

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

## 1. Introduction

Dryland agricultural systems comprise a highly diverse mixture of crop, rangeland, tree, and animal species cultivated by farmers and pastoralists in the world's dry areas, which constitute 40% of the earth's land area, including vast areas of the African and Asian continents. Agricultural productivity in the drylands is low because of drought, floods, extreme temperatures, land degradation, and other biophysical stresses. Climate change, which is projected to affect dry areas worst, will further exacerbate these stresses. But productivity is also hampered by many socioeconomic factors, including poor access to technology, underdeveloped markets, weak institutions, poor partnerships, and marginalization of key actors.

There are approximately 2.5 billion people living in dry areas, among whom one-third depends on agriculture for food security and livelihood. Moreover, most of the world's poor live in dry areas, including 400 million who live on less than \$1 per day. Today, governments in most dry areas face rapid population growth, unprecedented rates of urbanization, high unemployment, youth-skewed age distributions, and disenfranchisement of crucial groups, particularly women and youth. These demographic trends, coupled with poor agricultural productivity, have forced governments to import more and more grain and other foodstuffs, thereby exposing populations to external price shocks that have contributed to political and civil conflict, and disproportionately affected poor and marginalized communities and households..

Improving food security and livelihoods of those in the dry areas who depend on agriculture will doubtless require better technologies, including improved plant and animal genetics, and better evidence-based farming practices. But experience has shown that technologies alone cannot achieve their potential impact without other system components in place, including functioning markets, effective delivery institutions, enabling policies, and effective partnerships that facilitate impact among diverse groups, including women and youth. While technology and other system components are universally important to successful dryland production systems, the optimal mix of technologies, markets, institutions, policies, and partners will be specific to a specific agricultural, social, and political setting. This underscores the importance of taking a systems approach to get the mix right for a particular dryland production system.

Successful dryland systems are productive and sustainable, support rural and urban economies, and provide vital ecological and social services. The CGIAR Research Program on Dryland Systems<sup>1</sup> (Dryland Systems) recognizes that dryland systems in developing countries must better contribute to improving food security and livelihoods, and the tremendous stakes involved. The consequences of doing nothing include land degradation on a massive scale, increased poverty and food insecurity, rising unemployment and rural exodus, and growing conflict and instability that will inevitably affect the rest of the world. By improving agricultural systems in dry areas, Dryland Systems will reduce poverty, improve food security, contribute to better health and nutrition, conserve natural resources, and reduce social inequity for millions of people.

## 2. Theory of Change

The drylands are challenged by high rainfall variability and associated risk, periodic

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<sup>1</sup> <http://drylandsystems.cgiar.org/>

drought and flooding, pervasive land degradation, limited transport and marketing infrastructure, high rates of rural poverty, fast population growth, a high percentage of young people, over exploitation of common property resources, low crop and animal productivity, and a low level of integration with the larger agricultural economy. Future projections suggest progressive decline in natural vegetation and associated changes in hydrology as a result of increasing demographic pressure and climatic variability (Obersteiner, 2013; Smith, et al, 2010). Because of the pressures on the natural resource base and uncertain livelihoods, drylands are increasingly associated with threats to national and global security. All of this highlights the urgent need for development in the drylands, and in particular in those where livelihoods are primarily based on agricultural production.

Generating improvement in livelihoods within agriculturally based economies of drylands is complex because of the multiple constraints to improving productivity, increasing net income, accessing or integrating markets, and sustainably managing natural resources. To address this complexity, Dryland Systems' Theory of Change begins with basic principles contained in eight intermediate development outcomes (IDOs). The IDOs focus initially on improving livelihood systems and their underpinning production base, and subsequently on the reality that these are nested within larger agroecological, market, institutional, and social systems which must be addressed for innovations to function at large scale. That is, improving productivity, stability and sustainability of farming practices in dry areas requires not only better, appropriate technology options, but also incentives for farmers to adopt these technologies, and service delivery systems to make them available to rural communities. This interaction between farm scale changes and market, institutional, and policy changes, creates a series of important feedbacks in the process of achieving impact (Batchelor and Goodman, 2012). Furthermore, studies have shown that impact cannot be achieved at scale without explicitly addressing issues of equity, including gender gaps in agriculture (FAO, 2011) and the vital role of youth in sustaining rural economies (FANRPAN, 2013).

Thus, to capture this interaction and achieve impact at scale, Dryland Systems' IDOs are framed at two levels. The first involves attitudes, knowledge, skills and behavior among actors directly using research outputs that are required to effect change in dryland systems. The second is related to taking these outputs to scale to achieve the four CGIAR System Level Outcomes (reduced rural poverty, improved food security, better nutrition and health, and sustainable management of natural resources). The nested approach allows greater flexibility in identifying critical entry points for the different complex settings in which Dryland Systems, and facilitates diversification in production, consumption, marketing, and other system components that must exist to improve production system sustainability, stability, and resilience in dryland agroecologies.

A simple articulation of Dryland Systems' theory of change is presented in Figure 1. The principal impacts derived from research outputs are obtained at the household level through two different pathways, which depend on the asset base (natural resource, financial, social, etc.) of the household. For those households with sufficient assets, there is potential for welfare gains (improved food security, reduction in poverty, or improved nutrition) from intensification of a specific farming system. For households with insufficient assets, many of whom live in more marginal agroecologies with limited access to markets, the focus is initially on risk mitigation and improving system resilience in order to better cope with such external shocks as price volatility, drought, or disease.



2. *More stable and higher per capita income for intensifiable households.*
3. *Women and children in vulnerable households have year round access to greater quantity and diversity of food sources.*
4. *More sustainable and equitable management of land and water resources in pastoral and agropastoral.*

The remaining four IDOs relate to requirements for the first four to be realized:

5. *Better functioning markets underpinning intensification of rural livelihoods.*
6. *More integrated, effective and connected service delivery institutions underpinning resilience and system intensification.*
7. *Policy reform removing constraints and creating incentives for rural households to engage in more sustainable practices that improve resilience and intensify production.*
8. *Women and youth have better access to and control over productive assets, inputs, information, market opportunities and capture a more equitable share of increased income, food and other benefits.*

For each IDO, Dryland Systems will achieve proof-of-concept within individual Action Sites in one or more of five regions. Making impact at larger scale will require widespread use of these concepts, including the development and use of methods, tools, processes and policies developed by appropriate development actors at national, regional and global scales (Fig. 2).

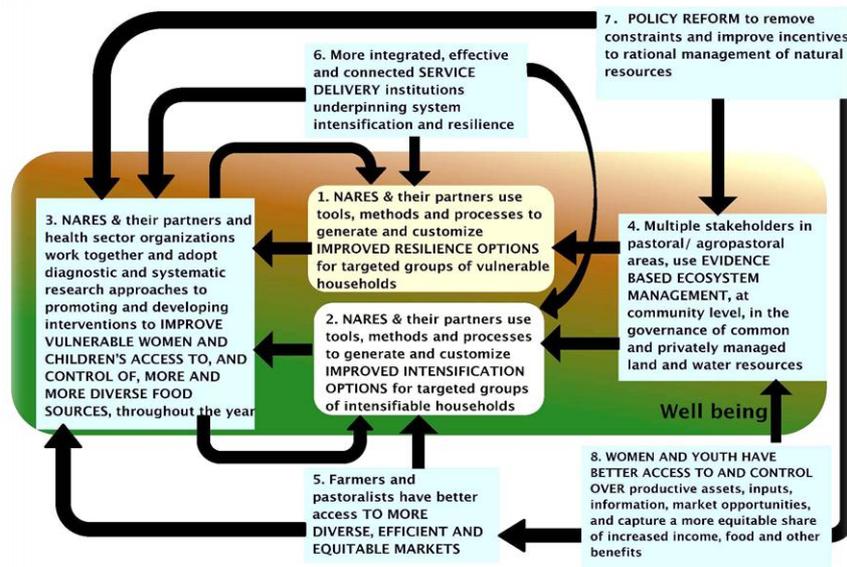


Figure 2. Behavioral change by key actors required for IDOs to make impact.

Dryland Systems IDOs are therefore stated in two stages-- firstly, changing behavior of key actors to effect impact at scale; and secondly, creating an enabling environment to achieve expected impact. A brief discussion of each IDO follows; their impacts, outcomes, outputs, and indicators are generically in Figures 3-6. Initial impact targets are discussed in Section 4.

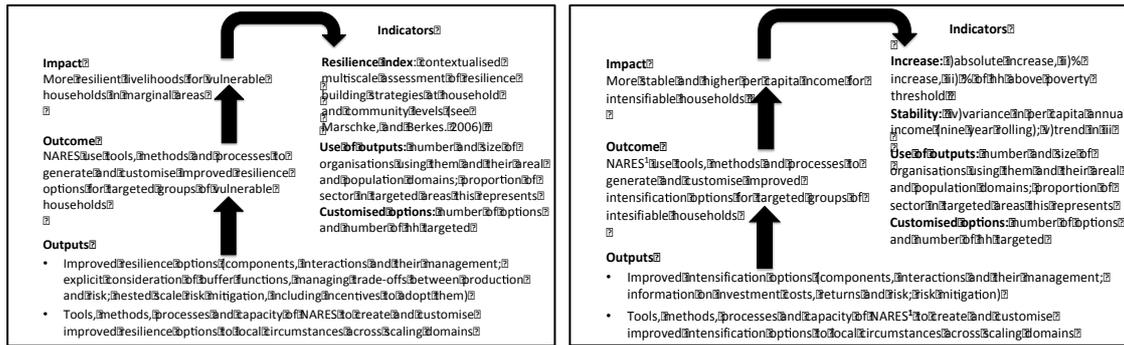


Figure 3. Impact Pathways for IDOs 1 and 2 of Dryland Systems.

**3.1 Resilience.** Households below a critical asset threshold struggle to cope with such stresses and shocks as increasing land pressure and drought. For these, the first priority for Dryland Systems is to improve resilience.

**3.2 Sustainable intensification.** For households above a critical asset threshold, the priority for Dryland Systems is to sustainably intensify production systems, thus contributing to greater food security and reduced poverty while maintaining or enhancing the underlying resource base.

**3.3 Dietary diversity.** The development of resilience and intensification options (IDOs 1 and 2) builds on much existing work, but improving dietary diversity, and particularly for women of child bearing age and young children in resource-poor, vulnerable households, is a new challenge within the Dryland Systems context, requiring co-operation across agricultural and health sectors. Improving year round access to greater quantity and diversity of food sources is a complex target that must take into account food systems, market availability, access and consumption of a diverse range of nutritious and safe foods of high quality.

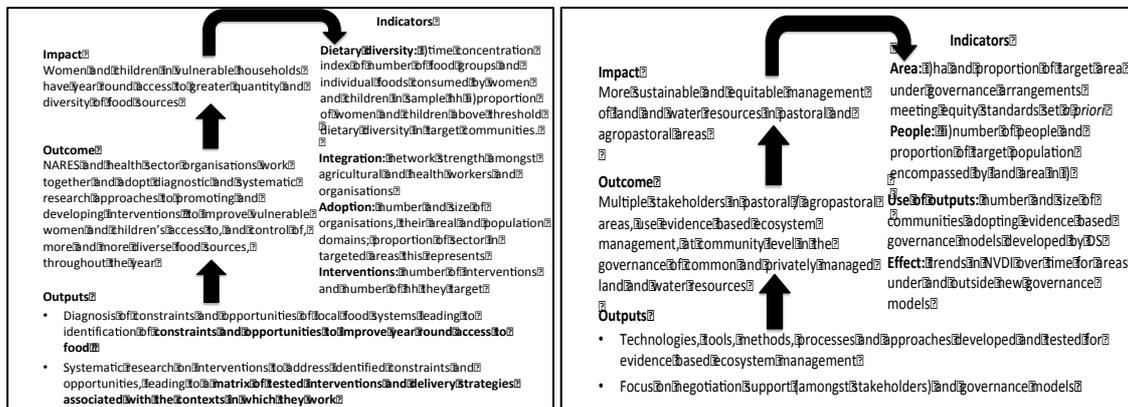


Figure 4. Impact Pathways for IDOs 3 and 4 of Dryland Systems.

**3.4. Sustainable and Equitable Agropastoral Management.** There is a key gap in tools to support management of dryland production systems where competition for limited land and water resources exists. This is a universal challenge in dry areas that often leads to conflict over land, water, forage, crop residue, and trees. Resource competition and conflict can be associated with migration due to culture and tradition, climate change, drought, conflict, and demographic pressure. Approaches that link farmland and rangeland level decisions to larger ecosystems and landscape scales, including spatial and temporal patterns in availability of fodder, water, and other natural resources are urgently needed, together with governance models that can

achieve equitable outcomes and resolve conflicts. Equity refers to gender, youth, and other disenfranchised groups as well.

**3.5. Markets.** People and production systems are sparsely distributed in dry areas, creating high transaction costs and limited market access. While there are examples of innovations that improve market efficiency, we propose systematic research to develop and test the most appropriate models for different dryland contexts.

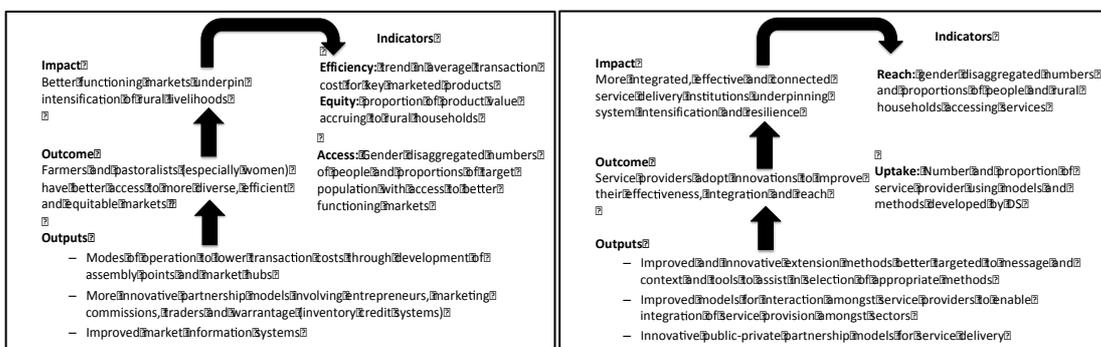


Figure 5. Impact Pathways for IDOs 5 and 6 of Dryland Systems.

**3.6. Service delivery.** Similar to markets, the sparse distribution of people in some dryland settings creates challenges for effective service delivery. Dryland systems will conduct systematic research on appropriate extension methods for different messages and contexts and appropriate models for integrated service delivery that include private and public partners. Other potential partners among service providers include those from the banking and insurance sectors.

**3.7. Policy.** In much of the global dryland area, prevailing policy and institutional contexts discourage adoption of sustainable practices by farmers and livestock keepers. Forest law may discourage farmers from having indigenous trees on their farms. Insecure land tenure may discourage investment in long term soil health. On the other hand, incentives may be required to enable farmers to invest in sustainable practices that bring dividends in the medium term. Dryland Systems will undertake systematic research to understand links between policy alternatives and desirable outcomes and on how best to ensure that policy is evidenced-based.

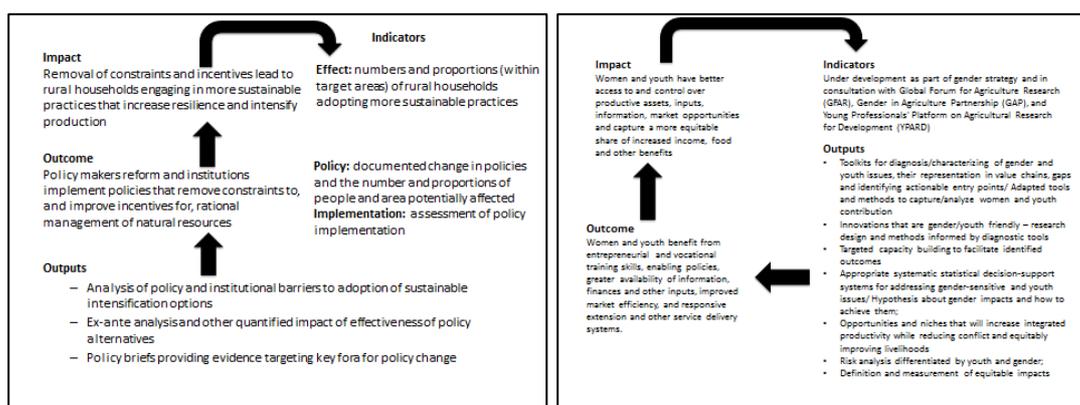


Figure 6. Impact Pathway for IDOs 7 and 8 of Dryland Systems.

**3.8. Gender and Youth.** Women make essential contributions to agriculture, and on average comprise 43% of the agricultural labor force in developing countries, and 50% in sub-Saharan Africa (FAO, 2012). But women in agriculture and rural areas have less

access to productive resources and opportunities. This “gender gap” is present for many assets, inputs and services, and has costs for the larger agricultural economy and society as a whole. Closing the gender gap in agriculture would generate significant gains. Equally important, the disenfranchisement of youth is an especially vexing problem in rural drylands that has been associated with a multitude of societal problems. The prospects of rural youth finding decent work in many countries of the developing and emerging economy worlds, particularly in Africa and South and Central Asia, where Dryland Systems works, is limited (Proctor and Lucchesi, 2012). Opportunities for work outside agriculture in these sub-regions make the situation for young rural people particularly precarious. There remains a low level of policy and investment intervention that focuses explicitly on rural youth and on youth employment opportunities in the agriculture and agribusiness sectors. Dryland Systems will research on policies and interventions tailored to the dry areas to ensure that women and youth have better access to and control over productive assets, inputs, information, and market opportunities, and capture a more equitable share of increased income, food and other benefits.

#### 4. Impact Pathways and Targets.

Dryland Systems embeds its research within development praxis to ensure impact at scale, and is refining the illustrated, generic impact pathways for the eight IDOs to fit all action sites in all five regions to provide an organizational frame for research. The CRP has just completed implementation workshops with its many partners to complete regional workplans based on IDO outputs and outcomes, and has included the cross-cutting themes including youth, gender, and biodiversity. Similarly, it will incorporate the use of common programmatic tools, including those for modeling, data-flow, geoinformatics, and information management and communication.

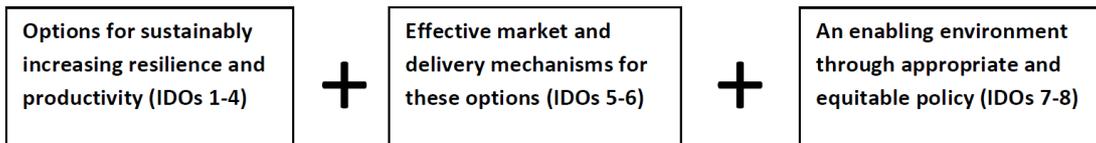
We have stressed that, in our Theory of Change, IDOs 1-4 are related to impacts on household wellbeing and the natural resource base. In contrast, IDOs 5 to 8 are key components of the scaling strategy for each action site that must take into account such variable constraints as low population densities, underdeveloped markets, weak institutions and governance, and poor equity. Although these four IDOs are thus a critical part of the program’s success, at this early stage, we are focusing on interventions related to wellbeing and resource management rather than those needed to take interventions to scale. Therefore, impact targets are only initially made for IDOs 1-4 in the table below.

IDO	Outcome	Development Outcome	Indicators	Units	Adoption Rate			Impact		
					Cycle 1	Cycle 2	Cycle 3	Cycle 1	Cycle 2	Cycle 3
1	Tools, methods and processes to generate and customise improved resilience options for targeted groups of vulnerable households	Reduce Vulnerability and Increase Productivity by 15%	Resilience Index and Net Productivity	Number of individuals	1%	3%	15%	228334	685003	3425015
				Number of women				114167	342501	1712507
				Number of youth				45667	137001	685003
		Mitigate Land Degradation by 15%	Land Degradation Index	Number of ha	634445	1903335	9516673			
2	Tools, methods and processes to generate and customise improved intensification options for targeted groups of intensifiable households	Increased income and raise 15% above poverty level	Resilience Index and Net Productivity	Number of individuals	1%	3%	15%	231328	754237	3469925
				Number of women				115664	377119	1734962
				Number of youth				45667	137001	685003
		No further land degradation under intensified systems	Sustainability Index	Number of ha	729959	2189876	10949379			
3	Interventions to improve vulnerable women and children’s access to more, diverse food sources throughout the year (S. Asia, W. Africa, and E&S Africa)	Increased knowledge about nutrition and healthy diets to improve demand and supply of safe, diverse and nutritious food.	Standard methodologies from WHO, FAO, and FANTA on farm and dietary diversity, markets, and food access.	Number of women and young children	10%	10%	10%	78425	156850	235275
4	Multiple stakeholders in pastoral / agropastoral areas , use evidence-based ecosystem management, at community level in the governance of common and privately managed land and water resources	More resilient, sustainable and productive agro-pastoral systems under equitable governance	Area under sustainable and equitable ecosystem management	ha	0.1%	1%	3%	63444	634445	1268890
			Equity index	Individuals				22833	251168	479502
		Number of women		31722				317222	634445	
		Number of youth		12689				126889	253778	

Table 1. Current working impact targets for IDOs 1-4 of Dryland Systems.

To estimate impact targets in IDOs 1-4, Dryland Systems has 1) used available data on population, demographic distribution, and land area, 2) made assumptions regarding staged adoption rates over three 3-year cycles, and 3) estimated impact using assumed targeted development outcomes and indicators that can be fairly reliably measured. We recognize, however, that better data are needed in all target regions on farming systems and households to better specify indicators and impact pathways, including scaling strategies. These impact targets will be better defined and pathways better articulated as the program acquires more information in each action site.

**4.1 Scaling up and out.** The Dryland Systems IDO framework was designed with a focus on taking innovation to scale, starting with the premise that developments on the ground require three interrelated elements to be in place:



Integrated research in all three areas is necessary to make progress, as shown in the connections amongst IDOs. Dryland Systems implements research in five target regions or “flagships”. Within each, there are large action sites that represent our initial scaling domains. Options, delivery mechanisms and policies are designed and tested within each of these action sites through application of a co-learning paradigm (Figure 7) that brings partners together across the research-to-development spectrum. Capacity development and relationships with key regional partners are then used to replicate and inform co-learning paradigms to scale out across larger target areas within each region.

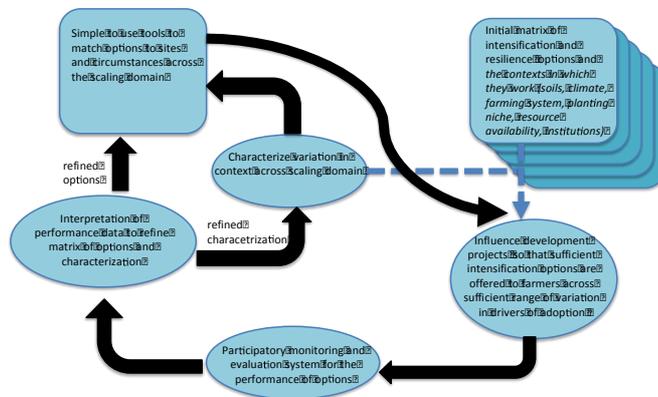


Figure 7. Co-learning paradigm that embeds research within development praxis.

**5. Partnership**

Successful partnership has been built into the CRP as a guiding principle since the beginning because of the belief that successful dryland production systems evolve through the right mix of partnerships, technologies, and policies. This is necessary because Dryland Systems’ research outputs and outcomes cannot go to scale or achieve impact without partner support and buy-in. Partners are involved all along the Impact Pathway and include Development agencies, Policy makers, Farmers associations, NGOs, Extension systems, NARS, Advanced Research Centers, etc. Partnership is explicitly part of the conceptual framework upon which Dryland Systems was developed. Partners were involved in the participatory selection of Action Sites and the extensive groundwork conducted to characterize them. Partners were involved in research prioritization exercises that took place as part of five regional workshops, and are also

involved in governance of the program at multiple levels, including the Steering Committee. Partners are clearly defined in workplans approved by the Steering committee, and clear expectations are made within program on budget sharing.

## 6. Flagship projects

Dryland Systems works in five major Target Areas of the world (Figure 8): The West African Sahel and Dry Savannas, East and Southern Africa, North Africa and West Asia, Central Asia and the Caucasus, and South Asia. As a global research program, the program has emphasized commonalities among the five dry regions through the eight thematic IDOs. Nonetheless, it is clear that the regions are at different stages of development and are confronted by different challenges. Thus, specific pathways to impact will vary among and even within the five regions, as will entry points. Furthermore, it is recognized that donors will have different regional priorities. We have therefore identified five geographically based “flagships” corresponding to the Target Areas in which we work. Baseline characterization of Action Sites of the five flagships, including constraints and opportunities for improving dryland agricultural systems, are available at <http://drylandsystems.cgiar.org/>.

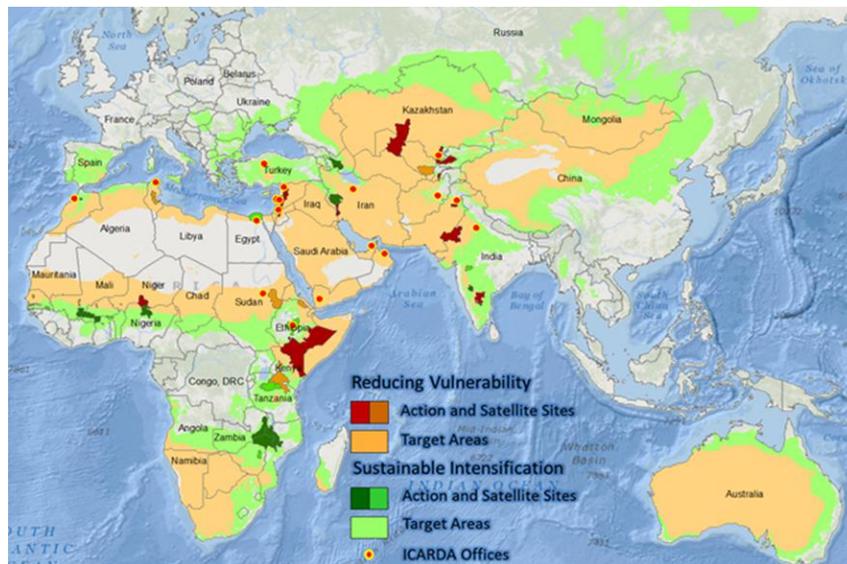


Figure 8. Target Areas and Action Sites addressed by Dryland Systems.

## 7. Nine- year Notional Budget.

A proposed nine-year budget is broken down into annual amounts in three, 3-year cycles for each of 8 IDOs and five regional flagships. These amounts include all funding sources, i.e. Windows 1 and 2, Window three, and bilateral grants. The amounts below reflect an initial annual budget of 45 million dollars, and a 10% increase in subsequent cycles. These amounts, and their regional distribution, are roughly in line with the original proposal approved in March 2013. Also, these amounts are exclusive of an additional 10.5% for the director’s office (the current internal overhead level approved by the Steering Committee).

Notional annual and total budgets for nine years for Dryland Systems (x \$1,000)																
IDO	West Africa			East and Southern Africa			North Africa and West Asia			South Asia			Central Asia			Total
	2015-2017	2018-2020	2021-2023	2015-2017	2018-2020	2021-2023	2015-2017	2018-2020	2021-2023	2015-2017	2018-2020	2021-2023	2015-2017	2018-2020	2021-2023	
1	2700.0	2970.0	3267.0	2700.0	2970.0	3267.0	2250.0	2475.0	2722.5	2250.0	2475.0	2722.5	1350.0	1485.0	1633.5	111712.5
2	1620.0	1782.0	1960.2	1620.0	1782.0	1960.2	1350.0	1485.0	1633.5	1350.0	1485.0	1633.5	810.0	891.0	980.1	67027.5
3	1080.0	1188.0	1306.8	1080.0	1188.0	1306.8	900.0	990.0	1089.0	900.0	990.0	1089.0	540.0	594.0	653.4	44685.0
4	1080.0	1188.0	1306.8	1080.0	1188.0	1306.8	900.0	990.0	1089.0	900.0	990.0	1089.0	540.0	594.0	653.4	44685.0
5	1296.0	1425.6	1568.2	1296.0	1425.6	1568.2	1080.0	1188.0	1306.8	1080.0	1188.0	1306.8	648.0	712.8	784.1	53622.0
6	1188.0	1306.8	1437.5	1188.0	1306.8	1437.5	990.0	1089.0	1197.9	990.0	1089.0	1197.9	594.0	653.4	718.7	49153.5
7	1080.0	1188.0	1306.8	1080.0	1188.0	1306.8	900.0	990.0	1089.0	900.0	990.0	1089.0	540.0	594.0	653.4	44685.0
8	756.0	831.6	914.8	756.0	831.6	914.8	630.0	693.0	762.3	630.0	693.0	762.3	378.0	415.8	457.4	31279.5
Totals	10800.0	11880.0	13068.0	10800.0	11880.0	13068.0	9000.0	9900.0	10890.0	9000.0	9900.0	10890.0	5400.0	5940.0	6534.0	446850.0
Regional		35748.0			35748.0			29790.0			29790.0			17874.0		446850.0

## References

- Batchelor, Simon and Ruth Goodman. 2012. Theories of Change and Impact Pathways. Cross-cutting analysis of the 15 CGIAR Research Programs. Rome: Independent Science and Partnership Council.
- CGIAR, 2011. A Strategy and Results Framework for the CGIAR.
- FAO (2013). Warrantage scheme boosts Niger farm incomes  
<http://www.fao.org/news/story/en/item/40281/icode/>
- FAO (2011). Women in Agriculture. Closing the gender gap for development. Food and Agricultural Organization of the United Nations, Rome, Italy.
- FANRPAN. Food, agricultural and natural resources policy analysis network.  
<http://www.fanrpan.org/projects/youth-in-agriculture/>
- Marschke, M. J., and F. Berkes. 2006. Exploring strategies that build livelihood resilience: a case from Cambodia. *Ecology and Society* **11**(1): 42. [online] URL:  
<http://www.ecologyandsociety.org/vol11/iss1/art42/>
- Obersteiner, Michael. 2013. Addressing planetary challenges through ecosystem management: An analysis of major synergies and trade-offs. UC Davis: Climate Smart Agriculture: Global Science Conference.
- Smith, Pete, et al. 2010. Competition for land. *Phil. Trans. R. Soc. B* (365): 2941–2957.
- Proctor, F. and V. Lucchesi. 2012. Small-scale farming and youth in an era of rapid rural change. IIED/HIVOS, London/The Hague.
- Ruel, M.T. (2002). Is dietary diversity an indicator of food security or dietary quality? a review of measurement issues and research needs. Food Consumption and Nutrition Division Discussion Paper No. 140, IFPRI, Washington.