ICRISAT Strategic Plan to 2020

Inclusive Market-Oriented Development for Smallholder Farmers in the Tropical Drylands




our vision a prosperous, food-secure and resilient dryland tropics **our mission** to reduce poverty, hunger, malnutrition and environmental degradation in the dryland tropics **our approach** partnership-based international agricultural research-for-development that embodies science with a human face

ICRISAT
Science with a humanface
International Crops Research Institute for the Semi-Arid Tropics

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The ICRISAT Strategic Plan to 2020 describes **what** the Institute will do and **why** over the decade 2011–2020. ICRISAT's Business Plan (2011–2015) describes **how** we will fulfill these commitments, for the first five years of the decade. A three-year Medium-Term Plan, updated annually, will provide additional 'how' detail, indicating expected yearly milestones at the activity level.

This Strategic Plan is intended for both internal (ICRISAT) and external audiences desiring a broad understanding of the Institute's priorities and directions. The Business Plan will be most useful for guiding the Institute's own management and operations with a five-year horizon, including mechanisms for monitoring and assessing progress. The Medium-Term Plan's main purpose is for internal annual activity planning (with a rolling three-year horizon) and for reporting to the Consultative Group on International Agricultural Research (CGIAR).

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Acronyms

AGRA	Alliance for a Green Revolution in Africa
AIDS	Acquired Immunodeficiency Syndrome
APAARI	Asia-Pacific Association of Agricultural Research Institutions
ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa
AVRDC	The World Vegetable Center, Taiwan
CAADP	Comprehensive Africa Agriculture Development Program
CGIAR	Consultative Group on International Agricultural Research
CIAT	International Center for Tropical Agriculture, Colombia
CIMMYT	International Maize and Wheat Improvement Center, Mexico
CLNA	Central Level Nodal Agency
COMESA	Common Market for Eastern and Southern Africa
CORAF	West and Central African Council for Agricultural Research and Development
CRPs	CGIAR Research Programs
FAO	Food and Agriculture Organization, Rome
FARA	Forum for Agricultural Research in Africa
HIV	Human Immunodeficiency Virus
HPRC	Hybrid Parents Research Consortium, ICRISAT
ICARDA	International Center for Agricultural Research in the Dry Areas, Syria
ICRAF	World Agroforestry Centre, Kenya
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics, India
ICT	Information and Communication Technology
IER	Institute for Economic Research, Mali
IFPRI	International Food Policy Research Institute, USA
IIT	Indian Institute of Technology, Bombay, India
IITA	International Institute of Tropical Agriculture, Nigeria
ILRI	International Livestock Research Institute, Kenya
IMOD	Inclusive Market-Oriented Development
IRRI	International Rice Research Institute, Philippines
ITPGRFA	International Treaty on Plant Genetic Resources
IWMI	International Water Management Institute, Sri Lanka
IWMP	Integrated Watershed Management Program
NARS	National Agricultural Research Systems
NASFAM	National Smallholder Farmers' Association of Malawi
NGOs	Non-Governmental Organizations
NRI	Natural Resources Institute, UK
NRM	Natural Resource Management
ST	Strategic Thrust
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organization

Foreword

With strategic international agricultural research-for-development, there is hope of breaking the stubborn grip of poverty, hunger, malnutrition and environmental degradation. The Consultative Group on International Agricultural Research (CGIAR), to which ICRISAT belongs as one of 15 member centers, embodies the world's commitment to this cause. The CGIAR's foresight has proven its worth. Over the course of nearly 40 years of investment, a growing pipeline of innovations and impacts has been changing lives on a large scale. Very high returns to social investment have been generated, in excess of 17 dollars for each dollar invested during just the first three decades of the system's existence.[1]

This precious pipeline could, however, dry up if it is not nurtured. The CGIAR is currently enacting fundamental reforms to bolster strategic planning, investment and action. In that same spirit, we have taken the time to carefully re-examine our own strategic directions. This *Strategic Plan to 2020* is the fruit of that year-long effort.

Since ICRISAT is already a thriving institution, we sought a tone of celebration in our strategic planning, rather than one of crisis management. We challenged ourselves to be bold and imaginative rather than defensive. We were determined to build on past accomplishments and expertise, but not to rest on them.

We are excited about the outcomes described in these pages. Our conceptual framework of Inclusive Market-Oriented Development (IMOD) envisions a path to end poverty, not just alleviate it. This concept relies on unleashing the energies of the poor by enabling them with diverse, purposeful, innovative and action-oriented partnerships, more productive and resilient technologies, and supportive policies.

IMOD is a powerful unifying concept for our *Strategic Plan to 2020*. We see it as a vehicle to orient our thinking, not to confine it. Its value will be measured in part by how often it prompts us to explore important new frontiers.

Our Strategic Plan will remain a living document. As we learn, our understanding will grow and we, together with our partners, will become even more effective. We invite you to join us on this journey of hope for the tropical dryland poor.

Sincerely yours,

Nigel J. Poole
Chairman, Governing Board

William D. Dar
Director General

[1] **Raitzer DA.** 2003. Benefit Cost Meta-Analysis of Investment in the International Agricultural Research Centres of the CGIAR. Science Council (*renamed Independent Science and Partnership Council in 2010)* Secretariat. Rome, Italy: FAO. Download at: www.sciencecouncil.cgiar.org/fileadmin/user_upload/sciencecouncil/Impact_Assessment/0303-1.pdf

Executive Summary

Vision and Mission

Our ICRISAT Strategic Plan to 2020 (the Plan) envisions **a prosperous, food-secure and resilient dryland tropics.** To achieve that Vision, our Mission will be to **reduce poverty, hunger, malnutrition and environmental degradation in the dryland tropics.** Our Approach will be through **partnership-based international agricultural research-for-development that embodies *Science with a Human Face*** in tropical dryland Africa and Asia.

From pessimism to possibility

The conventional view of the tropical drylands has long been one of pessimism. These areas are seen as resource-poor and beset by destabilizing shocks, such as drought, that trap people in inescapable poverty and hunger, forever to be dependent on external aid.

We challenge that pessimistic view. Our partnership-based work over the past 38 years has found that the tropical dryland poor are ingenious and resourceful. By using scientific innovations they are able to multiply the productivity of their crops, and consequently their incomes, by several-fold while improving the resilience of their lands and livelihoods.

Converting this potential into prosperity on a wide scale however has proven difficult. How can we, our partners and society as a whole spark a transformative dynamic that reaches hundreds of millions of poor?

Unifying conceptual framework: Inclusive Market-Oriented Development (IMOD)

Throughout the history of agriculture, one path has provided a consistently effective way out of poverty: the generation of surpluses that are stored for later use, or sold into markets to earn income. Stored food provides a buffer in times of hunger, and higher incomes make it possible to purchase more food when needed. Income also enables the poor to purchase inputs, such as seed, fertilizer, labor, tools, livestock, insurance and education. These inputs raise farm productivity and prosperity further and enable another round of investment and productivity growth, creating a self-reinforcing pathway out of poverty.

Inclusive Market-Oriented Development (IMOD) is the unifying conceptual framework of the Plan. We will help the tropical dryland poor to grow their way out of poverty through market-oriented agriculture, rising to a new level of resource access, stability, security and productivity – escaping the poverty trap for good.

Systems perspective and partnerships

To map out this pathway to prosperity, we will employ a ***systems perspective*** in setting our priorities to ensure that all of the important issues along the pathway are addressed holistically. Partners will be essential in order to tackle system challenges that require special competencies, so **complementary, purposeful partnerships are the foundation of the systems perspective.**

Secure, equitable and resilient development

To succeed, IMOD must wrestle with risks, such as drought and climate change, that can derail development and discourage investment. Poverty-stricken subsistence farms are highly vulnerable and easily degraded. With partners we will help to **increase the resilience of tropical dryland farming** – that is, its ability to withstand and recover from stress and shocks – by developing system, policy and technology options and building capacities that enable the

"We will help the tropical dryland poor to grow their way out of poverty through market-oriented agriculture"

poor to withstand and recover from weather shocks, climate change, market price swings and other risks.

The *inclusive* market-oriented transformation of tropical dryland agriculture will enable the poor, particularly women, to participate and benefit rather than be sidelined. With our partners we will design our research in ways that especially benefit women and the children that depend on them, as well as other disadvantaged members of smallholder households, such as the landless, marginalized ethnic communities, unemployed youth and the elderly.

Strategic Thrusts

Our contributions will be expressed through four Strategic Thrusts:

Resilient Dryland Systems: Reducing vulnerability to drought and climate change while increasing crop diversity and value

Markets, Institutions and Policies: Harnessing development pathways for inclusive prosperity

Grain Legumes: Raising and securing productivity for health, income and sustainability

Dryland Cereals: Increasing productivity to help end hunger

These research-for-development thrusts will generate products and innovations that help provide the poor with the goods and services they need to participate in IMOD. They align well with the research-for-development strategies of major regional institutions in Africa and Asia, ensuring that our work addresses their priorities; and with the new CGIAR Strategy and Results Framework and CGIAR Research Programs.

Aspirational targets

We have set four bold targets for 2020 that will enormously benefit the well-being of tropical dryland smallholder farming households. Achieving these targets requires partnerships with and actions by a wide range of actors in addition to ICRISAT. With partners at our side, we will harness IMOD to help millions of these households to **halve poverty**, increasing their incomes through more productive, stable, diverse and profitable crops and crop products.

We will help these households to **halve hunger** incidence by contributing products and innovations that increase on-farm yields by at least 30% on a wide scale, and through policy advice that stabilizes food prices and availability.

We will also help these households to **halve childhood malnutrition** incidence by enhancing the nutrient content of staple foods and by helping them to diversify their crops, thereby delivering more nutritious and safer food.

Last but not least, we will help to **increase the resilience of tropical dryland farming** through innovations that stabilize, safeguard and enhance livelihood capital (natural, social, human, physical and financial), biological and systems diversity, and land health.

Our four bold targets aim to halve poverty, halve hunger, halve childhood malnutrition and increase the resilience of smallholder farming households in the tropical drylands

I Vision, Mission, Approach and Aspirational Targets

Through the strategic planning process we have reformulated our Vision, Mission and Approach, which together guide our path with partners in pursuit of Mission-oriented Aspirational Targets.

ICRISAT's Vision

A prosperous, food-secure and resilient dryland tropics

ICRISAT's Mission

Reduce poverty, hunger, malnutrition and environmental degradation in the dryland tropics

ICRISAT's Approach

Partnership-based international agricultural research-for-development that embodies Science with a Human Face

We will continue to improve five important staple food crops of the dryland poor: sorghum, pearl millet, groundnut, chickpea and pigeonpea, and the farming systems based on them. However, the quartet of mission goals (reducing poverty, hunger, malnutrition and environmental degradation in the dryland tropics) is the paramount aim of our work, so activities and approaches most relevant to those aims will take precedence.

Our geographic focus is on the semi-arid tropics of Africa and Asia, referred to for brevity in the rest of the Plan as 'the tropical drylands' or simply 'the drylands' (see Figures 1a and 1b). Some 6.5 million square kilometers in over 55 countries is classified as dryland tropics. More than 2 billion people currently live in the drylands, with 600 million considered to be poor. Research on our five focus crops may also extend to areas in other agro-ecozones where they are cultivated, but the tropical drylands will remain our primary focus.

Our Approach, as well as our core value, is captured by our motto ***Science with a Human Face.*** This motto indicates our commitment to put people's welfare first when we set our priorities. Our commitment to reducing land degradation and improving dryland resilience, for example, is based on the premises that land is the resource base that sustains the livelihoods of most poor dryland inhabitants, and variation in weather, climate and economic circumstances strongly affects their well-being. Similarly, we do not pursue crop research simply for the sake of supporting commodity industries; rather, we pursue only aspects of those commodities that hold value for the poor by providing them with more and better food, nutrition and income in an environmentally sustainable manner.

The challenges facing the dry tropics are far too large and varied for any single institution to handle, so partnerships are central to our Approach. But we do not engage partnerships simply for partnership's sake. We engage in **partnerships with purpose**. The overarching purpose that we aim for is to achieve our Mission goals more effectively by joining forces with those who share those goals and are able to contribute complementary expertise and capacities. We treat partners as respected equals, working shoulder-to-shoulder with them in an interdisciplinary manner from the planning through the execution and evaluation stages of the joint effort.

Aspirational targets

Specifically what do we, working with partners, expect to contribute to help society to achieve the quartet of Mission goals (reduce poverty, hunger, malnutrition and environmental degradation) by 2020? It is difficult to predict precisely how fast and how far development

Our motto Science with a Human Face embodies our people-centered approach

will proceed, since impacts will be highly dependent on the actions of a vast array of institutions, governments, non-governmental organizations (NGOs), the private sector, communities and farmers. We also recognize that the causes of these four major human and social challenges are numerous, complex and intertwined (we discuss in more detail how impact pathways unfold and the projected outputs, outcomes and milestones along the way in Chapter IX as well as in the Business Plan and the Medium-Term Plan). Nevertheless, clear targets are useful for guiding the path towards our Mission goals, and we believe that it is reasonable to aspire to the following overarching Mission targets in tropical dryland Africa and Asia by 2020.

Poverty

We will help to **halve** the incidence of absolute **poverty** in smallholder farming households through more profitable, stable and productive crops and crop products.

Hunger

We will help to **halve hunger** incidence in smallholder farming households by increasing crop productivity, raising on-farm yields by at least 30% on a wide scale, and developing policy advice that helps dryland countries to improve food availability and affordability.

Malnutrition

We will help to **halve child malnutrition** incidence in smallholder farming households through staple crops enhanced for key nutrients and through diversified crops yielding more nutritious and safer foods.

Environmental degradation

We will help to significantly **increase** the **resilience** of tropical dryland smallholder farming through innovations that stabilize, safeguard and enhance livelihood capital (natural, social, human, physical and financial), biological and systems diversity, and land health.

Africa and Asia: semi-arid tropics, 2050

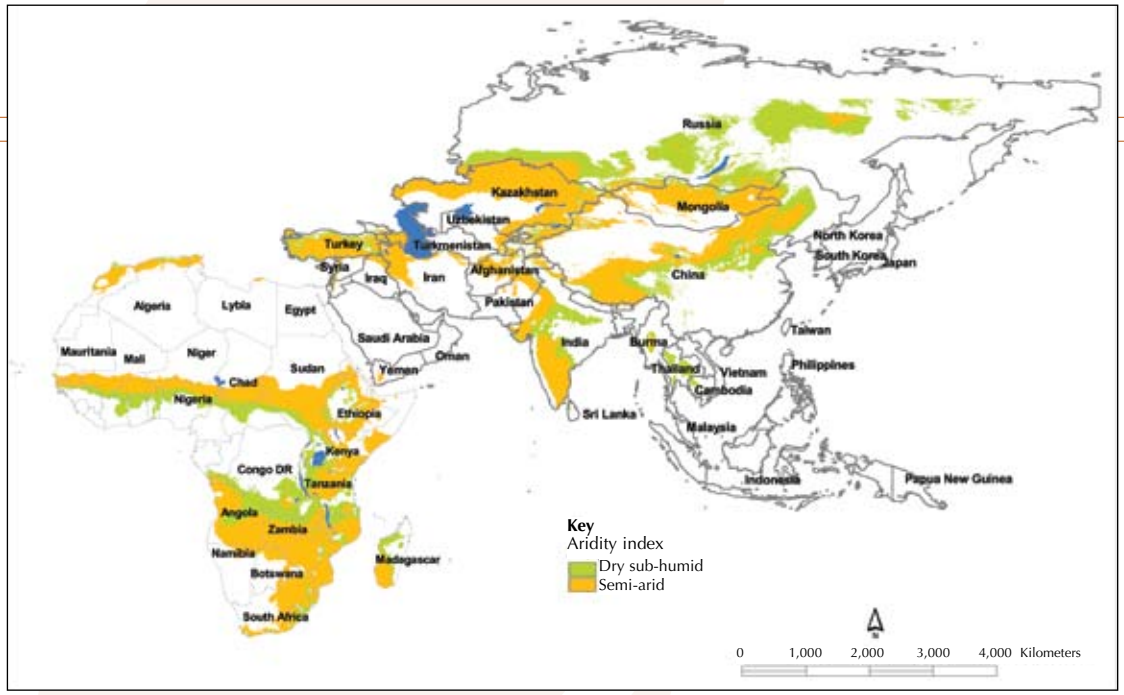


***Figure 1a**. Projected tropical drylands of Africa and Asia in the year 2050, based on climate change models. Both maps were produced starting with year 2000 data from the CRU-TS 3.0 Climate Database and using the HADCM3 output of the A2a scenario to determine the year 2050 areas. The dryland tropics were delineated using the Aridity Index (the ratio of the average precipitation to reference evapotranspiration, where 0.20–0.50 is semi-arid and 0.50–0.65 is dry sub-humid) of FAO and UNESCO. The map is only one of many possible scenarios given the many uncertainties inherent in future climate change calculations.*

Africa and Asia: changes between 2000 and 2050

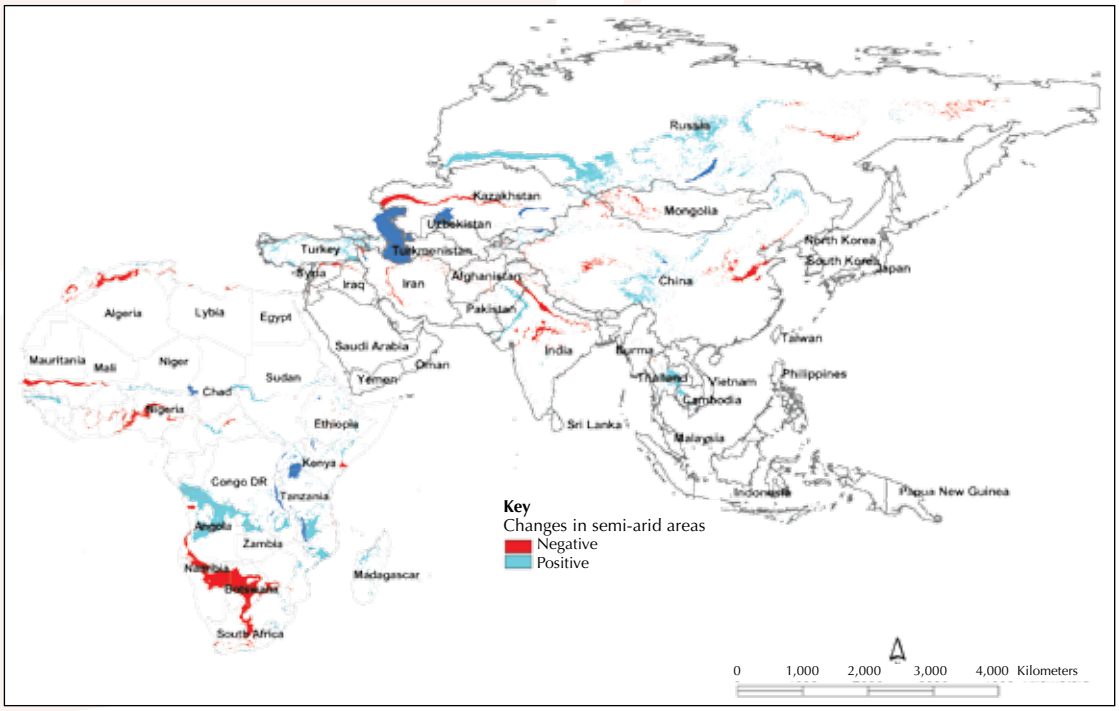


***Figure 1b**. Projected changes in the tropical drylands of Africa and Asia between the years 2000 and 2050. Negative changes indicate areas that are currently dryland tropics (semi-arid or dry sub-humid) but that are projected to become even drier (arid). Positive changes indicate those areas that are currently not classified as tropical dryland, but are projected to fall into that category by 2050.*

II Background

As the first decade of this century draws to a close, ICRISAT is a healthy, vigorous institution with high morale. But that is no reason for complacency. It is a decided advantage to be able to develop a strategic plan from a position of strength, rather than as a reaction to crisis.

Strategic planning process

To provide a knowledge base for strategic planning, an update of the extremely comprehensive 2001 analysis by Ryan and Spencer of past, current and future trends in the dry tropics was carried out (Walker 2010[2]). This analysis fed into three intensive, professionally facilitated consultation meetings held in our three target regions during the first two months of 2010, plus a fourth consultation of diverse external experts from national agricultural research systems, universities, the private sector and other partners. Approximately 400 pages of documentation chronicle these consultations.

There was considerable convergence of thinking across regions on major trends, drivers, challenges and emerging science opportunities, and how these should influence our future directions. This stream of thought was congruent with many of the ideas emerging from the CGIAR's reform process as documented in the new CGIAR Strategy and Results Framework. The main elements of this thinking were shared for initial guidance with our Governing Board, and revised accordingly.

During April and May 2010, those revised elements were presented for comment in an online survey of 650 stakeholders around the world. Feedback was strongly supportive of the elements of the Plan, and valuable write-in advice was received on many issues.

Based on that feedback, a first draft of the Plan was produced in May and shared with the Governing Board, the new CGIAR Consortium, CGIAR sister Centers and other key stakeholders. Further revisions were made, and in July the second draft was shared with close external stakeholders, such as regional agricultural research organizations and development investors. The third draft followed and was further enhanced. The fourth and final draft was enhanced and approved by our Governing Board in September 2010.

The Plan elaborates the overarching logic and main objectives of our work for the period 2011–2020. A companion document, the Business Plan (2011–2015) provides more detail on the organizational and operational steps that we will take in order to achieve those objectives during the first five-year period. A three-year Medium-Term Plan, updated annually, will provide further details including expected milestones down to the activity level.

We begin by describing the world in which we work, and major changes occurring in that external environment that will shape our own strategy.

A changing world

The consultations noted that the tropical drylands are changing rapidly, and the challenges are mounting. The globalization and liberalization of food markets is increasingly affecting the demand for and supply of dryland crops. Accelerating environmental threats such as climate change, land degradation and biodiversity loss add new pressures to longstanding challenges of poverty, food

[2] **Walker T.** 2010. Updating and Reviewing Future Challenges and Opportunities for Agricultural R&D in the Semi-Arid Tropics for ICRISAT Strategic Planning to 2020. Hyderabad, India: International Crops Research Institute for the Semi-Arid Tropics.

"A 'perfect storm' of converging pressures is surrounding the drylands, and it will punish the poor most severely"

insecurity, drought, increasing populations, and rising costs of food and inputs in the dry tropics. A 'perfect storm' of these converging pressures is surrounding the drylands, and it will punish the poor most severely. We will adjust our strategy and intensify our activities to help these poor to survive this storm.

At the same time, great advances in scientific methodologies and technologies are increasing humankind's ability to address these challenges, especially in such areas as biotechnology, geospatial sciences and modeling, and information and communication technology. These advances, if harnessed for the good of the poor, hold the potential to increase enormously the power and effectiveness of our research in a range of areas. They will be particularly effective in improving our use of genetic resources (genetic material of plants that is of value for present and future generations of people) and genetic information for crop improvement; in the analysis and integration of complex environmental information; in the management of the unprecedented quantities of data emerging from advanced research; and in improving exchanges of knowledge with partners.

Despite scientific advances, however, a crisis continues. The drylands are home to the deepest pockets of poverty on earth. The incidence of poverty is highest in rural areas, where agriculture is the main occupation. Nearly every year, drought and hunger hit hard somewhere in the drylands. The external image of the tropical drylands is one of perennial crisis and suffering, a zone that will forever remain dependent on emergency relief aid.

Yet there are signs of hope. The incidence of absolute poverty (purchasing power parity-adjusted income less than one dollar per day) has declined substantially in dryland Asia, from 55% in 1980 to 34% in 2008 (Table 1). However absolute poverty remains stagnant at a high level in Africa (47%), and the African poor lie further below the dollar-a-day poverty line than the Asian poor. Asia's higher total population means there are still twice as many poor in the drylands there than in dryland Africa (185 versus 95 million), although the gap is decreasing because of poverty incidence trends plus higher population growth rates in Africa than in Asia (approximately 3% versus 2%, both expected to decline by a percentage point by 2020).

Despite Asia's declining poverty rate, childhood malnutrition remains at a totally unacceptable rate (42% of dryland children malnourished), even higher than in Africa (27%). Childhood

Table 1. A snapshot of poverty and hunger in the dryland tropics (from Walker 2010).

Region	Absolute poverty incidence[1] ($1 per day)	Poverty incidence[1] ($2 per day)	Childhood malnutrition rate[2]
Dryland sub-Saharan Africa	47% (95 million)	80% (162 million)	27%
Dryland Asia[3]	34% (185 million)	80% (544 million)	42%

1. Percent of population earning the indicated amount or less per day (percentages from 2008 data; numerical populations projected to 2010).
2. 2005–2006 data.
3. Estimated from data for India, home to over 90% of the dryland tropical population in Asia.

Childhood malnutrition in Asia remains at a totally unacceptable rate (42% of dryland children malnourished) – even higher than in Africa (27%)

malnutrition rates are higher in the tropical drylands than in any other agro-ecological zone (Walker 2010). Meanwhile HIV/AIDS continues to deplete Africa's workforce, especially in Eastern and Southern Africa.

Battling these scourges will be even more challenging in view of the perfect storm converging on the dryland poor. Solutions must be found.

Dryland development dynamics

The Walker report analyzed dryland trends and implications flowing from two major recent World Development Reports (World Bank 2008, 2009)[3] on agricultural development and the geography of poverty. The Bank analysis concluded that national economies can be broadly described in terms of three states of agricultural development: subsistence agriculture, transitional, and urban market-oriented. The emergence from subsistence to market-oriented agriculture reduces poverty, because markets stimulate demand for a wider diversity of higher-value foodstuffs and agro-industrial products that raise rural incomes (as well as creating opportunities beyond agriculture).

Our unique, long-term Village Level Studies provide ground-level detail to complement the World Bank's macro-scale picture. The Village Level Studies confirm that where poverty has declined it is because of a diversification beyond staple food crops into market-connected activities, as well as off-farm employment. Our staff concurred with this perspective in our regional consultations;

[3] **World Bank**. 2008. World Development Report. Agriculture for Development; and: **World Bank**. 2009: World Development Report. Reshaping Economic Geography. Washington DC: The World Bank.

helping the poor emerge from subsistence agriculture to sustainable market-oriented agriculture emerged as a consensus priority.

Sub-Saharan Africa's drylands today are largely subsistence based, while dryland Asia finds itself in transition towards a market-oriented agricultural economy. There are, of course, local variations within each of these large regions, especially depending on distances to urban markets, ease of transportation, and communications infrastructure. Also, individual smallholder farm households carry out differing mixes of subsistence versus market-oriented activities, and this mix changes over years in response to market forces. Nevertheless, **subsistence versus commercial orientation explains much about rural dryland poverty and insecurity, and about livelihood strategies and decision-making.**

As Asian farmers have diversified into cash crops, the monetary value of ICRISAT's five focus crops (sorghum, pearl millet, chickpea, pigeonpea and groundnut) as a percentage of the total value of all crops grown in the drylands fell from 50% in 1950 to 20% in 2005–06 in India. A major factor on the supply side has been increasing access to irrigation which has displaced rainfed crops, including the coarse cereals traditionally consumed by the very poor, in favor of government price-supported crops, such as rice and wheat. On the demand side, an important factor has been a shift in consumer preference towards these two cereals. However, the ascendance of markets for a range of other commodities has also been a major factor (maize, soybean, rapeseed, castor, potato and horticultural and floricultural crops, along with dairy, poultry and eggs). Such market-oriented diversification

Crop diversification opens the door to new contributions that ICRISAT can make to improving dryland farming livelihoods

opens the door to new contributions that we can make to dryland farming systems beyond our focus crops, in addition to adding value to those focus crops through alternative uses (eg, nutritionally enriched foods and feeds, export-quality grain types, and raw materials for biofuel and industrial purposes).

Smallholder farm households that are beginning to emerge out of poverty, hunger and environmental degradation are still vulnerable. The Walker analysis noted that when the dollar-per-day threshold that defines absolute poverty is relaxed to two dollars per day, poverty rates in dryland Asia and Africa become similar (about 80% of the dryland population in both regions lies below the two-dollar-per-day poverty line). This suggests that even though market-oriented development has begun to increase incomes, especially in the Asian drylands, escape from poverty is still in the early stages. Institutions and policies must change to enhance the adoption of new technologies if the pace of commercialization, and consequently of poverty reduction, is to accelerate.

In accordance with the link between subsistence farming and poverty, ICRISAT crops account for a much higher share of total crop value (40%) in dryland West and Central Africa than in Asia, and that share is not declining. Our focus crop value share is also stable in Eastern and Southern Africa albeit at a lower percentage (20%), which is similar to that of Asia.

While the higher value share of our focus crops in West and Central Africa implies greater leverage from our research, the subsistence nature of cultivation there creates challenges. Interventions in the subsistence sector are difficult because farmers earn little or no net cash from subsistence cropping, severely limiting their ability to invest in new technologies. They are, understandably, also risk averse because of the threat of drought and lack of safety nets and enabling infrastructure and services. ICRISAT will play a catalytic role in overcoming this obstacle by bringing together researchers, farmers, processors and other stakeholders to find solutions.

Livestock are as important as crops in value share of production in the drylands, though with strong variations across locations and regions. They diversify and hedge risks; for example, cattle can move from one grazing area to another to escape drought (although restrictions on land access are increasingly constraining this option in many areas). Cattle diseases are also less troublesome in dry areas. Livestock are a strategic investment when cash is available, and a cash source when times are hard (sometimes referred to as 'walking wealth'). They also generate ecological synergies with crops; for example, farmers allow herders to graze their animals on crop stubble so that subsequent crops can benefit from soil-enriching manure deposits. A demand-driven livestock revolution is underway in South Asia and Africa (as seen in the growing demand for milk and meat), offering an opportunity for smallholder farm households to increase their incomes as well as capture the farming benefits highlighted above.

We work closely with our sister center, the International Livestock Research Institute (ILRI), which is focused on livestock issues, to exploit crop–livestock synergies. For this reason, and not any implication of lesser significance of livestock in dryland systems, this Plan emphasizes crop and crop–livestock integration

issues rather than livestock issues per se. The same perspective is maintained regarding agroforestry issues, which are the core topic of another sister center with which we collaborate closely, the World Agroforestry Centre (ICRAF). We also work in close partnership with the World Vegetable Center (AVRDC) on diversifying farming systems to integrate high-value, nutrition-enhancing vegetable crops into smallholder dryland farming. All three of these partnerships involve the sharing of staff and facilities and the joint planning and execution of projects.

Past accomplishments pave the way for the future

Reflecting on our past, we have achieved much over our 38 years as the world's premier international agricultural research-for-development institute focused on the dryland tropics. A wide range of improved varieties of five staple food crops has been developed and tested, and 680 of these have been released by partner institutions for use by smallholder farmers across dryland Africa and Asia. The genetic resources of these crops have been collected, conserved, characterized, disseminated and used in breeding programs worldwide (see the *Genetic Resources Conservation* box on page 38). Improved natural resource management techniques have been devised and implemented for increasing grain yields on impoverished dryland soils and for reducing the degradation of those lands. Technologies that enable competitiveness in export markets have increased poor smallholder incomes substantially in a number of locations. Policy analyses have helped partners and donors to develop action plans. Tens of thousands of young scientists have been trained, strengthening our partner institutions. Knowledge-sharing networks have been formed and sustained, providing ongoing mentoring support and partnerships in action. Our record of success is documented comprehensively on our website (www.icrisat.org).

Despite our successes, a range of obstacles has prevented many smallholder farm households from enjoying the benefits of these innovations. We will intensify our efforts to help people to overcome these obstacles by applying a systems perspective to our work planning (described in Chapter IV). Through a better understanding of the dynamics of poverty escape we will design clearer market-oriented impact pathways that **enable the poor to grow their way out of poverty,** increasing our effectiveness even further over the coming decade. Our strategy for achieving this ambition is explained in the chapters that follow.

III Unifying Conceptual Framework: Inclusive Market-Oriented Development (IMOD)

The preceding discussion highlights an overarching dryland development dynamic – the emergence from subsistence farming to market-oriented agriculture. Special care must be taken to ensure that the poorest are enabled to participate, rather than being left behind. For brevity, we refer to this framework as **Inclusive Market-Oriented Development (IMOD)**. This dynamic forms the unifying conceptual framework of our new Strategic Plan.

Figure 2 distills the key ideas involved in this unifying conceptual framework. While it cannot portray all the nuances, its main purpose is to describe **poverty escape as a dynamic process of emergence from poverty-plagued subsistence farming to inclusive, market-oriented prosperity**, enabling the poor to change their lives for the better, permanently.

The poorest dryland farm households lack access to markets in which to sell their produce. Without sales, they cannot earn the cash that they need to invest in inputs that could increase their farm productivity. Without inputs, they are usually not able to produce enough food to feed themselves. When trouble, such as drought, strikes, the situation becomes much worse. Food supplies run short months before the next harvest, and they have no savings to draw upon. Hunger and malnutrition tighten their grip. Women and children are the most vulnerable, and the damage lasts a lifetime.

These households are caught in the poverty trap of subsistence farming. Hunger and despair are its hallmarks. People need help to break out of this trap.

The way out of this trap, proven time and again over the course of history and around the world, is to generate surpluses that can be stored to survive hungry periods or sold into markets to earn income. Income also enables the poor to purchase inputs that raise smallholder farm productivity and prosperity further, sparking a development pathway that leads out poverty.

Development pathway thinking, and market-oriented development in particular, focus attention on the *dynamics* of agricultural development. Rather than considering poverty to be a 'normal' and inevitable state in the drylands, this conceptual framework seeks a fundamental transformation to a different state – one of markedly higher agricultural growth and prosperity. Our strategy is designed not to alleviate poverty, but to help end it.

For this transformation to be sustainable and inclusive of the poor, it must be driven largely by the actions of the poor themselves instead of being dependent on unrealistically high and continuous levels of public assistance. Rather than relief aid, the engine that drives this transformation is increased income resulting from technical and policy innovations enabled by realistic, carefully targeted support from governments, research and development institutions, and development investors. **Enabling the poor to connect to markets to reap higher rewards triggers a self-reinforcing cycle of re-investment in raising productivity, which raises incomes even further**. This engine runs not on relief aid, but on the innovation, ingenuity and energy of the poor and of those who help them.

Inclusiveness

As already mentioned, to be inclusive the market-oriented transformation of dryland agriculture must ensure that the poorest gain

Our strategy is designed not to alleviate poverty, but to help end it

Inclusive Market-Oriented Development (IMOD)

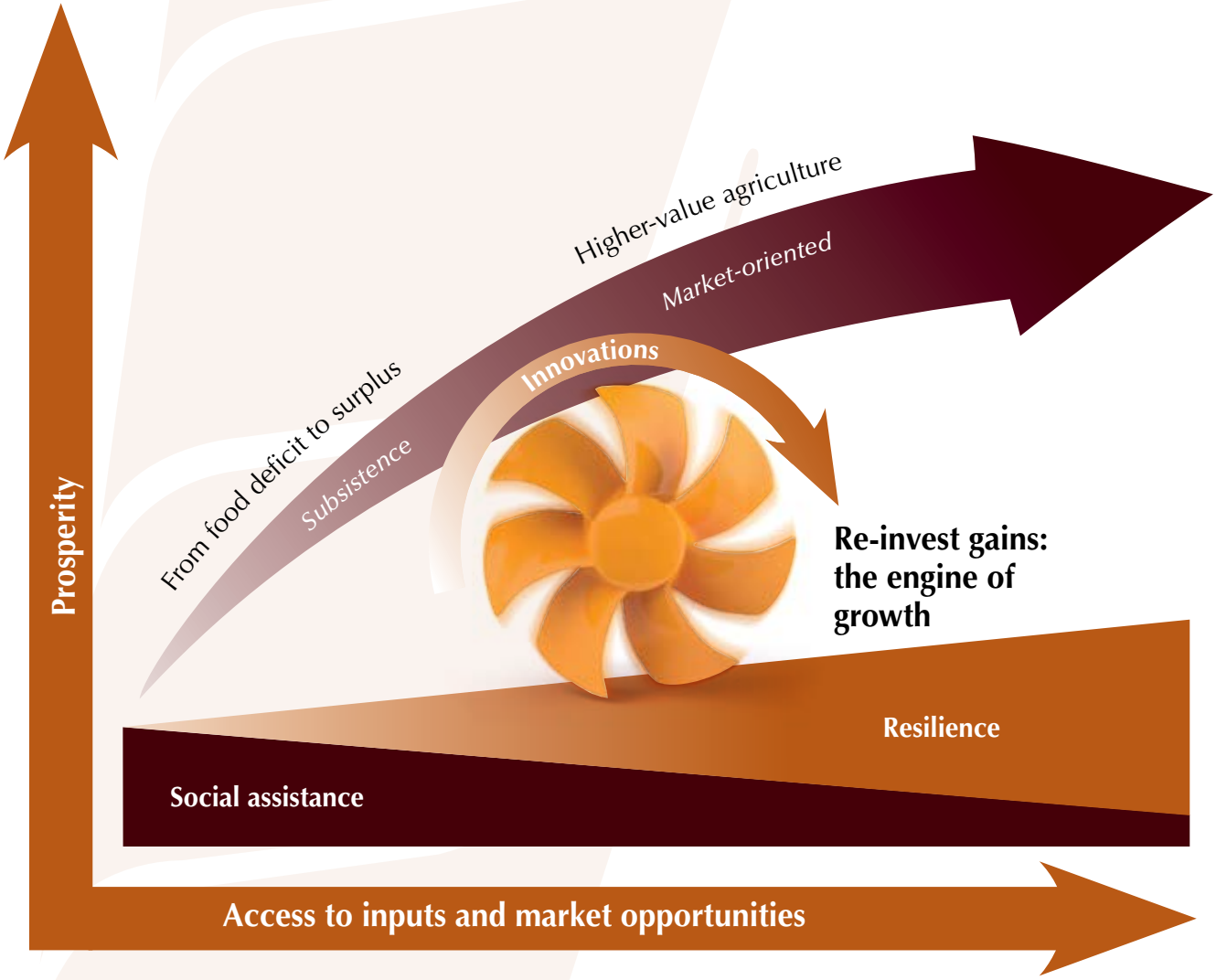


Figure 2. ***Inclusive market-oriented development (IMOD)*** *is the unifying conceptual framework for the ICRISAT Strategic Plan to 2020. It envisions a pathway for poverty escape by better linking farmers to markets to increase incomes. Research-for-development generates technology and innovations that increase the productivity and value of dryland farming, such as those indicated in ICRISAT's four Strategic Thrusts. A portion of the surplus value is re-invested in additional innovations in following years, further increasing gains in a self-reinforcing cycle (engine of growth). Gains are also reinvested in building resilience (eg, by increasing stocks of human, social, natural, physical and financial capital), supplanting the need for high levels of social assistance such as emergency relief aid.*

Our concept of IMOD recognizes that public and social interventions influence markets

much of the benefit. Our strategy harnesses the private sector as a central force in the marketplace, but not the sole force. Our concept of IMOD also recognizes that public and social interventions influence markets, especially for those who live near or at the subsistence end of the spectrum and may have difficulty establishing market connections. Because of their potential to help the poor, we believe that such interventions merit significant research-for-development attention. **We will carry out research to improve assistance programs and policies, strengthen safety nets, and build resilience – thus opening doors to IMOD** as indicated in Figure 2.

Towards this end, we will provide science-based evidence to policy makers and decision makers to help inform their deliberations on strategies and options including:

- Vulnerability analyses to identify those who are most likely to suffer and ensure that they receive the most intensive assistance;
- Preparatory, preventive and coping measures, such as early-warning systems and insurance;
- Safety nets, such as grain, fodder and seed banks and emergency food reserves;
- Genetic improvement strategies for critical traits, such as tolerance of drought and heat;
- Natural resource management strategies to improve supplies of water and nutrient resources and to increase system resilience (ability to withstand and recover from stress);
- Farm management strategies – such as agricultural diversification and affordable, efficient and sustainable small-scale irrigation – that hedge risks and broaden opportunities; and
- Capacity-strengthening strategies that improve knowledge flows.

Through our *inclusive* approach we are signaling that our work will engage the poorest members of society in market-oriented development. The conventional approach – to focus on poverty *relief*, rather than on poverty *escape* – would leave market opportunities to be captured by the more fortunate. Our commitment to deliberately enable the poorest will counteract trends that increase disparities of wealth.

Of major concern are potential gender gaps. Women in the drylands tend to be less empowered, have less access to production resources, and have restricted roles in certain production and marketing activities. The welfare of women also directly impacts that of children who are the future of the drylands; childhood malnutrition is especially widespread in dry areas. With our partners we will conduct agricultural research-for-development to address gender-related risks associated with market-oriented development, and will find solutions that benefit those most in need (see the *Strategic Opportunities for Women in the Dryland Tropics* box on page 17 and Critical Focus Area *Gender and equity analysis* on page 39). **In addition to our special focus on benefiting women and children (by combating childhood malnutrition), our inclusiveness objective will encompass other less empowered members of rural smallholder communities, such as landless labor, disadvantaged ethnic groups, the elderly and unemployed youth.**

Risk management

Dryland development must manage risks that especially threaten the poorest, who are also the most vulnerable. Weather variability is the norm in drylands, with drought the extreme case. In addition to causing direct human

suffering, the risk of crop failure discourages investments in technologies, inputs and infrastructure needed for IMOD. Therefore, **interventions that provide protection, resilience and safety nets against risks are vital and will receive close attention** (as reflected in the themes listed on the previous page).

Environmentally sustainable and resilient development

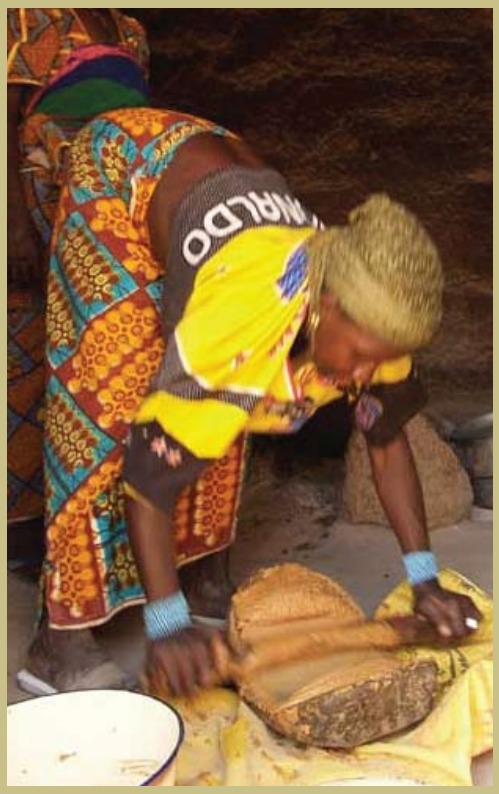
Market-oriented development can either be beneficial or harmful for the environment. If it is structured in a way that rewards the depletion of natural resources for short-term financial gain, it can be destructive. On the other hand, many cases are known in which dryland smallholder farm households respond to incentives for good stewardship of the land, for example when they perceive stable land tenure and inheritance rights, and when working together for the collective management of rangelands. **Our research-for-development will adhere to IMOD pathways that are environmentally sustainable.**

Sustainable dryland systems must be resilient – able to withstand and recover from – such recurring stresses as drought, heat, windstorms and disease epidemics. We have longstanding experience developing strategies for coping with such stresses, and in modeling future scenarios of change. These strengths will become increasingly valuable as climate change induces unprecedented changes in the types and levels of stress in many dryland areas.

Resilience is not just a biophysical issue; social and economic resilience interact strongly with biophysical factors affecting farm livelihoods. IMOD will help the poor to increase their resilience by building all the dimensions of livelihood capital[4]– natural, social, human, physical and financial. Shortfalls in these capital resources render subsistence farmers especially vulnerable to shocks. For example, investments in water harvesting and small-scale drip irrigation require financial and social capital in order to increase resilience against a biophysical threat (drought). And improved seeds require modest amounts of financial capital in order to protect small-scale farmers from plant disease outbreaks. **IMOD will take a systems perspective towards building the livelihood capital needed to become resilient against such threats.**

[4] Livelihood capital is a concept advanced within the well-known Sustainable Livelihoods Approach advocated by the UK Department for International Development and others. Its application to the tropical dryland context of ICRISAT's mission is elaborated in: **Rao KPC, Bantilan MCS, Singh K, Subrahmanyam S, Deshingkar P, Parthasarathy Rao P and Shiferaw B.** 2005. Overcoming Poverty in Rural India: Focus on Rainfed Semi-Arid Tropics. Patancheru 502 324 Andhra Pradesh, India: International Crops Research Institute for the Semi-Arid Tropics. 96 pp. ISBN 92-9066-474-6. Order code BOE 035. Download at http://dspace.icrisat.ac.in/handle/10731/1070

We will help women in the drylands engage with markets and gain access to production resources



Strategic Opportunities for Women in the Dryland Tropics

Women in the dryland tropics are less empowered than men in many ways, such as access to land and capital, employment opportunities and decision-making. While social change may eventually ease some of these constraints, we believe that in the meantime much can and should be done through agricultural research-for-development to improve women's livelihoods and well-being.

We will intensify our assessments of women's needs and opportunities through our Village Level Studies and through our Critical Focus Area on gender and equity (see Chapter VII), investigating such issues as the participation of women in decision-making on choices of crops and crop varieties, input and output marketing, and household food management.

While we strengthen our knowledge base we will continue to build on our experiences over four decades that have identified five strategic opportunity areas:

Women's home advantage: *Women often face duties such as child-rearing that restrict their activities mainly to the homestead area. This situation offers an opportunity because the land around the home is where soils are richest and the highest-value crops – such as groundnut, vegetables, tree seedling nurseries and seed banks – are cultivated. The homestead is also where income-generating enterprises such as vermiculture, compost production, and goat, pig and poultry raising are managed. We will intensify our studies on enhancing high-value homestead-based cropping and agro-enterprise.*

Strength in numbers: *When organized, women are able to gain access to resources and opportunities that are otherwise unavailable to them. We are helping women's groups in East Africa to gain access to the seed and skills that they need to grow and export high-value crops like pigeonpea; and in West Africa and Asia to rehabilitate degraded lands to grow high-value indigenous vegetables and to gain access to irrigation for highly profitable vegetable cultivation in 'market gardens'.*

Leading and learning: *Although women are expert farmers, men tend to be chosen for training and knowledge-sharing opportunities. To counteract this bias we are seeking and engaging women as leaders in our farmer-to-farmer knowledge-sharing and training activities in such areas as crop management, participatory variety selection, crop processing, marketing and agro-enterprise development.*

High skills = high value: *Women are often extraordinarily skilled in tasks requiring high concentration, patience, attention to detail and manual dexterity. But these opportunities must be close to home. We will build on successes that have engaged women in enhanced high-value skilled operations near the household such as tree grafting in West Africa, and tree nursery cultivation and bio-pesticide production in watersheds in Asia. Such opportunities can expand into village-scale agro-enterprises.*

Reducing drudgery: *Women carry out laborious, time-consuming household tasks, such as manually milling grain, shelling and cleaning pods and husks (and other arduous food processing tasks), and collecting and carrying firewood and water. We will build on successes and explore opportunities to devise appropriate labor-saving machines, drip irrigation to replace buckets, agroforestry for household firewood, biogas and biodiesel to replace firewood and fossil fuel, and other opportunities that ease women's burden.*

IV Systems Perspective

Why systems?

Organizing our work into Strategic Thrusts (Chapter VI) helps to clarify the research areas that we will emphasize. However, it also carries a risk of fragmenting the research agenda into disciplinary sectors. Too often in the past, agricultural research-for-development has focused on narrow interventions. Insufficient attention was paid to enabling factors that needed to be addressed simultaneously in order to achieve impact.

For example, Dr Norman Borlaug, who won the Nobel Peace Prize in 1970 for contributions to increasing the world's food supply, said, "Working in Africa has been the most frustrating experience of my professional career. The yield potential is there, but you can't eat potential. We need inputs, access to markets, infrastructure and credit if African agriculture is to experience a Green Revolution."[5] Borlaug saw that a larger system needed to be addressed if impact was to be achieved. ICRISAT has developed a similar approach over the course of nearly four decades of agricultural research-for-development in the dry tropics.

To ensure interdisciplinary integration across our Strategic Thrusts we will apply a **systems perspective** to agricultural research-for-development. Constraints and opportunities that in the past might have been left as 'someone else's issue' will be explicitly recognized and partnerships formed to ensure that all critical issues are attacked by the most appropriate partner(s). Where such obstacles are judged too difficult to overcome, we will refrain from investing in agricultural research-for-development that has a low probability of ultimate impact.

What are systems?

Systems are conceptual constructs of factors that interact to produce some outcome of interest. Interdisciplinary dialogue with our partners will identify and describe the systems that are most relevant to our Mission. Borlaug's observation above applies to many crop commodity value-chain systems in Africa. IMOD should be geared to increase the proportion of total value within the chain that is captured by the poor, eg, through cooperative land and farm operations management, collective marketing and related strategies. Where possible, it should also broaden and enhance market opportunities by developing more valuable uses of crop products for more market sectors.

Other types of systems besides value chains are equally relevant to our Mission. Both natural and agricultural ecosystems generate goods and services that are essential for longer-term human well-being. However, their value is often taken for granted and is difficult to assess in the short term or in monetary terms. For example, the poor often depend on biodiversity assets for food, medicines and energy (firewood), but this value is overlooked by society. Agro-ecosystem resilience is difficult to measure in simple terms but is vital for successful progression along the IMOD pathway.

Knowledge systems also generate value by empowering the poor (and institutions that assist them) to more effectively overcome a wide range of challenges and to capture knowledge-intensive market opportunities. Social and policy systems and informal

[5] **Ortiz R, Mowbray D, Dowswell C** and **Rajaram S**. 2007. Dedication: Norman E. Borlaug – the humanitarian plant scientist who changed the world. Plant Breeding Reviews 28: 1–37.

"The yield potential is there [in Africa], but you can't eat potential!"
– Dr Norman Borlaug, Nobel Laureate

Kenya: poverty and accessibility map

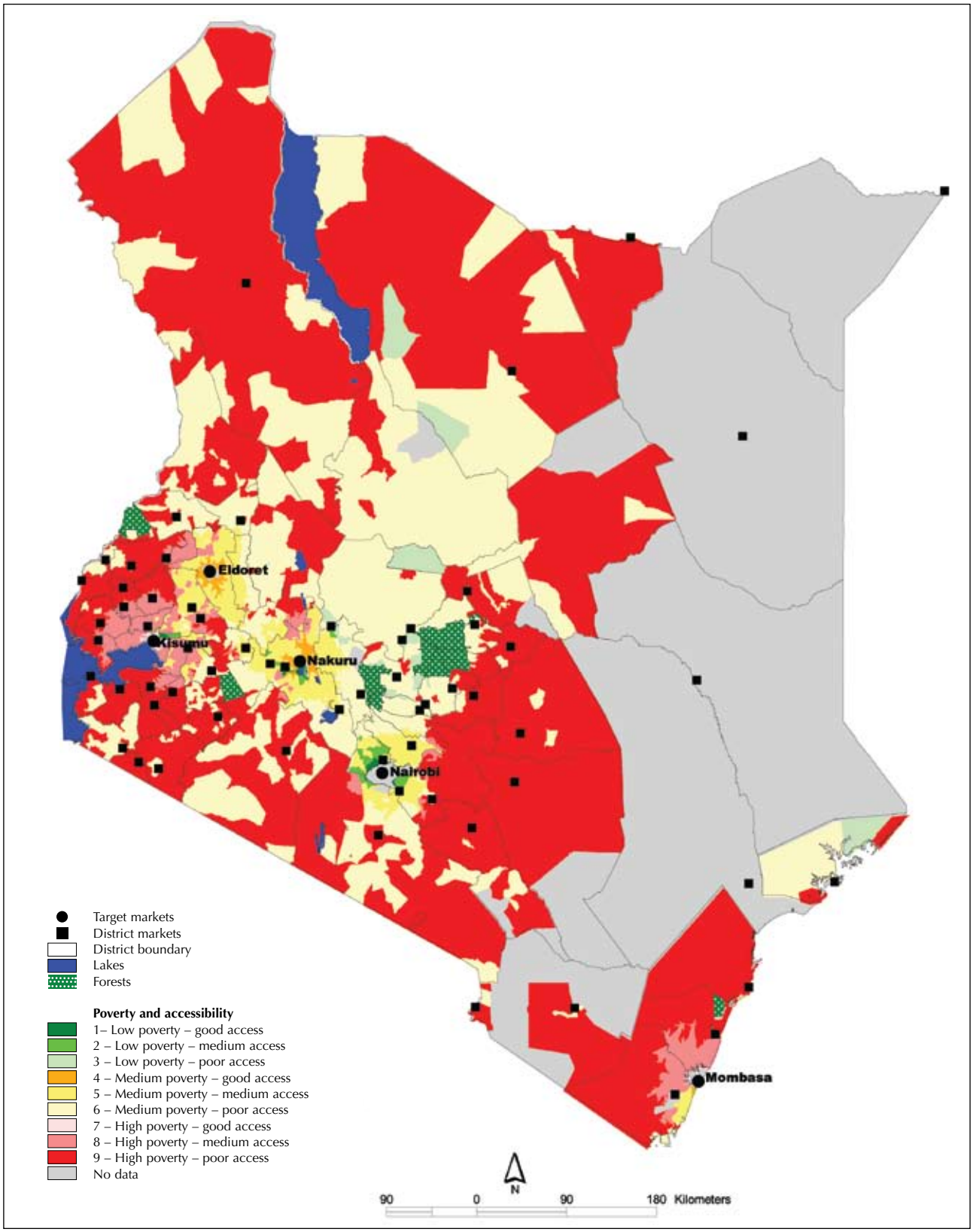


Figure 3: *Geospatial maps are powerful aids for visualizing the driving forces associated with poverty, hunger, malnutrition and environmental degradation in different geographic areas in the tropical drylands. However, insufficient map data are a widespread constraint to this approach in Africa. This map of Kenya illustrates the distribution of two IMOD-related parameters: poverty and market access. It indicates that areas with poor market access are widely associated with high poverty incidence (deep red); in contrast, areas with good access to markets rarely exhibit high poverty incidence (scarcity of light pink areas). Medium-access areas near Nairobi, Nakuru and Eldoret are less poor (have less medium-pink area) than medium-access areas near Kisumu (Lake Victoria region) and Mombasa (east coast). Such maps stimulate hypotheses for further investigation of locational differences, improving the targeting and effectiveness of research-for-development.*

Data types and sources
Poverty incidence: percent of population living on less than one US dollar per day, grouped into three classes: low poverty <25%; medium poverty 25-50%; high poverty >50%. Source: 1999 census by Kenya's Central Bureau of Statistics and ILRI collected at sub-location level (two levels below 'district' administrative level; there are around 6700 sub-locations in Kenya).

Market access calculated using Accessibility Analyst, an ESRI ArcView extension developed by CIAT, which estimates access based on a cost-distance analysis along transport networks including motorable roads, railway lines and footpaths (roads data layer from Kenya Public Works, 2006).

networks provide safety nets and define cultural values that condition farmer decision making. We will also address these aspects of IMOD systems because they significantly affect the livelihoods of the poor.

Applying the systems perspective

The first step in applying the systems perspective is to conduct a careful analysis of how the system works, allowing accurate diagnosis of problems and opportunities. This diagnosis identifies specific entry points (potential interventions) where change is needed to improve the functioning of the system.

To carry out this analysis, **we will assemble diverse interdisciplinary teams that include not only scientists from different disciplines, but also people** who understand different aspects of how the system works. Depending on the system being studied, team members will be drawn from such stakeholder groups as national agricultural research systems (NARS), NGOs, farmer organizations, government agencies and agri-businesses. Such diverse teamwork will avoid blind spots and counteract pre-existing assumptions with new insights and fresh perspectives.

Once potential entry points are identified, priorities among them will be set. The prioritization of entry points requires ex-ante (predictive) analysis of how they would influence our Mission goals (reduce poverty, hunger, malnutrition and environmental degradation). Our approach to impact assessment is discussed further in Chapters VII (see the Critical Focus Area *Monitoring, evaluation and impact assessment* on page 39) and IX.

If priority entry points require effort in areas that lie beyond our competence, we will address them through partnerships with appropriate institutions. Even within our areas of competence, partnerships will be vital, for example to provide additional expertise

in basic science from advanced institutions as well as from development agencies to translate science into impact on the ground. Thus, strong and effective partnerships will form a cornerstone of the systems perspective leading to impact. This is discussed further in Chapters VIII and IX.

Systems, people and poverty

Most experts today consider poverty to be more than just a lack of income. The Millennium Ecosystem Assessment advocated the improvement of 'human well-being' in drylands, defined as a composite of the basic materials for a good life, health, freedom and choice, good social relations and security. In a similar way, the United Nations Development Program's Human Development Index advocates unleashing constraints to human capabilities such as financial poverty, poor health, lack of education, insecurity and social disempowerment. The Millennium Development Goals address these same issues but add focus on issues of gender, children and environmental sustainability. Our own Mission, like that of the CGIAR, posits a relationship between poverty, hunger, malnutrition and environmental degradation.

Since our ultimate purpose is to benefit the dryland poor, this will also be the central objective in improving systems function. In order to achieve this, **we will increase the depth and texture of our understanding of dryland poverty during the Plan period.** We will intensify our long-term Village Level Studies that provide an important window into the human face of poverty and the factors that underpin it in the dryland tropics. Issues such as the nature of poverty, the geography of poverty, intra-household and inter-community differences in poverty (equity issues) and the dynamics of poverty escape will be clarified through research.

These efforts will be particularly strengthened by enhancing our geospatial science capabilities (see Critical Focus Area *Geospatial science methods* in Chapter VII). Partnerships with new initiatives that are attempting to obtain better data about the drylands of Africa will receive special focus, as advocated by Walker (2010). Geographic information systems and modeling will enable the identification, mapping and testing of hypothesized cause-effect relationships and correlated associations among data on a range of factors including land degradation, market access, household status, human mobility and other facets of poverty.

Strong and effective partnerships will form a cornerstone of our systems perspective

V Regional Elaboration of our Global Strategy

Regional emphases

One of the greatest strengths of the unifying framework of IMOD is its universality. In all regions of the globe, connections to markets are the most effective means for escaping poverty. Without access to markets, there is little that smallholder farm households can do within agriculture to change their economic and food-security conditions significantly.

Nevertheless, regions, locations within regions, households and individuals do differ in their positioning along the spectrum from subsistence towards market-oriented agriculture. They also differ in agro-ecological conditions, in the crops that they grow, in input supply and output market opportunities, in the roles of government versus the private sector, in the capacities of partners and in other important aspects. These aspects condition the approaches that we and our partners will employ in pursuing IMOD in particular settings. Here we briefly review some of the main distinguishing features in our three focus regions: West and Central Africa, Eastern and Southern Africa, and Asia.

Dryland West and Central Africa

West and Central Africa has the highest proportion of subsistence-oriented smallholder farm households among our three focus regions and the highest dependence on our focus cereal crops, sorghum and pearl millet. Of our grain legumes, only groundnut is a major crop. Cowpea, a crop studied by our sister center, the International Institute of Tropical Agriculture (IITA), is very important in these dry areas and we will partner with IITA to include this crop in our systems perspective. Rates of both poverty and population growth are highest in this region. Market connections are weaker than in the other two regions, although this is changing with urbanization.

The agro-ecological setting is typified by ancient, weathered soils, drifting sands from the Sahara and a remarkably steady climatic pattern stretching across a vast west-to-east belt. This pattern is characterized by a rainfall gradient that ranges from very dry in the northern Sahelian ecozone to the wetter Guinea savanna ecozone that lies further south. This gradient renders the northern areas most suitable for livestock (cattle) grazing, while crops are favored in the south. The two systems intermingle in the middle zone. Cattle are moved seasonally to the south in order to access crop stubble for grazing during the dry season, and to reach market outlets in gateway cities that connect to the more heavily populated humid zone. Another remarkable feature of this region is the traditional integration of crops with indigenous trees to protect soils and increase their fertility as well as to provide animal fodder and high-value human foods, medicines and specialty products.

Considering these features, we will place a relatively heavier emphasis on helping subsistence farmers to improve their natural resource base, achieve food security, improve their access to inexpensive inputs (especially fertilizer and seed) and form initial market connections in this region. Sorghum, pearl millet and groundnut will receive crop improvement emphasis. Crop-tree-livestock integration will also be emphasized in partnership with sister centers AVRDC, ICRAF and ILRI. Local traditions of using trees and diverse crops such as sesame, sorrel and indigenous vegetables will be built upon to help the poor diversify into high-value, market-oriented, nutritious fruit and vegetable cultivation and marketing. Innovations in small-scale drip irrigation, tapping vast groundwater and riverine resources that can transform

dryland agriculture if used sustainably, will also be explored.

Dryland Eastern and Southern Africa

This region is agro-ecologically more complex than the other regions that we focus on because of a wider range of geological, soil morphological, altitude, latitude and climatic attributes. Maize is the predominant grain in human diets, and livestock is even more important to rural incomes than in West and Central Africa. Pearl millet is relatively unimportant in this region but sorghum, pigeonpea, chickpea and groundnut are all important crops. Because of the pre-eminence of maize as a dietary cereal, our crops do not collectively play as important a role in dryland incomes as in West and Central Africa. Dryland smallholder farmers are particularly disadvantaged by policies favoring maize and in some areas by the importation of rice.

Climate change is considered by some to already be aggravating droughts in the southern part of this region. Access to soil nutrient-enriching inputs is severely constrained for the poor, largely because of governance and infrastructural shortcomings. The complex topography presents an opportunity for improving watershed management, leveraging our learning from Asia to Africa. The threat of climate change on food security will continue to receive significant research attention.

Export opportunities are stronger in this region than in West and Central Africa because of close historical connections and proximity to large markets in Arabia and South Asia, particularly for our legumes, which are exported for consumption to those areas and worldwide. This requires addressing the disease and insect problems and seed supply issues that plague these crops. We will continue to enable poor smallholders and especially women to take increasing advantage of the grain legume cash-earning opportunity, including emphasis on mycotoxin control and grain quality traits to meet export standards, and to capitalize on the benefits of maize-legume rotations in collaboration with sister institute, the International Maize and Wheat Improvement Center (CIMMYT). Hybrid sorghum could also find a niche paralleling the region's success with hybrid maize. Finger millet (unrelated to our focus crop pearl millet) also has an important niche.

Because of agro-ecosystem diversity and climatic variability, we will continue to breed for diverse adaptive characteristics in crops in this region. Raising livestock causes perennial shortages of fodder that will be addressed from a systems perspective. Small household livestock, such as goats, that especially benefit women will receive particular attention.

Dryland Asia

Dryland Asia is the most market-connected of our three regions, although with its very high population relative to arable land resources, its drylands continue to struggle under the weight of poverty. Dryland Asia is home to twice as many absolute poor as dryland sub-Saharan Africa, although the proportion of poor is less and is falling in Asia (see Chapter II) in concert with vigorous economic growth occurring in the non-agricultural sector. Social assistance programs are stronger than in Africa, including safety nets, educational opportunities, fertilizer and water subsidies and other important agricultural supports. Paradoxically, given the greater wealth of Asia and stronger government social programs, the rate of childhood malnutrition is higher than in dryland Africa,

tragically threatening this region's future potential (see Chapter II).

From an agro-ecological perspective the Asian drylands are relatively better endowed with productive soils and water resources than most of West and Central Africa, and are comparable with Eastern and Southern Africa. Irrigation is far more developed than in sub-Saharan Africa, available over approximately one quarter of the dryland Asian area, although further expansion appears unlikely and contraction of supplies cannot be ruled out as burgeoning cities gain increasing political clout. Dryland Asia is also increasingly concerned about the potential and still uncertain impacts of climate change on its water supplies. We will continue to help poor dryland Asian farmers to collectively improve the management of their water resources, and use them to produce high-value foods that earn them a share of the growing wealth of the regions' booming urban centers.

All five of our focus crops are grown in dryland Asia, although their collective value share in dryland India (where 90% of Asia's tropical dryland poor live) has fallen to 20% of smallholder income because of the increasing cultivation of higher-income crops such as oilseeds (see Chapter II). Livestock for dairy products and draft power are very important to the poor, and sorghum straw in particular is an important feedstock, being the only cereal that is grown well into the dry season when other sources are exhausted. With urbanization, fossil fuel shortages will increase in the future, presenting an intriguing opportunity to increase dryland smallholder household incomes through the cultivation of biofuel crops such as sweet sorghum. Capitalizing on strong and growing market demand and vibrant economies, and working closely with partners such as AVRDC, the Indian Council of Agricultural Research and ILRI, we will help dryland Asia's poor to diversify into higher-value crops and crop products, and to develop and harness leading-edge agricultural innovations through public–private research partnerships and agri-enterprise incubation.

ICRISAT's Global Presence

Our global headquarters were established near Hyderabad, India, in 1972. Over the past decade our presence in Africa has steadily strengthened through increased investments in staff, facilities and partnerships. Our scientists are based at three locations in West and Central Africa (Niamey, Niger; Bamako, Mali; and Kano, Nigeria) and in three locations in Eastern and Southern Africa (Nairobi, Kenya; Lilongwe, Malawi; and Bulawayo, Zimbabwe).

Our Directors for these two regions are presently based in Niamey and Nairobi. Collectively, this extensive presence forms the world's leading international agricultural research-for-development capacity dedicated to the tropical drylands. We will continue to increase the number of scientists and partnerships in Africa as well as in Asia during 2011–2020.

VI Strategic Thrusts

We will contribute to IMOD through four **Strategic Thrusts** (STs), executed through partnerships that maximize complementation and synergy.

Strategic Thrust 1
Resilient Dryland Systems: Reducing vulnerability to drought and climate change while increasing crop diversity and value

Strategic Thrust 2
Markets, Institutions and Policies: Harnessing development pathways for inclusive prosperity

Strategic Thrust 3
Grain Legumes: Raising and securing productivity for health, income and sustainability

Strategic Thrust 4
Dryland Cereals: Increasing productivity to help end hunger

Collectively, these STs are designed to help the poor navigate the pathway out of poverty by establishing a foundation of food and livelihood security (ST1), giving them confidence to venture into remunerative markets (ST2) by leveraging our historical strength in high-yielding commodity performance (ST3 and ST4) as an initial income-earning step that paves the way towards even more diverse, higher-value crops and crop products.

Strategic Thrust 1 – Resilient Dryland Systems: *Reducing vulnerability to drought and climate change while increasing diversity and value*

The dryland poor are the people most vulnerable to climatic variability and land degradation. To emerge from poverty and insecurity, they must increase the resilience and productivity of their land and livelihoods while reducing their vulnerability to risks and adding value through more diverse crops. ST1 will help create a foundation of security and resilience for the poor, and open new crop income-earning opportunities that engage them in IMOD.

ST1 will help smallholder dryland farm households to prepare for, adapt to, cope with and recover from climatic variability. Vulnerability assessment techniques will be improved using advanced geospatial and modeling methods. Risk-reducing policies, safety nets (eg, food reserves and insurance), early warning systems, crop and landscape management strategies, and resilience and recovery strategies will be investigated.

Many have lamented the lack of a 'Green Revolution' in Africa. Although high-yielding varieties have long had the potential to erase food production deficits, Dr. Norman Borlaug memorably exclaimed that the hungry *"can't eat potential!"* In ST1, challenges to improving water and nutrient management, including both on-farm and purchased sources will be addressed so that higher yields will actually be achieved on the farms of the poor.

Crop diversification will both contribute to risk management and add new income streams. Crop–tree–livestock synergies will be devised to increase incomes while enriching and buffering water and nutrient supplies, protecting soils and moderating microclimates. Socio-economic research will develop policy advice that supports the participation of disadvantaged groups in these innovations and encourages the sustainable use of ecosystems.

ST1 will build on our and our partners' past and current experiences on topics such as:

- Intensive Village Level Studies that develop understanding of how smallholder farm households deal with drought and insecurity;
- The application of crop simulation models to examine the consequences of different crop management actions for coping with drought and adapting to climate change in drylands, leading to our 'Hypothesis of Hope' that identifies high-impact adaptive strategies;
- Research on community management of shared natural resources in watersheds and rangelands in Asia and Africa that maximizes the sustainability of resource use;
- Tree–crop–livestock synergies that provide multiple benefits such as better use of straw residues while protecting soils and improving their fertility, and raising incomes through diverse higher-value fruits, vegetables and specialty crops;
- Microdosing with fertilizer to boost yields cost effectively;
- High-value tree crops and drip-irrigated, market-oriented vegetable production by women's groups; and
- Rehabilitation of degraded land through high-value cropping and market linkages (also by women's groups).

With partners, ST1 will focus on s***ix research areas*** that will produce a number of significant expected ***outputs***, which will lead to important ***outcomes*** and ***impacts***.

Research areas	Expected outputs	Intended outcomes and impacts
■ Assessing drought and potential climate change impacts on the dryland poor ■ Developing integrated, crop–livestock–tree systems for sustainable natural resource use and risk reduction ■ Identifying and developing diverse, high-value dryland crop systems ■ Identifying and implementing integrated crop, soil, water, nutrient, pest and disease management strategies ■ Implementing community-based natural resource management of watersheds/ systems at a larger scale ■ Enhancing knowledge sharing and communication of climate change impacts and integrated, high-value dryland system options to increase impacts	■ Climate sensitivity analyses of dryland agricultural systems and livelihoods and analysis of crucial vulnerabilities ■ Profitable systems for smallholder farm households that integrate crops, trees, livestock for multiple benefits ■ Improved soil management options to reduce erosion and enhance water and nutrient supplies under dryland farming conditions ■ Water harvesting and sustainable smallholder irrigation strategies to increase farm water supplies and water productivity ■ Strategies to improve fertilizer access and nutrient use efficiency for smallholder dryland farm households ■ Fruit trees, oilseeds, vegetables (indigenous as well as exotic), and other cash crops identified and systems adapted for dryland smallholder farm households ■ Models for community action to use natural and human/social resources more effectively and sustainably ■ Information and communication technologies and strategies to improve farmer access to key climate and market information and advice	■ Dryland smallholder farm households and communities less vulnerable and more resilient against drought and climate change ■ Increased and more reliable crop production in the targeted regions ■ Increased smallholder farm incomes through crop diversification ■ Improved human nutrition due to more diverse diets ■ Increased nutrient- and water-use efficiency and productivity on smallholder farms ■ More sustainable and resilient community management of natural resources ■ Farmers and communities using agricultural information and communication technologies to reduce farming risks and enhance productivity

Partners include regional organizations the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA), the West and Central African Council for Agricultural Research and Development (CORAF), the Asia-Pacific Association of Agricultural Research Institutions (APAARI); NARS in countries such as India, Kenya, Mali, Niger; NGOs in many countries, eg, CARE, ACTIONAID, OXFAM, WorldVision and local NGOs; advanced research institutes such as Kansas State University, the UK's Natural Resources Institute (NRI), the University of Hawaii, Wageningen University; businesses and foundations such as Coca Cola SAI and Unilever in India, Syngenta in Kenya; and CGIAR and other Centers including AVRDC, the International Center for Agricultural Research in the Dry Areas (ICARDA), IITA, ILRI, ICRAF and the International Water Management Institute (IWMI).

Strategic Thrust 2 – Markets, Institutions and Policies: *Harnessing development pathways for inclusive prosperity*

Increasing farm production alone will not end poverty. Farmers must have access to markets in which to sell their produce if they are to enjoy prosperity. ST2 will focus on interventions that enable the poor to harness markets to generate higher productivity and income. ST2 will address not only private-sector but also public-sector dynamics that influence markets.

A particular objective will be to ensure that market-oriented development is inclusive, ie, to capture as much of the value in the chain as possible for the poorest households, and for women in particular. This is vital in order to eliminate the extreme poverty that lies at the root of hunger. Since, more than anyone else, the poor depend on staple crops for their survival, using staple crops as a springboard into market-oriented development is integral to ST2's inclusiveness strategy.

'Value chain' systems are particularly relevant to commodities, eg, crops, livestock and vegetables. Through interdisciplinary teamwork, a value-chain perspective will broaden and deepen our historical crop production research focus to also address obstacles such as insufficient access to productivity-boosting inputs, and the need for more robust output channels for crop products. Interdisciplinary research will investigate the interactions between social, economic, knowledge and technological factors that are important in value chains.

ST2 will elucidate the most important drivers for IMOD, and ways to accelerate them. Issues such as competitive and comparative advantages of smallholder farming households, innovation, infrastructure, social organization, and quality and reliability of production will be investigated. Timely knowledge flows about market demand and outlook, prices and technologies, new crop products, reliable input supplies, credit, risk and vulnerability management strategies, and the translation of these factors into actual use through the public and private sectors (policies, value networks and models for efficient dissemination of improved technologies through public and private sectors) are opportunities that will be explored.

ST2 will build on a number of established activity areas related to market, institution and policy research at ICRISAT, including:

- Village Level Studies of dryland rural economies and understanding of the causes and consequences of poverty, and poverty escape pathways;
- Situation and outlook analyses of ICRISAT mandate crops, and studies on the future of the semi-arid tropics;
- Market baseline studies and innovations linking smallholders to markets;
- Institutional and financial management strategies such as warrantage (inventory credit) to maximize value capture for the poor from commodity production;
- Analyses of safety net options such as rainfall insurance and the impacts of policy choices such as public employment schemes and water subsidies;
- Adoption studies and impact assessments of dryland technologies; and
- Analyses of smallholder farm household adaptation to market changes such as new technology options (eg, improved pigeonpea and chickpea for export, and sorghum for poultry feed and industrial raw material).

With partners, ST2 will focus on eight research areas that will produce a number of significant expected ***outputs***, which will lead to important ***outcomes*** and ***impacts.***

Research areas	Expected outputs	Intended outcomes and impacts
■ Enhancing policies and technology dissemination to stimulate inclusive growth for dryland smallholder farm households ■ Enhancing access of the poor to input supply and output markets by identifying input and marketing channels, value chains and information flows ■ Improving assistance and safety-net programs for the most vulnerable poor ■ Improving research delivery models to hasten participation in inclusive market-oriented agriculture and technology uptake ■ Analyzing and leveraging value chains and enhancing smallholder access to input supply and outputs marketing channels ■ Identifying market opportunities for both staple and diversified dryland crops including diversification of their uses ■ Tracking changes and responses in dryland rural household and village economies in sub-Saharan Africa and Asia via participatory Village Level Studies ■ Supporting decision making in dryland agriculture through strategic foresight and scenario analyses	■ Scientific information, future projections, strategies, databases, methodologies, protocols and platforms to influence policies and to enhance the use of innovations ■ Strategies and options for improving safety nets to help the poor to manage risks ■ Market strategies to overcome constraints in accessing and affording inputs and linking to markets to reduce transaction costs along the value chain ■ Research delivery models, institutional strategies and options that enhance participation of the poor in value chains and value capture and in safety nets ■ Network architecture and institutions mapped for interventions and to strengthen assets of the rural poor ■ Well documented high-quality databases and analysis of agricultural and social change in the drylands ■ Plausible future scenarios in dryland agriculture	■ More effective sharing of, use of and impact from improved technologies, knowledge and policy advice ■ Enhanced participation by the poor in markets due to better knowledge ■ Decision makers change research priorities in ways that favor the dryland poor ■ More effective social protection measures to reduce the risks to the poor of investing in improved productivity ■ Improved access by the poor to more affordable inputs ■ Improved community cooperation, increasing incomes for the poor by capturing a higher share of the value chain ■ Village Level Studies and other results used by decision makers and scientists worldwide to generate new knowledge on growth and development ■ New and enhanced markets for our focus staple crops, diversified crops and value-added products ■ Advanced research institutions using the Village Level Study data to generate new knowledge on growth and development ■ Enhanced participation by the poor in markets due to better knowledge

Partners include regional organizations ASARECA and APAARI; NARS in Bangladesh, China, Ethiopia, India, Kenya, Malawi, Niger, Nigeria, Mali, Sri Lanka, Tanzania, Thailand, Vietnam and Zimbabwe; NGOs such as SocioConsult–Bangladesh; advanced research institutes such as Brown University, Cambridge University, Cornell University, the Indian Institute of Technology (IIT)–Bombay, Oxford University, the University of Arizona, the University of Florida and Yale University; and CGIAR Centers including the International Center for Tropical Agriculture (CIAT), IITA, the International Rice Research Institute (IRRI), the International Food Policy Research Institute (IFPRI), ILRI and IWMI.

Strategic Thrust 3 – Grain Legumes:

Raising and securing productivity for health, income and sustainability

Grain legumes such as chickpea, pigeonpea and groundnut are important complements to cereals in dryland farming systems and in human and livestock diets. By fixing atmospheric nitrogen these crops improve soil fertility, a major constraint for the poor. Women often cultivate crops like groundnut and pigeonpea for income (including high-value exports) and to improve the nutritional value of their family's diet (these crops are sometimes referred to as 'poor people's meat'). Leaves and stems (haulms) and pod walls are also valuable as livestock feed.

However, legumes are more susceptible to pests and diseases than cereals. This increases the risk for smallholder farmers and constrains the adoption of improved cultivars. We have scored important successes in this area and will continue to battle these biotic constraints in an integrated way, including breeding for resistance as well as the judicious use of biological, crop-management and chemical-control methods.

Additional breeding targets will include grain quality and nutritional traits, improved food safety, improved nitrogen fixation, hybrids, drought tolerance and avoidance, and adaptation to diverse dryland agro-ecosystems and to differing rotations with cereal crops. Breeding will be enhanced with modern genomic and molecular tools, precise phenotyping and crop simulation modeling.

Another major constraint of legumes that will be tackled in ST3 is the availability of affordable improved seed. Groundnut and chickpea produce fewer seeds per plant than cereals do, slowing the multiplication process required to build up large quantities of seed. In storage, legume seeds also lose their viability in a relatively short time and are attacked by pests. Overcoming seed system constraints will increase research impacts significantly.

This Thrust builds on our longstanding legume improvement research that has achieved major milestones in many areas including:

- The world's largest collection of chickpea, pigeonpea and groundnut genetic resources;
- *Fusarium* wilt resistance in pigeonpea and chickpea, which has had major impact in Asia and Africa, and rosette virus resistance in groundnut, which has benefited Africa;
- The creation of the world's first commercial hybrid grain legume crop (pigeonpea);
- Pre-breeding, wide crossing, genomic and genetic, and transformation research to transfer new disease- and insect-resistance genes into groundnut, chickpea, pigeonpea;
- Breeding for drought-tolerance and drought-avoidance;
- Short-duration chickpea varieties that have enabled an expansion of the crop into tropical latitudes in Asia and Africa;
- High-value pigeonpea and chickpea types suitable for export from Eastern and Southern Africa to India and other countries;
- Aflatoxin control research in groundnut;
- Helping the National Smallholder Farmers' Association of Malawi (NASFAM) achieve quality standards to export groundnut to the European Union; and
- Seed systems and policy research on grain legumes.

With **partners**, ST3 will focus on ten research areas that will produce a number of significant expected ***outputs***, which will lead to important ***outcomes*** and ***impacts***.

Research areas	Expected outputs	Intended outcomes and impacts
■ Collecting, conserving, characterizing and distributing chickpea, groundnut and pigeonpea genetic resources and information ■ Enhancing genomic and genetic tools and information systems for chickpea, groundnut and pigeonpea ■ Incorporating novel, enhanced or high value traits through the use of biotechnology approaches ■ Developing and disseminating pest- and disease-resistant chickpea, groundnut and pigeonpea germplasm/ breeding lines/cultivars and integrated pest/disease management strategies ■ Improving productivity and adaptation of value-added grain legumes using integrated conventional and molecular breeding methods ■ Improving food safety and nutritional quality of grain legumes (aflatoxin, beta-carotene, iron, zinc, oil) ■ Improving chickpea, groundnut and pigeonpea seed systems for dryland smallholder farmers ■ Promoting labor-saving, drudgery-reducing mechanization options, especially oriented towards women's needs ■ Increasing production of grain legumes through policy research to help governments adopt effective policy instruments for grain legumes	■ Global genetic diversity for chickpea, groundnut and pigeonpea conserved, characterized and shared ■ Improved genomic/genetic tools and understanding for breeding chickpea, groundnut and pigeonpea ■ Valuable new alleles/traits and genetic diversity identified ■ Improved genetic resistance to diseases and pests ■ Integrated pest and disease management methods ■ Adapted, stress-tolerant, more productive germplasm/ breeding lines/cultivars, including enhanced nitrogen fixation ■ Strategies to monitor and reduce aflatoxin contamination in groundnut ■ Germplasm/breeding lines/ cultivars with high-value food characteristics favored by rural, urban and export markets ■ More efficient systems for multiplying and disseminating high-quality seed to dryland smallholder farmers ■ More efficient postharvest processing methods, reducing drudgery for women ■ Policy options for increased and dependable supplies of grain legumes	■ More effective use of genetic diversity in legume research and breeding ■ More efficient and effective breeding methods for grain legumes ■ Higher and more stable yields though better control of diseases and pests that plague grain legume production ■ Higher and more stable grain legume yields and larger area under cultivation through the adoption of improved, widely adapted varieties and hybrids ■ Improved nutrition of poor people who consume grain legumes ■ Reduced health risk from aflatoxin consumption and increased access to international markets as health safety standards are met ■ Smallholder farm households selling higher-value grain legumes into markets ■ Seed agencies and enterprises more effectively reaching smallholder farmers with improved seeds ■ Postharvest inefficiencies and drudgery reduced, particularly for women, through mechanization ■ Improved policies increasing legume production

Partners include NARS in China, Ethiopia, India, Kenya, Malawi, Mali, Niger, Nigeria and Tanzania; NGOs including CARE and NASFAM; advanced research institutes such as the University of California Davis, the University of Sydney and the University of Western Australia; the Gates Foundation; more than 30 private-sector seed companies in India, Kenya, Malawi, Mexico, Tanzania and USA; and CGIAR and other Centers including AVRDC, Bioversity International, CIAT, ICARDA, IITA and ILRI.

Strategic Thrust 4 – Dryland Cereals:
Increasing productivity to help end hunger

Staple food grains are the first priority of the poor because their very lives depend on these foodstuffs. Yet, most dryland smallholder farm households do not grow enough grain to feed themselves for the entire year, and shortfalls become even worse when drought hits, resulting in severe hunger and malnutrition, especially affecting women and children. ST4 will contribute improved germplasm, breeding lines and cultivars that raise land productivity (yield per hectare) and yield stability, which in combination with the outputs of ST1 and ST2 will enable staple food crops to become a springboard into IMOD. We will also address cereals such as finger and foxtail millet where they are important from a systems perspective, but such crops will not become major breeding targets.

Our longstanding investments in sorghum and pearl millet genetic resources, along with research to improve these crops, will continue to help farmers capitalize on within-crop diversity to reduce risk. This work will also continue to enhance yield potential, resistance to diseases and pests, and tolerance of environmental stresses, such as drought. Progress will accelerate as genomic and bioinformatics tools improve. Applications likely to play a major role include high-throughput, low-cost genome sequencing and whole-genome scanning, and modeling better match genetic traits with target environments. Hybrid sorghum and pearl millet have achieved major impact in Asia but are only beginning to take hold in Africa. As hybrid seed of these crops costs just a fraction of the price of hybrid maize, which is already well established in Africa, they offer great potential.

The superior stress-resistance traits of sorghum and pearl millet will be explored both to further enhance their expression, and to build a knowledge base leading to eventual use of the relevant genes in wide transfers to improve other crops targeted by the CGIAR. We will continue biofortification breeding to increase sorghum's and pearl millet's iron and zinc content to counter malnutrition. Sorghum grain mold research will continue with the aim of improving food safety. Breeding for value-added alternative uses, particularly for livestock and poultry feed, fodder quality and quantity, and innovative biofuel applications will also continue. Seed systems research will ensure the effective delivery of research outputs to our intended beneficiaries.

ST4 will build on longstanding work on sorghum and pearl millet within a systems perspective in the following areas:

- The world's largest genetic resources collection of sorghum and pearl millet;
- Ongoing genomic and genetic research using modern molecular methods;
- Research to help farmers benefit from within-crop diversity;
- More effective and efficient transfer of new traits from the genetic resources collection into new varieties;
- Sorghum and pearl millet breeding (including hybrids) for yield potential, stress resistances and tolerances (eg, drought, disease, insect and problem soils), and other traits;
- Food–fodder–fuel sorghum types to capture income opportunities in bioethanol and livestock markets in India and Africa;
- Farmer-participatory approaches to variety selection (including hybrids) and seed systems;
- Biofortification breeding; and
- Policy research on sorghum and pearl millet commodity and seed issues.

With partners, ST4 will focus on nine research areas that will produce a number of significant expected ***outputs***, which will lead to important ***outcomes*** and ***impacts***.

Research areas	Expected outputs	Intended outcomes and impacts
■ Collecting, conserving, characterizing and distributing global sorghum and millet genetic resources and information ■ Applying enhanced genomic, genetic and bioinformatics tools in sorghum and pearl millet research ■ Incorporating novel/enhanced traits using biotechnology ■ Improving the productivity and stability of sorghum and pearl millet by integrating conventional with molecular breeding methods ■ Biofortifying pearl millet and sorghum for increased iron and zinc content ■ Improving postharvest management, value addition and alternative uses of dryland cereals ■ Improving cereal productivity through mechanization ■ Enhancing seed systems for dryland cereals ■ Enabling increased production through policy research on sorghum and pearl millet commodities and seed systems	■ Well organized and documented genetic resources safely conserved, well characterized and shared with researchers globally; improved use of diversity endowments in situ ■ Increased genomic knowledge and novel alleles/genes transferred into breeding pools ■ Improved germplasm/breeding lines/cultivars with high yield potential (of both food and fodder) and resistance/tolerance to major stresses ■ Germplasm/breeding lines/cultivars with nutritionally enhanced levels of iron and zinc in the grain ■ Higher-value alternative uses of staple cereals ■ Improved seed systems for sorghum and pearl millet, more easily accessed by smallholder farmers ■ Methods/tools to reduce postharvest losses and improve productivity through mechanization ■ Evidence-based advice to policy makers to help countries improve seed systems	■ Enhanced use of the full genetic and genomic resources of sorghum and pearl millet ■ Broadened genetic base of sorghum and pearl millet with valuable new traits used by breeders worldwide ■ Increased and stabilized food and fodder yields of sorghum and pearl millet through improved seed systems leading to widespread adoption of improved varieties and hybrids ■ Improved nutrition of dryland poor (especially women and children) ■ Diversified income opportunities from staple cereals (eg, specialty foods, industrial raw materials, feeds, fodder and biofuels) ■ Reduced risk of consuming mold-infected grain, access to new markets ■ Improved policies encourage higher and more stable production and availability of these commodities

Partners include NARS in Burkina Faso, China, Ethiopia, India, Kenya, Mali, Niger, Nigeria, Sudan, Tanzania, Uganda and Zimbabwe; NGOs including CARE and the Helen Keller Institute; advanced research institutes in Australia, Europe, India and USA; the McKnight and Gates Foundations; more than 30 private-sector seed companies in India, Kenya, Malawi, Mexico, Tanzania and USA; and CGIAR centers including Bioversity, CIMMYT, ICARDA, IFPRI, ILRI and IRRI.

Genetic Resources Conservation

ICRISAT plays a vital role in the collection, conservation, characterization and sharing of germplasm of dryland crops and their wild relative species. The germplasm is conserved in-trust for humanity in perpetuity, and is available for research and training following the conditions of the Standard Material Transfer Agreement of the International Treaty of Plant Genetic Resources for Food and Agriculture. The collection is a treasure trove of new traits for crop improvement. It consists of more than 119,000 accessions from 144 countries of the five crops that are mandated for the Institute: sorghum, pearl millet, chickpea, pigeonpea and groundnut. In addition, accessions (samples of crop varieties or wild relatives collected at a specific location and time) of wild relatives of these mandate crops and of six small millet crops (finger millet, foxtail millet, barnyard millet, kodo millet, little millet and proso millet) are conserved. For security the collection is being duplicated in the Svalbard Global Seed Vault in Norway.

Over its history our genebank has distributed more than 1.3 million samples to scientists in 144 countries, and 66 accessions have been directly released by 44 countries for cultivation by farmers. Germplasm collections lost because of various calamities have been restored to countries in Africa (Botswana, Sudan, Cameroon, Ethiopia, Kenya, Nigeria and Somalia) and Asia (India and Sri Lanka). To help identify useful traits and germplasm, we have developed representative core (10% of the entire collection) and mini-core (1%) sets representing the entire diversity of the collection for our five mandate crops as well as for finger millet and foxtail millet. Most of these core and mini-core accessions have been characterized molecularly. The management and sharing of this huge volume of information is also a major activity of our genebank.

Strategic emphasis to 2020 will be placed on expanding the collection of wild relatives of mandate crops; filling gaps by collecting landrace varieties (farmer-developed varieties of crops that are adapted to local environmental conditions) from areas of high diversity; and pre-breeding analysis to access diverse traits for use in research, including efforts to obtain genome sequences for a large portion of the collection.

VII Critical Focus Areas

Cutting across the Strategic Thrusts are a number of capacities that we will strengthen during the Plan period. We have termed these Critical Focus Areas and consider them all to be of equal priority. Not all of this strengthening will occur in house. Since many of these involve rapidly advancing, modern research methods that lie within the comparative advantage of universities and other research institutions, much of this strengthening will occur through enhanced partnerships. ICRISAT's ability to mobilize global collaborations will be key to success in these areas.

The Critical Focus Areas are:

Monitoring, evaluation and impact assessment
As described in Chapter IX, we will incorporate rigorous, credible monitoring, evaluation and impact assessment into all activities during the Plan period so that we can better account for the impacts of our investments. We will use projected benefits as a basis for more effectively setting priorities and for mid-course adjustment of our activities. To further improve priority setting, our capacity for ex-ante impact assessment will receive particular attention.

Gender and equity analysis
While much has been achieved in this area already (see the *Strategic Opportunities for Women* box on page 17), our emphasis on helping the poorest members of dryland society requires a deeper understanding of gender and equity issues than is available today. Unfortunately, the poorest tend to also be the most forgotten members of society and, as a result, information on their condition, needs and priorities is scant. Therefore we will intensify our efforts to collect and generate data that are detailed and disaggregated by gender

and equity criteria. We will use this increased understanding to identify additional strategic opportunities for improving the well-being of women and other disadvantaged members of smallholder farm households.

Geospatial science methods
Geospatial knowledge is vital in support of inclusive, market-oriented development. It adds great insight into issues of market access, natural resource endowments, agro-ecosystems function, crop adaptation, cultural and economic conditions, and many other development dynamics. Today, however, only approximate, low-resolution information is available about many of these dynamics. We will strengthen our geospatial analysis capacities to gain a deeper understanding of dryland dynamics and trends.

Modeling and scenario analysis
Climate change, booming populations, urbanization, landscape change, dwindling and more costly natural resources and inputs, and other massive shifts are under way with major implications for dryland welfare. Decision makers must choose between alternative development paths that have huge implications for the future. We will strengthen our capacity to model future scenarios to help decision makers understand the likely consequences of these choices. Modeling will also be used to determine target traits for breeding and to enhance genetic resources activities.

Modern breeding platforms integrating genetic, genomic and phenotypic information
Advances in genetics and genomics have fostered a revolution in genome-level understanding of crops. This in turn has been accelerated by advances in digital technology applied through biostatistics and bioinformatics. Together, these hold exciting potential to accelerate plant breeding progress. Past techniques limited mainly to selection among phenotypes (visible traits in the field) and classical genetics will be strengthened by building a seamless connection from gene to genome to phenotype utilizing high-throughput, genomic map-based and marker-assisted selection and related techniques, through integrated breeding platforms supported by modern data management systems.

Information and communication technology
ICT underpins many of the critical focus areas described here. Advances in ICT have a fundamental, crosscutting impact on research-for-development. We will strengthen our capacity to stay abreast of and use appropriate ICTs as they emerge worldwide. For example, we will build on our success with Agropedia (an online repository for information on agriculture in India) to construct knowledge tools related to the IMOD and systems perspectives, through alliances with ICT developer communities in both the public and private sectors.

Knowledge sharing and innovation
Distance and inadequate communications infrastructure have long been major hindrances to carrying out our Mission. New ICTs hold the potential to peel away this constraint during the Plan period. We will take advantage of this opportunity by using ICTs to enhance the way that information, skills and ideas are shared among stakeholders worldwide. Such knowledge sharing will be pivotal in strengthening capacities, stimulating innovation and widening the scope of impact from research. This will be fostered across an array of channels and platforms (eg, the internet,

cell phones, online advisory services and communities of practice for knowledge sharing).

Fostering agro-enterprise

Over the past decade we have explored models for engaging the private sector to accelerate the adoption and impact of research innovations. We are investigating agro-enterprise incubation, forming consortia with seed companies, training women and youth in high-value village-based enterprises, and forming research alliances with government agencies. These initiatives, which together aim to scale up research to critical mass for impact, have been highly promising and so will be intensified during the Plan period. All associated outcomes will be analyzed for lessons learned and ways to leverage successes globally while tailoring them to regional conditions, customs and needs.

Our Approach to Genetic Engineering

Our strategy for genetic modification of our mandate crops is guided by CGIAR policy. It emphasizes the biosafety of all materials that reach farmers, and partnerships at national and international levels with government agencies, advanced research institutions, the private sector and others. To address the enormous challenges facing dryland agriculture, we will use the most effective scientific tools available for each challenge. This includes the use of genetic engineering where genetic diversity within a species is lacking for overcoming a particular constraint or capitalizing on an important opportunity that will benefit the poor. All such materials will be developed in close partnership with one or more national agencies based on a clear expressed national need, and where biosafety legislation exists to permit the development and testing of such materials. We follow all guidelines and policies within the country where such materials are being developed and tested, and will not transfer any material before we have evaluated it for effectiveness and safety. We take these approaches to ensure that these materials are developed in a responsible manner, are safe, and meet the needs of those whom we serve.

VIII Partnerships and Capacity Strengthening

Partnerships with purpose

ICRISAT has a long history of strong partnerships. In 2010 we were involved in 190 active partnerships and distributed 20% of our budget to partners to execute joint research-for-development activities.

Effective and complementary partnerships, however, are much more than a numbers game. We believe that the most effective partnerships and capacity strengthening efforts are those that target a clear research-for-development purpose. The systems perspective and impact pathways described earlier provide the rationale and framework for such purposeful partnerships. Different system entry points require partners that can supply the requisite capacities and expertise. For example, as the impact pathway diagram in Chapter IX illustrates, partners that specialize in development outreach should take a progressively increasing role as research outputs are translated into outcomes and impacts.

More diverse partnerships

Collectively the partners that form around a system objective in this manner constitute an 'innovation system', ie, a partnership configured to generate innovations to improve the functioning of that system. Such partnerships will tend to be more diverse than in decades past. They will include a wider range of organizations from the government, non-governmental, community-based and private sectors, both within and beyond the realm of agricultural research-for-development. While welcoming greater diversity, we will be careful to recognize and overcome challenges of differing organizational cultures, priorities and perspectives (eg, regarding the ownership of intellectual property, roles and priorities, and different knowledge bases).

We have already made significant innovations in this area. Our pioneering effort to engage the private sector in taking research results off the shelf and out to the intended beneficiaries through our Agri-Science Park activity in Asia has gained attention and plaudits worldwide. This effort has stimulated more than 100 joint ventures with agri-business entrepreneurs in India over the past four years. It has also helped partners to explore novel outreach approaches in Africa by applying mechanisms such as warrantage, microdosing and small fertilizer packs to get fertilizer to the farm, to encourage African market gardens to diversify into high-value produce, and to foster seed entrepreneurism. Agri-Science Park has fostered such innovation systems as the Hybrid Parents Research Consortium (see the *Hybrid Vigor in Partnerships* box on page 44), the Agri-Business Incubator and the NutriPlus Knowledge Center. This approach will be strengthened during the Plan period in all three of our regions and we will continue to engage partners that can add significant value.

We have also partnered vigorously in recent years with government development authorities and programs, eg, watershed development and land tenure agencies in India, seed regulatory agencies in Africa, and with the UN Conventions on Climate Change, Desertification and Biodiversity. Work at this 'science–policy interface' will gain further momentum during the Plan period.

Capacity strengthening for change

At the same time that partnerships are innovating solutions, capacity strengthening will also be taking place, giving it a clear purpose that contributes to impacts. **Purposeful capacity strengthening** generates impact for the long term by establishing capacities in-country

Geospatial analysis laboratory – joint partnership with IER, Mali

In 2010 we were involved in 190 partnerships and distributed 20% of our budget to partners to enable their participation in joint activities

that are ready and able to sustain development initiatives long after development investor support has ended.

Capacity strengthening during the Plan period will be pursued through learning-by-doing with partners, working shoulder to shoulder on the entry point challenges identified as priorities within inclusive market-oriented systems (Chapter IV). Our joint geographic information systems laboratory with the Institut d'Economie Rural (IER) in Mali is an innovative example, among others. Learning-by-doing will be supplemented by demand-driven skills training courses and degree programs. Since our inception in 1972, we have trained over 15,000 specialists from 48 countries, including 620 in postgraduate degree programs (Masters and PhD) through partnerships with universities worldwide.

Capacity strengthening applies not only to partners; it also applies to ICRISAT. We will continually advance our own capacities to keep up with the rapid increases in knowledge being generated in the agricultural, environmental and related sciences, and with changes in what the world needs and expects from us. We described a number of capacities as Critical Focus Areas in Chapter VII that we intend to strengthen during the Plan period. Much of this internal capacity strengthening will be realized by leveraging the expertise of other institutions through close working partnerships.

The revolution in information and communication technology (ICT), and its potential to be used to increase our impact, provides just one example of our need to recognize and rapidly acquire capacities in fields that lie outside our traditional domain.

Hybrid Vigor in Partnerships

Our first foray into public–private partnership was our Hybrid Parents Research Consortium (HPRC), established in 2000. Its main objective is to increase access by millions of smallholder farmers to better hybrid cultivars of sorghum, pearl millet and pigeonpea (and potentially other dryland crops). HPRC has become a resounding success. Many companies have joined over time, with 31 currently participating. Enthusiasm for HPRC is built on the historical appreciation of seed companies for the value and impact that they generated by using germplasm bred or developed by ICRISAT. Several companies have acquired international repute.

Most of the consortium members are based in India, where the initiative began. Each member pays an annual fee that helps to support the research that generates the hybrids. We share the improved hybrid parental lines with consortium members on a non-exclusive basis. Breeding materials are also freely available to public-sector research institutions.

Capacity strengthening in ICT, for example, will supplement traditional face-to-face training with online training to deepen and extend partners' learning experiences and relationships with ICRISAT. Value will also be added to online training materials by extending their utility beyond our walls into educational materials for school and college students through the creation of reusable learning objects, as demonstrated by our efforts in the pilot-phase Agricultural Open Curriculum and Learning Initiative.

Alignment of the Strategic Plan with regional priorities

During the Plan period we will continue to align our priorities with those of the regional partners that we serve. The Comprehensive Africa Agriculture Development Program (CAADP) – an initiative of the African Union's New Partnership for Africa's Development – is the guiding light for sub-Saharan Africa's agricultural development priorities, and is reflected in the strategies of Africa's sub-regional agricultural research-for-development organizations CORAF, ASARECA and Southern African Development Community. Our ICRISAT Strategic Thrust 1 (Resilient Dryland Systems) aligns directly with CAADP's first Pillar on Land and Water Management. Our Strategic Thrust 2 on Markets, Institutions and Policies fits CAADP's second Pillar on Market Access. Our third and fourth Strategic Thrusts (Grain Legumes and Dryland Cereals) contribute directly to CAADP Pillar III on Food Supply and Hunger. And our overall agricultural research-for-development strategy aligns squarely with CAADP's Pillar IV on Agricultural Research.

The Forum for Agricultural Research in Africa (FARA), which holds lead responsibility for implementing CAADP Pillar IV, considers our Strategic Plan to 2020 to be well aligned with FARA's own Framework for African Agricultural Productivity. It also finds our systems perspective to be congruent with FARA's Integrated Agricultural Research for Development proof of concept within the CGIAR's sub-Saharan Africa Challenge Program (which addresses the most significant constraints to reviving agriculture in Africa). In summary, our four Strategic Thrusts effectively address the expressed priorities of premier African agricultural research and development organizations.

Our Strategic Thrusts are also congruent with the priorities expressed in the Vision 2025 of APAARI. That Vision emphasizes the promotion and facilitation of *"novel partnerships among NARS and other related organizations that contribute to sustainable improvements in the productivity of agricultural systems and to the quality of the natural resource base that underpins agriculture, thereby enhancing food and nutrition security, economic and social well being of communities and the integrity of the environment and services it provides."* **The APAARI Vision clearly resonates with IMOD** implemented through a systems perspective to achieve sustainable and equitable development.

Mainstreaming through regional development initiatives

We do not wish to see our research results gathering dust on a shelf. To avoid this we align our work closely with regional priorities (as described earlier) and work in concert with major regional initiatives, in order to mainstream our outputs through their delivery mechanisms as well as to participate in the development and strengthening of those mechanisms.

Our four Strategic Thrusts address the priorities of premier African agricultural research and development organizations

In Eastern and Southern Africa our IMOD strategy, for example, is mainstreamed with the Common Market for Eastern and Southern Africa (COMESA)'s Market Linkages Initiative. We are working with COMESA on seed policy harmonization. We also mainstream through ASARECA on managing climate change risks and raising water productivity.

In West and Central Africa we are closely mainstreamed with the regional research network CORAF, which has commissioned us to carry out a number of research-for-development activities. We also serve on several of CORAF's scientific committees. We are working closely with Mali's Sahel Institute to develop their seed policy and biosafety policies. We are likewise engaged in seed policy issues with the Economic Community of West African States, and are involved in a joint climate change project with Niger's African Centre of Meteorological Applications for Development and Centre Regional Agrhymet.

The Strategic Plan to 2020 of the Alliance for a Green Revolution in Africa (AGRA), a major investor and partner in our work, resonates with similar themes to our own. AGRA targets a 50% reduction in food insecurity, a doubling of incomes of 20 million smallholder farm households, and putting African countries on track for achieving and sustaining a uniquely African Green Revolution. We partner with AGRA on major projects on improving systems productivity through legume intensification in Eastern and Southern Africa, and on fertilizer microdosing to boost cereal productivity in West and Central Africa.

In Asia we mainstream natural resources management research through the Government of India's Integrated Watershed Management Program (IWMP), a convergence of all watershed programs in the country that resulted from the Comprehensive Assessment of watershed programs in India that we convened with our partners. We are represented on the Central Level Nodal Agency (CLNA) for IWMP and are actively involved in capacity building, monitoring and evaluation, and policy guideline formulation. We participate in a similar area development approach in China convened by the Asian Development Bank. The private sector is also a mainstreaming channel for agricultural research-for-development, and we convene the Hybrid Parents Research Consortium described earlier (see earlier the *Hybrid Vigor in Partnerships* box on page 44).

CGIAR Center partnerships and the emerging context of CGIAR Research Programs

Our partnerships with ILRI and ICRAF to address the livestock and agroforestry dimensions of dryland systems were described in Chapter II. We will also continue to strengthen our longstanding partnership with ICARDA, our sister dryland Center responsible for non-tropical zones. We share our chickpea mandate with ICARDA and are working closely with them on the development of the new dryland and crop-oriented CGIAR Research Programs outlined below. We also partner in a wide range of project activities with other Centers as indicated in the Thrust profiles (Chapter VI) and other parts of the Plan. Just a few of many examples are a major joint project with IITA and CIAT on tropical legumes; with IWMI on water management in the Limpopo Basin in Southern Africa; and with CIMMYT and IRRI in Asia to develop modern bioinformatics breeding systems.

Information and communication technology offers a revolutionary opportunity to mobilize global science and partnerships in ways never before possible

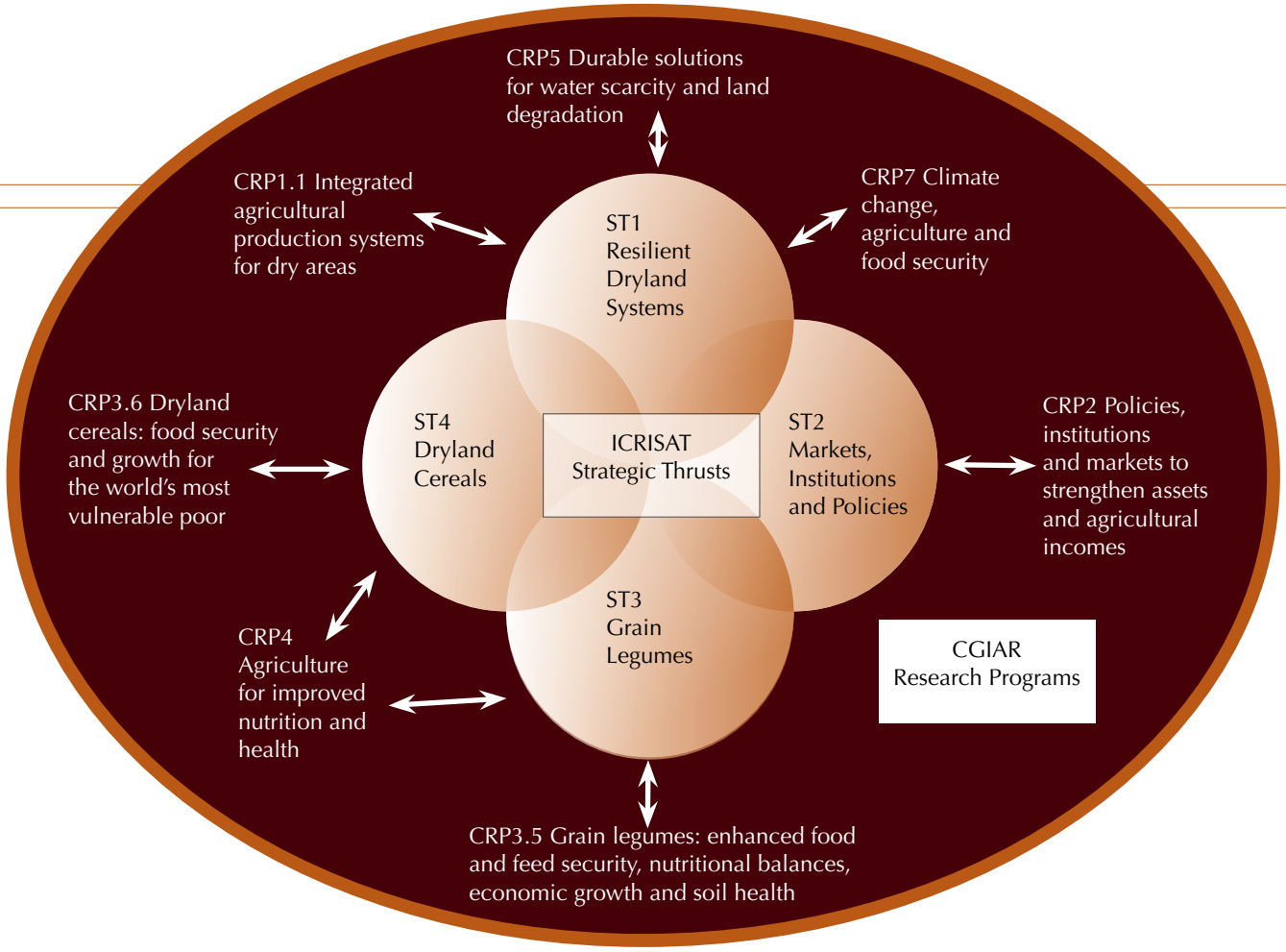


Figure 3. *Linkages between ICRISAT Strategic Thrusts and CGIAR Research Programs (CRPs).*

Inter-center partnership is evolving dynamically. The Consortium of CGIAR Centers is creating a unified Strategy and Results Framework, which harmonizes collective Center efforts through CGIAR Research Programs. The relationship between these ICRISAT and CGIAR frameworks is illustrated in Figure 3.

We will continue to work closely through the Consortium with our sister centers and with partners in formulating the CGIAR Research Program strategies and work plans in ways that ensure that these connections are harmonized, transparent and effective.

ICT to mobilize global science partnership for impact

The new tools of ICT are steadily dissipating a longstanding major constraint to our work: the large physical distances that until now have made it difficult for staff, partners, clients and other stakeholders to share knowledge in an immediate and interactive way. Knowledge that in the past could only be accessed through long, costly and arduous travel can increasingly be accessed through the click of a computer mouse. We now have a revolutionary opportunity to mobilize global science and partnerships in ways never before possible.

ICT will be a key enabler of this transformation, giving us access to top scientific expertise worldwide. Global ICT-enabled communities of practice will be fostered on key topics in support of dryland research-for-development. Such communities provide valuable new ideas and the seeds of new partnerships as well as advisory, mentoring and joint project management functions.

IX Pathways to Impact

Our contributions to IMOD will be in the form of international public goods and innovations (scientific knowledge, problem-solving expertise, technologies, methods and related outputs). These contributions will be made freely available to all, complementing the contributions of partners at local, national, regional and international levels from both public and private organizations inside and outside the realm of agricultural research-for-development.

The ultimate purpose of these contributions is to enhance progress towards the four Mission goals (reduce poverty, hunger, malnutrition and environmental degradation). We will rigorously document and publish the outputs, outcomes and impacts of our work to learn what works, what doesn't, and why. This will serve three main purposes:

- To provide the understanding needed to make appropriate mid-course corrections to improve the effectiveness of ongoing activities and to improve future planning;
- To provide stakeholders with evidence of what their efforts and investments achieved; and
- To provide knowledge to others working on similar problems.

Impact pathways within IMOD

IMOD challenges conventional assumptions about pathways to benefit the poor and the hungry. Conventional views of the dryland poor see them as powerless victims beset by a long list of constraints that require complex, costly and unlikely investments from governments – investments that only partially relieve the plight of these 'permanently poor'. IMOD, in contrast, is designed to empower the poor to escape poverty largely through their own actions. It strives for permanent change for the better by sustainably enhancing people's incomes and re-investing some of that income to further improve farm enterprises. Governments, investors, NGOs, research institutions and the private sector all have crucial roles to play as enablers, but the poor are the central driving force in escaping poverty.

Who do we serve, and how?

A core mantra for any successful business is 'know your customers'. We recognize that those we serve are a diverse group with differing needs across development sectors and across vast geographical distances. As an international organization, however, we will focus on widely applicable issues that can lead to impact on a large scale. We see our services being provided to four broad groups:

- **Stakeholders**: all those who are affected by, or who affect, our work;
- **Partners**: those stakeholders that engage in joint activity with us;
- **Clients**: direct users of our outputs, such as government policy makers, NARS, development agencies, NGOs, networks and seed companies; and
- **Beneficiaries**: those who ultimately receive the intended benefits of our work, such as smallholder farm households, communities, consumers and users of scientific knowledge.

More than just one of these roles may apply to a particular organization, eg, a partner may be a client if it receives direct services from us, and may also be a beneficiary of capacity strengthening and knowledge sharing. However, different services are often provided through different institutional channels and personnel, so these multiple roles will be

IMOD empowers the poor to escape poverty through their own actions

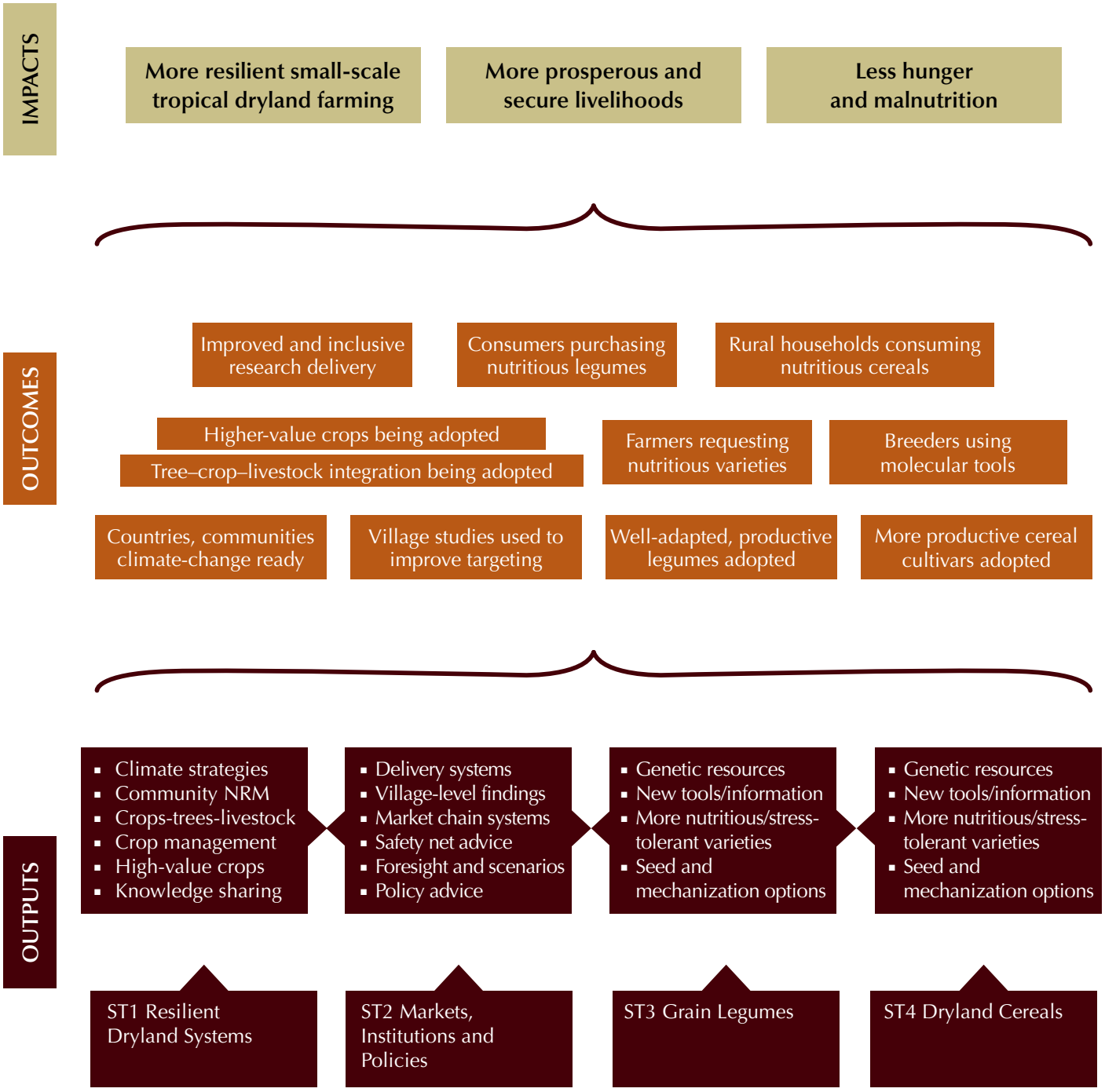


Figure 4. *Generalized impact framework of the Strategic Thrusts and how they contribute to the Mission goals.*

distinguished and served appropriately. We will ensure that our impacts on these groups are well understood and differentiated so as to most effectively serve our Mission through effective **impact pathways.**

An example of the importance of differentiating between the needs of different stakeholders is the distinction between clients and beneficiaries. One of many examples is hybrid seed. Hybrid parents for seed production are one of our outputs that requires infrastructure and organization that is beyond the means of many smallholder farm households. It must reach those households through clients, namely seed companies (or community seed associations). To attract seed companies, the hybrids must be profitable, as well as offer traits that are desired by smallholder farmers. Therefore, our impact strategy must address the differing needs of both clients and beneficiaries.

Within the beneficiaries group, and as discussed in Chapter III, special attention will be paid to women and children because they tend to be the poorest and least empowered citizens of the drylands. Recognizing that children are highly dependent on women for their well-being, and that malnutrition is short circuiting their potential provides a strategic reason for doubling the importance of agricultural research-for-development for gender equity in our and our partners' work.

Impact terminology and monitoring and assessment framework

Following the model of the CGIAR Strategy and Results Framework, our impact pathway framework highlights three stages:

- **Outputs** are the *direct results* of our research, for which we are *accountable*;
- **Outcomes** are the *use* of those outputs by partners and clients, for which we are *co-responsible* through our knowledge-sharing, training and dissemination activities; and
- **Impacts** are the *valued results* of those outcomes received by beneficiaries – we stay *engaged* with partners and many others to help support the achievement of impact that lies largely in their domains.

Expected outputs and intended outcomes and impacts are outlined for each of the four STs in Chapter VI and summarized in Figure 4. In general, each ST will deliver a specified number of quantifiable outputs that include novel tools, capacity-strengthening services, improved varieties, new information resources and other valuable products. By involving partners, these outputs, individually and in combination will produce a number of outcomes such as the use of new tools and approaches, better policies and regulations based on sound scientific advice, adoption of better and higher-value varieties, consumption of more nutritious foods and marketing of excess production. As these outcomes are further reinforced through development activities of many other players globally, we will together achieve the desired impacts of more resilient dryland farming and halving poverty, hunger and malnutrition in smallholder farm households.

Progress towards the delivery of outputs and achievement of outcomes will be monitored and evaluated via *Milestones* established across and for each ST and documented in the Medium-Term Plans. Baselines, benchmarks

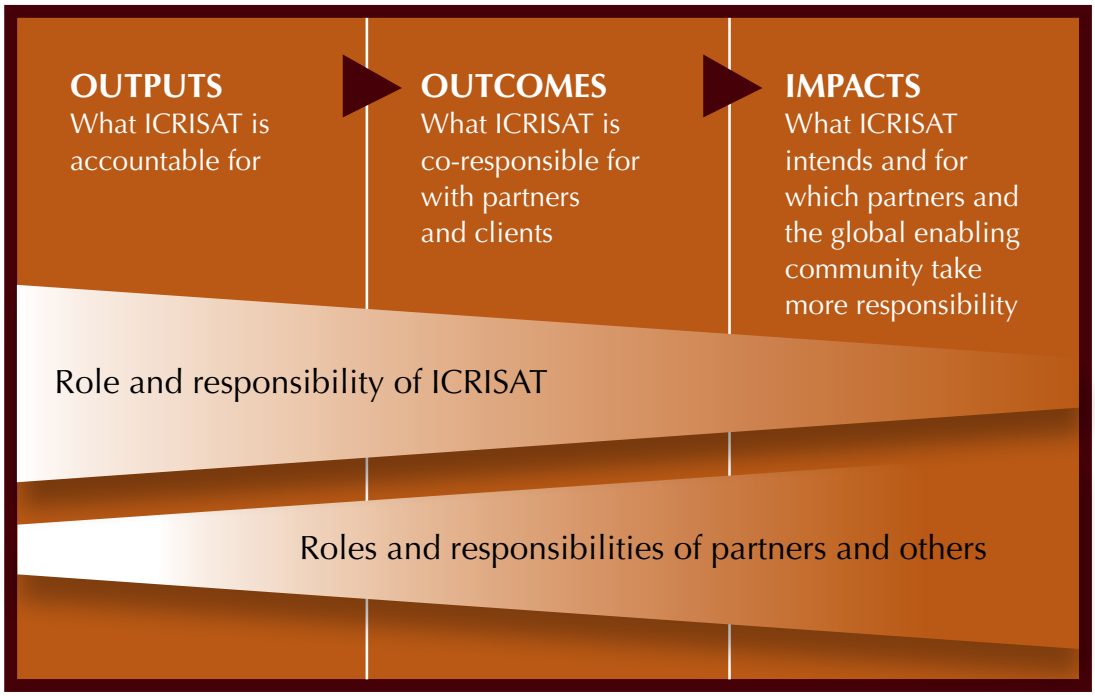


Figure 5. *Roles and responsibilities of ICRISAT, partners and others along the impact pathway.*

and counterfactual treatments (ie, considering what would happen in the absence of certain outputs) will be established to serve as a basis for measuring progress.

In achieving impacts, we recognize the roles and responsibilities of different partners as well as the enabling influences of external factors. As our outputs progress along the impact pathway towards outcomes and impacts to benefit the poor, the roles and responsibilities of development-oriented agencies and other enabling parties increases (Figure 5). We will remain engaged along this transition to the extent appropriate in order to assist (but not to replace) those parties, providing them with the knowledge and expertise they need to maximize the intended outcomes and impacts.

X Cultural Change at ICRISAT

ICRISAT needs new perspectives, knowledge, ideas and capacities to keep pace with the rapid global changes described in Chapter II. One of the most frequent perspectives urged by management and staff during the consultation meetings convened for this Plan was '**don't settle for business as usual**.' We sought change not only in *what* we do, but also in *how* we do it. But change can be unsettling, and requires concrete efforts to ensure that new ways of doing business take root.

Towards a learning culture

To adapt to change, we aspire to become a 'learning organization' that embraces and shares new ideas and innovations. Our learning culture will become a powerful instrument for adjusting the Institute's strategic directions, activities, operations and work plans on a continuing basis.

We will institutionalize important cultural changes required for ICRISAT to become more effective as a learning organization, including:

- Stronger interdisciplinary and inter-institutional teamwork at all stages from planning to execution to impact assessment, fostered by changes in structures and processes;
- Solidly rooting research planning and management in a systems perspective;
- Rigorous monitoring and assessment, squarely dealing with identified shortcomings by changing approaches and priorities;
- Welcoming challenges to conventional assumptions;
- Being willing to recognize knowledge gaps, inviting new expertise and insight;
- Engaging at the science–policy interface with nontraditional partners such as parliamentarians and other decision makers as well as the private sector and civil society organizations that can help enhance impacts; and
- Valuing, encouraging and rewarding innovation, while using failure as a learning opportunity.

Cultural change will be institutionalized through supporting structures, processes, incentives and practices. We will organize regular collective-learning events in which changes in the external environment and outcomes and impacts of the Institute's work will be reviewed and assessed. Learning and knowledge-sharing activities will be encouraged through recognition. Critical self-review and new ideas will be encouraged so that true learning can be achieved and novel ideas can emerge.

Resource mobilization and project culture change

Over the past decade, all CGIAR Centers have experienced a steady transition from program-based to project-based support and management of research activities. This trend resulted largely from development investors' preference for more targeted, shorter-term activities yielding demonstrable impacts. A dichotomy emerged between unrestricted ('core') funding that Centers could deploy flexibly, versus restricted (special project) funding that was closely tied to specific activities and time frames.

The project culture created a number of management challenges. As core funding declined scientists actively sought special project support, but this consumed large amounts of time on writing proposals and

We have sought change not only in what we do, but also in how we do it

reports for numerous individual projects. We found it challenging to harmonize large numbers of small projects into a unified portfolio that matched the Institute's strategic priorities and emphases, and longer-term objectives. These challenges also hindered cross-Institute teamwork, knowledge sharing and flexibility.

The CGIAR reform process is tackling these issues by harmonizing donor and CGIAR Consortium (funder versus implementer) processes. We will likewise harmonize our project culture with the Plan's unifying conceptual framework of IMOD. All funding support will be geared to support the Institute's agreed work program. Thus, the funding source will become less of an issue over time; the important issue will be to deliver on each project's objectives.

Human resources and cultural change

Human resources management will play a critical role in fostering cultural change at ICRISAT. Cultural values such as interdisciplinary teamwork, partnership, knowledge sharing and innovation will be recognized in annual staff performance reviews, awards and other incentives. External expertise in implementing cultural change and developing a culture of learning will also be sought. Our experiences in cultural change will also be useful for NARS and other partner institutions as they embark on similar paths.

Change will require expertise in new scientific areas as well. Alternative staffing arrangements will be adopted, including part-time retainers and consultancies that do not require relocation of staff. These will be reinforced by short visits designed to enrich these relationships with face-to-face communications and field visits. The experts involved will be encouraged to deploy talented students to carry out research at our locations to increase the intensity of cutting-edge research activity across the Institute, while also strengthening capacities and building lifetime relationships that benefit dryland development.

Gender and diversity gaps present human resource challenges at ICRISAT. In the last five years, the number of female scientists at ICRISAT has declined; however the number of female scientists from developing countries has increased. We will implement a stronger gender and diversity staffing policy, and accompanying goal, during the Plan period.

As we enter our 39th year, the staff members hired in the 1970s and early 1980s are on the verge of retirement. Funding constraints severely limited recruitment during the late 1990s through the early 2000s. As the Plan period begins, the retiring generation is being replaced by a younger group, resulting in a relative scarcity of mid-career staff. Bringing in new and talented individuals creates both opportunities and challenges. New staff bring new knowledge, skills and ideas that can fuel innovation. However, young staff members who are moved too quickly to fill managerial gaps may miss opportunities to develop their research reputations and to become seasoned through well-rounded experiences in different institutional roles. Losses of experienced staff can result in discontinuity in institutional memory, leading to 'reinventing of the wheel'.

To ensure that we hire only the best candidates, our competency-based selection and talent management review mechanisms will be strengthened to ensure that scientists, managers and associates are ready to assume

greater responsibilities when the opportunity comes. We will continuously review our market-referenced compensation system and enhance a supportive working environment in order to retain our most talented scientists, managers and staff.

Public awareness and cultural change

An understanding of our work by stakeholders is vital for earning their confidence and their continued support of the Institute. Face-to-face interaction remains the most effective means for influential communications, but is impractical on the scale needed to frequently reach our global array of stakeholders. Meanwhile, advances in information and communications technology continue to revolutionize the possibilities for raising public awareness. We will stay abreast of these developments and will capitalize on them as they arise.

Science, being largely a technical pursuit, requires skilled crafting of messages in ways that will be understood by, and connect emotionally with, the non-scientific public. Complexities, uncertainties and assumptions must be handled in a way that does not mask the key message. We will convey the importance of our work in our communications without sacrificing scientific objectivity and credibility. Communications will be simple, concise and as free of jargon and acronyms as possible. They will refer to the trail of evidence supporting major assertions so that interested readers can dig deeper to assure themselves of the scientific foundation of our messages. Partner contributions will always be fully acknowledged, and the limits of current knowledge – what we don't know – will be recognized.

A major opportunity lies in the exploitation of the ever-expanding toolbox of digital technologies. Technologies that enable dialogue rather than monologue, often identified as Web 2.0 will receive special attention because dialogue can connect us much more closely with our stakeholders and with the interested public. Web 2.0 tools include blogs, wikis and social and professional networking applications (such as Facebook, Twitter and YouTube).

Ever-increasing bandwidth and connectivity worldwide will also be exploited to improve the richness of our communications. For example, the increased online use of short video clips and photography will help the public develop a clearer perception of the places where we work and of the people whom we serve.

Our website is a strategic facility for raising public awareness. It will be continually reviewed and improved to better communicate the Institute's most important public awareness messages. It also plays a strategic role as a repository of research reports and publications. Continuous improvements in that function will also be made to ensure that our 'crown jewel' – our scientific knowledge – is readily accessible to the public.

In addition to our website, additional portals and platforms are increasing in importance and will be exploited. Many dryland inhabitants who cannot afford a computer nevertheless own a cell phone. Radio also plays an important role and is often the only or main portal in the least developed areas of the drylands.

Enhanced public awareness will bolster support for our work and that of our partners

In Conclusion

We launched our strategic planning exercise in mid-2009 with more questions than answers. Where should we begin? How should we organize global consultations? How should we synthesize unifying directions and themes out of a mass of diverse ideas and challenges? How should we build on the past while transitioning in an innovative way into the future?

What we found, to our pleasant surprise, was that many of these questions took care of themselves. Our staff and partners participated enthusiastically and listened carefully to each other. Out of those discussions, a prevailing consensus emerged on the major directions that we should take to meet the changing times. There was wide agreement on the need for market-oriented development that is pro-actively inclusive of the poorest (the unifying conceptual framework of IMOD) and which builds on our historical strengths; the importance of a holistic systems approach to overcome past impact obstacles; and the urgency of building resilience against growing environmental threats. Across these topics the importance of strong, purposeful partnerships, the regional focusing of global themes, and capitalizing on the potential of new scientific tools and on the power of information and communication technology arose, time and again.

The heart of this Plan lies in the buy-in of staff and partners of the ideas that it captures. The Plan reflects our collective will and commitment to harness these ideas to reduce poverty, hunger, malnutrition and environmental degradation across the dry tropics of Africa and Asia. It is a daunting challenge, but an inspiring one. The frequent expressions of support that we receive from our many stakeholders around the world also give us heart, and strengthen our resolve to deliver on these commitments as effectively as we possibly can. Working shoulder to shoulder with partners, we are confident that we will take major strides towards achieving our Mission goals over the course of the coming decade.

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The International Crops Research Institute for the Semi-Arid-Tropics (ICRISAT) is a non-profit, non-political organization that conducts agricultural research for development in Asia and sub-Saharan Africa with a wide array of partners throughout the world. Covering 6.5 million square kilometers of land in 55 countries, the semi-arid tropics are home to over 2 billion people, and 644 million of these are the poorest of the poor. ICRISAT and its partners help empower these poor people to overcome poverty, hunger, malnutrition and a degraded environment through better and more resilient agriculture.

ICRISAT is headquartered near Hyderabad, Andhra Pradesh, India, with two regional hubs and four country offices in sub-Saharan Africa. It belongs to the Consortium of Centers supported by the Consultative Group on International Agricultural Research (CGIAR).

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