



RESEARCH  
PROGRAM ON  
Dryland Systems

# World Agroforestry Centre 2015 Annual Report

February 2016

*Food security and better livelihoods  
for rural dryland communities*

The CGIAR Research Program on Dryland Systems aims to improve the lives of 1.6 billion people and mitigate land and resource degradation in 3 billion hectares covering the world's dry areas. Dryland Systems engages in integrated agricultural systems research to address key socioeconomic and biophysical constraints that affect food security, equitable and sustainable land and natural resource management, and the livelihoods of poor and marginalized dryland communities. The program unifies eight CGIAR Centres and uses unique partnership platforms to bind together scientific research results with the skills and capacities of national agricultural research systems (NARS), advanced research institutes (ARIs), non-governmental and civil society organizations, the private sector, and other actors to test and develop practical innovative solutions for rural dryland communities.

The program is led by the International Centre for Agricultural Research in the Dry Areas (ICAR-DA), a member of the CGIAR Consortium. CGIAR is a global agriculture research partnership for a food secure future.

For more information please visit: [drylandsystems.cgiar.org](http://drylandsystems.cgiar.org)

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## List of Acronyms

DGIS	Directoraat Generaal Internationale Samenwerking
DryDev	The Drylands Development Program supported by DGIS
DS	Drylands Systems Research Program
ICRAF	World Agroforestry Centre
IDOs	Intermediate Development Outcomes
KKM transect	The Kano – Katsina - Maradi transect in West Africa
WAS	West African Sahel
WBS transect	The Wa – Bobo - Sikasso transect in West Africa

## SECTION I – KEY MESSAGES

### a. Synthesis of Progress and Challenges

**Synthesis of Progress.** In 2015 ICRAF undertook drylands research in two transects of the West African Sahel (WAS) and the Ethiopian action site in East and Southern Africa (ESA). The research was supported through 0.7 million USD of W1/2 funding and 6.8 million USD of bilateral and W3 (SmATScaling, McKnight, Africa Rising, Evergreen Maize Africa, Biodev, DryDev and Land Restoration) funded projects. Together these activities contributed (see Table 1) to all four poverty related Intermediate Development Outcomes (IDO 1.1 increased resilience of the poor to climate change and other shocks, 1.2 enhanced small holder market access, 1.3 increased incomes and employment and 1.4 increased productivity), all three IDOs related to food, nutrition and health (IDO 2.1 improved diets for poor and vulnerable people, 2.2 improved food safety and 2.3 improved human and animal health through better agricultural practices) and all three Natural Resource Management IDOs (IDO 3.1 Natural capital enhanced and protected especially from climate change, 3.2 enhanced benefits from ecosystem services and 3.3 more sustainable managed agro-ecosystems).

**Table 1.** Overview of the contribution of the various projects to achieving the Intermediate Development Outcomes (IDOs) and the overarching goals of the Drylands Systems Research Programme. ○ = intended output, ◆ output in 2015; ✓ = outcome.

Project Name	Donor	Manager	Poverty				Food, Nutrition, health			NRM			Overarching Issues				
			1.1 - Resilience to CC	1.2 - Market access	1.3 - Income	1.4 - Productivity	2.1 - Diets	2.2 - Food safety	2.3 - Health	3.1 - Natural capital	3.2 - Benefits from ES	3.3 - Sustainability	A1 - Mitigation & adaptation	B1 - Equity and inclusion	C1 - Enabling environment	D1 - Partners enabled	
Africa Rising	USAID	J. Blnam															◆
Agforward	EU	F. Sinclair															
BioDev	Finland	A. Kalinganire			○	○		○				◆	◆	◆			○
DryDev	DGIS	P. Sola and Y. Ouedraogo	○	○	○	◆		◆		◆	○	○	○	◆	◆		
Evergreen Maize Africa	Du Pont	S. Carsan				◆				◆	◆	◆					
FMNR East Africa	World Vision	J. Muriuki	○			○				○		○	○				
Land restoration	EU IFAD	L. Winowiecki	○			○		○	○	○	○	○	○	○	○	○	○
SmAT-Scaling	USAID	A.Djalal	◆	◆	○	◆	◆	○	○	◆			◆	◆			◆
ESA Trees on farm Ethiopia	W1/2	K. Hadgu				◆				◆					◆		◆
ESA Project Governance	W1/2	J. de Leeuw															
WAS transect KKM	W1/2	P. Savadogo	○			○				◆		○	◆				○
WAS transect WWA	W1/2	J. Bayala	○			○		○		◆		◆	◆				○
Sum ○ output			5	1	3	5	1	4	2	2	2	4	3	1	1	1	4
Sum ◆ output in 2015			□	1		□	1	1	1	6	1	1	4	1			3
Sum ✓ outcome in 2015																	

The projects also contributed to the four overarching goals of the drylands systems research program, including A1 Mitigation and adaption achieved, B1 Equity and inclusion achieved, C1 Enabling environment improved and D1 National partner and beneficiaries enabled. Most of the projects mapped to the CRP are in their early stages and while we report outputs there are few outcomes to report on thus far. However, ICRAF anticipates that several projects will reach the stage of generating outcomes in 2016, for example Biodev and SmATScaling. In this 2015 annual re-

port ICRAF reports an outcome from the Africa Rising project on farmers adopting tree based food banks in the West African Sahel.

**Synthesis of challenges.** The ICRAF portfolio of bilateral and W3 projects consists largely of projects with a strong development orientation. ICRAF considers it an opportunity to undertake and deliver research outputs and outcomes while doing research within the context of development-oriented projects. The challenge is to secure funding to support such research because most projects have limited resources for research activities. To address this challenge ICRAF actively develops proposals to undertake research in development. For example, ICRAF managed to secure the EU IFAD Land Restoration project and used this project to start up research in one of its biggest development projects, the DGIS funded DryDev project. Further, ICRAF manages to deliver research outputs through careful planning; how to make the resources available in these projects work to deliver on development outcomes and also generate research outputs. Further challenges that have affected the operations of ICRAF in 2015 included the budget cuts of the DS research program, the Ebola crisis and the insecurity in West Africa. ICRAF managed these challenges through being proactive in budget re-adjustments and implementing an adaptive risk management strategy, which included working through partners in risky areas. Finally, turnover of key scientific staff, particularly in the West African flagship further challenged the implementation of the drylands program.

## b. Significant Research Achievements

In 2015 the World Agroforestry Centre undertook drylands research in East and West Africa with a portfolio consisting of W1/2 funded research and five bilateral and W3 projects. The W1/2 research and seven of the eight W3 / bilateral projects had been initiated relatively recently, and for these no outcome has been achieved so far. In here we report one outcome of the Africa Rising project, which has been running since 2012.

The Africa Rising project has been supporting the establishment of tree based food banks in the drylands of southern Mali. These foodbanks are established to remove nutritional deficiencies in the diets of children who suffer a high level of stunting in this area. This is achieved through the planting of improved indigenous trees such as the baobab and moringa within irrigated fields. When grown under irrigation these tree species provide fresh leaves year round, a nutritive addition to local diets rich in vitamins, minerals and important nutrients. Normally it would take several years before health benefits could be derived from planting trees, but when grown under irrigation the baobab and moringa supply leaves within a year. The project also supports the planting indigenous fruit trees such as *Vitellaria paradoxa*, *Ziziphus mauritiana* and *Tamarindus indica*. So far, 17 farmers including 6 women have taken up the technology partly for their own consumption and also to avail a fresh supply to the market during the dry season. The [Africa Rising project](#) anticipates to increase the uptake of tree based food banks to 380 farmers in each district at the end of the 2016 growing season.

## c. Financial Summary

ICRAF's 2015 CRP Dryland Systems Final Financial Report is available on [CGXchange](#).

## SECTION II– IMPACT PATHWAY AND INTERMEDIATE DEVELOPMENT OUTCOMES

In 2015 ICRAF contributed to research in development in rainfed systems in East Africa and the West African Sahel.

### a. ESA/Rainfed

#### I. Progress towards outputs

**Farmer perception on intensification on farm tree cover.** In 2016 ICRAF undertook a study to investigate the perception of farmers on the density and species composition of trees on their farm, aiming at an outcome of increased awareness among female and male farmers (incl. youth) on the benefits of trees on farm. The reason for this research was that while there are various scientific publications that propose intensification of trees on farm, there has been little attention to the perception of farmers on this issue. To address this knowledge gap ICRAF investigated the perception of farmers in the central rift valley of Ethiopia on the density and potential for intensification of tree cover on their farm. Group discussions and discussions with key experts held in the first half of 2016 ([report](#)) revealed that the density of trees that farmers consider optimal was below the optimal density according to experts. More detailed farm level surveys among male and female-headed households revealed that both male and female considered a higher tree density attractive in their homesteads, but not as much in their croplands ([report](#)). Farmers also expressed a wish for species composition different from current ones, with a wish for more fruit species among female farmers.

**DGIS Drydev.** See narrative under West Africa.

**EU IFAD Land restoration.** The EU IFAD [land restoration project](#) started in March 2015 with signature of the IFAD part of the contract, which reflects 1/3 of the donor budget. The project aims to reduce food insecurity and improve livelihoods of poor people in African drylands by restoring degraded land and returning it to effective and sustainable tree, crop and livestock production, thereby increasing land profitability and landscape and livelihood resilience. Between April and December ICRAF contracted three other CGIAR partners and organized planning meetings to develop an implementation plan for the project. Following this, the partners organized three [training sessions](#) in applying [the options by context approach](#) and organized workshops in Kenya and Ethiopia to analyze options by context with the trained stakeholders for specific areas. Through these activities, ICRAF and its CGIAR partners started developing a community of practice in applying the options by context approach (that will result in a [dataset](#)) and strengthened the partnership with development partners involved in rural development (see project [brief](#)). At the same time ICRAF started writing a paper on the options by context approach that will be submitted for publication in 2016. Further ICRAF and partners (ILRI and SLU) published a [paper](#) in Pastoralism reviewing the effects of enclosures on land in West Pokot Kenya. With this progress and anticipating the release of the remaining funding in early 2016, ICRAF considers that the project is on track and well placed to expand its activities to the originally anticipated scope.

#### II. Progress to achievement of research outcomes and IDOs

Given start dates of the above three projects it is premature to expect achievement of research outcomes, however ICRAF has made significant progress towards this. With the Drydev project,

now well underway, ICRAF expects outputs and outcomes to start emerging from 2016 to 2018. The impact pathway of the recently started EU-IFAD funded project makes it reasonable to expect outcomes emerging towards the end of the project.

### III. Progress towards Impact

There has been significant progress towards impact in 2015, with one project (Drydev) commenced and now on track; a second project (Land restoration) moving from its inception to implementation phase and a third project (Trees on farm) that will be closed down about to be reporting its outputs. In 2016 and beyond ICRAF anticipates reporting significant outputs and outcomes that are geared towards achieving impact from the Drydev and the Land Restoration projects.

#### b. Progress in WAS/Rainfed

##### I. Progress towards outputs

**DGIS-DryDev.** The DGIS Drydev programme is implemented in the rainfed systems in Ethiopia, Kenya, Mali, Burkina Faso and Niger. In the long run, the Drydev program aims at outcomes of improved NRM and increased land productivity, more vibrant rural economies contributing to poverty reduction and income generation and enabling institutions and policies. Progress towards outputs in the Drydev project has been as follows: The inception period was ended by 31 March 2015 and an [inception year narrative report](#) was submitted to the donor by 31 June 2015. Based on the lessons learned during the inception phase ICRAF developed a more robust [inception report with programme strategy](#), with a revised theory of change and log frame, making the program more participatory and farmer led with greater clarity on program governance and partnership arrangements and more robust procedures for monitoring and evaluation. Based on the strategy ICRAF facilitated development of the [four-year implementation plan](#). Based on this strategy and implementation plan ICRAF then developed a community visioning and action planning which included guidelines for integrating the [options-by-context approach](#), which will be published in 2016 and will be key to ensure that the program is participatory and inclusive and reflects the interest of farmers and their organizations. During this phase ICRAF worked closely with partners at national and local level to tease out farmer priorities, and prioritize the options that the project would support in every individual country. In addition to the options each country has prioritized farmer learning priorities that will be used in action research by farmers, implementing partners including ICRAF scientists and other stakeholders. In summary much of 2015 has been used to develop procedures and a plan for implementation and limited effort was devoted to implementing the project and generating development outputs. However, several activities, such as policy analysis and stakeholder engagement and mapping that have not yet been reported were initiated in 2015. Further a number of tools have been drafted and will be published in 2016. With this ICRAF anticipates that the Drydev program will generate more significant research and development outputs from 2016 onwards.

**EU IFAD Land restoration.** See the land restoration narrative under East Africa.

**SmAT-scaling.** The SmAT-Scaling project aims at enhancing access to and use of tree-based climate-smart technologies (including fodder) through effective scaling-up of existing and proven climate-smart technologies and improved market access, in order to increase food and nutritional security, as well as build resilience of farming systems in the 'Feed the Future Zone of influence' in Mali. To achieve this ICRAF established fruit tree mother blocks trials in five villages for increased availability and accessibility of improved planting material (trees, shrubs) for rural co-



operatives and their union for setting a food bank. One of the major activities of the project is the construction of the Rural Resource Centers (RRCs). These RRCs are built with participation from the local communities and in cooperation with existing agricultural extension services in order to improve access to the latest information on new technology and practices that improve access to nutritious food, markets, and resilience to climate change. The RRCs are training and demonstration hubs that are managed by grassroots organizations and often operate outside the formal extension model. They create opportunities for farmers to share experiences and to receive technical guidance and services that are tailored to their livelihood needs. During the first year of implementation, the SmAT-Scaling project funded by USAID/Mali Feed the Future (FtF) worked through a consortium comprising Aga Khan Foundation (AKF), World Vision Mali (WV), Catholic Relief Services (CRS) Interchurch Organization for Development Cooperation (ICCO), Mali Biocarburant SA (MBSA), Near East Foundation (NEF), Institut d'Economie Rurale (IER) and Regional Directorates of Agriculture, Water and Forest (DRA and DREF) and supported the construction of RRCs. ICRAF has initiated training with partners. The first two quarters of the project focused on introductory activities including community sensitization about the project objectives and their buy-in for effective and sustainable project interventions, selecting project intervention sites, preparing the groundwork for the establishment of Rural Resource Centers and identifying potential tree nursery groups for local and context-specific seed and seedling production and commercialization. The third quarter of the project focused on securing rights to the RRCs' plots of land in order to begin their construction, as well as training the project team and the communities for the management of the centers. The replication of these trainings at the community level has resulted in reaching 24,215 (with 10% being women) beneficiaries with short-term trainings. ICRAF and Partners were also able to begin identifying trainer farmers who will lead the efforts in the dissemination of climate smart agroforestry practices. Collaboration with project partners has facilitated the finalization of pre-requisite documentation for the Baseline study, the SWOT and Value Chain Mapping studies and the technical preparation for the addition of effective information technology tools into the SmAT-Scaling monitoring and evaluation system with SMILER.

In this Public-Private Partnership (PPP) arrangement, the private sector plays a critical role in terms of not only improving quality and increasing harvestable quantities, but also in encouraging environmental friendly business activities. SOATAF (Société Africaine Talla et Frères), a Malian private company that exports tropical fruits to regional and international markets, has pledged a forward \$1.2 million purchasing commitment and is investing over \$100,000 in building a warehouse with a capacity of 3,000 tons in Bamako, Mali. Furthermore, Olvea Burkina Faso, a subsidiary of Olvea Group is engaging women cooperatives to establish commercial relationships to source organic shea. The project has worked across 809 villages in 103 communes where more than 10.8 million new trees of diversified local context adapted species are planted on farms across CRS, WV, AKF, ICCO, SOATAF, MBSA sites in Mali. The following Feed the Future's key indicators (see more information on [FtF Handbook](#)) were achieved:

- Number of farmers and others who have applied improved technologies or management practices as a result of USG assistance: 24,020 (against 16,620 Year1 target)
- Number of individuals who have received USG supported short-term agricultural sector productivity or food security training: 24,215 (against 19,919 Year1 target)
- Number of food security private enterprises (for profit), producers organizations, water users associations, women's groups, trade and business associations, and CBOs receiving USG assistance: 199 (against 30 Year1 target)

- Number of stakeholders implementing risk-reducing practices/actions to improve resilience to climate change as a result of United States of America Government (USG) assistance: 20,788
- Number of jobs attributed to Feed the Future implementation: 17 (unplanned for Year1)
- Number of public-private partnerships formed as a result of Feed the Future assistance: 28 (unplanned for Year1)

These results are the fruits of ICRAF efforts and dedication coupled with deployment of diversified scaling-up approaches. They include:

- Effective use of existing qualified field based staff, networks and facilities through sub-contracts with field-based NGOs, and national government agencies such as DRA, DREF, IER with remote monitoring in areas affected by insecurity (e.g. Timbuktu);
- Demand driven and context specific Agroforestry technologies diffusion;
- Establishment and facilitation of community-lead Rural Resource Centers (RRCs);
- Facilitation of sustainable market access for high priority trees products through Public-Private-Partnership for value chains of shea oils (from Karite/shea trees) and bio-fuels from *Jatropha* plant; and
- Effective synergic actions with other USAID partners intervening in the same zones.

**Biodev.** In 2015 ICRAF produced an assessment of current knowledge on the potential of trees/shrubs to improve nutrient and water availability for sorghum and millet in Burkina Faso. ICRAF also developed a methodological framework for assessment the linkage between tree regeneration and conservation on farmland, income and food security and nutrition of small farms in the semi-arid area in western Burkina Faso (IDO 4). ICRAF additionally organized on-farm trials/demonstrations in 415 farmers' fields at the dryland system benchmark site in Burkina. ICRAF also tested tree-crop interaction on-farm using different tree species and cereal varieties. Further ICRAF characterized and made available (to 415 farmers) climate change adapted tree germplasm. The Biodev project will be completed in 2016. ICRAF anticipates generating outcomes; and producing two outcome stories on sustainable natural resource management policy and on tree seeds and seedling systems.

**Africa Rising.** The overall purpose of the Africa research in sustainable intensification for the next generation (Africa RISING) is to provide pathways out of hunger and poverty for small holder families through sustainably intensified farming systems that sufficiently improve food, nutrition, and income security, particularly for women and children, and conserve or enhance the natural resource base. The project wants to achieve both research and development objectives. From one hand, the research objectives aim to (i) identify and evaluate demand-driven options for sustainable intensification that contribute to rural poverty alleviation, improved nutrition and equity and ecosystem stability, (ii) evaluate, document and share experiences with approaches for delivering and integrating innovation for sustainable intensification in a way that will promote their uptake beyond the Africa RISING action research sites. From the other hand, the development objectives aim to, (i) create opportunities for smallholder farm households, within Africa RISING action research sites, to move out of poverty and improve their nutritional status – especially of young children and mothers – while maintaining or improving ecosystem stability; (ii) facilitate partnered dissemination of integrated innovations for sustainable intensification beyond the Africa RISING action research sites. ICRAF is contributing to this in collaboration with their partners through two research themes namely “Intensifying cereal-legume-vegetable cropping” where agroforestry

climate smart innovations are being developed/promoted and “partnership and socio-economics of intensification”.

In 2015 ICRAF developed a methodological framework for assessment of the linkage between tree regeneration and conservation on farmland, income and food security and nutrition of small farms in semi-arid area in Mali. ICRAF also experimented on tree based soil fertility management and organized on-farm trials/demonstrations in two farmers’ fields (7ha and 6ha) at dryland system benchmark site in Mali. ICRAF also promoted early fruit and fodder production species through participatory action research on superior accessions and grafting techniques by facilitating the establishment of 10 food banks for people and fodder banks for livestock and reported on these as an outcome. ICRAF is in addition leading the community mobilization and R4D platform work package and within this framework, a scoping study was carried out to:

- Inventory the existing and potential stakeholders in Bougouni and Koutiala;
- Identify the main agricultural critical issues faced by the selected stakeholders;
- Analyse the identified stakeholders interest and influence on these critical issues;
- Map stakeholder characteristics and interactions;
- Determine where stakeholder relationships need to be improved, amended or created;
- Advise on the extent to which certain groups should or could participate in planning, implementation and evaluation of the programme.

The accessibility and affordability of appropriate inputs and credit was one of the most important issues faced by stakeholders implementing their working plans. The Centre Commercial des Produits Agricoles du Mali (CCPAM), the Association Malienne pour la Securite et la Souverainete Alimentaire (AMASSA) and TAGO are influential organizations that can help to address these issues. They might also be very critical actors by playing the role of Bridgers within the platforms in Koutiala. The social network analysis results also help to identify five clusters featured by; AMEDD- Association Malienne d’ueil pour le developpement durable (also considered as “bridgers” or “brokers”), (2) AMASSA, (3) UCPTC (Union des cooperatives des producteurs et des transformateurs de cereales), (4) CCPAM, and, (5) ULCFBV (Union locale des cooperatives de la filiere betail et viande). Finally, the social network mapping also presents ICRISAT as the hub i.e. the most influential stakeholder in the area. These results thereafter brought about the establishment of four innovation platforms in Koutiala, Bougouni, Flola and M’pessoba. The social network and power analysis helped to guide the establishment of four operational and inclusive R4D platforms by engaging both marginalized, prominent, influential and bonding stakeholders that will help to foster co-learning and co-evolution of technical, institutional and organizational innovations leading to increased resilience of farming systems in southern Mali.

**W1/2 funded research.** In 2015 ICRAF carried out three W1/2 funded research activities in the KKM transect which resulted in the following:

**Factors influencing the conservation of trees on farmlands:** In 2015 ICRAF undertook at KKM transect (Milli and Gourdjia in Maradi) and its satellite site (Fakara, Niger) a study to understand “[what induced farmers to protect and manage on-farm tree natural regeneration in Nigerien Dryland](#)”. The specific objectives were to: i) determine factors influencing the conservation of trees on farmlands and silvicultural management activity and ii) document farmers innovative silvicultural practices on farmland. To this end, group and individual interviews were conducted among 400 heads of household. The rationale of this activity was that rural households could benefit from the accelerated spread of Farmer Managed Natural Regeneration (FMNR). Nonetheless, barriers remain to scaling up FMNR successes and many agricultural

development programs have not mainstreamed support for FMNR. The research revealed that the main motivation for tree conservation on farmland are the perceived economic (fuelwood provision, fodder for livestock, fruit and medicine, indication of property ownership) and environmental (biodiversity conservation and restoration of land) benefits from trees. The main barriers to adoption of tree conservation: household resource endowments (land tenure) and biophysical factors (site quality and climatic conditions). Incentives received from government and development agencies (training, sensitization, land policy) and participation in social network of increased awareness on the benefits of trees on farm and the practice of FMNR. Additionally ICRAF collaborated in a [study](#) aimed at estimating the effects of FMNR on food security status, land productivity and potential for climate change mitigation, ingredients of a climate-smart agriculture practice. Field research was conducted at the satellite site in the Fakara region of Niger, where the performance of farm household, their estimated food security status associated with practice of FMNR at different intensity to test the hypotheses that farmers who practice intensive FMNR achieve higher food security and self-sufficiency than farmers who do not and that these effects are explained through a positive effect on farm productivity and on incomes.

**Scaling up dryland agroforestry practice:** As part of its planned effort to take to scale dryland agroforestry practice, [training on FMNR](#) was conducted at the satellite site of Fakara in Niger (KKM transect). In 30 villages of the rural communes of Diantandou, Hamdallaye and Koure, it facilitated peer-to peer learning and supported the development of community of practice on farmer-led innovations in tree conservation on farm that are already taking place. ICRAF also contributed in raising youth's awareness about FMNR through training to school children. The aim was to raise consciousness of the existing challenges related to agriculture and provide the necessary information for mitigation through change in behavior towards trees. A total of 600 individuals (comprising 200 school children, 300 adult men and 100 women farmers) were trained and sensitized.

**Tree diversity on farm:** To provide understanding on how much biodiversity can be found in agricultural landscapes, ICRAF and partners (INERA, University of Ouaga in Burkina Faso) developed a methodological framework for assessment of tree biodiversity on farm under farmer managed natural regeneration practice and published a [paper](#). The paper reports on species diversity (richness and evenness) of *Piliostigma* (an agroforestry species) plant communities; and the influence of soil characteristics and rainfall on species richness, species composition, and abundance.

In addition ICRAF undertook two W1/2 funded research activities in the WBS transect which resulted in the following:

**Linkage between tree conservation and management on farmland and food security:** In 2015, ICRAF supported a field activity for the [MSc thesis](#) of a female Msc student from the University of Bobo (Burkina Faso). A [survey](#) was conducted on the linkage between tree conservation and management of tree regeneration on farm-land and food security at Dryland systems benchmark site in WBS transect (questionnaire was administered before 1141 heads of household at Samogohiri, Kadomba and Koti villages respectively in Kenedougou, Houet and Tuy province). The preliminary results show that all surveyed farmers practice agroforestry to some extent, which contribute to their livelihood diversification as additional source of income (selling of fruits mainly) and a nutritive addition to local diets. Additionally, drivers of tree con-

servation on farmland were assessed in a [study](#) based on a survey conducted in the framework of a PhD project. The results showed that farmer's decision to participate in conservation of trees on farmland was mainly influenced by silvicultural knowledge and skills, participation in farmers' groups or other social organizations with interest in tree conservation, the social value of biodiversity in the rural, and the perceived economic benefits of trees on farm.

**Agro-ecological intensification of sorghum and pearl millet-based production systems.** ICRAF conducted a project entitled “Agro-ecological intensification of sorghum and pearl millet-based production systems in the Sahel through agroforestry: linking farmers’ knowledge to process-based science”. The objectives of the project are to: (1) Enhance the knowledge on the ecosystem functions provided by parkland agroforestry to sustain the production in sorghum and millet-based systems in the face of high human pressure and variable and uncertain rainfall, and (2) Understand, assess, improve and support current development efforts to reduce human vulnerability in the Sahel through identification of current ‘best practices’ and promote the use of such approaches. All actions were geared towards improving the performance of millet and sorghum-based agricultural systems by reinforcing the ecosystem functions of tree component of parkland systems. Specifically, ICRAF and partners worked on analysing trade-offs between provisioning and other ecosystem services. Papers were published on “[field-scale modelling of soil tree crop interactions](#)” and a “review on [processes in soil-tree-crop interactions](#) in parkland systems in the West African Sahel.

## II. Progress towards achievement of research outcomes and IDOs

Given start dates of several of the above projects it is premature for outcomes to have been achieved. For example, outcomes of the DGIS Drydev project are expected to start emerging from 2016 to 2018. The impact pathway of the recently started EU IFAD funded project makes it reasonable to expect outcomes emerging towards the end of the project. The AfricaRising, had an outcome which is reported in this annual report as an outcome story.

The SmAT-scaling project is also in its initial phases, however the training on natural assisted regeneration led to the establishment of plots where this technique was applied. Also, together with farmers the project has identified innovational techniques that are being scaled up (project report available). This is starting to show a change in the behavior of farmers, the main beneficiar-

### Box 1: Proven Agroforestry Innovative technologies

The World Agroforestry Centre (ICRAF) and his partners have introduced and diffused in various areas different agroforestry technologies. These technologies include shrub/tree fodder banks with *Gliricidia sepium*, *Pterocarpus erinaceus* and *P. lucens* (Segou District), live fencing with *Jatropha curcas* (e.g. in Koulikoro, Segou, Koutiala and Sikasso) Farmer Managed Natural Regeneration (FMNR) with *Acacia senegal* (gum Arabic), *Vitellaria paradoxa* (Shea tree), *Parkia biglobosa* (nere) or *Faidherbia albida*, fruit trees with other enrichment tree plantings in crop fields and rangelands; food banks with *Adansonia digitata* (baobab), *Moringa oleifera*, (Koutiala, Bougouni, Mopti). ICRAF has tested these technologies integrating (1) cereal millet-sorghum based systems in partnership with ICRISAT (ICRAF/WCA-Sahel, 2011), (2) livestock including cattle, goats and sheep with ILRI (ICRAF/WCA-Sahel, 2012, 2014), and (3) vegetables with AVRDC. Shrubs/trees are proven to produce economic and nutritional products including fodder, fiber, fuel, fruits, and medicines (Kalinganire, et al. 2008) as well as providing environmental services, such as soil fertility enhancement, soil erosion mitigation, microclimate modification, and carbon sequestration (Bayala, et al. 2014). There has been equally impressive labour investment by farmers for land rehabilitation and sustainable agricultural intensification, and with water management practices such as Zai pits, half-moons, and stone contours (Bayala, et al. 2011; Vagen and Walsh, 2012).

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## SECTION III – CROSS-CUTTING ISSUES

### a. CRP Governance

ICRAF contributed significantly to the governance of the Drylands Systems Research Program. ICRAF led the management of the West African Flagship site and contributed to the management of the program while attending meetings and implementing research in East and West Africa. Further the ICRAF Centre Coordinator contributed to the development of a [report](#) to the CGIAR Fund Council from the Dryland Systems Task Force on Drylands and Mission Critical Research Areas for the CGIAR. The ICRAF Centre Coordinator also Chaired the Oversight Committee that supported the consultant team to produce the [Centre Commissioned External Evaluation](#) (CCEE) of the Drylands Systems Research Program. Finally, as part of the global mandate of the Drylands Systems Task Force, the ICRAF Centre Coordinator Managed the delivery of two reports on [Trees and Livelihoods](#) and [Trees and Watershed Management](#) that were produced for the DFID Evidence on Demand to provide guidance to DFID Uganda in its planning for future interventions in the Karamoja region of Uganda. These reports relied on existing knowledge available from Karamoja and the wider Drylands Systems ESA region, and are an example of outscaling knowledge from the flagship region and its action sites to specific areas within the flagship region.

### b. Gender Research Achievements

In 2015 ICRAF conducted a gender strategic research in three countries: Niger (in KKM transect), Burkina and Mali (in WBS Transect). The focus was on two major themes: 1) Gender equity in decision-making, access to and control over labour and 2) Gender equity in access to extension services. The survey coupled with focus group discussion were carried out with a total of 498 farmers (including 254 women) in Burkina-Faso, 507 (including 249 women) in Niger and 500 individuals (including 262 women) in Mali for both research themes under WAS-DS flagship.

***Gender equity in access to and use of labour and related resources in [Burkina-Faso](#), [Mali](#) and [Niger](#):*** Women provide 47 to 57 percent of agricultural work on their own fields as well as on the household farm. However, this labor does not have influence on their likelihood to participate in decision-making. Ethnicity, primary activities and annual income has influence on men' labour. Women's decision making as well as the number of children and agricultural asset improve women' access to labour. Animal traction plowing, demanding physical strength and benefiting of highest rates of 2000FCFA<sup>1</sup> / day and 15000FCFA / day, are the exclusive domain of men and boys. In salary terms, for the same field of agriculture and agroforestry targeted, women and youth's labour is underpaid, 500 to 1000FCFA, which is lower compared to male labour. Among the determinants of the gendered division of paid work in agriculture, social norms establishing male and female areas of work come in first place with 38 percent of frequency followed by lack of physical strength raised mostly by women (34 percent) and religion with only 3 percent. Other reasons include poverty and increasingly higher living costs hustling gender boundaries occupy 12 percent. Regarding the determinants, gender does not have a significant impact on access and use of technology as opposed to agricultural, property and livestock assets playing positive

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<sup>1</sup> 1\$US= 550FCFA

and significant influence. Also the different assets and annual income increases women's opportunities to access technology.

**Gender equity in decision-making and control over labour and related resources in [Burkina-Faso](#), [Mali](#) and [Niger](#):** As might be expected, men, women and youth's decision-making varies according to the agricultural sub areas and type of farmland. Key insights gained from this research: (i) 65 to 95 percent of men make decisions on the management of different work related to their farm activities (ii) The decision regarding the management of household labour in 33% of the cases are made by women (iii) women have higher decision-making power in managing the labour on their own farm either as household head (divorced or widowed) or on farms allocated to them by their husband (48 to 95 percent) (iv) Time allocated to work on women farmland can be decided by man (25 to 49 percent).

**Gender equity in access to and control of extension services:** in the study areas, the national agricultural extension services (NAES) the major source (83 percent) of veterinary agroforestry and agricultural information. These services are also provided (in a lower coverage 17 percent) by NGOs, Community-based Organizations (CBOs) and private sector. No research institution operates in extension. Very few farmers (7 percent) over the entire sample has effectively used at least one extension service during last 12 months. The study shows that the majority of those who have access to this extension services are adult men (72 percent) with no youth.

For youth, the top challenge was the lack of agricultural equipment (63 percent), followed by the lack of capital including land and loans (61 percent). To address these challenges, a majority of respondents suggested that an external support from NGOs and the national agricultural extension services (NAES) intervening in the study areas in West Africa was still needed. This support would help provide them with equipment and inputs. Women would like to have access to credit or income-generating activities that would enable them to meet their agricultural needs and empower them. Literacy and training/advice in agriculture are other means that could help address some of the challenges.

In addition in East Africa ICRAF undertook [gender-disaggregated surveys](#) among male and female-headed households on their perception on the density and species composition of trees on farm among farmers in the central rift valley in Ethiopia. The research revealed a remarkable congruence in opinion between men and women on the optimal density of trees in croplands and homesteads. Men and women differed however in the species they preferred in both parts of their farms. Another relevant finding was that women were less aware of tree based options on farm than men, because they had been informed less frequently by extension services than men. A database with the gender disaggregated data that were collected for this research has been submitted to the drylands CRP MEL website.

Based on the finding from WAS-DS, some key interventions and actions points are needed to strategically influence policy, practices, technology, change attitudes and ensure sustainable women and youth empowerment:

Regarding the gender equity in access to and use of labor and related resources, agricultural and processing equipment supports for self-help women and youth groups will strengthen their income generating activities while enhancing the related assets ownership. Knowing that assets are important determinants for access to different agricultural technology, increasing women and youth access to assets will lead to greatest access and use of technologies and further increase their farm productivity and annual income. Policy makers and support organizations in the re-

gion need to reinforce gender equity in the distribution of subsidized fertilizer and other input to build a fair accountability mechanism in agriculture inputs system that profit t marginalized groups. Since women and youth have a strong participation, leadership and influence in the agricultural, tontine and agroforest product processing units, these frameworks could be well suitable for fostering their decision making capacity and furthermore improve their access to and control over labor. Promoting cooperation between men and women is also important as their different labor has significant influence on overall labor allocation on both household farmland and women farmland. Finally specific trainings marketing skills and entrepreneurship for women and youth may be helpful for them to better manage their income generating activities for a greater market bargaining power and opportunity (mainly in Burkina-Faso with cashew processing).

Regarding gender equity in access to and control of extension services, large campaigns of information, sensitization and training involving all the relevant stakeholders could help increase awareness in extension services and agricultural and livestock innovations adoption. Also traditional communication channels for the overall extension need to be strengthened and improved to be gender sensitive. For that purpose, gender sensitive trainings could be organized towards NAES and NGOs on basic gender principles and its relevance in agriculture, agroforestry and livestock and how it can be taken into account in the overall extension system.

Governments in West Africa nowadays understand the need for engaging private sectors and NGOs in extension services to solve the major challenge of physical distance. Actions are needed to foster this opportunity in promoting gender responsive community-based and community-led extension services that take into consideration local context-specificities (land access, norms, cultures, ethics, endogenous practices etc.).

### c. Partnerships Building Achievements

**DGIS-DryDev.** As part of the inception year, in 2015 ICRAF continued spending significant effort on building and strengthening partnerships necessary for governance and implementation of the Drydev program (See inception report). Much attention has been given to proper description of responsibilities and reporting guidelines. A closer partnership with the drylands CRP would have been beneficial in the forthcoming period as during implementation the Drydev program could have benefited from the knowledge available among the drylands CRP. It is unfortunate that the start of the implementation of the DryDev program coincides with a scaling and closing down of the drylands CRP.

**EU IFAD Land Restoration.** Following inception of the EU IFAD project ICRAF has established contracts with the three other CGIAR centres implementing the project. Further, ICRAF has established partnerships with NGO and NARS in the West African project focus country to capitalize, share experiences, form connections and learn how degraded land restoration can support a healthy and prosperous society. In Mali ICRAF has established links with SahelECO and its network of farmers organization who have been successful in the past in translating successful parkland rehabilitation among locations. In Niger ICRAF established links with the INRAN (Institut national de recherche agronomique du Niger), CRESA (Centre Régional de l'Enseignement Spécialisé en Agriculture), the University of Abdou Moumouni, Niger, and Care International. They all have a long experience in encouraging farmers to grow trees and plants on their land. The exchanges with the partners testify that restoration can benefit from techniques that are underway and that future projects can be informed by approaches that are already working. At the regional level in the Sahel, discussion have been initiated with the Permanent Interstates Committee for Drought



Control in the Sahel (CILSS), a regional body in charge of natural resource management, to share experience and lessons learnt about restoration. In East Africa ILRI who coordinates operations in Ethiopia liaised with the IFAD country program manager and national agricultural research institutes. In Kenya ICRAF has been engaging with partners already aligned with the DryDev project, including the Kenyan Ministry of Agriculture, Livestock and Fisheries, and World Vision.

In SmAT-Scaling ICRAF has developed an innovative arrangement where the project supplies matching funds to private partners who implement activities to achieve the projects development goals and scaling up of various agroforestry techniques. Partnerships are also core to scaling up of various techniques that are supported by the Biodev, the Africa Rising and the McKnight projects. In these projects ICRAF works with local communities, national and international, NGO, NARS and government institutions.

There is significant cooperation with other CGIAR research programmes in many of the above projects. For example, while the DGIS funded Drydev program that aims at enhancing land productivity has been mapped partly to drylands, other activities have been mapped to CRP 2 (Policies and Institutions), and CRP 6 (Forests, Trees and Agroforestry). Similarly, activities of the SmAT-Scaling and Africa-RISING projects on scaling up agroforestry technologies and on the sorghum and millet intensification were mapped to DS and FTA while other activities on climate-smart techniques such as climate-smart villages have been mapped to CRP 7.

#### d. Capacity Building Achievements

**DGIS-DryDev.** In 2015, 4800 men and 2700 women from three DGIS countries in West Africa (Mali, Niger and Burkina Faso) trained on integrated natural resources management. These participants were trained on various technical themes (natural assisted tree regeneration, composting) and a young technician has been trained. Implementing on-farm trials is also used to improve the skills of all actors in ecological intensification of the production systems. With support from W1/2 funding a total of 160 farmers at the dryland benchmark site in Niger were trained on tree crop integration in Sahelian farming. With support from World Vision, ICRAF supported the national scientists, particularly the students (PhD and Master), in conducting studies related to restoration of degraded rural landscape in face of climate variability and for livelihood diversification as well as tree conservation in the agricultural landscape in Niger. A total of 400 farmers were trained and sensitized on farmer managed natural regeneration and its benefit in Niger. Additionally 23 male farmers were trained on grafting *Ziziphus*, *Moringa* and other wild and domesticated fruit trees in collaboration with World Vision Niger. Further, there has been limited effort on formal capacity building in the east African countries but there has been informal capacity development in options by context approaches. Capacity building will be significant from 2016 onwards, now that the strategy and implementation plans have been agreed upon.

**Training in other projects.** In Africa Rising, Biodev and SmAT-Scaling, ICRAF supported training of trainers including lead farmers, extension agents as well as local development agents on how to set up improved local fruit and food agroforestry banks. The Biodev project supported the training of one master student (University of Bobo Dioulasso) on tree seeds and seedling delivery systems. In Mali the Africa Rising project supported the training of 319 (204 male and 115 female) farmers and extension agents on natural regeneration. Specific to SmAT-Scaling was the training of 1977 men within the framework of disseminating learning agenda on resilient-smart technologies to improve the adaptive capacity of smallholder farmers in Mopti region, Mali in 2015.

## **e. Risk Management**

Two problems have affected the implementation of the research implemented by ICRAF.

The volatile and declining level of W1/2 funding received from the CGIAR challenged implementation of the drylands research program. ICRAF responded to these various budget cuts while re-adjusting the allocation of budget to the various activities.

The Ebola crisis and insecurity in various parts of West Africa has delayed activities in some projects such as Biodev. Now that the epidemic is over ICRAF will catch up and the delay in reporting outputs to the drylands CRP will be made good in 2016.

## **f. Lessons Learned**

We have learned that with dwindling resources there is a danger of an imbalance between excessive time spent on management and administration at the expense of time available for research. This imbalance also stresses the possibility to support strategic partners from W1 and 2 resources. ICRAF manages to support its partners from its bilateral and W3 projects. However, these are mostly short lived and it is difficult to maintain longer-term strategic partnerships with these resources.

## SECTION IV - RESEARCH OUTCOME STORIES

### Farmers adopting tree based food banks in the Sahel

In the drylands of Mali farmers are adopting tree based food banks. This is to address nutritional deficiencies in the food of children. Food deficient in minerals and vitamins is a major source of malnutrition and stunting among children in the developing world. For example the fertile region of Sikasso, a major cereal producing area in the south of Mali, has the highest stunting prevalence (45 – 47%) of children under-five in Mali.

Indigenous tree based fruits and vegetables offer an opportunity to address this problem and strengthen the countries' nutrition security. Tree based fruits and vegetables that contain vitamins and important nutrients are part of the traditional diet in areas with sufficient trees around. However, in more densely populated areas fruits and vegetables have become increasingly scarce and diets have impoverished accordingly.

The problem could be solved while planting appropriate tree species that supply these minerals and vitamins throughout the year. Research undertaken by the World Agroforestry Centre (ICRAF) found that the inadequate availability of good quality plant material and limitations in harvesting, processing and conservation technologies was one of the reasons behind the lack of adoption and cultivation of indigenous fruit and vegetable trees in the area. Heeding further recommendations to promote fruit and vegetable tree garden establishment at household level, especially for children and women in Sikasso Region, ICRAF in 2013 undertook research on superior accessions and grafting of five priority tree species including baobab (*Adansonia digitata*), jujube (*Ziziphus mauritiana*), moringa (*Moringa oleifera*), tamarind (*Tamarindus indica*), and shea (*Vitellaria paradoxa*).

Mapped to the CGIAR Research Program on Dryland Systems (known as Dryland Systems) and supported through the USAID Africa RISING project, one of the outcomes of the research is currently the launch of tree based fruit and vegetable gardens also known as food banks in ten villages across Sikasso. The first of its kind, the concept of foodbanks is to allow farmers to have a ready source of fresh, rich nutrient sources with locally consumed tree leaves such as baobab and moringa. It is still work in progress but already in 2015, seventeen individual farmers have taken up the technology partly for their own consumption and partly in order to be able to avail a fresh supply to the market during the dry season. In addition ten women associations with 500 female members have adopted tree based food banks.

"Baobab leaves are an extremely valuable source of proteins, vitamins A and B, as well as a range of essential minerals. The leaves of the Baobab tree are consumed as a leafy green vegetable, and as a sauce. As the leaves are available during the rainy season only, they are dried and kept for the long dry season. This results however in loss of vitamins and micronutrients. "In nature the fresh Baobab leaf is available for only a very short time" says Brehima Kone, Research Assistant at the World Agroforestry Centre based in Samanko, Mali. "But now with the science of species selection and domestication, we have varieties that make fresh leaves it available all year round.

The moringa tree is also a veritable health treasure, and with the food bank we get both of

them to provide a fuller range of micronutrients". Moringa is consumed as an equivalent to spinach, but the leaves are far superior providing protein, vitamins A, B and C and minerals such as calcium and iron. They are also an excellent source of sulphur containing amino acids methionine and cystine, which is often not available in a diet composed of cereals alone.

Normally it would take several years before health benefits could be derived from planting trees. "What makes the food bank exceptional" says Antoine Kalinganire, ICRAF West Africa Sahel and Dry Savannas Flagship Coordinator, is that both the baobab and moringa are extremely fast growing trees and now with superior accessions and reductions in growth time with graftings, they can provide an abundant supply of leaves within a year. The current spacing type (0.3m x 0.3m with 72 plants per plot), (0.5m x 0.5m with 45 plants per plot) and 1m x 1m with 15 plants per plot have so far been used to install 11.25 m<sup>2</sup> plots (4.5m x 2.5m) in the districts of Koutiala and Bougouni in Sikasso".

"It is promising to see that these food bank have been adopted so quickly" says Antoine Kalinganire and we expect to see further adoption in the year to come. The tree based food banks are part of a broader technology park initiative implemented by ICRAF with other centers such as the World Vegetable Centre (AVRDC), the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT). As a community based experiment, the technology parks aim to provide hands on training to farmers and students, facilitate knowledge flow not only from science to farmers but also from farmers to science, and farmers to farmers. It also helps research and development organizations understand the dynamics behind farmer's preferences for technologies in the region. Each technology park is expected to increase the uptake of improved technologies such as the tree based food banks to 380 farmers in each district at the end of the 2016 growing-season. With an easily available source of nutrients and vitamins - often lacking in staple foods - this will contribute to addressing the prevailing micronutrient deficiencies known as hidden hunger - in Sikasso and the West African Sahel at large.

See also: <http://blog.worldagroforestry.org/index.php/2016/02/03/of-trees-and-banks/>

## SECTION V – LIST OF 2015 PUBLICATIONS AND SCIENTIFIC OUTPUTS

In 2015, ICRAF produced under the framework of the CGIAR Research Program on Dryland Systems a total of 12 published articles (9 indexed by ISI), one technical report and four other publications. Most of the articles had a systems orientation, indicating a clear move towards the examination of new systems approaches is emerging in this body of scientific knowledge. We expect the systems approach will generate greater public awareness of agricultural livelihood issues in dryland areas and reshape traditional thinking about key performance determinants of dryland agro-ecosystems and relevant responses to meet challenges faced by rural dryland communities.

The following represents a summary of all 2015 publications and research outputs produced by ICRAF under Dryland Systems, including full and correct citation of all publications, weblinks and categories of scientific output marked with the following codes to indicate:

- (S) = multidisciplinary/system research
- (M) = mono-disciplinary research
- [X.XX]= ISI Impact Factor<sup>2</sup>
- (O) = Open Access

Table 1. Summary of all ISI publications

Region/ALS	ISI Articles	ISI Factor [range of ISI scores]	ISI Open (% of ISI articles)	ISI Monodisciplinary (% of ISI articles)	ISI Multidisciplinary (% of ISI articles)
WAS	8	0.5 – 3.4	100%	37%	63%
ESA	1	3.4	0%	0%	100%
TOTAL	9	0.5 – 3.4	89%	33%	66%

Table 2. Summary of Non-ISI Publications

Region/ALS	Non-ISI Articles	Technical Reports & Working Papers	Tools	Factsheet & Briefs	Datasets	Other
WAS	2	17	1		4	9
WAS&ESA		5	1	2	1	2
ESA	1	5		1	1	
TOTAL	3	27	2	3	6	11

<sup>2</sup> For ISI, the JCR Impact Factor List for 2013 has used (<https://www.360researchpapers.com/resources/impact-factor>, accessed 6 July 2015). For journals not listed, the website of that journal was checked and if it lists an Region ISI factor, this was recorded.

## ISI Journal Articles (9)

1. (S) (O) [1.205] Aleza K. • Wala K. • Bayala J. • Grace B. V. • Dourma M. • Atakpama W. • Akpagana K. Population structure and regeneration status of *Vitellaria Paradoxa* (C. F. Gaertner) under different land management regimes in Atacora department, Benin. *Agroforestry Systems* DOI 10.1007/s10457-015-9787-9; **WAS transect WBS**. [Mel](#)
2. (M) (O) [1.205] Bouda Z. H.-N. • J. Bayala • J. S. Jensen • B. Markussen • A. Ræbild. Reactions of *Adansonia digitata* L. provenances to long-term stress at seedling stage. *Agroforestry Systems* (2015) 89:113–123. **WAS transect WBS**. [Mel](#)
3. (S) (O) [2.906] Luedeling E. et al. (2016). Field-scale modeling of tree–crop interactions: Challenges and development needs. *Agricultural Systems* 142, 51-69. **WAS transect WBS**. [Mel](#)
4. (S) [3.402] Bayala J. et al. (2015). Advances in knowledge of processes in soil–tree–crop interactions in parkland systems in the West African Sahel: A review *Agriculture, Ecosystems and Environment* 205, 25–35. **WAS transect WBS**. [Mel](#)
5. (M) (O) [0.887] Yelemou B., Savadogo P., Traore S., Millogo-Rasolodimby J. & Hien V 2015. Floristic diversity of *Piliostigma* associations in relation to latitudinal gradient, soil and climate variables in Burkina Faso, West Africa. *Tropical Ecology* 56(1): 57-76. **WAS transect KKM**. [Mel](#)
6. (M) (O) [2.451] Sexton G J. et al (2015). Influence of putative forest refugia and biogeographic barriers on the level and distribution of genetic variation in an African savannah tree, *Khaya senegalensis* (Desr.) A. Juss. *Tree Genetics & Genomes* (2015) 11:103. **Biodev**. [Mel](#)
7. (S) (O) [0.971] Nyemeck, B.J., Oduol, J., Place., F., et al., 2015. Unlocking Market Potential of Agroforestry Products among Rural Smallholder Farmers in the Sahelian and Sudanian Ecozone Countries of West Africa. *Small Scale Forestry* 14(4): 507-529. **Biodev** [Mel](#)
8. (S) (O) [0.553] Arinloye, D.-D. A., A. R. Linnemann, G. Hagelaar, O. Coulibaly and O. S. Omta (2015). Taking profit from the growing use of mobile phone in Benin: A Contingent Valuation approach for market and quality information access. *Information Technology for Development* 21(1): 44-66. **WAS transect WBS**. [Mel](#)
9. (S) [3.402] Bosire C, Said MY, Krol MS, Ogotu JO, de Leeuw J. and Hoekstra AY, 2015. Trends and spatial variation in water and land footprints of meat and milk production systems in Kenya. *Agriculture, Ecosystems and Environment* 205: 36-47. **CRP 1.1 Governance**. [Mel](#)

## Non-ISI Journal Articles and Theses (4)

1. (S) Nyemeck, B.J., Place, F., Kalinganire, A., et al., 2015. Effects of farmer managed natural regeneration on livelihoods in semi-arid West Africa. *Environmental Economics and Policy Studies* 17(4): 543-575. **Biodev**. [Mel](#)
2. (M) Arinloye, D.-D. A. A., S. Pascucci, A. R. Linnemann, O. N. Coulibaly, G. Hagelaar and O. S. W. F. Omta (2015). Marketing Channel Selection by Smallholder Farmers. *Journal of Food Products Marketing* 21(4): 337-357. **WAS transect WBS**. [Mel](#)
3. Kon, B., 2015. Analyse des liens entre régénération des arbres, revenu et sécurité alimentaire et nutritionnelle des petites exploitations agricoles en zone semi-aride dans l'Ouest du Burkina Faso. MSc thesis. **WAS transect WBS**. [Mel](#)
4. (S) (O) Nyberg G, Knutsson P, Ostwald M, Öborn I, Wredle E, Otieno DJ, Mureithi S, Mwangi P, Said MY, Jirstrom M, Grönvall A, Wernersson J, Svanlund S, Saxer L, Geutjes L, Karmebäck V, Wairore JN, Wambui R, De Leeuw J, and Malmer A. 2015. Enclosures; transforming land, livestock and livelihoods in drylands. *Pastoralism: Research, Policy and Practice* 5:25. **Land Restoration**. [Website](#)

## Technical Reports and Working Papers (27)

1. Stringer, N., ....., de Leeuw, J. et al., 2015. Drylands and Mission Critical Research Areas for the CGIAR. A report to the CGIAR Fund Council from the Dryland Systems Task Force. **CRP 1.1 Governance**. [Mel](#)
2. Gelaw A M; Hadgu K; Oduol J; de Leeuw J. 2015. Assessment of beneficiaries and benefits from ecosystem services of tree-based farming systems in the semi-arid Central Rift Valley of Ethiopia. Addis Ababa, Ethiopia: World Agroforestry Center (ICRAF) Internal Report 2015 CRP 1.1 Research, 26p. **ESA Trees on Farm**. [Mel](#)
3. Hadgu, K., 2015. Farmer Perceptions on Optimization of Tree Cover in Agroforestry Landscapes in the Central Rift-Valley of Ethiopia. Technical Report. **ESA Trees on Farm**. [Mel](#)
4. Egeru, A.; Okia, C.; De Leeuw, J. 2015. Trees and livelihoods in Karamoja, Uganda. An Evidence on Demand Report Commissioned by DFID Uganda. Nairobi, Kenya: World Agroforestry Centre 32p. **DS CRP Governance**. [Mel](#)
5. Mbogga, M.; Malesu, M.; De Leeuw, J. 2015. Trees and watershed management in Karamoja, Uganda. An Evidence on Demand Report Commissioned by DFID Uganda. Nairobi, Kenya: World Agroforestry Centre (ICRAF) 25p. **DS CRP Governance**. [Mel](#)
6. Bayala, J., 2015. Factors influencing conservation of trees on farmland and silvicultural management activities in a Sudanian agro-ecosystem, West Africa. Manuscript unpublished. **WAS transect WBS** [Mel](#).



7. Savadgo, P., 2015. Provenance variation in seed- and seedling-related traits in survival, growth and dry matter partitioning of *Sclerocarya birrea* subsp. *caffra*, a potential agroforestry species, in response to water stress. Working document. **WAS transect WBS**. [Mel](#)
8. Savadogo, P., 2015. What induced farmers to protect and manage on-farm tree natural regeneration in Nigerien Dryland? **WAS transect KKM**. [Mel](#)
9. Kalinganire, A., 2015. Building Biocarbon and Rural Development in West Africa. **BIODEV**. [Mel](#)
10. Arinloye, A.A., 2015. Community Leadership and Resources Management – Communautés, Leadership et Gestion des Centres de Ressources. **SmAT-Scaling** [Mel](#)
11. The Drylands Development Program (DRYDEV), 2015a. Inception Year Narrative Report. A farmer led programme to enhance water management, food security, and rural economic development in the drylands of Burkina Faso, Mali, Niger, Ethiopia and Kenya. ICRAF 29p. **Drydev**. [Mel](#)
12. The Drylands Development Program (DRYDEV), 2015b. Final Inception Report. A farmer led programme to enhance water management, food security, and rural economic development in the drylands of Burkina Faso, Mali, Niger, Ethiopia and Kenya. ICRAF, 68 p. **Drydev**. [Mel](#)
13. The Drylands Development Program (DRYDEV), 2015c. Consolidated 2016 detailed Implementation Plan (DIP) for the Drylands Development Program (DRYDEV). A farmer led programme to enhance water management, food security, and rural economic development in the drylands of Burkina Faso, Mali, Niger, Ethiopia and Kenya. ICRAF, 60 p. **Drydev**. [Mel](#)
14. Carsan, S., 2015. EMA Project Report. **Evergreen Maize in Africa**. [Mel](#)
15. Kalinganire, A., 2015. Food Bank. Report. **Biodev**. [Mel](#)
16. Arinloye, A.A., 2015. Gender in decision making, access to and control over labor and extension services: A Perception survey in Burkina-Faso. Report. **WAS transect WWA**. [Mel](#)
17. Arinloye, A.A., 2015. Gender in decision making, access to and control over labor and extension services: A Perception survey in Mali. Report. Report. **WAS transect WWA**. [Mel](#)
18. Arinloye, A.A., 2015. Gender in decision making, access to and control over labor and extension services: A Perception survey in Niger. Report. **WAS transect KKM**. [Mel](#)
19. Savadogo, P., 2015. How climate-smart is the FMNR practice: co-benefits that lead to food security in Niger drylands. Draft manuscript. **WAS transect KKM**. [Mel](#)
20. Doumbia, L., 2015. Monitoring and Evaluation tools - Outils de suivi evaluation. Report. **Smatscaling**. [Mel](#)
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## Annex 1: CRP indicators of progress, with glossary and targets

Center	ICRAF	2015
<b>KNOWLEDGE, TOOLS, DATA</b>		
1. Number of flagship “products” produced by CRP	<p><b>Concept:</b> Extension Services: constraints and opportunities for women access and strengths and weaknesses in services delivery., African climate change science quality enhanced, Improved germplasm for key priority tree species produced , Improved tree planting materials</p> <p><b>Framework:</b> Identification of factors influencing the conservation of trees on farmland and silvi-cultural management activity</p> <p><b>Geographical Focus:</b> Burkina Faso, Mali, Niger</p>	5
2. Number of flagship products produced that have explicit target of women farmers/NRM managers (Selection from Above)	<p><b>Concept:</b> Extension Services: constraints and opportunities for women access and strengths and weaknesses in services delivery., African climate change science quality enhanced</p> <p><b>Framework:</b> Identification of factors influencing the conservation of trees on farmland and silvi-cultural management activity</p> <p><b>Geographical Focus:</b> Burkina Faso, Mali, Niger</p>	3 (60%)
3. Number of flagship products produced that have been assessed for likely gender- disaggregated impact (Selection from Above)	<p><b>Concept:</b> Extension Services: constraints and opportunities for women access and strengths and weaknesses in services delivery., African climate change science quality enhanced</p> <p><b>Framework:</b> Identification of factors influencing the conservation of trees on farmland and silvi-cultural management activity</p> <p><b>Geographical Focus:</b> Burkina Faso, Mali, Niger</p>	3 (60%)
4. Number of “tools” produced by CRP	<p><b>tools:</b> Data Management Support Pack, Tools for capacity development interventions and disseminate the findings of the project towards beneficiaries</p> <p><b>Guideline:</b> Strategic tools for research data quality and research data management</p> <p><b>Geographical Focus:</b> Ethiopia, Kenya, Mali, Niger, Tanzania</p>	2
5. Number of flagship tools produced that have explicit target of women farmers/NRM managers (Selection from Above)	<p><b>tools:</b> Tools for capacity development interventions and disseminate the findings of the project towards beneficiaries</p> <p><b>Geographical Focus:</b> Ethiopia, Kenya, Mali, Niger, Tanzania</p>	1 (50%)

6. Number of flagship tools produced that have been assessed for likely gender- disaggregated impact (Selection from Above)		0 (0%)
7. Number of open access databases maintained by CRP	<b>Socio-Economics survey data:</b> Dataset-What induced farmers to protect and manage on-farm tree natural regeneration in Nigerien Dryland?, Linkage between tree regeneration and conservation on livelihood at DS benchmark site in Burkina Faso, Gender and age disaggregated data on tree-based ecosystem services on farms and homesteads <b>Other:</b> Provenance variation in seed- and seedling-related traits in survival, growth and dry matter partitioning of <i>Sclerocarya birrea</i> subsp. <i>caffra</i> , a potential agroforestry species, in response to water stress, Options by Context dataset by site	5
8. Total number of users of these open access databases		0
9. Number of publications in ISI journals produced by CRP	<b>Publications:</b> Trends and spatial variation in water and land footprints of meat and milk production systems in Kenya.	1
10. Number of strategic value chains analyzed by CRP	<b>Value chains:</b> Land and water footprints of meat and milk production	1
11. Number of targeted agro-ecosystems analysed/characterised by CRP	<b>Type:</b> Mixed Crops (1), Monoculture (0), Agroforestry (0), Livestock System (0) <b>AEZ:</b> semi arid <b>Geographical Focus:</b> Burkina Faso, Ghana, Mali, Niger, Nigeria	1
12. Estimated population of above-mentioned agro- ecosystems		0
<b>CAPACITY ENHANCEMENT AND INNOVATION PLATFORMS</b>		
13. Number of trainees in short-term programs facilitated by CRP (male)	<b>Subjects:</b> Option by Context Workshop , Research data quality and research data management, Open Access Week, Training on Farmer Managed Natural Regeneration at CCAFS benchmark site (Fakara- Niger), Techniques to enhance food production through better management of soils as well as community mobilization , Field Training and Implementation of the Options by Context Approach with partners, Options by Context Training for ICRAF Scientists and Staff, Climate-Smart Agriculture (CSA) and Agroforestry practices in Sahelian countries,	19,852

	Agroforestry groups (#210) skills' improved., Community Leadership and Resources Management Centers – Communautés nn Leadership et Gestion des Centres de Ressources, Monitoring and evaluation tools, Sustainable Land Management and Water in a context of climate change in the Sahel, Agroforestry techniques (Government, NGO extension officers and farmers -50% women and youth), Handling agroforestry tree seed and basic principles of agroforestry practices (Community level farm input traders - Agro-dealers - 50% women and youth)	
14. Number of trainees in short-term programs facilitated by CRP (female)	<b>Subjects:</b> Option by Context Workshop , Research data quality and research data management, Open Access Week, Training on Farmer Managed Natural Regeneration at CCAFS benchmark site (Fakara- Niger), Techniques to enhance food production through better management of soils as well as community mobilization , Field Training and Implementation of the Options by Context Approach with partners, Options by Context Training for ICRAF Scientists and Staff, Climate-Smart Agriculture (CSA) and Agroforestry practices in Sahelian countries, Agroforestry groups (#210) skills' improved., Community Leadership and Resources Management Centers – Communautés nn Leadership et Gestion des Centres de Ressources, Monitoring and evaluation tools, Sustainable Land Management and Water in a context of climate change in the Sahel, Agroforestry techniques (Government, NGO extension officers and farmers -50% women and youth), Handling agroforestry tree seed and basic principles of agroforestry practices (Community level farm input traders - Agro-dealers - 50% women and youth)	5,061
15. Number of trainees in long-term programs facilitated by CRP (male)		0
16. Number of trainees in long-term programs facilitated by CRP (female)	<b>Subjects:</b> Rural Development Studies - Socio-economy(MSc)	1
17. Number of multi-stakeholder R4D innovation platforms established for the targeted agro-ecosystems by the CRPs		0
<b>TECHNOLOGIES/PRACTICES IN VARIOUS STAGES OF DEVELOPMENT</b>		
18. Number of technologies/NRM practices under research in the CRP (Phase I)	<b>Management and cultural practices:</b> Enhanced knowledge on tree domestication and propagation for better resilience, Farmer managed natural regeneration of trees (FMNRT), Tree species introduction and benefit to local communities., Climate smart Agroforestry technologies successfully scaled up through: effective extension approaches, improved seeds and seedlings	4

	production, distribution and commercialization, diversified market opportunities, nutritional security, Climate smart practices and Public Private Partnership <b>Geographical Focus:</b> Niger, Burkina Faso, Ghana, Mali, Ethiopia, Kenya	
19. Number of technologies under research that have an explicit target of women farmers (Selection from Above)	<b>Management and cultural practices:</b> Enhanced knowledge on tree domestication and propagation for better resilience, Farmer managed natural regeneration of trees (FMNRT), Tree species introduction and benefit to local communities., Climate smart Agroforestry technologies successfully scaled up through: effective extension approaches, improved seeds and seedlings production, distribution and commercialization, diversified market opportunities, nutritional security, Climate smart practices and Public Private Partnership <b>Geographical Focus:</b> Niger, Burkina Faso, Ghana, Mali, Ethiopia, Kenya	4 (100%)
20. Number of technologies under research that have been assessed for likely gender- disaggregated impact (Selection from Above)	<b>Management and cultural practices:</b> Enhanced knowledge on tree domestication and propagation for better resilience, Farmer managed natural regeneration of trees (FMNRT), Tree species introduction and benefit to local communities., Climate smart Agroforestry technologies successfully scaled up through: effective extension approaches, improved seeds and seedlings production, distribution and commercialization, diversified market opportunities, nutritional security, Climate smart practices and Public Private Partnership <b>Geographical Focus:</b> Niger, Burkina Faso, Ghana, Mali, Ethiopia, Kenya	4 (100%)
21. Number of agro- ecosystems for which CRP has identified feasible approaches for improving ecosystem services and for establishing positive incentives for farmers to improve ecosystem functions as per the CRP's recommendations		0
22. Number of people who will potentially benefit from plans, once finalised, for the scaling up of strategies		0
23. Number of technologies /NRM practices field tested (phase II)	<b>Management and cultural practices:</b> Techniques to enhance food production through better management of soils as well as community mobilization and other integrative approaches, Agroforestry interventions, Priority agroforestry practices identified <b>Geographical Focus:</b> Burkina Faso, Ethiopia, Kenya, Mali, Niger, Zambia	3
24. Number of agro-ecosystems for which in-		4

novations (technologies, policies, practices, integrative approaches) and options for improvement at system level have been developed and are being field tested (Phase II)		
25. Number of above innovations/approaches/options that are targeted at decreasing inequality between men and women	<b>Management and cultural practices:</b> Techniques to enhance food production through better management of soils as well as community mobilization and other integrative approaches <b>Geographical Focus:</b> Burkina Faso, Ethiopia, Kenya, Mali, Niger	1 (33%)
26. Number of published research outputs from CRP utilised in targeted agro- ecosystems		5
27. Number of technologies/NRM practices released by public and private sector partners globally (phase III)		0
<b>POLICIES IN VARIOUS STAGES OF DEVELOPMENT</b>		
28. Numbers of Policies/ Regulations/ Administrative Procedures Analyzed (Stage 1)		0
29. Number of policies / regulations / administrative procedures drafted and presented for public/stakeholder consultation (Stage 2)		0
30. Number of policies / regulations / administrative procedures presented for legislation(Stage 3)		0
31. Number of policies / regulations / administrative procedures prepared passed/approved (Stage 4)		0
32. Number of policies / regulations / adminis-		0

trative procedures passed for which implementation has begun (Stage 5)		
<b>OUTCOMES ON THE GROUND</b>		
33. Number of hectares under improved technologies or management practices as a result of CRP research	<b>Geographical Focus:</b> Niger, Burkina Faso, Ghana, Mali, Ethiopia, Kenya, Zambia	10
34. Number of <b>MALE</b> farmers and others who have applied new technologies or management practices as a result of CRP research	<b>Geographical Focus:</b> Niger, Burkina Faso, Ghana, Mali, Ethiopia, Kenya, Zambia	200
35. Number of <b>FEMALE</b> farmers and others who have applied new technologies or management practices as a result of CRP research	<b>Geographical Focus:</b> Niger, Burkina Faso, Ghana, Mali, Ethiopia, Kenya, Zambia	100

## Annex 2: Performance indicators for gender mainstreaming with targets defined

Performance Indicator	CRP performance meets requirements
<b>1. Gender equality targets defined</b>	<ul style="list-style-type: none"> <li>• Sex-disaggregated social data collected and used to diagnose important gender-related constraints in at least three of the CRP's main target action sites</li> <li>• And the CRP has defined and collected baseline data on the main dimensions of gender inequality in the CRP's main target populations relevant to its expected outcomes ( IDOs)</li> </ul>
<b>2. Institutional architecture for integration of gender is in place</b>	<ul style="list-style-type: none"> <li>• CRP scientists and managers with responsibility for gender in the CRP's outputs are appointed, have written TORS, included in their Job description and funds allocated to support their interaction.</li> <li>• Procedures defined to report use of available diagnostic or baseline knowledge on gender routinely for assessment of the gender equality implications of the CRP's flagship research products as per the Gender Strategy</li> <li>• CRP M&amp;E system has protocol for tracking progress on integration of gender in research</li> <li>• And a CRP plan approved for capacity development in gender analysis</li> </ul>

## **Annex 3: List of Centre Research Staff contributing to Dryland Systems**

ICRAF's 2015 CRP Dryland Systems Final List of personnel and consultants contributing to CRP Dryland Systems in 2015 is available on [CGXchange](#)





RESEARCH  
PROGRAM ON  
Dryland Systems

The CGIAR Research Program on Dryland Systems aims to improve the lives of 1.6 billion people and mitigate land and resource degradation in 3 billion hectares covering the world's dry areas.

Dryland Systems engages in integrated agricultural systems research to address key socioeconomic and biophysical constraints that affect food security, equitable and sustainable land and natural resource management, and the livelihoods of poor and marginalized dryland communities. The program unifies eight CGIAR Centers and uses unique partnership platforms to bind together scientific research results with the skills and capacities of national agricultural research systems (NARS), advanced research institutes (ARIs), non-governmental and civil society organizations, the private sector, and other actors to test and develop practical innovative solutions for rural dryland communities.

The program is led by the International Center for Agricultural Research in the Dry Areas (ICARDA), a member of the CGIAR Consortium. CGIAR is a global agriculture research partnership for a food secure future.

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