

CGIAR Research Program on  
Dryland Agricultural Production Systems

The global research partnership to improve agricultural  
productivity and income in the world's dry areas

# New Research Approaches to improve drylands agriculture

to deliver a more prosperous future



CGIAR

RESEARCH  
PROGRAM ON  
Dryland Systems

**Acknowledgements**

This report summarizes the main concepts and approaches of the CGIAR Research Program on Dryland Systems. It draws on the work of some 250 researchers, development partners and rural development specialists, since 2010, from international, regional and national levels who were involved in developing the Dryland Systems research proposal and regional consultations that produced the inception report.

**Feedback**

The program welcomes comment and feedback on this publication.

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Maps have been drawn to support program communication and are not intended to show political boundaries.

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## About this report

This report presents the outline and context for the CGIAR Research Program on Dryland Systems. It examines the 'systems thinking' that underpins the Program, against the background of climate change and the host of related problems that rural communities in the world's drylands are increasingly facing. It details the target regions where the program is putting its research into action to test approaches to scale-up technology and policy interventions that can have a direct and positive impact for people living in these regions.

The concepts presented and summarized here draw on the Dryland Systems research proposal and Inception Report that was drawn up after two years of extensive scientific consultations in five regions, that was the basis for the program's design in 2012. The report explores how systems thinking can provide long term improvements to dryland agricultural production systems, as outlined in the recent ICARDA publication – *Innovative Agriculture for Food Security*. On climate change, it refers to the recent joint publication of the CGIAR Climate Change program (CCAFS) and ICARDA – *Strategies for Combating Climate Change in Drylands Agriculture*.

It is hoped that planners, policymakers and development partners will find the information and analysis presented here useful in appreciating why there is an urgent need for new approaches to research for development – to address the problems faced by people that depend on drylands for their food security and livelihoods– and how the Dryland Systems program addresses them.

## FOREWORD

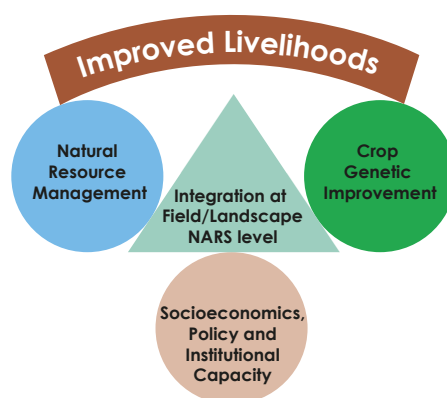
Poverty, food insecurity, natural resource degradation and climate change are global challenges; but they impact most severely on rural communities in dry areas. Addressing these challenges requires a combination of innovative science, integrated approaches to research-for-development, and effective partnerships.

The CGIAR Research Program on Dryland Systems presents such integration with new thinking and new approaches in efforts to tackle the myriad problems of dry areas and to feed a hungry world.

The thinking and conceptual approach of the CRP Dryland Systems grows out of the experience and agricultural research achievements over the past decades by many organizations and science programs, including the CGIAR and its many national partners. As the lead center for the Dryland Systems Program, ICARDA brings 36 years' experience working closely with more than 40 drylands countries – on joint research to develop improved crop varieties, effective water and land management practices, integrated crop-livestock production systems and institutional and policy options based. Over the years, this combined experience has evolved into the concept of 'integrated agro-ecosystems' approaches to helping rural communities living in dryland agricultural systems improve their food security and income.

The Dryland Systems program has partnerships at its core. Its strategy and science program were developed through extensive consultation with stakeholders across the non-tropical dry areas. These include: national authorities, research and extension agencies, civil society organizations, universities, donors, regional and international bodies, private sector and other partners.

The program will identify and develop resilient, diversified, and more productive combinations of crop, livestock, rangeland, aquatic, and agroforestry systems that increase productivity, reduce hunger and malnutrition, and improve the quality of life of the rural poor. Sustainability in the use of the natural resource base particularly water, biodiversity and land will be a major concern in dry areas. The initiative will also promote appropriate market linkages, policies and income-generating activities.



*The three pillars of an integrated approach to address challenges facing dry areas*

Potential solutions will include crop and livestock genetic improvement, better water productivity, and more sustainable farming techniques such as conservation agriculture. 'Climate smart' strategies and technologies also have an important role to play, helping to increase food production, while safeguarding precious natural resources.

If we are to maximize the potential impact of these and other high-potential interventions, they must be introduced as part of a package, alongside sustainable natural resource management techniques, appropriate policies, and income-generating activities. The mix must include innovative thinking, sustained funding and strong political support and will.

It is a tough agenda to follow. We have set ambitious targets to meet, but the prize is certainly worth the effort. We must end the daily trudge of searching for food in fragile drylands ecosystems, severe water scarcity, the degradation of natural resources and desertification.

The earnest hope and design of Dryland Systems is that millions of people and billions of hectares will see a more productive and sustainable future. Let the hard work on the ground continue with new innovative thinking and extended partnerships.

Mahmoud Solh  
ICARDA Director General

# 1. A change in direction for the world's dry areas

## *New hope in fighting poverty and marginalization*

The dry areas of the developing world presently occupy over 40% of the earth's land surface and are home to approximately 2.5 billion people. These regions struggle to provide sufficient food for their growing populations and face a series of daunting physical and demographic challenges: high poverty levels and unemployment, rapid urbanization, severe water scarcity, and land degradation. Unfortunately, many of these problems and constraints are expected to worsen as a result of climate change. "Making the desert bloom" has never been a harder challenge. Drylands will increase.

Without support and assistance, these regions could potentially witness debilitating levels of out-migration and instability, damaging their social fabric and confining them to a future of low productivity, limited economic growth, and marginalization. How we respond to the needs of dryland countries, and how quickly we can address and reverse the constraints they confront, will determine the fate of these insecure regions in years to come. Agricultural research can promote the solutions and technologies needed – but the challenge we face is complicated by the inadequacies of some current development interventions which are based on just a few technologies or commodity crops.

### **Raising productivity and food security on marginal lands**

Our efforts to raise productivity and strengthen food security in marginal production systems are also frustrated by the short-term funding commitments of donors, and a lack of practical policy options that can help countries respond to the realities they face. Given these limitations, what changes are needed to the way we approach rural development in dry areas? And what would an improved 'research-for-development' agenda in these regions look like?

We propose a holistic and integrated approach that considers all aspects of integrated agro-ecosystems. One that identifies, quantifies, and integrates the driving forces and interactions that shape and constrain farming systems, and the management of natural resources. Such an approach is provided by the ICARDA-led CGIAR Research Program on Dryland Systems, which brings together a wide range of partners, including rural communities, national governments, and research for development organizations, and more.

The Dryland Systems research program will identify and develop resilient, diversified, and more productive combinations of crop, livestock, rangeland, aquatic, and agroforestry systems that increase productivity, reduce hunger and malnutrition, and improve the quality of life of the rural poor. The initiative will also promote appropriate market linkages, policies and income-generating activities.

The program's research teams – in close partnership with rural communities and national governments – will validate the effectiveness of interventions in representative integrated agro-ecosystems, and promote their scaling-out in the dry areas of five target regions: West Africa Sahel and the Dry Savannas, East and Southern Africa, North Africa and West Asia, Central Asia and the Caucasus, and South Asia.

### **In the coming six years, the program targets improvements for:**

- 23 million people in the West African Sahel and Dry Savannas region and to mitigate land degradation on over 200,000km<sup>2</sup>.
- 20 million people in East and Southern Africa, and to mitigate land degradation on 600,000km<sup>2</sup>.
- 1.1 million people in North Africa and West Asia on 18,600km<sup>2</sup>.
- 500,000 people in Central Asia and the Caucasus, and to mitigate land degradation on 2,900km<sup>2</sup>.
- 65 million people in South Asia, and to mitigate land degradation on 465,000km<sup>2</sup>.

### **Systems solutions**

Potential solutions will include crop and livestock genetic improvement, better water productivity, and more sustainable farming techniques such as conservation agriculture. 'Climate smart' strategies and technologies also have an important role to play, helping to increase food production, while safeguarding precious natural resources.

Consider the example of 'raised bed' farming in Egypt. This is a live example, and is a practical and cost-effective intervention, which has successfully increased wheat yields by 20% - using 20% less water. Or supplemental irrigation, which improves water productivity and allows farmers to plant and manage crops at the optimal time, regardless of climate vagaries.

If we are to maximize the potential impact of these and other high-potential interventions, they must be introduced as part of a package, alongside sustainable natural resource management techniques, appropriate policies, and income-generating activities.



## 2. Drylands - addressing the difficult challenges ahead

*In this millennium, global drylands face a myriad of problems that present tough research, management, and policy challenges. Recent advances in dryland development, however, together with the integrative approaches of global change and sustainability science, suggest that concerns about land degradation, poverty, safeguarding biodiversity, and protecting the culture of up to 2.5 billion people can be confronted with renewed optimism (Reynolds, et al. 2007).*

The paper *Global Desertification: Building a Science for Dryland Development* (Reynolds et al, SCIENCE 316,847, 2007) sets a new scene for solving the problems faced by people living in dryland food production systems. Among the five points proposed by the authors as a new pathway to address dryland systems issues are the conviction that researchers and practitioners need to adopt an integrated approach: that ecological and social issues are interwoven, as are options for livelihood support and ecological management; that short-term measures to address the situation in drylands tend to be superficial and do not resolve the underlying, persistent, chronic problems faced by their inhabitants; and that in dealing with problems of dry areas, cross-scale interactions must be anticipated.

The authors go on to say that the Convention to Combat Desertification and related efforts receive comparatively little exposure in the popular and scientific media, in part because of the absence of a focused international science program.

### **A voice for drylands populations**

It is often hard for dryland areas and their populations to find a voice to get their development message heard on water scarcity, poverty and food insecurity. The populations living on drylands are usually more sparse, more mobile, more remote from markets, and distant from the centers (and priorities) of decision-makers. This makes it more difficult for drylands issues to be placed at the top of national and international political agendas.

Likewise, institutional and policy arrangements devised for other types of agro-ecosystems, such as farming or livestock systems will not necessarily transfer directly to provide solutions for people living in dryland production systems. As a result, dryland populations tend to lag behind populations in other parts of the world on a variety of economic and health indices, even when allowing for 'ruralness' with such trends as higher infant mortality, severe shortages of drinking water, and much lower agricultural productivity per capita.

Inaction is not an option. The consequences of failing to address poor productivity of dryland systems include further land degradation and loss of biodiversity, more poverty, increased food insecurity, poorer nutrition, rising unemployment, rural exodus, and even greater social inequality. None of these bode well for political stability, as recent events in some of the dry areas illustrate.

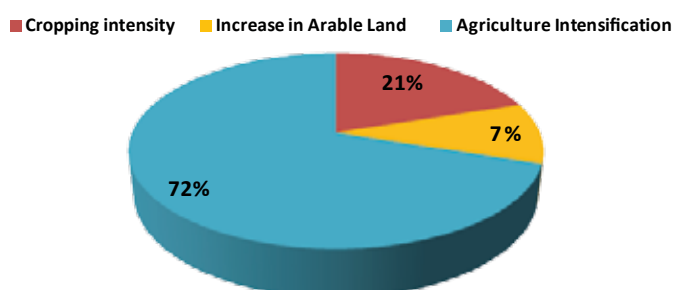
Now the CGIAR Research Program on Drylands Systems is set to make a step change in the intervention and development effort for agriculture and dryland communities, as the first drylands research for development program with a truly global scope. With it, many of the needs of the globe's most vulnerable population, that make their livelihoods on the world's marginal lands – some 11 billion hectares – will start to be answered. nas, East and Southern Africa, North Africa and West Asia, Central Asia and the Caucasus, and South Asia.

## 2.1 Why push now for “integrated and sustainable agro-ecosystems for improved food security and livelihoods in dry areas”?

Dry areas of the developing world are by definition characterized by persistent water scarcity and commonly suffer from land degradation. Most of the world's poor live in dry areas, including 400 million “poorest of poor” who survive on less than US\$1 per day. Dry areas face several demographic challenges, including rapid population growth, high urbanization, age distribution that is heavily skewed towards youth, and the world's highest unemployment rate.

Among the 2.5 billion people living in dry areas, about one-third depend on dryland agricultural production systems for their food security and livelihoods. Dryland production systems cover about three billion hectares, or 41% of the Earth's land area, and employ a highly diverse mixture of crops used for food, feed and fiber; rangeland and pasture species; trees used for a multitude of purposes; and fish and livestock.

### Sources of Increase in Food Production & The Trend Towards Intensification of Production Systems



**The case for 'sustainable intensification':** an increase in the area of arable land may only result in a 7% increase in food production. Yet this might be an optimistic figure, as the combination of unsustainable land use, over-exploitation of resources, and climate change can potentially desertify millions of hectares.

The integrated agro-ecosystems in which dryland production systems operate are challenging environments because of numerous biophysical and socioeconomic constraints. Biophysical constraints include drought, floods, temperature extremes, salinity, marginal soils, loss of biodiversity, and high vulnerability to land degradation. Socioeconomic constraints include poverty, social inequity, poor access to technology, underdeveloped markets, high population growth, and weak institutions. As a result of these many constraints, dryland systems in the developing world produce much less than is possible and, more importantly, much less than is needed by the growing populations who depend upon them for food security and livelihoods.

Because of the low productivity of dryland systems, developing countries in the dry areas have had to rely increasingly on imported grain and other foodstuffs to meet their basic food requirements. Arab countries, for example, are the largest importers of cereals in the world. Countries in the dry areas have also witnessed proportionately greater rises in food prices than the rest of the world during recent commodity price shocks, and as a result their poor have suffered proportionately more. Increased dependence on imported food and higher food prices constitute threats to food security and livelihoods, and put the poor and vulnerable at particular risk.

### **Drylands - the hardest hit by climate change**

The situation looks likely to become even more severe, specifically for people producing food on the world's marginal lands. Almost all global circulation models, and changes experienced over the last 20 years, predict that climate change will hit dry areas hardest, and particularly those in North Africa, sub-Saharan Africa, and West Asia. Specific projections of these models tend to suggest that climate change will further exacerbate the biophysical and socioeconomic stresses that societies in the dry areas must face, and with which their agricultural production systems must contend to ensure food security and livelihoods.

Benefits of sustainably increasing productivity of dryland systems include reduced poverty, improved food security, better health and nutrition, conservation of natural resources, and reduced social inequity.

#### **Key problems facing dryland countries and production systems:**

- Food production systems in dryland countries are highly fragile
- Some 16% of the population of dry lands live in poverty
- Food imports are untenably high
- Water scarcity is a constant and growing problem
- Adverse climate events (extreme heat and cold; drought and flooding) are aggravating vulnerability

#### **Proposed solutions:**

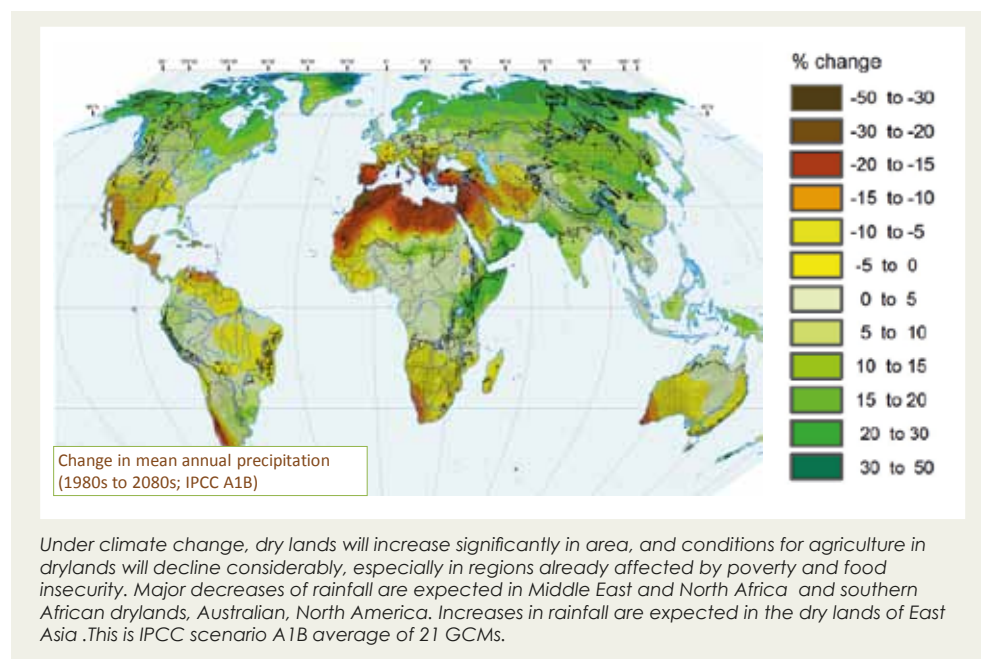
- Securing more resilience and reducing vulnerability of people living in marginal lands
- Achieving sustainable intensification of higher-potential agricultural areas
- Improved crop varieties and livestock breeds
- Integrated crop-livestock systems
- Conservation agriculture
- Diversification of food production systems
- Natural resource and especially water management
- More agricultural research and investment
- Climate smart agriculture initiatives
- Greater focus on the potential of agriculture in climate change negotiations
- Taking an integrated agro-ecosystem approach to these actions.

## **2.2 Tapping the potential of drylands agriculture in the face of climate change**

Strong agricultural adaptation measures are the key to developing food production in drylands, but these are contingent on policy and financial support. Since agriculture holds so many of the answers to challenges posed by changing weather patterns, it makes sense that this sector and associated research take center-stage in climate change negotiations.

The main challenges related to climate change currently facing drylands are both biophysical and non-biophysical in nature. Key biophysical constraints include natural resource limitations and degradation, specifically in water scarcity and increasing desertification, in addition to salinity problems in irrigated areas. The main non-biophysical limitations are inadequate and unequal access to land, water, markets, and inputs compounded by limited access to information about alternative production technologies.

Given the complexity of these challenges there is no single “silver bullet” solution for solving the problems faced by dryland agriculturalists. However, there are practical solutions currently available that will increase food security. These practical solutions follow an integrated agro-ecosystems approach that involves sustainable natural resource management and inputs, crop and livestock genetic improvement, and enabling policy environments. Partnerships are also critical success factors, given the complexity of the challenges facing drylands, and the necessity of an integrated approach. Countries now need more precise action plans in the face of combat climate change that follow an integrated agro-ecosystems approach and develop strategic partnerships to find solutions to increase the productivity of agriculture in the drylands.



There are attainable possibilities for significantly improving food security in drylands. Target areas for improving food security can be broken into two sections; increasing resilience and sustainable intensification. One example comes from Egypt where strategies like raised-bed farming for wheat have improved productivity by 20% while using 20% less water. In rangeland areas, herders are being encouraged to decrease and diversify their stock and to produce value-added products such as yoghurt and cheese that command high market prices.

In the developing world few countries are making significant investments in science and technology for agriculture despite their ability to provide a real force for advancing national food security and nutritional goals. It should be noted that the countries who have invested in agriculture; China, Argentina, and India, have grown very well. Unfortunately, in many low-income countries, the sentiment that agriculture does not contribute to the national economy is still predominant. The research of the Dryland Systems program is working to change this thinking.

More can be done to mobilize greater investment in agricultural research and technology. It is important that we demonstrate the benefits and impact of such agricultural research to decision makers within the various ministries of agriculture, environment, planning, and finance in the countries in which we operate. We have compelling arguments with which to do so.

### 3. The CGIAR Research Program on Dryland Systems

*A new approach to improving food security, nutrition and livelihoods in the world's dry areas*

The Dryland Systems program targets improving the livelihoods of people in:

- **Marginal areas, with high vulnerability and low production potential**, where the goal is to increase productivity by 10–20% (CGIAR Strategic Research Theme 2).
- **Higher production potential areas, and with scope for the sustainable intensification** of agricultural production, in which the goal is to increase productivity by 20–30% (CGIAR Strategic Research Theme 3).

#### Regional targets

In the coming six years, the program aims to improve the lives of:

#### Proposed solutions:

- **20 million people in East and Southern Africa**, and to mitigate land degradation on 600,000 km<sup>2</sup>.
- **500,000 people in Central Asia and the Caucasus**, and to mitigate land degradation on 2,900 km<sup>2</sup>.
- **23 million people in the West African Sahel and Dry Savannas** region and to mitigate land degradation on over 200,000km<sup>2</sup>.
- **65 million people in South Asia**, and to mitigate land degradation on 465,000 km<sup>2</sup>.
- 1.1 million people in North Africa and West Asia on 18,600km<sup>2</sup>

The program's goal is to identify and develop resilient, diversified and more productive combinations of crop, livestock, rangeland, aquatic and agroforestry systems that increase productivity, reduce hunger and malnutrition, and improve quality of life among the rural poor.

The research will validate and propose a series of integrated technology and policy interventions. These packages will combine improved plant and animal varieties, and diversification of agricultural systems as a means of mitigating risk and increasing income. This includes approaches for sustainable land and water management, integrated disease and pest management, socio-economic considerations (particularly for women and youth) and policy and institutional options that are needed to scale-out these solutions across countries and rural communities.

The aim is to reduce the vulnerability of rural communities and entire regions across the world's dry areas – targeting improvements in some 11 billion hectares of dry areas over a 12-year period.

The CGIAR Research Program on Dryland Systems embodies new systems thinking. Its research will bring rural communities living in the world's dry areas practical solutions for improved livelihoods and food security. The budget for the initial three years of this initiative is more than \$120 million.

#### The Dryland Systems research partnership

The CGIAR Research Program on Dryland Systems is led by the International Center for Agricultural Research in the Dry Areas (ICARDA), with a wide range of partners, including more than 60 national agricultural research systems, advanced research institutions, development agencies, civil society organizations and the private sector. It involves regional organizations: GFAR, FARA, AARINENA, APAARI, CACAARI, ASARECA and CORAF; and nine CGIAR Centers: Bioversity International, CIAT, CIP, ICARDA, ICRAF, ICRISAT, ILRI, IWMI, WorldFish), the CGIAR Challenge Program for Sub-Saharan Africa,

## Highlights of the research design and inception phase

The program's research agenda and priorities were set by a broad and intense scientific consultation between project partners in five agro-ecological target regions. This resulted in the detailed characterization of research Action Sites published in the Dryland Systems Inception Report.

### Targeted outcomes

**The Dryland Systems research program will result in:**

**Improved crop and livestock productivity** and reduced variability in agricultural production in target systems.

**New agribusiness and market opportunities** and increased employment from the diversification of production systems and adding value to agricultural products.

**Increased capacity of vulnerable smallholder farmers to adapt to climate change** by adopting natural resource management options that improve the resilience of their livelihoods.

**Equitable access to natural resources** and better resources management.

**Innovation platforms**, across impact pathways.

**Access to new knowledge for policy makers in target areas** about agro-ecosystem development, and better focused investment in drylands.

The priority setting and characterization process was unique in its approach. The partners have identified, and will address together, a set of common problems and issues that they face in managing their drylands production systems – ranging from West Africa to South Asia. The Dryland Systems' research 2012 site selection and characterization process has inspired similar processes used in the past year by the World Bank's Drylands Program, the USAID Africa Rising Initiative and the France's CIRAD Transmed Program, and have referred to the Dryland Systems method in their planning.

The inception process provides a socioeconomic and biophysical state of five target regions with a view towards identifying and prioritizing research for reducing the vulnerability of more marginal agricultural systems of the dry areas, and sustainably intensifying systems, which have greater production potential.

### Target Regions

- West Africa Sahel and the Dry Savannas
- East and Southern Africa
- North Africa and West Asia
- Central Asia and the Caucasus
- South Asia

The Action Sites were chosen by consensus between the partners on priority areas for research investment. The characterizations outline climate, soil, land use, land degradation, water resources, farming systems, poverty, market linkages and institutional support data as well as highlight major constraints, partners, and impact pathways for each regional Action Site. This is probably the first global research program that is based on a detailed socio-economic and biophysical characterization of research sites across the world's dry areas.

The research site characterizations are summarized in Section 5 of this report and presented in greater detail in the Dryland Systems *Inception Report*, available at:

[//apps.icarda.org/wsInternet/wsInternet.aspx/DownloadFileToLocal?filePath=Dryland\\_Systems/Dryland\\_Systems\\_Proposal.pdf&fileName=Dryland\\_Systems\\_Proposal.pdf](http://apps.icarda.org/wsInternet/wsInternet.aspx/DownloadFileToLocal?filePath=Dryland_Systems/Dryland_Systems_Proposal.pdf&fileName=Dryland_Systems_Proposal.pdf)



## Gender and Youth in drylands agro-ecosystems

Women and youth are the two groups in drylands agriculture who are most affected by high levels of inequity and often marginalization. In many cases, women run the farm in addition to managing the family the year round, while their husbands seek gainful employment living in other locations. Women are the de facto household heads in many dryland food production systems, and are often responsible for high-value fruit and vegetable production. Likewise, children and young people, especially females, are helping to run many day-to-day aspects of smallholder agriculture.

Because gender inequality directly affects the likelihood of success in achieving development outcomes, the program has a series of cross-cutting gender and youth research and learning activities, applied to all program themes. These take the form of capacity building, involvement in local components of the research, socio-economic analyses and assessments of gender and youth aspects of technology dissemination and issues related to the potential for scaling-up of new farming approaches.

The main objective of including gender in all aspects of this program is to ensure that the knowledge generated by this research will have positive and equitable impact on both women and men and will not inadvertently disadvantage women or other vulnerable groups. Including gender in the research portfolio also increases the potential for overall impact. Leaving it out means a significant part of the population is excluded.

## Impact Goals

- 10-20% increase in productivity in SRT2 systems
- 20-30% increase in productivity in SRT3 systems
- 20% adoption rate within Action Sites
- Larger scope for impact through outscaling

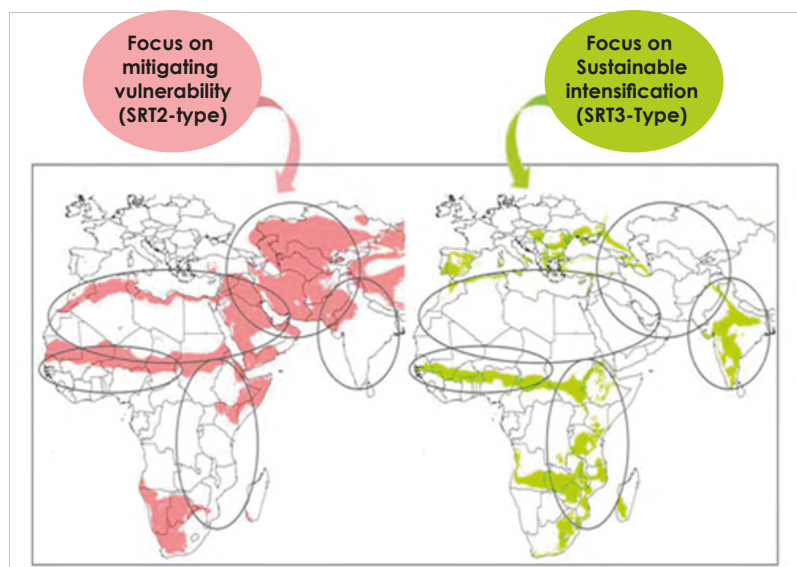
| Region                        | Lives Improved (millions) | Land Degradation Mitigated (km <sup>2</sup> ) |
|-------------------------------|---------------------------|---|
| SubSaharan Africa             | 20.0                      | 600,000                                       |
| Central Asia                  | 0.5                       | 940   |
| South Asia                    | 65.0                      | 465,000                                       |
| North Africa and West Asia    | 1.1                       | 18,600  |
| Total Impact in Dryland Areas | 86.6                      | 1,084,540                                     |

## Agro-biodiversity

The five target regions involved include major centers of diversity for crops, livestock species, vegetables, and trees of global importance. The genetic resources from these regions have evolved under harsh conditions, and are therefore crucial to overcoming the challenges of climate change and land degradation and for further diversification of farming systems to increase their resilience.

This agrobiodiversity holds high potential for increasing diversification and sustainable intensification of the dryland farming systems, and can offer substantial opportunities for diversification and improvement of incomes in local communities to ensure sustainable livelihoods. Their potential for scaling out to other regions is also high.

Consultations during the design and inception phases of the Dryland Systems program made clear that a great deal can be done in these systems. In the production systems of dry, marginal, resource-poor areas with poor institutions and poor market connectedness (Strategic Research Theme 2) — there are opportunities to avoid resource degradation and reduce vulnerability to system and climate change shocks. In systems with less marginal areas that tend to have better institutional support and access to markets (Strategic Research Theme 3) —there are opportunities to sustainably intensify production. A significant number of partner organizations are already present in the areas in which the program proposes to conduct its research activities, and with whom collaboration is established, or will be sought.



*The focus of the Program*

Consequently, synergy with other organizations, as well as with other CGIAR Research Programs, will add to the effectiveness of the program. Factors constraining productivity of the agricultural systems in each of the target regions have been identified by consultation during the design and inception phase, better enabling the program to contribute to solving “real world problems.”

### **Partnerships**

The program is a partnership between more than 60 organizations – ranging from international, national, regional and community, in the target regions. The research agenda and priorities were developed by these groups during 2010 -2012. Partners include: farming communities, national research and extension systems, policy-makers, international and regional organizations, advanced research institutes, civil society and non-governmental organizations (NGOs), the private sector, and development agencies. While producing the specific results and outcomes for research Action Sites in the target regions, the program also encourages learning across regions, where partners will work together to solve common problems. This learning and the research solutions developed will be packaged and made available as ‘international public goods’ (IPG) that can be scaled-out to areas with similar agro-ecosystems. Priorities for the Dryland Systems program are defined in the target regions, in needs assessments among multiple stakeholders and at community levels.



## The Dryland Systems Research for Development Partnership

The CGIAR Dryland Systems research program builds on partnerships with the major stakeholders in the research – for - development continuum including:

- National Research and Extension Systems
- The research centers supported by the CGIAR
- Advanced research institutions
- Farming communities
- The Global Forum for Agricultural Research and its sub-regional organizations
- Development agencies
- Sub-regional organizations
- Civil society organizations
- Private sector

## Dryland Systems Research Program: Strategic Research Themes and Outputs

| Strategic research theme  | Output   |
|---|--|
| 1. Approaches and models for strengthening innovation systems, building stakeholder innovation capacity, and linking knowledge to policy action | 1.1 Approaches and models for strengthening innovation systems, building stakeholder innovation capacity, and linking knowledge to policy action<br>1.2 Enhanced capacity for innovation and effective participation in collaborative processes for international agricultural research for development<br>1.3 Strategies for effectively linking research to policy action in a dryland context                       |
| 2. Reducing vulnerability and managing risk through increased resilience  | 2.1 Combinations of institutional, biophysical, and management options for reducing vulnerability designed and developed<br>2.2 Options for reducing vulnerability and mitigating risk scaled up and out within regions<br>2.3 Trade-offs among options for reducing vulnerability and mitigating risk analyzed (within regions). Knowledge-based systems developed for customizing options to sites and circumstances |
| 3. Sustainable intensification for more productive, profitable, and diversified dryland agriculture with well established linkages to markets   | 3.1 Sustainable intensification options designed and developed<br>3.2 Sustainable intensification options scaled out<br>3.3 Trade-offs among sustainable intensification and diversification options analyzed (within regions). Knowledge-based systems developed for customizing options to sites and circumstances   |
| 4. Measuring impacts and cross-regional Synthesis   | 4.1 Future scenarios and priority setting<br>4.2 Livelihood and ecosystem characterization. Across-region synthesis of lessons learnt from SRTs 2 and 3<br>4.3 Program impacts measured  |

## 4. The systems approach applied: How the Dryland Systems research program works

### Target Regions

The more than 60 Dryland Systems partner organizations are located in the world's five major drylands agriculture regions. These research teams will work with rural communities and countries to validate the effectiveness of 'technology and policy packages' in these representative integrated agro-ecosystems, and promote their scaling-out in the dry areas of five target regions:

1. West Africa Sahel and the Dry Savannas
2. East and Southern Africa
3. North Africa and West Asia
4. Central Asia and the Caucasus
5. South Asia

### A unique research-for-development approach

A wealth of research on dryland food production systems has been progressing for the past three decades by a number of universities, programs and research centers, including ICARDA. The Dryland Systems program attempts to build on this knowledge and expertise.

Even so, current project-focused and vertical approaches of research programs and development agencies – that target solutions-based on just a few crop commodities or disciplinary technologies – can still increase their effectiveness by taking a more open and holistic agro-ecosystems approach.

This 'integrated agro-ecosystems' perspective is consistently applied by the Dryland Systems program, combining, for example: crops and vegetables, trees, livestock, fish, natural resources management, appropriate policies, and income options for rural communities.

The 'systems' approach of Dryland Systems builds on past systems work and is based on the sound principles of the biophysical and socioeconomic sciences, development theory, and project management. This creates the right mix of partnerships, technologies, and policies to improve targeted dryland systems in major dry areas of the developing world.

### Testing and scaling out technology and policy packages

Agricultural research has helped countries improve the livelihoods of many smallholder farmers in dry areas over the past several decades. But much more intense, systems-based efforts are needed to get useful technologies into the hands of agricultural communities on a wider scale. The need for systems-based research is more urgent than ever, given several 'mega trends' - including water shortage, land degradation, urbanization, recurrent commodity price shocks, and last but not least climate change, which will hit dry areas hardest.

The program builds on state-of-the-art 'systems thinking' that takes research-for-development ideas much further than traditional research approaches. This starts with the premise that successful dryland agricultural production systems, such as those in parts of Australia and North America, have evolved through an integrated systems approach that includes the right mix of innovative partnerships, diverse technologies, and appropriate policies.

For example, the continuous development of new crop varieties – the foundation of the past 50 years of agricultural research and innovation – is vital to the world's future food security, but they need to be delivered in a context that meets the daily reality of smallholder farming communities. In other words, we need to get the mix right. For rural communities living in low-rainfall areas and marginal lands, these realities include lack of access to water, infertile soil and unpredictable climate patterns that cause drought and bring new kinds of crop pests and diseases that have not previously existed in many of these regions.

The program will use innovation platforms, involving all players along the impact pathway, to understand what interventions work best where, and to encourage their adoption.

*Examples of 'systems' approaches presented at Dryland Systems program research consultations:*

**Index-based livestock insurance:  
reducing risk and vulnerability in pastoral dryland systems in Africa**

Simple and highly innovative financial instruments are helping to protect small-scale livestock producers in Kenya from climate-related asset losses such as animal deaths caused by drought.

Index-based livestock insurance (IBLI) involves actuarial analyses of risk and economic and climate data. The underlying concept is that policy-holders (livestock owners) are compensated based on a clear, measurable outcome that neither insurer nor policy-holder can influence, - such as the amount and distribution of rainfall. With this approach, it is easier to administer and more cost-effective to develop than many other livelihood interventions aimed at supporting livelihoods or reducing risk. Several pilot programs in India and various countries in Africa and Latin America have proven the feasibility and affordability of such index-based products.

IBLI benefits livestock keepers in three ways. First, it can stabilize asset accumulation and enhance economic growth. Insurance addressed the high risk of investment in dry environments, improving incentives for households to build their asset base and climb out of poverty. Second, it can increase the availability of finance for investment more generally. For example, private creditors might be more willing to lend to households who insure their livestock assets. Third, because it provides indemnity payments after a shock, IBLI can help prevent vulnerable but currently non-poor households from falling into poverty following a crisis such as drought.

Following detailed field work and stakeholder consultation, an IBLI contract has been modeled, priced, and sold to the public on a pilot basis in Kenya's drought-prone Marsabit District in 2010. Nearly 2000 contracts have been sold to poor pastoral households. Contracts are based on livestock mortality, which is modeled using an empirical relationship between mortality and the Normalized Difference Vegetation Index (NDVI) as a proxy for plant biomass and forage availability. Currently, monitoring and evaluation of the impact that IBLI has had on herders' livelihoods and livestock-management decisions, in particular on changes in herd size, is ongoing.

**Integrated watershed development in South Asia**

The productivity and sustainability of a dryland agro-ecosystem depends on the quality and reliability of water resources—which in turn depend on the health of its watersheds. Research on watersheds in the 1970s and early 1980s produced a number of technologies for improved soil conservation and fertility management, but adoption of these technologies remained poor. This changed when the producer and technology-driven approach was replaced by a community-based, demand-driven approach—integrated watershed programs that address livelihoods, community empowerment, agricultural production, and natural-resource management.

The lessons learned are being successfully applied by policy-makers in Asia. Crucially, the introduction of new technologies must be based on incentives. In India, higher groundwater levels have proved to be sufficient incentive for small-scale farmers to adopt improved watershed technologies.

Other lessons to be shared are:

- (interventions are needed that enable specific target groups to diversify production and seek new markets Community based mechanisms should be used to improve resource allocation at various levels,
- from farm to landscape scale, depending on livelihood or natural resource management issues.

Using this approach, technologies that previously had low adoption rates are now being adopted and demand has been created for new technologies. These include new crops and varieties, more efficient irrigation methods, high-value products such as vegetables and milk, improved livestock breeds, and agroforestry techniques. With the new community-based, participatory approach, watersheds have become a growth engine for sustainable development of rainfed agriculture in Asia.

Productivity, livelihoods and ecosystem services (e.g. groundwater recharge, reduced runoff and soil loss, improved water quality, increased carbon sequestration) have improved, while maintaining equity. The Government of India has now implemented policies to support integrated watershed management. Some state governments have gone further and put all crop production under watershed programs.

Integrated crop–agroforestry–livestock systems in North Africa  
Crop–livestock systems in Morocco and Tunisia face problems caused by low rainfall, soil erosion, and declining soil fertility: severe shortages of livestock feed and poor crop productivity. An in-depth analysis with stakeholders identified alley-cropping of fodder shrubs (salt-bush and cactus) in barley-based systems as a potential solution to both problems. National and international research centers worked together to develop and promote alley-cropping technologies, and conducted adoption and impact studies that provide lessons for future efforts.

Salt-bush (*Atriplex* sp.) and spineless cactus (*Opuntia* sp.) alley-cropped between rows of barley provide a reliable supply of fodder, reduce erosion and rainfall run-off, and increase soil-moisture retention. The technology, once developed and proven, was out-scaled by the International Fund for Agricultural Development (IFAD) within their development projects. Impact assessments, conducted through case studies show:

- 26% of farm area alley-cropped with salt-bush in target areas in Morocco
- 40% adoption of cactus alley-cropping in target areas in Tunisia
- Farmers were able to reduce purchases of feed concentrates by up to 72%
- Internal rate of return was 50–90% in Morocco (salt-bush) and 20–40% in Tunisia (cactus)
- Economic rate of return, after factoring in cost of subsidies and other government support, was 25–48% in Morocco and 7–15% in Tunisia.

The studies highlighted several issues relevant to policy-makers, including:

- Adoption depends on multiple factors including productivity, income and subsidies.
- Subsidies are important in encouraging adoption, especially for the resource-poor. Small-scale livestock keepers could not have adopted this technology without subsidies, as they have to remove animals from the field until the alley-crop is established.
- Benefits from a technology may be direct and immediate (e.g. increased household income), or indirect and long-term (e.g. reduced soil erosion).
- Poor producers will adopt a technology only if it provides direct, immediate benefits. In such situations there is a strong economic justification for providing subsidies or other incentives to encourage adoption and realize the substantial indirect or long-term benefits and for creating safety nets to manage risk.

## 5. The Dryland Systems Partnership: Target Regions and Action Sites

The program's inception phase, delivered in 2012, comprised an intense round of scientific consultations with more than 200 research and development partners and decision makers in the five target regions. A Target Region and Research Action Sites were chosen, where the program will be put into action.

- West Africa Sahel and the Dry Savannas
- East and Southern Africa
- North Africa and West Asia
- Central Asia and the Caucasus
- South Asia

These five regions have common problems and constraints along with common widely shared projected outcomes. (See Annex). Common problems include high levels of rural poverty; moisture stress; resource stress; inadequate policies on technology adoption and market access; the marginalization of women and youth.

Common widely shared outcomes include improved rural employment , better water utilization, better access to markets; improved food security and nutrition; greater empowerment of women and youth.

### Selection criteria for identifying Dryland Systems target areas (non-exhaustive)

| Biophysical   | Socioeconomic  |
|---|--|
| <b>Accessibility</b> <ul style="list-style-type: none"> <li>• Closeness to partners' headquarters</li> <li>• Proximity to research facilities</li> </ul>  | <b>Demography</b> <ul style="list-style-type: none"> <li>• Population</li> <li>• Poverty</li> <li>• Employment (e.g. women/men differential aspects)</li> <li>• Nutrition status</li> </ul>                      |
| <b>Climate</b> <ul style="list-style-type: none"> <li>• Rainfall patterns</li> <li>• Temperature profile</li> <li>• Drought and heat indices</li> <li>• Length of growing period</li> <li>• Elevation</li> </ul>                  | <b>Climate</b> <ul style="list-style-type: none"> <li>• Rainfall patterns</li> <li>• Temperature profile</li> <li>• Drought and heat indices</li> <li>• Length of growing period</li> <li>• Elevation</li> </ul> |
| <b>Soils</b> <ul style="list-style-type: none"> <li>• Nutrient-supply capacity</li> <li>• Water-holding capacity</li> <li>• Morphology</li> <li>• Soil erodability</li> <li>• Degradation/desertification</li> </ul>              | <b>Access to water and land</b> <ul style="list-style-type: none"> <li>• Communal/private ownership</li> <li>• Pricing</li> <li>• Access</li> </ul>  |
| <b>Biotic stresses</b> <ul style="list-style-type: none"> <li>• Diseases</li> <li>• Pests</li> <li>-Weeds (e.g. Striga spp)</li> </ul>  | <b>Gender and disadvantaged groups' responsiveness</b> <ul style="list-style-type: none"> <li>• Differential aspects</li> <li>• Absolute aspects</li> </ul>  |
| <b>Farming systems</b> <ul style="list-style-type: none"> <li>• Crops</li> <li>• Vegetables</li> <li>• Livestock</li> <li>• Trees</li> <li>• Mixed systems</li> <li>• Gap between actual economic and potential yields</li> </ul> | <b>Governance, institutions, and policy</b> <ul style="list-style-type: none"> <li>• Inclusiveness of stakeholders</li> <li>• Equity</li> <li>• Accountability</li> <li>• Transparency</li> </ul>                |
| <b>Sensitivity to global change</b> <ul style="list-style-type: none"> <li>• Climate (variation and change parameters)</li> <li>• Globalization</li> </ul>  |  |
| <b>Land degradation</b> <ul style="list-style-type: none"> <li>• Physical</li> <li>• Chemical</li> </ul>  |  |

Source: After Palm et al. (1995), Wood et al. (1999), De Pauw (2003), Douthwaite et al. (2003b), Hyman et al. (2008).

## West African Sahel and Dry Savannas

In the **West African Sahel and Dry Savannas**, key findings included serious challenges to reducing vulnerability and sustainable intensification resulting from drought, poverty, soil nutrient mining, and soil erosion. Poor infrastructure and a lack of institutional support for agriculture also greatly affect the area. Restricted livestock mobility and expansion of cropping onto marginal lands formerly used for grazing pose serious challenges to pastoral and agro-pastoral systems.



(All maps – ICARDA GIS Unit)

Poverty is a serious challenge throughout this region, which is classified among the poorest in the world; Niger has the worst health and development problems of all 182 countries included in the UN Human Development Index, and this situation is deteriorating. In the SRT2 (reducing vulnerability) area the network of local markets is dense, but the dirt roads that connect villages to urban centers are in poor condition, which increases the cost of transportation and limits access to inputs. Constraints in the transportation system limit the ability of farmers to market their products elsewhere, causing local gluts of produce immediately after harvest, which significantly reduces the prices paid for crops. In general, institutional support for agriculture can be considered weak because of the limited numbers of extension and research staff and low overall investment at the farm level. Growth in the agricultural sector in this region has historically come from expansion of the area cropped or grazed. Today, demographic pressures have largely exhausted available land and in many areas farm sizes are shrinking. Land degradation and decreasing soil fertility also tend to result from increasing land scarcity and deforestation.

Major opportunities exist through increasing linkages of smallholder producers to regional livestock markets, increasing the capacity among farmers to raise production through improved access to inputs and technology, and providing sound options for better cropping and land-management systems.

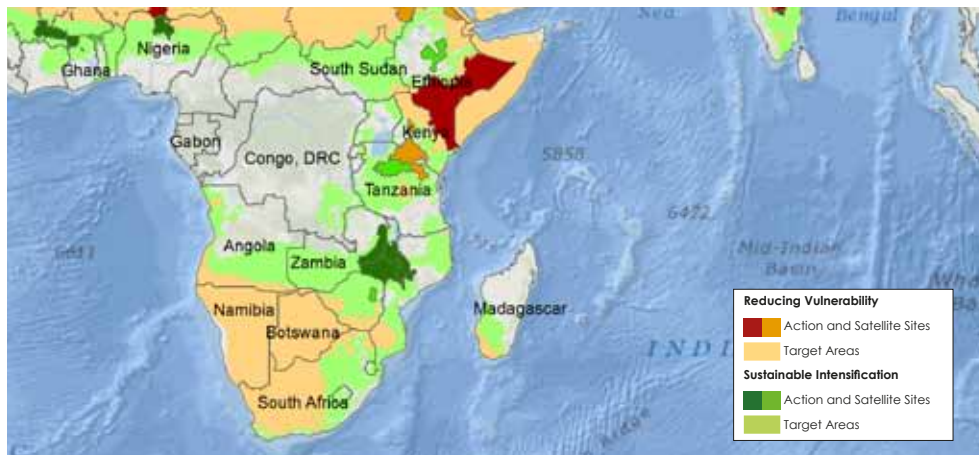
The program aims to improve the lives of 23 million people in the West African Sahel and Dry Savannas region and to mitigate land degradation on over 200 000km<sup>2</sup>.

There is significant government investment in irrigation, and farmers are investing in vegetable production (onions, tomatoes, cabbage, potatoes, peppers) and fruit-tree-based systems. Most governments in the WAS & DS subsidize about 25% of the cost of fertilizer used for specific commodities. There are no restrictions on farmers' autonomy of decision-making for their cropping system. Consequently, farmers are not likely to face institutional impediments to improved farm practices.



## East and Southern Africa

In East and Southern Africa major swaths of agricultural land are categorized as arid or semi-arid, and frequent drought conditions affect livestock and crop production. Vulnerability to drought is exacerbated by poor infrastructure, low political will to serve these communities, and little market engagement.



Over 70% of the SRT2 (reducing vulnerability) area in East and Southern Africa is categorized as arid, and most of the rest as semi-arid. PET is three to four times the average annual rainfall. Not surprisingly, this area is subject to frequent drought, with significant effect on assets, income, and food security. Livestock losses are often heavy during drought and droughts are so common that herds do not have time to recover between them. Severe to very severe range degradation exists in the SRT2 (reducing vulnerability) area. Increasing human populations, declining mobility of livestock populations, and sedentarization around water points has led to over-use of land and water and localized land degradation. Conflict is also occurring as a result of land fragmentation. The primary system in the SRT2 (reducing vulnerability) portion of the action site is livestock production. Poverty levels in the action site are high (55–70%), resulting in very high vulnerability.

Low political will and economic marginalization, resulting from the geographic isolation and poor infrastructure of much of the SRT2 (reducing vulnerability) portion of the action site, has led to high levels of neglect by the central governments. Increases in basic services and infrastructure would promote diversification and market engagement and reduce vulnerability in the region. In the SRT3 (sustainable intensification) areas, very high population density is contributing to land degradation and decreasing farm size through fragmentation. Market access is also a significant issue in SRT3 (sustainable intensification) area as only 22% of households can reach the nearest market in less than three hours, and nearly one quarter require more than 12 hours to get to the market. Poverty in the SRT3 (sustainable intensification) area ranges between 55 and 97%.

However, opportunities exist for improvement. Water bodies cover almost 4% of the total land area in this region, providing significant opportunity for irrigated cropping as well as livestock watering. Despite the existence of relevant knowledge on agricultural adaptation and interventions at a farm level through the high social capital evident in the action site, this social capital is not being capitalized upon to spread information.

In the coming six years, the program aims to improve the lives of 20 million people in East and Southern Africa, and to mitigate land degradation on 600 000 km<sup>2</sup>.

## North Africa and West Asia

Currently, in North Africa and West Asia aquifer degradation is a pressing problem that will be exacerbated in the near future by climate change. Out-migration, farm fragmentation, and rejection of agropastoral lifestyles are also threatening the sustainability of farming in the region.



High temporal variation in precipitation is an issue in SRT2 (reducing vulnerability), with annual coefficients of variation ranging between 23 and 60%. This variability, along with climate-change projections that predict a reduction in precipitation by 10–30% by the end of the century, poses severe challenges to rainfed cropping.

Poor households, often utilizing less than one hectare of land, comprise approximately 30% of the households in Syria and approximately 10% of the households in Jordan. Most households are not able to immediately rebuild their flocks and herds following droughts because they do not have access to credit. Farm fragmentation was also identified as a serious problem in Morocco and research on aggregation has been proposed.

In the SRT3 (sustainable intensification) areas there is a distinct rejection of pastoral activity by the younger generation; this is leading to out-migration from rural communities. A lack of skilled agricultural and pastoral labor could become a serious problem in the agricultural sector. This region however has many opportunities. Highly mechanized agricultural systems exist within the SRT2 (reducing vulnerability) area. In the SRT2 (reducing vulnerability) area there is also a strong preexisting network of traders for high-value items such as dairy products, sheep, wool and fruit. Because of the poor quality of roads, there is a high likelihood of spoilage en route to major markets, which has led to a complex relationship between middlemen and producers.

The growing period in the SRT3 (sustainable intensification) areas of North Africa are quite long, ranging from 200 to 240 days. Given the favorable temperature regimes across most of the site, conditions are excellent for growing a diverse range of climatically adapted crops. There are few "problem soils" in the SRT3 target area and the soil map does not give evidence of any significant problems such as salinity. Thus, most of the soils in this region are good agricultural soils and are already under cultivation. This makes the potential for substantial short- to medium-term production gains more likely. Moderate to good access to improved varieties is reported and the national Green Moroccan Plan provides subsidies for soil inputs in SRT3 (sustainable intensification) action site. In addition, farmers enjoy a high degree of autonomy to choose the crops and cropping areas that they utilize.

North African SRT3 (sustainable intensification) areas are well-enough connected to the European Union market that its agricultural production systems are under pressure to be efficient in order to compete with global players.



## Central Asia and the Caucasus

In **Central Asia and the Caucasus** one of the major needs is for appropriate levels of mechanization for relatively large-scale farms. Because of the poor availability of heavy tractors, indurated pans are forming in some areas, restricting rooting depth in crops. The formation of salt-affected soils, caused by evaporation of surface waters in low rainfall areas, soluble salts found in surface water and groundwater, and salts in surface drainage water, is also of concern. Farmers lack the water-management expertise needed to conserve the soil and maximize yield.



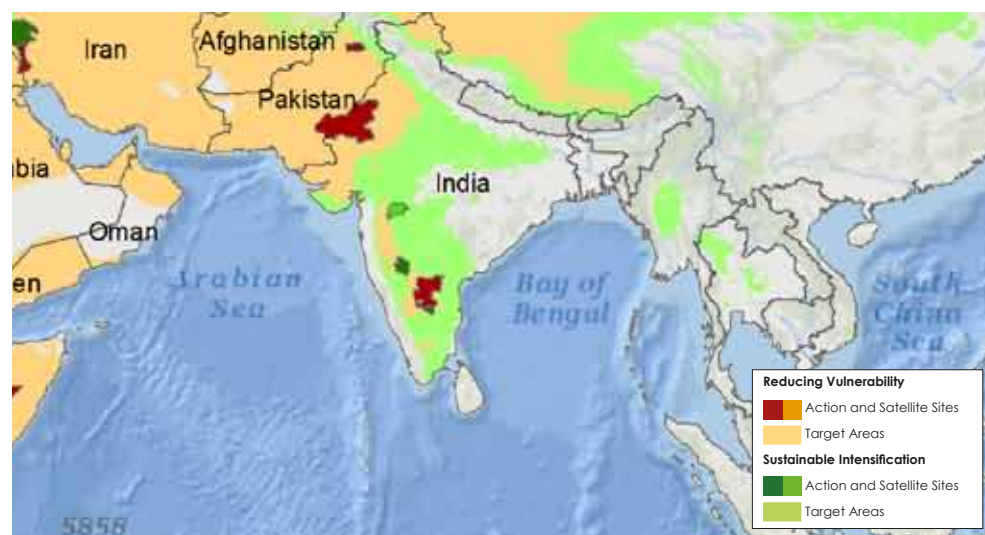
In addition, farmers are often not allowed to manage their own water resources, as the decentralization process has not been completed in this region. Since the end of collective farming at the end of the 1990s, demographics have changed significantly in farming communities. Most farmers are young and do not possess the background knowledge needed to farm effectively. For all crops, except for cotton, difficult customs rules limit access to the international markets in the SRT2 (reducing vulnerability) area. Most countries are also landlocked, making access to international markets a significant issue.

The region has significant water resources that could be used for irrigated cropping. Farm holding size is shrinking but still relatively large compared with most of the developing world, with plot sizes averaging approximately 17 ha. Water supplies are shrinking, but reducing water wastage offers huge opportunities to expand irrigated cropping. Almost all settlements can reach their nearest market within three hours of driving.

The program aims in six years to improve the lives of 500 000 people in Central Asia and the Caucasus, and to mitigate land degradation on 2 900 km<sup>2</sup>.

## South Asia

In **South Asia** major areas of land are classified as hot and hyper-arid, usable only as rangeland for ruminants, with only 250–500 mm of precipitation per year and annual potential evapotranspiration of 1800–2000 mm per year. There is thus a huge deficit of water for crop and livestock production throughout the year. Poor rainfall distribution is also a major constraint. Traditionally this arid zone depends on uneven monsoon rainfall, which is scattered in distribution and very unpredictable. Groundwater forms a critical component of the overall water resources scenario in the SRT2 (reducing vulnerability) districts. Its availability, quality, and management are major concerns.



Salinity is major problem, and substantially limits efforts to develop water resources. Groundwater has been exploited for irrigation for many years in the three SRT2 (reducing vulnerability) districts. There is general concern that groundwater is overexploited in some areas. There is also a shortage of labor; consequently, labor is increasingly costly throughout the SRT2 (reducing vulnerability) action site. Greater mechanization must be a priority in both SRT2 and SRT3 (sustainable intensification) areas, and contract farming is noted as being potentially important as a change agent. Landholding sizes are shrinking and are now generally too small to sustain livelihoods. In all districts the ratio of small holdings relative to large holdings is decreasing and this is widely recognized as a major issue.

Despite this aridity, rivers and groundwater resources are present and already playing a major role in providing water for irrigation. Livestock production systems based on small and large ruminants exist in the SRT2 (reducing vulnerability) areas with low rainfall. Some of the large-ruminant-based systems are evolving towards intensive dairy production to meet an emerging demand from population centers. Livestock diseases and shortage of feed are major constraints to this system; fodder availability is declining as a result of the increasing importance of groundnut for human consumption and an increase in livestock numbers. SRT3 (sustainable intensification) areas are well connected by rail and road to major cities to both the north and the south. Water from tube wells is classified as “overexploited” for irrigation in only 12% of the areas in which it is utilized, meaning that its use is largely sustainable for the foreseeable future.

In the coming six years, the program aims to improve the lives of 65 million people in South Asia, and to mitigate land degradation on 465 000 km<sup>2</sup>.

## End Notes

<sup>1</sup> Research and practice in these fields have increasingly converged on a set of five general lessons concerning the condition and dynamics of H-E systems as they apply to sustainable development in drylands. (i) Both researchers and practitioners need to adopt an integrated approach: Ecological and social issues are fundamentally interwoven, and so are the options for livelihood support and ecological management. (ii) There needs to be a heightened awareness of slowly evolving conditions: Short-term measures tend to be superficial and do not resolve persistent, chronic problems nor deal with continual change. (iii) Nonlinear processes need to be recognized: Dryland systems are not in equilibrium, have multiple thresholds, and thus often exhibit multiple ecological and social states. (iv) Cross-scale interactions must be anticipated: Problems and solutions at one scale influence, and are influenced by, those at other scales. (v) A much greater value must be placed on local environmental knowledge (LEK).

## Annexes

### Selected Reading List

CGIAR Research Program on Climate Change, Agriculture and Food Security  
(CCAFS)  
<http://ccafs.cgiar.org/>

CGIAR Research Program on Dryland Systems  
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## **Common problems among the five target regions of the Program**

- The unsustainable management of natural resources given high rainfall variability and moisture stress
- High levels of rural poverty
- Resource stress as a result of demographic change
- Limited understanding of the degree and scope of vulnerability among dryland populations
- Lack of communication between national research and development programs, NGOs and CGIAR Centers
- Inadequate policy to promote technology for agricultural and pastoral rehabilitation within government
- A policy environment that does not encourage adoption of new technology and limits market access
- The marginalization of women, youth, and other groups.
- Poor soil- and water-management practices that cause land and water degradation
- Development goals are not agreed upon in a participatory, multi-stakeholder environment
- Decreasing or insufficient biomass and system productivity
- Declining or insufficient agrobiodiversity
- Poor access to information regarding new technologies or techniques
- Decreasing landholding size
- Inaccessibility of markets and financial resources
- The increasing vulnerability of rural farming communities as a result of resource, knowledge, and institutional changes
- The inefficient utilization of water resources in dryland environments
- Degraded soils constrain productivity and sustainability
- Climate change is causing rapid degradation of natural resources
- Increasing competition for scarce biomass
- A lack of investment in the production of livestock-related products.

## **Widely shared outcomes between the five target regions of the Program**

- A widely agreed upon framework to define and measure vulnerability for the purpose of informing policy and programming
- Farmer attainment of higher plant and livestock productivity and profitability
- Increased food security, including better nutrition
- Improved rural employment
- Greater biomass availability for animal and cropping systems
- Improved access to and adoption of appropriate technology and technical advice by smallholder farmers
- Better access to markets and financial services by smallholder farmers
- High-value product markets made accessible to smallholder farmers
- More-effective buffering and system resilience to reduce vulnerability to system shocks and climate change
- Higher levels of empowerment for youth and women in community decision-making
- Stronger institutions to serve the rural poor and greater government awareness about system and livelihood interdependencies, leading to more-effective policy changes and institutional innovations
- Broad stakeholder participation in the research and development cycle through innovation platforms
- Higher levels of biodiversity and lower levels of land degradation facilitated through better management of soil, water, and genetic resources
- Farmers are equipped to manage their natural resources in a more sustainable way
- Improved options for mixed production systems are communicated to smallholder farmers.



- Trade-off analyses to establish the optimal mix of land use/land cover and cropping systems
- Dryland Systems CRP to inform other CRPs, and vice versa
- Better understanding of system characteristics, opportunities, and constraints
- Effective communication of CRP findings to all stakeholders
- Postharvest and processing technologies have been improved and communicated and valueadding options increased.

### **Dryland Systems Proposal Document**

The Dryland Systems Proposal contained an extensive list of research priorities to specifically address CGIAR Funding Committee requests or “must-haves”.

The full proposal and detailed report of the inception process can be downloaded here:

#### **Research proposal**

[https://apps.icarda.org/wsInternet/wsInternet.aspx/DownloadFileToLocal?filePath=Dryland\\_Systems/CRP1-1\\_Dryland\\_Systems\\_Proposal.pdf&fileName=CRP1-1\\_Dryland\\_Systems\\_Proposal.pdf](https://apps.icarda.org/wsInternet/wsInternet.aspx/DownloadFileToLocal?filePath=Dryland_Systems/CRP1-1_Dryland_Systems_Proposal.pdf&fileName=CRP1-1_Dryland_Systems_Proposal.pdf)

#### **Inception Report**

[https://apps.icarda.org/wsInternet/wsInternet.aspx/DownloadFileToLocal?filePath=Dryland\\_Systems/Dryland\\_Systems\\_Proposal.pdf&fileName=Dryland\\_Systems\\_Proposal.pdf](https://apps.icarda.org/wsInternet/wsInternet.aspx/DownloadFileToLocal?filePath=Dryland_Systems/Dryland_Systems_Proposal.pdf&fileName=Dryland_Systems_Proposal.pdf)

### **CGIAR Research Program on Dryland Systems: Shortlist of critical research priorities**

1. Characterization of dryland systems
2. Clear hypotheses as an organizing principle to prioritize the research and results agenda
3. Provide criteria for choice of target areas and action sites in both the biophysical and social sciences
4. Prioritize activities to be carried out working from desired impacts to research activities
5. Provide detail on the underpinning science and agronomic, genetic, and farming system approaches to be evaluated once the first phase has progressed
6. Provide a comprehensive theory of how social change will result from the livelihood, gender, and innovations systems approaches in the current proposal
7. Discuss current research priorities and how they affect new initiatives
8. Identify clearly the research interventions proposed as a result of the diagnosis of the problems and constraints
9. Describe the framework for selecting external and center partners, their respective research activities, and how these activities collectively contribute to an integrated agroecosystem research agenda
10. Differentiate the roles of the crop/commodity CRPs and this systems CRP
11. Integrate available lessons learned from the Sub-Saharan Africa Challenge Program of the CGIAR
12. Develop a logical framework and articulate impact pathways to explicitly link a cluster of outputs to outcomes and impacts and to system-level outcomes of the CGIAR Strategy and Research Framework
13. Include a performance management framework
14. Build climate variability resilience and sustainable dryland systems through an integrated program combining indigenous knowledge with improved technologies, information dissemination, and engagement with stakeholders
15. Redefine management structure to ensure that the Steering Committee (strategic oversight) and the Research Management Committee (manage research) are not both chaired by the DG of the lead center, to avoid potential conflict of interest
16. Broaden the focus of the proposal to include Latin America and South Asia (cereal systems)



RESEARCH  
PROGRAM ON  
Dryland Systems

**The CGIAR Research Program on Dryland Systems** brings together a wide range of partners, including countries, research and development organizations to bring rural communities living in the world's dry areas practical solutions for improved livelihoods and food security. The goal of Dryland Systems is to identify and develop resilient, diversified and more productive combinations of crop, livestock, rangeland, aquatic and agroforestry systems that increase productivity, reduce hunger and malnutrition, and improve quality of life among the rural poor. To develop solutions, research teams - in partnership with rural communities and countries - will validate the effectiveness of interventions in representative agro-ecosystems, and promote their scaling-out in the dry areas of five target regions: West Africa Sahel and the Dry Savannas; East and Southern Africa; North Africa and West Asia; Central Asia and the Caucasus.

The program involves a wide range of partners including nine CGIAR Centers (Bioversity International, CIAT, CIP, ICARDA, ICRAF, ICRISAT, ILRI, IWMI, World Fish), the Challenge Program for Sub-Saharan Africa, more than 60 national agricultural research systems, advanced research institutions, development agencies, civil societies and the private sector. It also involves research associations including GFAR, AARINENA, APAARI, CACAARI, FARA, ASARECA and CORAF.

**The International Center for Agricultural Research in the Dry Areas (ICARDA)** is the global agricultural research center working with countries in the world's dry areas. It is the lead center for the Dryland Systems Program.

**CGIAR** is a global agriculture research partnership for a food secure future. Its science is carried out by the 15 research centers who are members of the CGIAR Consortium in collaboration with hundreds of partner organizations. [www.cgiar.org](http://www.cgiar.org)

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