

# Science and Technology Strategies for Food Security and Sustainable Agricultural Development

Mahmoud B. Solh<sup>1</sup>

## Summary

Sustainable agricultural development is essential for economies in developing countries. The challenge is to ensure agricultural growth without degradation of natural resources. This paper describes a framework for the development of science and technology (S&T) strategies to enhance food security and sustainable development in dryland areas, using the West Asia and North Africa (WANA) region as a case study. This is a large, diverse region with multiple agro-ecosystems, poor rainfall, aggravated by inefficient water use, and severe land degradation. Lack of enabling policies and limited government investment in agricultural research are additional problems.

To be effective, an S&T strategy must take in to account many factors - the production potential and constraints in each major agroecology, production and demand trends, new scientific developments, research capabilities, the policy environment, as well as external factors such as competitiveness, globalization and international agreements. The strategy must develop and exploit partnerships at various levels; among different stakeholder groups, institutions, and scientific disciplines. Similarly, countries within a region must share resources, skills and information to address the many agricultural problems that cut across national boundaries. Training and capacity building for farmers, field research and extension staff, as well as managers and administrators are important.

Deployment and adoption of available, appropriate technologies has been disappointing; partly because the research and development system has been inadequate. Issues of management and organization are as important as technical issues. For example, changing the traditional organizational structure to increase multi-disciplinarity, and breaking down inter-institution barriers to implement integrated R & D projects. Ultimately, research must be linked with development; through the use of an integrated approach (multi-disciplinary, production system focus) that involves all partners and stakeholders with strong systems for dissemination, monitoring and evaluation.

**Keywords:** WANA; Natural Resource Degradation; Integrated Approach; Technology Dissemination; Marginal Lands.

## Introduction

Most developing-country economies are driven by agriculture. The majority of the population lives in rural areas. Agriculture is the largest employer and the largest contributor to GDP in many countries. Correspondingly, economic growth requires, most of all, sustainable agricultural development.

Developing countries face two major challenges: achieving food security by increasing agricultural production and accessibility to food; and preventing and reversing the degradation of natural resources. These challenges call for innovative science-based solutions: development of new technologies, ways to encourage farmers to adopt these technologies, and creation of a policy environment that fosters and supports development. This paper describes a framework for the development of science and technology strategies to enhance food security and sustainable development. The West Asia and North Africa (WANA) region is used as a case study. The major agro-ecologies in the region, and the constraints. Then discuss the elements of a framework for agricultural research and development; and accordingly research priorities for the WANA region are described. The approach and the broad principles described are applicable to dryland areas in many developing countries.

## Major Agro-ecologies and Production Systems in WANA

The WANA region covers 24 countries, in a roughly east-west belt extending from Iraq to Morocco. It includes coastal regions, highlands, desert ecosystems, and small areas of forest. The climate is mediterranean in the coastal areas and continental in inland areas. The region is characterized by cool to cold rainy winters and hot to extremely hot dry summers. Most of the region is arid or semi-arid (annual rainfall below 400mm), with a short crop-growing season. The major production systems are as follows (Casas *et al.*, 1999).

- **Irrigated areas** occupy 22% of the arable land in the region, but produce over 50% of the crop. They are generally highly intensive and diversified, with high productivity, but excessive irrigation has led to depletion of aquifers and salinization in many areas. There is considerable potential for improvement, particularly in water productivity, irrigation management and control of soil erosion.
- **Favorable rainfed areas** are predominantly wheat-based farming systems, usually wheat in rotation with legumes or oilseed crops, combined with relatively extensive small-ruminant production. The potential productivity of these areas is high, but improved technologies, access to inputs, and policy support are needed.
- **Marginal rainfed areas** comprise barley-based systems in areas with annual rainfall above 150mm, and

<sup>1</sup> Director General, International Center for Agricultural Research in the Dry Areas (ICARDA). P.O. Box 5466 Aleppo, Syria, Fax : (+963) 21 2225105. E-mail:m.solh@cgiar.org

rangeland/livestock-based systems in even drier areas. Small ruminants are a major component of both systems, and feed on barley, fodder and crop residues imported from the more favorable areas. Production potential is limited, particularly because of widespread degradation; but output and sustainability can be improved using available technologies, e.g. water harvesting, implemented through a community approach.

- **Highlands:** the rangeland/livestock system is common, although wheat- or barley-based systems are also found. Fruit trees are important components of these two systems. Production potential is low to medium, depending on topography and rainfall. Priority measures are soil erosion control and water harvesting.

### Constraints to Agricultural Development

The WANA region, which was the bread basket of the Roman Empire, is now a net importer of food. The natural resource base is threatened by desertification due to demographic and economic pressures, acute water shortages, lack of arable land, biodiversity loss, and other factors. Agricultural potential is severely limited by the harsh climatic conditions and inappropriate agricultural policies. During the period 1980-96, food production rose by 3.9% per year, compared to a population growth rate of 2.4%; but currently the region still imports 17% of its food requirements (Casas *et al.*, 1999). This section highlights the most important constraints, common across the region and in rainfed areas in many developing countries.

#### Scarce water resources and inefficient water use:

Frequent droughts cause immediate and severe damage to crops and livelihoods, as well as long-term, potentially irreversible damage by contributing to desertification. Water resources in WANA are more severely limited, in both absolute and per capita terms, than in any other region in the world. Several countries fall below the water poverty threshold, i.e. total renewable water resources (RWR) below 500 m<sup>3</sup>/capita/year (FAO, 1997 and Casas *et al.*, 1999). This is leading to unsustainable exploitation of underground water reserves. For example, withdrawals in Jordan already exceed RWR; withdrawals in Libya are over 90% of RWR. Inefficient water use aggravates the problem, particularly since agriculture accounts for 80% of total water use. Water losses can be as high as 60% in some irrigated production systems. Research needs to focus on water productivity and sustainable use of underground water.

#### Limited land resources and land degradation:

Lack of arable land limits expansion of crop production, because intensified agriculture is usually not a viable option in these environments. Fragmentation of small holdings hinders productivity growth. Land degradation is a serious threat: soil erosion due to water and wind; excessive grazing of rangeland; loss of fertility because of inappropriate land management and lack of fertilizer application; and salinity due to faulty irrigation methods. The situation is expected to deteriorate further, due to increasing demand for food, in

turn fuelled by rapid population growth.

#### Lack of research investment:

Agricultural research in the WANA region is limited by lack of investment, insufficient monitoring and impact assessment, limited coverage of unfavorable agroecologies, poor incentives for research staff in some countries, and limited regional and international cooperation. National research expenditures are much below 1% of agricultural gross domestic product - compared to 2% in most developed countries, where agriculture is relatively less important to the national economy (Casas *et al.*, 1999).

National agricultural research systems are correspondingly weak, except in Egypt, which has about half of all WANA researchers. Most countries have expanded their capacity in recent years, but much more is needed, especially to improve skills and facilities for biotechnology research. Available resources are often concentrated on more favourable areas. Marginal dryland areas, which support much more people and where poverty is highest, are understaffed and under-funded.

#### Policy environment:

Technology alone will have limited impact if not supported by an enabling policy. Researchers must provide scientific input into the development of national policies, e.g. policy and other options for agricultural development, disseminated to policy makers. For example, devolution of the decision-making process to local communities, empowering them to develop and enforce a code of conduct for managing common resources, has proven to be effective in protecting water and rangelands.

#### Limited infrastructure:

Infrastructure and rural services are a prerequisite for the dissemination and adoption of new technology. Small farmers, who contribute 80% of agricultural production, are particularly affected. For example, in 1997, the government of Egypt promoted drip irrigation in newly reclaimed desert areas in Nubaria, as an alternative to the inefficient traditional flood irrigation. Farmers rejected the technology because no local services were available to maintain drippers and water pumps. The government plan was based on drip irrigation over a large area; so the immediate consequence of adoption failure was a serious shortage of irrigation water.

### Science and Technology Strategy for WANA

An effective science and technology (S&T) strategy for agriculture must take in to account many factors - the production potential and constraints in each major agroecology, production and demand trends, new scientific developments, research capabilities, policy environment, as well as external factors. The strategy must develop and exploit partnerships among national institutions, and between national, regional and international agencies. It must also choose appropriate methodologies for research and extension (Solh, 1997).

#### Setting regional priorities:

It is crucial - but often difficult - to set clear research

priorities, because of the dynamic nature of agricultural systems and the conflicting nature of some components. ICARDA and its partners have participated in several priority-setting exercises for the WANA region; in 1992, 1995, and most recently in 2001-2. The partners included national governments, regional fora such as AARINENA, FAO, and CGIAR Centers. The process involved: (a) a comprehensive questionnaire completed by a wide range of stakeholders; policy makers, advanced research institutes, universities, farmer organizations, NGOs, and the private sector, (b) a series of sub-regional brainstorming meetings, (c) a CWANA Regional Meeting held in May 2002 at ICARDA to finalize the priorities for each sub-region. For example, research priorities for North Africa, developed through this process, are grouped under five clusters, and address the specific constraints identified by stakeholders (ICARDA *et al.*, 2003).

### Cluster 1. Germplasm Management

1 <sup>st</sup> priority	Germplasm improvement and biotechnology
2 <sup>nd</sup> priority	Genetic resources conservation Integrated pest management (3 <sup>rd</sup> priority for Egypt)
3 <sup>rd</sup> priority	Seed production (4 <sup>th</sup> priority for Egypt)
4 <sup>th</sup> priority	Crop diversification (5 <sup>th</sup> priority for Egypt)

Priorities on sub-clusters A (crops), B (animals), and C (fisheries) are available in ICARDA *et al.*; (2003)

### Cluster 2. National Resource Management

1 <sup>st</sup> priority	Water
2 <sup>nd</sup> priority	Soil Integrated crop management Rangeland (3 <sup>rd</sup> priority for Egypt)
3 <sup>rd</sup> priority	Biodiversity (4 <sup>th</sup> priority for Egypt)

### Cluster 3. Socioeconomics and Policy

1 <sup>st</sup> priority	Marketing/commerce and trade Institutional policies (3 <sup>rd</sup> priority for Egypt) Quality and value addition (3 <sup>rd</sup> priority for Egypt)
2 <sup>nd</sup> priority	Technology dissemination (1 <sup>st</sup> priority for Egypt) Post-harvest technology Impact assessment (3 <sup>rd</sup> priority for Egypt)
3 <sup>rd</sup> priority	Gender

### Cluster 4. Cross-Cutting Issues

1 <sup>st</sup> priority	Human resource development Capacity building
2 <sup>nd</sup> priority	Information and communication technology (1 <sup>st</sup> priority for Egypt) Biosafety and guarantee
3 <sup>rd</sup> priority	Indigenous knowledge Intellectual property rights (2 <sup>nd</sup> priority for Egypt)
4 <sup>th</sup> priority	Crisis and risk management (2 <sup>nd</sup> priority for Egypt)

### Cluster 5. Methodology and Approach

1 <sup>st</sup> priority	Strengthening and supporting existing sub-regional and regional cooperation (2 <sup>nd</sup> priority for Egypt)
2 <sup>nd</sup> priority	Networking (1 <sup>st</sup> priority for Egypt) Geographic information systems
3 <sup>rd</sup> priority	Participatory community approach (1 <sup>st</sup> priority for Egypt)
4 <sup>th</sup> priority	Integrated farming systems (2 <sup>nd</sup> priority for Egypt)

### Integrated approaches in research and technology transfer:

The S&T strategy must rest on the three pillars of sustainable agricultural development: integrated gene management and germplasm improvement, integrated natural resource management, and appropriate policies and institutional support. Integration must occur at different levels:

- Multi-disciplinary approach: for example, pest and disease management would involve specialists in molecular genetics, plant breeding, entomology, pathology, epidemiology, agronomy and socioeconomics
- Production systems approach: focus on the overall production system, rather than individual crops. For example, development of a crop/rangeland/livestock system would involve germplasm improvement, natural resource management, socioeconomics (including gender, property rights), and policy options
- Integration with different stakeholders: wide participation accelerates technology transfer and ensures that research and development are closely linked.

A good example of this integrated approach is ICARDA's Mashreq and Maghreb Project (ICARDA/IFPRI, 2000). It covers several commodities (barley, small ruminants, forages, cactus and crop residues) and eight countries: Algeria, Iraq, Jordan, Lebanon, Libya, Morocco, Syria and Tunisia. Several national institutions, numerous NGOs, as well as two international research centers (ICARDA and IFPRI) are involved. Working with poor farm communities in low-rainfall areas, the project has been able to improve the productivity of dual-purpose barley and forage legumes, ensure that livestock feed is available year-round, by supplementing natural grazing with feed blocks, and increase meat and milk production (through cross-breeding, distribution of improved Awassi rams, and studies on reproductive physiology).

### Improving farmer participation:

New technologies can be made more relevant to local needs and priorities, and adoption greatly improved, by strengthening farmer participation in the research-development-dissemination process. This is particularly true in dryland areas with resource-poor farmers. For example, ICARDA's participatory plant breeding methods not only identify superior genotypes more efficiently, but also reduce the time required for variety release. Breeders and farmers work together on early-generation selection under stressed environments. Farmers are involved in se-

lection and testing at every stage, starting with early segregating generations, through identifying, testing and eventually disseminating superior genotypes through farmer-managed demonstration plots. This approach has proved successful in Syria, Algeria, Libya, Morocco and Tunisia, and continues to be scaled out. Ultimately, the goal is to empower the community: improve their skills, enable them to better understand the dynamics of their farming system, adopt new technologies to move out of poverty, and gradually play a more active role in development.

#### **Advances in science and technology:**

Technological progresses will play a key role in the future of agriculture. Three areas are likely to be particularly influential.

**Biotechnology.** Molecular tools will become available for better understanding of the structure and function of genes and for supplementing traditional plant breeding methods. Recent advances include genomics, tissue culture, cloning, marker-assisted selection, and-most controversial of all-production of genetically modified organisms (GMOs). GMO research is predominantly concentrated in six countries: USA, Argentina, Canada, Brazil, China and South Africa; and three crops, soybean, maize and cotton. The key traits are insect resistance and herbicide tolerance. There have been various concerns about GMOs, but overall, the scientific consensus is that the advantages outweigh the disadvantages. However, two issues must be addressed: increasing public-sector GM research (to ensure access for resource-poor farmers), and developing legal frameworks for product standards, liability, and related issues, perhaps building on international standards and agreements such as the Cartagena Protocol.

**Geographic Information Systems.** GIS mapping has multiple applications: delineating zones of adaptation, e.g. targeting new varieties to specific geographic areas, studying land use and the health and distribution of natural resources, etc. For example, GIS mapping and analysis of satellite imagery has been successfully used to identify potential areas for water harvesting in the steppe of Central Syria (ICARDA/IFPRI, 2000) and to predict desert locust outbreaks in West Africa (FAO, 2002).

**Expert systems.** Detailed knowledge from experts in a particular field can be collected and packaged into an expert system that advises farmers and non-technical users on how to deal with specific problems. For example, the NEPER Wheat Expert System developed by the Central Laboratory for Agriculture Expert Systems (CLAES) in Egypt and ICARDA provides diagnosis and treatment advice for 38 disorders in wheat. The topics covered include diseases, irrigation, fertilization, seed selection, tillage, seed depth and density, pesticides and others. Similar tools could greatly accelerate technology dissemination.

#### **Scaling up, scaling out:**

To link research with development, one effective approach is the use of pilot sites. Pilot sites can be established in target agroecologies and farming systems, to be used as platforms for testing best-bet technologies and then disseminating

them across a broader region. In Egypt, the Matrouh Resource Management Project works with Bedouin communities in a low-rainfall area (130mm) in the Northwest Coast (Solh *et al.*; 1999). Pilot sites are established in watersheds, to demonstrate water harvesting, forage shrub plantations, range management, barley production and other technologies. Most of the work is done by the local community. The project is funded by the World Bank and implemented by Egyptian project staff in cooperation with ICARDA.

Similarly, ICARDA runs an integrated research site in Khanasser valley, in the badia area of northwest Syria. Research covers several areas: agronomic management and cropping systems, rehabilitation of rangeland, small ruminant productivity, water conservation and management, land management and soil conservation, and socioeconomics of natural resource management. The results have been excellent (Masri & Zoebisch, 2002 and Asgedom *et al.*, 2005).

One common problem is poor adoption of available, proven technologies that have been successfully used elsewhere. There are several reasons. One is lack of information on what technologies are available, or how and where they were applied (this can be crucial when a technology needs to be adapted to local conditions). In some cases there is lack of local capacity to assess and/or modify a particular technology to suit local conditions. This could be addressed through better documentation and information sharing; and where necessary, external technical assistance to make the necessary modifications.

### **National, Regional and International Partnerships**

Development problems are complex, and can usually be resolved only through the combined efforts of multiple organizations. At the national level, the various development agencies must collaborate more effectively, sharing resources, information and skills. Agricultural R & D was traditionally led by government research departments. We now recognize that many partners can contribute: research, extension services, universities, the private sector, NGOs, farmer organizations, and others. These complementary skills must be harnessed effectively.

Regional and international partnerships are equally important; and any S&T strategy must aim to strengthen these links. Many agricultural problems (including pests and diseases) cut across national boundaries, and are best tackled through a regional approach. However, management and coordination of regional collaboration will need attention. Collaboration must be based on sharing of information, resources, skills and responsibilities. In many cases, depending on comparative advantage, one country could lead a specific research theme, working on behalf of the region. The WANA region has a good record of regional cooperation, largely facilitated by ICARDA. In cooperation with national research programs, ICARDA, through its regional offices, hosts annual meetings as part

of the implementation of regional projects on cereals (wheat, barley), food legumes (faba bean, chickpea, lentil), forages, natural resource management (particularly water and rangeland), and small-ruminant production. These meetings develop annual regional action plans in each area, to be implemented by the national programs.

Regional networks can be established following the model of the ICARDA Nile Valley and Red Sea Regional Program. This in turn comprises six regional networks, which use a multidisciplinary, multi-institution approach to address specific problems (Solh, 1996). ICARDA's leadership of these networks has devolved to the national programs. Egypt takes the lead in three networks: wheat rusts, aphids and virus diseases, and water-use efficiency. Ethiopia leads the network on wilt/root rots diseases in food legumes. Sudan leads two networks on socioeconomics and thermo-tolerance in wheat, in addition to its leadership in the biological control of aphids.

International cooperation involves numerous CGIAR Centres: ICARDA, CIMMYT, ICLARM, IFPRI, IPGRI, IRRI, ISNAR and IWMI, as well as other agencies. Many of these links are regional, and mediated through ICARDA. In addition, bilateral cooperation is well established with several centers of excellence in the Near East, Europe and the USA. A good example of international cooperation is the EMPRES program for controlling desert locusts in West and North Africa.

### Capacity Building

For any S&T strategy to succeed, there must be adequate implementation capacity. This broad term covers many areas. Local level capacity (local institutions, social networks, etc) will determine whether interventions are well implemented, and whether they result in adoption of new technologies and eventually, improvement in rural welfare. Likewise, capacity is needed to design interventions, and to organize and manage the diverse components of a research and extension system. This is often lacking. One approach promoted by FAO and others, is to develop an agricultural research master plan for the country, precisely spelling out the research agenda, resources needed for its implementation, the political and institutional arrangements required to mobilize the needed resources, and especially the roles and responsibilities of each component in the system.

Such a master plan would be a necessary first step. Further, the system will require competent leadership at various levels, not only in research but also in administrative or support departments (finance, personnel). Often, what may be lacking, especially in public sector agencies, is capacity to manage across the sciences, or to negotiate through institutional barriers to quickly implement multi-institution multidisciplinary projects.

Training and capacity building for farmers, field research or extension staff, as well as managers and administrators should be part of the master plan. Regional and international agencies such as FAO often have funds

earmarked for capacity building, and these could be tapped, once a clear and realistic plan is in place.

### The Role of External Factors

International trends can significantly influence national development policy; and any S&T strategy must take these into consideration. In particular, globalization and the WTO era have far-reaching implications on development policy, because of its impact on competitiveness. Likewise, international conventions and multilateral international agreements can provide significant development opportunities, and sometimes impose additional costs, at least in the short term.

The nature and scope of agricultural opportunities will increasingly depend on global competitiveness. Research and technological innovation will continue to be the principle means of improving competitiveness - but countries with limited scientific capability or limited research resources could be severely affected. This emphasizes the importance of national investment in agricultural research in developing countries, to enhance global competitiveness of their agricultural products.

International conventions and agreements can help support agricultural development. United Nations conventions such as Agenda 21, presented at the Earth Summit 1992, emphasizing sustainable development, the UN Convention to Combat Desertification, the UN Convention on Biological Diversity etc, provide broad frameworks to address global issues. Other international agreements focus on more specific areas. The International Treaty on Plant Genetic Resources for Food and Agriculture provides for access to and transfer of plant genetic materials and technologies, and currently covers 35 crops and 29 forage species. The International Plant Protection Convention coordinates efforts to prevent the introduction and spread of pests. The Agreement on the Application of Sanitary and Phytosanitary Measures focuses on health risks from toxins and pathogens. The Cartagena Protocol on Biosafety aims to establish precautions against biotechnology risks. The Codex Alimentarius looks at issues of consumer health and fair practices in the food trade. The Code of Conduct suggests guidelines on pesticide use.

### Summary and Conclusions

The WANA region faces formidable challenges in its quest for sustainable agricultural development. But technologies are available that can reduce land degradation and increase productivity even in marginal dryland areas. Deployment of these technologies must be part of a comprehensive and clearly planned S&T strategy.

Such a strategy would require, first, clear priority setting bearing in mind the availability of skills and resources and opportunities for synergy among organizations within a country, or countries within a region. Issues of management and organization are as important as purely technical issues. For example, changing the traditional organizational structure to increase multi-disciplinarity, and breaking

down inter-institution barriers to implement integrated R&D projects. Rapid advances in biotechnology and other sciences will provide new opportunities, which can be exploited provided the necessary supporting structure is in place.

Some WANA countries lack an enabling policy environment for agriculture. In particular, government investment in research is low, and this could have serious consequences, for example, countries falling further behind as they fail to keep up with technological advances, or react too slowly to emerging opportunities and threats created by globalization.

Ultimately, research must be linked with development; through the use of an integrated approach (multi-disciplinary, production system focus) that involves all partners and stakeholders, and strong systems for dissemination, monitoring and evaluation.

## References

- Asgedom, H.; Becker, M.; Turkelboom, F. and Resier, A. 2005. Nutrient management and ecological interactions in the Khansser valley, Syria. ICARDA, Aleppo, Syria and Bonn University, Germany.
- Casas, J.; Solh, M. and Hafez, H., eds. 1999. The National Agricultural Research Systems in the West Asia and North Africa Region. ICARDA/FAO/AARINENA/CIHEAM. ISBN 92-9127-096-2.
- FAO. 1997. Food and Agriculture Organization of the United Nations, Water Reports. Rome, Italy.
- FAO. 2002. The State of Food and Agriculture 2002.

- Food and Agriculture Organization of the United Nations, Rome, Italy.
- ICARDA/IFPRI, with the National Programs of Algeria, Iraq, Jordan, Lebanon, Libya, Morocco, Syria and Tunisia. 2000. Integrating Crop-Livestock Production Systems in the Low-Rainfall Areas of West Asia and North Africa. The Mashreq and Maghreb Project, ICARDA, Aleppo, Syria.
- ICARDA, AARINENA, and CAC NARS Forum. 2003. Proceedings of the Regional Meeting on Agricultural Research Priority Setting in CWANA. ICARDA, Aleppo, Syria, 8-10 May 2002.
- Masri, Z. and Zoebisch, M. 2002. Indicators of soil erodibility for dryland degradation assessment. Proceedings of the 3rd International Symposium on Sustainable Agroecosystems: New Technologies and Applications, 26-29 October 2002, Cairo, Egypt.
- Solh, M. B. 1996. The Nile Valley Regional Program (NVRP): A Model for Technology Transfer. ICARDA/NVRP: Cairo, Egypt.
- Solh, M. B. 1997. Science and technology strategies for national development with reference to agriculture. Proceedings of the International Seminar on S&T Strategies for National Development in Islamabad, Pakistan, 13-14 December 1997.
- Solh, M. B.; Abo Elenein, R. A.; Haddad, N. I.; Ali, A.; Khalifa, H. E. and Bedier, M. A. 1999. A Research Approach for the Sustainability of Natural Resources. Nile Valley and Red Sea Regional program. ICARDA, Cairo, Egypt.

## الاستراتيجيات العلمية والتقنية للأمن الغذائي والتنمية الزراعية المستدامة

محمود الصلح<sup>1</sup>

### الخلاصة

تواجه منطقة عربي آسيا وشمال إفريقيا (WANA) تحديات جسيمة في سعيها لتحقيق تنمية زراعية مستدامة. بيد أن ثمة تقانات متاحة يمكن لها أن تُخفف من تدهور الأراضي، فضلاً عن أنها قد تُحقق زيادة في الإنتاجية حتى في المناطق الهامشية الجافة. ويتعين نشر هذه التقانات كجزء من استراتيجية شاملة للعلوم والتقانات مخطط لها بشكل واضح.

إن هذه الاستراتيجيات تتطلب - أولاً - إعداداً واضحاً للأولويات، آخذين في عين الاعتبار توافر المهارات والموارد والفرص لتأسيس علاقات تعاونية ما بين المنظمات داخل البلد، أو بين البلدان في المنطقة. وتتساوى قضايا الإدارة والتنظيم من حيث الأهمية مع القضايا التقنية الصرفة، من قبيل تغيير الهيكل التنظيمي التقليدي لزيادة التعددية في الاختصاصات، وتذليل الحواجز بين المؤسسات لتنفيذ مشروعات البحوث والتنمية. وسيعمل التقدم السريع في التقانات الحيوية والعلوم الأخرى على فتح أبواب فرص جديدة يمكن استثمارها شريطة وجود البنية الداعمة الضرورية في المكان المناسب لها.

تفتقر بعض بلدان WANA لمناخ السياسات الزراعية الكفوءة. ونرى، على وجه الخصوص، أن ثمة تدنٍ في الاستثمار الحكومي لبرامج العمل البحثي، الأمر الذي سيشتمخض عن نتائج خطيرة. فعلى سبيل المثال، تتخلف البلدان مع إخفاقها في مواكبة التقدم التقني أو نتيجة بطء تفاعلها مع الفرص المتاحة أو التهديدات التي تظهر نتيجة العولمة.

وعليه، يجب ربط البحوث بالتنمية، وذلك من خلال استخدام نهج متكامل متعدد الاختصاصات ويُرَكِّز على نُظُم الإنتاج ويشمل كافة الشركاء والمعنيين، وكذلك من خلال نظم قوية لنشر هذه البحوث ورصدها وتقييمها.

<sup>1</sup> مدير عام المركز الدولي للبحوث الزراعية في المناطق الجافة (إيكاردا)، ص.ب. 5466 حلب، سورية، فاكس: 2225105 (21) (+963)، بريد إلكتروني: m.solh@cgiar.org