate.
- The Central Laboratory for Aquaculture Research (CLAR).

[2] Water and Livelihoods Initiative (WLI) (2017); Research and Extension in Egypt; Socio-economic Report.

- The Central Laboratory for Date Palm Research and Development (CLDPRD).
- The Central Laboratory for Design and Statistical Analysis Research (CLDSAR).
- The Central Laboratory for quality control of poultry production (CLQP).
- The Central Laboratory of Organic Agriculture (CLOA).
- The Central Laboratory of Residue Analysis of Pesticides and Heavy Metals in Foods (QCAP) Accredited according to ISO 17025.
- Nanotechnology and Advanced Materials Central Lab.
- The Regional Centre for Food and Feed (RCFF). Accredited according to ISO/IEC 17025 from A2LA.
- Weed Research Central Laboratory (WRCL).
- National Bank of Genes and Genetic Resources.

5.6 Research stations

Animal production research stations

Anshass, Burg El-Arab; Fayoum; Gemmaiza; Mahallet Moussa; Mallawy; Qurada; Sabaheya; Sakha Sakha; Seru *and* Sids.

Field crops research stations

Agricultural Research Station of El-Kharga; Arish; Asyut; Bahtem; East Owainat; El-Hosainia Plain agricultural Research Station; Gemmaiza; Giza; Great Cairo; Ismalia; Isolation and Plant Protection; Itay El-Barood; Kfer EL-Hamam; Kom Ombo; Mallawy; Nubaria; Sabaheya; Sakha; Seru; Shandawel; Sids Agricultural Research Station; Sirs El-Layyan; Tag-elezz Agricultural Research Station; Tamiea

Horticulture research stations

El-Kanater Horticulture Research Station.; Nubaria; Qassaseen; Sabaheya; Sids and Southern Tahrir.

Multi subject stations

East channel; Marsa Matrouh; Mataena; Port Said; Qalapshoo and Valley South (Toshka)

Regional research stations

East Delta; Fayoum; Middle Delta; Middle Egypt; New Lands; New Valley; North Delta; Upper Egypt and West Delta

5.7 Desert Research Centre (DRC)[3]

The Desert Research Centre was first established in 1949 under the name "Fouad I Institute for the Sahara", which was officially inaugurated in 1950. In 1953, the institute became affiliated to the Permanent Council for National Production Development. After the July Revolution in 1952, the institute's name was changed to "The Desert Institute", and it was relocated to the current headquarter at "Prince Yousof Kamal's Palace" in Matareya area in Cairo in 1956. After one year, in 1957, the Desert Institute became affiliated to the National Research Centre, then transferred to the General Authority for Deserts Development in 1959, and again transferred to the Ministry of Scientific Research in 1963. Finally, the Republican Decree No. 90 of 1990 was issued to change the Desert Institute's name to "The Desert Research Centre", and to transfer its affiliation to the Ministry of Agriculture and Land Reclamation.

5.7.1 Vision

DRC's vision focuses on studying the deserts of Egypt, including natural protected areas, oases, land fertility, plants, insects, birds, animals, tourist places, and population groups in the desert and their characteristics.

5.7.2 Mission

Generally speaking, The Desert Research Centre, as an independent specialized scientific and research body, is concerned with studying all issues related to the fields of groundwater, rainwater harvesting, the nature of desert lands, the desert environment, plant and animal production in arid lands, in addition to human and economic studies. It is also focused on linking such study fields with the sustainable development of the Egyptian deserts and determining the optimal investment methods that ensure sustainability for the benefit of existing and future generations.

5.7.3 Objectives

1. Accurate scientific study of Egyptian deserts to explore all its natural and human resources, and to distinguish its geological, geophysical, hydrological, climatic, plant, animal, geographical, anthropological, and other characteristics.
2. To study the means of developing, preserving, and maintaining natural and human resources in Egyptian deserts, in addition to adequate preparing to ensure optimum utilization, rehabilitation and development of such desert areas.

[3] Desert Research Center's Website; https://drc.gov.eg/en/home/

3. To combat desertification, alleviate poverty among the inhabitants of desert areas, and to monitor and evaluate desertification in various agricultural ecological regions in Egypt.

5.7.4 Services

Land reclamation, drilling of water wells, remote sensing and geographic information systems unit, Tissue culture unit, Central Laboratory, Scientific Journal (DRC publishes a scientific journal under the name "The Egyptian Journal of Desert Research (EJDR)". It is an international peer-reviewed journal published annually in one volume of two issues. It deals exclusively with the issues of desert research and development that fall within the scope of environment, natural resources, water, soil, plants, animals, and human resources as well as socioeconomic aspects of desert development and a Library.

5.7.5 Divisions and departments

A. Water resources and desert soils division

The division consists of the following nine scientific departments and underlying research units:

1. Geology Department.
2. Hydrology Department.
3. Geophysical Exploration Department.
4. Hydrogeochemistry Department.
5. Pedology Department.
6. Soil Physics and Chemistry Department.
7. Soil Fertility and Microbiology Department.
8. Soil Conservation Department.
9. New and Renewable Energy Department.

B. Ecology and dry land agriculture division

The division consists of the following six scientific departments and underlying research units:

1. Plant Genetic Resources.
2. Plant Production.
3. Plant Ecology and Range Management.
4. Sand dunes.
5. Medicinal and Aromatic Plant.
6. Plant Protection Department.

C. Animal and poultry production division

The division consists of the following five scientific departments and underlying research units:

1. Department of Animal and Poultry Breeding.
2. Animal and Poultry Nutrition Department.
3. Animals and Poultry Physiology Research Department.
4. Animal Health Research Department.
5. Wool Production and Technology Research Department.

D. Economics and social studies

The division consists of the following three socioeconomic departments:

1. Department of Economic Studies.
2. Department of Agricultural Extension.
3. Department of Social Studies.

5.7.6 Research stations

North coast sector

The centre for sustainable development of Matroh resources

The Centre for Sustainable Development of Matroh Resources considered the largest and the most important pioneering project in the field of integrated development in the areas of rain-fed agriculture. It serves an area exceeding 15,000 km^2 along the Egyptian North-western coast, from Fouqua at Ras Al-Hikma in the east to Sallom in the west. The main objective of the Centre is to conduct research studies to: improve the livelihoods and preserve natural resources against deterioration; achieve water security; maximize the efficiency of rainwater use in cultivated and arable lands and to reduce soil erosion; introduce and disseminate methods of water use rationalization to expand cultivated areas; improve the state of vegetation cover and management of rangelands to provide fodder resources for livestock and protect the environment against desertification. Design plans for adding new areas of land with arable soils for developing the valleys; produce and disseminate modern techniques suitable for rainfed farming systems to maximize the profit from agricultural production; and to enhance agricultural industrialization and marketing processes to achieve value added from desert agricultural production. In addition, the centre provides training to enhance Bedouins' skills in fields other than agriculture to increase their income.

Siwa research station

Siwa Oasis is located 300 kms Southwest of Marsa Matroh and about 600 kms west of the Nile Valley. It is considered a closed valley in the Western Desert (18 m below sea level). Siwa Oasis is distinguished by its unique location, capabilities, and land and water resources, which make it one of the promising areas for comprehensive development programmes. The station consists of two farms, Tegzerti and Khemisa, with an area of about fifty acre each. Tegzerti farm is located 4 km west of Siwa's Markaz, and Khamisa farm is located 13 km west of Siwa's Markaz. The main objective of Siwa Research Station is conducting research studies to: solve the problems of animal, poultry and fish production under desert conditions; develop pastoral and fodder resources and maintaining natural pastures; identify and propagate good palm and olive species for economic investments and social development; develop and spread wheat and maize cultivation among Siwa community to achieve self-sufficiency and change some agricultural customs and patterns; stabilize sand dunes, to reduce the speed of dust-laden winds, and to cultivate of windbreaks and green fences; solve the problems of agricultural drainage and the high level of surface and ground water; provide agricultural extension services and technical support for farmers and investors in desert and newly reclaimed areas; produce vegetable and fruit seedlings and agricultural mechanization services with minor prices to the citizens; create job opportunities and provide farmers with the technical skills required to achieve agricultural development.

Mariout station

Mariout Research Station is located in El Amriya area, 31 km south of Alexandria. It was established in 1967 on an area of 100 acre. In 1993, the station surface has become about 45 acre after Mariout Agricultural Company has taken about 65 acre from its total area.

Objectives of Mariout research station:

1. Improving and maintaining the lime lands of the region.
2. Studying water relations under the conditions of the region to increase the productivity of the water unit.
3. Studying and evaluating different agricultural crops to choose the appropriate crop structures.
4. Developing and improving livestock and poultry in the desert and the newly reclaimed areas.
5. Providing applicable extension packages and scientific services for those who are interested in various agricultural activities in the region.
6. Organizing training courses in the fields of agricultural development, especially for young graduates.

Sinai sector

Ras Sidr station

Ras Sidr Research Station established in 1976, and located at 5 km North of Ras Sidr, 60 km from Ahmed Hamdy Tunnel, and about 200 km from Cairo on the western coastal road to South Sinai. Its total area is 27 acres.

Objectives of Ras Sidr Station:

1. Contributing in the development efforts in the region.
2. Activating the extension role of the station in serving the inhabitants of the region.
3. Evaluating the productivity of some species and varieties of different crops for cultivation under the conditions of South Sinai.
4. Cooperating with various internal and external research and scientific bodies that aim at reaching sustainable agricultural development in South Sinai.
5. Developing livestock, poultry and fish sources by improving the nutritional, veterinary and productivity status.

Balouza station

Balouza Research Station is located at Al-Salam Canal. It is in the domain of Balouza village, which is 35 km east of Qantara Shark city, 60 km of Bir Al-Abed, and 150 km of Al-Arish. The area of the station is 500 acre.

Objectives of Balouza Research Station

1. Producing modern scientific technologies to face the danger of climate change and its direct and indirect impact on agricultural production, opportunities for horizontal expansion, investment and development of available natural resources.
2. Producing appropriate technologies for combating desertification in desert surroundings areas that are eligible for future agricultural development and horizontal expansion.
3. Directing research towards applied fields that serve the challenges of agricultural development in Sinai. It includes producing agricultural crop techniques under conditions of drought and salinity. In addition to, producing seedlings resistant to different stress conditions, and using new and renewable energy.

Qantara station

Qantara Shark Research Station is located 35 km south of the city of Qantara shark, on the streams of Al-Salam Canal Branch No. 4 extending from the south of Jalbana village. Its total area is 470 acre.

Objectives of Qantara Shark Research Station:

1. Studying and developing farming systems and crop structures under the conditions of using Al Salam Canal mixed water.
2. Selecting high-yielding species and varieties for cultivation.
3. Introducing pure species of plants and animals with exceptional production.
4. Establishing model extension fields at the station and the inhabitants.
5. Directing studies and research to serve improve and develop agricultural production in all its sectors (animal-plant-land-irrigation-economy).

Sheikh Zuweid station

North Sinai Research Station (Sheikh Zuweid) was established according to the "decision of allocation" No. 901 for the year 1992 issued by North Sinai Governorate. The station is located 35 km East of Al-Arish city and 15 km west to the border of Rafah city. Its area is 17 acres.

Objectives of El Sheikh Zuweid station

1. Establishing the Egyptian Deserts Genes Bank, which is responsible for preserving Egypt's wealth of wild and natural desert plants.
2. Establishing a field genetic collector for the most important olive varieties in the Arab Republic of Egypt.
3. Establishing a genetic collector for the most important pomegranate varieties in the Arab Republic of Egypt.
4. Owning a large and distinct sector of vegetative propagation that works to outbreeding plant and horticultural species for the purposes of agricultural development on reclaimed lands.

Maghara station

El Maghara station was established by the Development Italian Project as an extension farm in 1987. In 1993, DRC took supervision over the farm. North Sinai Governorate issued Decision No. 382 in 2000 to transform the farm into a research station to serve agricultural development projects. The station is located on an area of 69 acres in El Hosna city. It is far from El Arish city with 90 km to the southwest, and it is 60 km far from the city of Bir Al-Abd.

Objectives of El Maghara research station:

1. Growing some new crops, such as Moringa.
2. Implementing a project to cultivate 50 acres of Jojoba in the station and creating a large nursery for the production of selected high-yield jojoba seedlings.
3. Establishing a Gene Bank for fruit crops, especially high-yielding species Jojoba, as well as Syrian pistachio trees imported to the station from The Arab Centre for the Studies of Arid Zones and Dry Lands (ACSAD).

The Southern sector of Egypt

New Valley station

The New Valley Research Station is characterized by a unique geographical and climatic nature. It is located 12 km North of Kharga City. The station is located in "El Sherka area" and is irrigated from El Sherka well number 3. The station is also characterized by the presence of multiple irrigation systems. The station conducts research and studies that serve agricultural development in the New Valley Governorate.

Objectives of the New Valley research station:

1. Improving and maintaining lands of the region.
2. Maximizing the utilization of water resources by applying modern irrigation systems and clean agriculture.
3. Evolving plant varieties that are appropriate to environmental, soil and water characteristics.
4. Developing oil crops, medicinal and aromatic plants.
5. Developing and increasing the environmental and nutritional awareness of the oasis residents.
6. Optimal investment of climate resources such as solar energy and winds in all sectors.
7. Contributing in planning and development feasibility studies for agricultural and industrial projects.
8. Contributing in developing and modernizing agricultural awareness and combating desertification through training and agriculture extension.

Toshka research station

Toshka station is located on an area of 500 acres for reclamation, 17 km away from Abu Simbel city. It consists of four wells that have been drilled out of total 85 wells in the area. Each well is drilled for irrigating 100 acres. This region is characterized

by high temperatures and dry climate. The station aims to search for the best ways to adapt to these environmental conditions. It aims also to get benefit from water and land resources in economic agricultural production to reach sustainable development at national and regional levels.

Objectives of Toshka research station

1. Providing job opportunities and redistributing the population map to benefit from the Egyptian desert.
2. Providing and updating information about the environmental aspects of the region.
3. Identifying the most appropriate systems for using the available land and water resources in the region.
4. Maximizing the economic income of water resource units.
5. Preserving water and land resources from degradation.
6. Conducting scientific studies and applied research in the field of improving the productivity of high production plant species and varieties under drought and high temperature conditions.
7. Providing organic fertilizers through an integrated system for clean organic crops.
8. Providing training and extension services for agricultural production.
9. Providing agricultural and economic models that can be applied.

Halayeb and Shalateen research station

Halayeb and Shalateen Research Station is located in Southeastern Egypt between latitudes 23-22 South in the zone of Elba Natural Reserve, which contains different types of rare and endangered plant and wild animal habitats. The area of the research farm in Shalateen is approximately (55 acres) 146 000 m^2. The total area of the research farm for animal production in Halayeb is 5 acres where animals feed on natural pasture.

Objectives of Halayeb and Shalateen research station

1. Creating sustainable development in Halayeb, Abu Ramad and Shalateen Triangle.
2. Studying, surveying and reproducing natural plants within the station zone.
3. Working to promote agriculture through cooperation and participation in the funded agricultural development projects.
4. Working and cooperating with Shalateen City Council in spreading agricultural awareness among the Bedouins living in the region by conducting seminars and training courses.
5. Working in a distinctive breed of sheep that can adapt to the conditions of the region.

6. Working on introducing new strains of fattening and laying poultry with high production and adapted to the surrounding environment.
7. Conducting applied scientific research on pastures and animal production.
8. Early detection of animal diseases crossing the Egyptian-Sudanese borders through DRC veterinary convoys.

5.8 The Central Administration for Agricultural Extension (CAAE)[4]

The Central Administration for Agricultural Extension CAAE consists of 16 specialized administrations at the central level. Their main function is to participate in the design, planning and implementation of extension programs at the level of the 16 administrations, these are:

- livestock;
- horticulture;
- cotton and fibre;
- sugar crops;
- grain crops;
- leguminous and oil crops;
- new land crops;
- extension programs: preparation and planning extension programs in various areas of agricultural production;
- materials and means for extension activities: preparation and production of information materials and audio-visual means;
- marketing: participation in the implementation of the marketing extension programs;
- agricultural councils: supervising the accomplishment of activities of the agricultural councils at the governorate level;
- extension units: supervising affiliated agricultural fields and units and outputs of agricultural and extension activities;
- extension centres: supervising the establishment of extension centres and follow up the implementation of assigned outreach activities;
- rural development: supervision of rural development centres and implements extension and training programs for women and rural youth;
- financial and administrative affairs;
- technical office: organization of secretarial work, preparation of weekly and annual reports on the achievements of each administration.

[4] Water and Livelihoods Initiative (WLI) (2017); Research and Extension in Egypt; Socio-economic Report.

5.8.1 Extension areas

As indicated in Table 52, there are nine Extension Areas affiliated to the Central Administration of Agricultural Extension at the national level in North Delta, West Delta, North and Central Delta, East Delta, South and Central Delta, Northern Upper Egypt, Middle Egypt, Upper Egypt and the North Coast. Each Extension Area is responsible for providing extension services for a group of governorates and for the research stations in each governorate.

Table 52. Extension areas in Egypt

#	Region	HQ Office	Governorates Covered
1	North Delta	Kafr El Sheikh	Kafr El Sheikh and Behera
2	West Delta	Nubaria	Nubaria, Matruh and Alexandria
3	North and Middle Delta	Dakahlia	Dakahlia, Dameitta and Port Said
4	East Delta	Sharkia	Sharkia, Ismailia, Suez and Red Sea
5	South and Middle Delta	Gharbia	Gharbia, Qalyoubia and Menofia
6	Lower Egypt	Beni Sweif	Beni Sweif, Fayoum and Giza
7	Middle Egypt	El Menia	El Menia, Assiut, New Valley and Owainat
8	Upper Egypt	Luxor	Luxor, Sohag, Qena Aswan and Toshka
9	East North Coast	Arish	North and South Sinai

Source: Water and Livelihoods Initiative (2017); Research and Extension in Egypt; Socio-economic Report.

5.9 The National Research Centre (NRC)[5]

NRC is the largest multidisciplinary R4D centre in Egypt devoted to basic and applied research in major fields. NRC possesses an impressive scientific and technological infrastructure and human resources of 4809 research staff. NRC Consists of 14 divisions and 109 departments covering the major areas of industry, health, environment, agriculture, basic sciences, and engineering. NRC is chaired by a president with ministerial status, assisted by two vice presidents, one for research and the other for technical affairs. The minister of state for Scientific Research is the higher president of NRC. The Division of Agriculture and Biology Research is the main division responsible for conducting agricultural research activities at NRC.

5.9.1 Vision of the division of agriculture and biology research

Development and innovation of new technologies to improve agricultural production, achieve food security and self-sufficiency.

[5] National Research Center's Website, https://www.nrc.sci.eg/

5.9.2 Mission

Achieving sustainable development goal and promoting the agricultural sector through increasing agricultural production by applying modern technologies.

5.9.3 Objectives

Supporting agricultural development through applied research for:

- contributing to national efforts exerted to increase food and fibre production in Egypt;
- introducing advanced agricultural technologies as biotechnology and nanotechnology as well as organic farming to maximize the utilization of available resources in producing healthy food;
- conducting studies and research in basic and applied areas to improve production efficiency and recent trends in the production of animal feed, poultry, and fish;
- raising the productivity of crops under modern irrigation, rationalize water consumption systems and improve the properties of the soil systems;
- reducing soil and water pollution by improving water-use efficiency in terms of quantity and quality;
- integrated Pest Management of insects and pathogens;
- recycling agricultural residues;
- new and renewable energy;
- encouraging communication among the businessmen, exporters and investors in the field of agriculture;
- promoting collaborative research programs with international agricultural bodies and foreign agriculture universities;
- supporting technology transfer to the agriculture sector across different geographic areas in Egypt to assure sustainable agriculture growth;
- identifying future research needs, priorities and assessment of problems to achieve sustainable productivity.

5.9.4 Departments

- Botany;
- pests and plant protection;
- soil and water use;

- agricultural economy;
- animal production;
- field crops;
- agricultural microbiology;
- plant pathology;
- water relations and field irrigation;
- pomology research;
- vegetables research;
- plant nutrition;
- plant biochemistry;
- ornamental plants and woody trees;
- fertilization technology;
- technology of horticultural crops.

5.9.5 Special units

- Agricultural and consulting services;
- animal production services and poultry;
- the assessment of land resources;
- biotechnology to improve the nutritional values;
- plant health and soil amelioration;
- plant diseases and nematodes;
- assess and address the contamination of soil and plants;
- production of ornamental plants;
- bio-fertilizer production;
- production of bio-pesticides;
- production and marketing of medicinal plants;
- technology drying vegetables and fruits;
- improve the quality of egyptian vegetable seed;
- moringa production;

- the Division also provides specialized training courses in all areas of agricultural fields i.e. environmental and advanced irrigation systems, livestock production and other activities.

5.10 The Ministry of higher education and scientific research

5.10.1 Vision

Achieving an Egyptian scientific society that, in construction and development, depends on a perpetually learning generations that generate and use the knowledge to provide scientific practical solutions to society problems, and to export the knowledge within a system that supports innovation and stimulates knowledge-based economy.

5.10.2 Mission

Creating an encouraging environment for science, technology and innovation, capable of producing and marketing knowledge efficiently and effectively, and creating an atmosphere of excellence-based scientific competition, in order to increase the growth rate of the national economy and achieve the type of sustainable development that elevates the society and human well-being to higher levels.

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