

Adaptation & Performance of Spineless Cactus in Hilly/ Degraded Lands in for Fodder Security in Tribal Areas in Odisha



Spineless Cactus in Hilly/ Degraded Lands and Grass pea in Winter Fallows for Fodder, Food & Nutrition Security in Tribal Areas in Odisha Project

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1.0 Background

In the context of climate change, the food and fodder availability for both human beings and livestock is being severely affected due to declining land productivity. Around 30% of India's total geographical area is under degradation and climate change is the main driver behind it. As per the National Bureau of Soil Survey and Land Use Planning, soil degradation in India is estimated to be occurring on 147 million ha of land. The situation is affecting more to small and marginal farmers who depend on multiple subsistence livelihood options including livestock rearing.

The Economic Survey of Odisha published in Feb 2021 reveals that the area under fallow land has increased to 10.79 lakh ha in 2019-20 from 10.47 lakh ha in 2018-19. In the context of climate change, due to prolonged droughts, frequent dry spells and desertification, the rural poor and smallholders are getting heavily affected.

The enhanced livestock productivity has a direct bearing on the rural economy. Evidences indicate that feed-related problems accounted for about 36 percent loss (per annum in value terms) in dairy animals and losses due to scarcity of dry and green fodder were estimated to be 11.6 percent and 12.3 percent, respectively (Birthal and Jha 2005).

As per the report submitted by State Level Task Force on Agriculture Development, in Odisha, there is a 55% shortage of green fodder. Based on production statistics, the green fodder availability is 13 million tons against the requirement of 28.7 million tons. Similarly, there is a shortfall of dry fodder by 50% (Rejuvenation of Agriculture, GoO). The scarcity affects the animal productivity most during drier months and hence calls for interventions to make green fodder available during those scarce days.

ICARDA and the Government of Odisha (Directorate of Soil Conservation and Watershed Development, Agriculture and Farmers' Empowerment Department) have joined hands to make the productive use of degraded hilly and wastelands. This initiative has been taken up in collaboration with different research and resource agencies to promote spineless cactus in degraded and wastelands for enhancing fodder availability and grass pea to improve livelihood security of poor and marginal households. The project contributes to the CGIAR thematic areas on increased food and nutrition security for better health and sustainable management of natural resources. The project contributes to the CGIAR thematic areas on increased food and nutrition security for better health and sustainable management of natural resources.

1.1 Goal

Productive use of hilly degraded/ wastelands, and winter crop fallows; and livelihood enhancement through the production of multipurpose spineless cactus and grass pea for fodder, food, and value-added products in the Indian state of Odisha.

1.2 Objectives

- a. Introduction and multiplication of local suitable spineless cactus and grass pea species;
- b. Standardize zero-till, agronomy, harvest, food/ fodder/ feeding/ value addition strategy;
- c. Productive use of waste, degraded, winter fallow land, and enhanced community livelihood;
- d. Capacity building of community, department, CBOs, and other stakeholders;



e. Science publications and papers on project impacts;

1.3 Strategy

ICARDA collaborates with agencies/ partners having reputation in both research and out-scaling. It also pulls in its in-house skills and competencies for smooth and effective implementation. ICARDA, over the last three years, has been collaborating with OUAT, other research agencies, local communities, and CBOs under this project.

The strategies being followed under the project are illustrated in the chart.



1.4 Geographical Spread of the Project

The project is being intensively implemented in 144 villages of 36 Gram Panchayats of 18 blocks in 6 districts of Odisha. In the extensive districts like Ganjam, Nayagarh, Kandhamal, and Khordha, only foundation nurseries have been established.

Based on the performance and acceptability of the fodder cactus by the local livestock, agencies & individuals from districts like Keonjhar, Jajpur, Sambalpur, Nuapada, Dhenkanal, Kendrapada, and Cuttack are showing interest to take up similar nurseries and plantation activities.

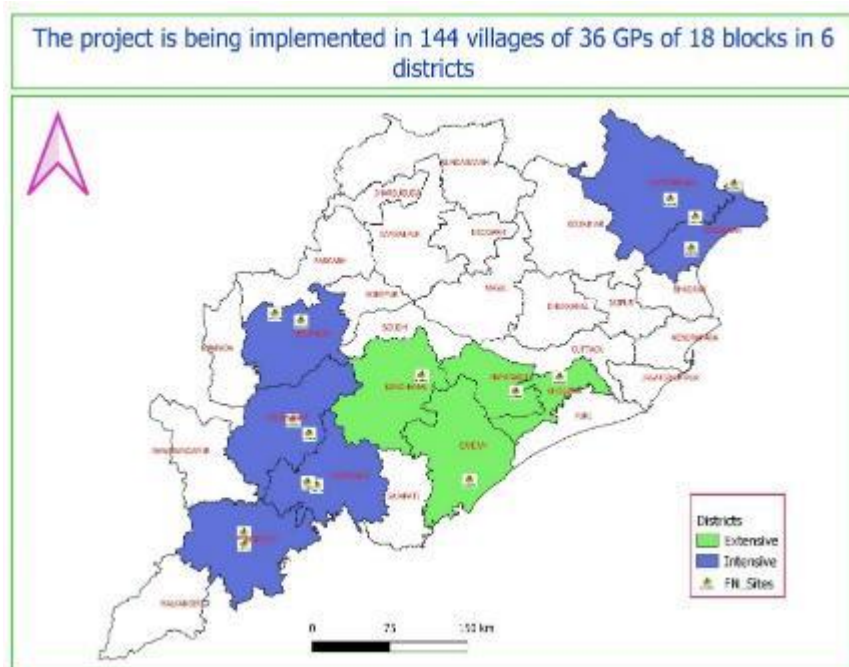


Figure 1: Map on project districts



2.0 Adaptation & Performance of Cactus Accessions

2.1 Performance of Accessions at FLRP, Amlaha

ICARDA has been maintaining the live cactus germplasm (field gene bank) at its India Research Platform for all promising cactus accessions (long-term monitoring, assessment, and training). The institute is engaged in evaluating and testing genetic diversity in targeted species for enhanced fodder production and nutritional and anti-nutritional factors. FLRP, Amlaha has also developed sustainable livestock feeding and production systems using spineless cactus as fodder grown under different land management systems.



Figure 3: Foundation Nursery- Amlaha



Figure 2: Pear Cactus at Amlaha Foundation Nursery

2.2 Establishment of Foundation Nursery

In total 16 nurseries have been established in 10 districts (2 in each intensive district and 1 in each extensive district) to select best-performing accessions in different agro-climatic zones. The rate of survival and biometric performance (length, breadth, thickness, and fresh weight) are the main parameters to select the best accessions for the locality. At an average 24 varieties and a total of 5627 plants are being maintained in 16 CFNs.

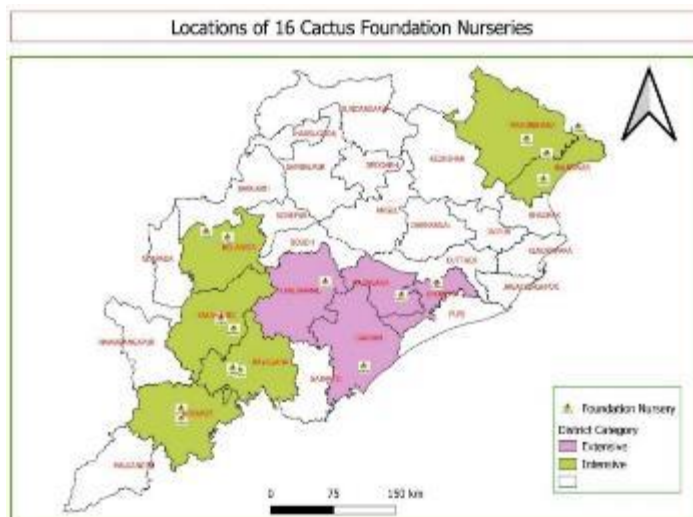


Figure 4: Location of Foundation Nurseries



Table 1: Details of Foundation Nurseries

District	Place	Land ownership	Date of plantation	No of plants	No of species
Balasore	Panapana	SC dept	03-10-2018	288	24
	Raibania	Private	19-05-2019	776	24
Bolangir	Mayabarha	Private	03-10-2018	288	24
	Kangaon	Private	05-07-2019	504	24
Mayurbhanj	Bangra	Private	30-05-2019	476	24
	Managovindpur	Private	24-01-2019	244	24
Rayagada	Kultiguda	SC dept	11-10-2018	240	20
	Bhalumaska	Private	01-06-2019	483	23
Kalahandi	Goicharcha	Private	03-06-2019	336	17
	Beheraguda	SC dept	11-10-2018	288	24
Koraput	Municipality	SC dept	14-09-2018	288	24
	Panasput	Private	10-01-2019	288	24
Khordha	Nuapada	Private	09-01-2019	299	24
Ganjam	Ankushpur	CPR	11-11-2018	288	24
Nayagarh	Biruda	Private	04-01-2019	253	24
Kandhamal	Sikidikia	Private	07-03-2019	288	24
Total No of plants				5627	
Total area under FN in ha				2.813	

After around 2 years of establishment, the nurseries have started producing good quality planting materials and the communities have started getting income by selling the mature pads. So far 86,850 mature pads have been harvested and planted in 139 ha of new community lands @ 625 per ha. Table no: 2 indicates the number of mature pads harvested from various nurseries of the project districts.

Table 2: Mature Pad harvest details

Sl No	District	No of mature pads harvested
1	Balasore	4298
2	Mayurbhanj	10769
3	Bolangir	12117
4	Kalahandi	10154
5	Rayagada	15247
6	Koraput	9711
7	Ganjam	2433
8	Kandhamal	2461
9	Nayagarh	14801
10	Khordha	4859
	Total	86850

(Sufficient to plant 139 ha @ initial double spacing planting; for in-situ intensification in subsequent years)



Figure 5: CFN Kultiguda, Rayagada



Figure 6: CFN, Bangra, Mayurbhanj



Figure 8: CFN Khordha



Figure 7: CFN Koraput

2.3 Establishment of Mega Nursery

To meet the local planting material demands and to assess long term benefits of the spineless cactus, a mega nursery has been established in November 2020 in Jhaptupalli village of Patnagarh block of Bolangir district.

50 plants each from 31 varieties are being maintained and the various biometric parameters are being monitored on regular basis.



Figure 10: Mega Nursery, Jhaptupalli, Bolangir



Figure 9: New Pad Emergence in Mega Nursery



2.4 GP Adaptation & Multiplication Nurseries

Adaptation and Multiplication Nurseries have been established in each project gram panchayats and hence 36 such nurseries have been established and are being maintained in participatory manner. The prime objective of establishing such nurseries is to select the best performing accession for that locality so that those can be successfully scaled up locally.

The following table indicates the details of GP adaptation & multiplication nurseries established through the project.



Figure 11: Location of GP Nurseries

Details of GP Adaptation & Multiplication Nurseries						
District	Block	Name of the GP (s)	Latitude (N)	Longitude (E)	Area (Ha)	No. of Species
Bolangir	Bolangir	Mayabarha	20.750951	83.241502	1	4
	Bolangir	Bhundimuhan	20.732445	83.266435	1	7
	Patanagarh	Sunamudi	20.707656	83.133532	1	15
	Patanagarh	Dhubalpada	20.715452	83.244615	1	22
	Patanagarh	Deulgaon	20.770512	83.189687	0.5	5
	Belpada	Gambhari	20.745078	82.959973	1	4
Balasore	Jaleswar	Shyamnagar	21.911361	87.112165	1	3
	Jaleswar	Shyamnagar	21.932009	87.155867	1	6
	Jaleswar	Kalika	21.885459	87.165653	1	2
	Jaleswar	Kalika	21.891434	87.180871	1	6
	Jaleswar	Raibania	21.944431	87.161144	1	5
	Nilagiri	Chhatrapur	21.524247	86.637838	1	4
Kalahandi	Golamunda	Badchergaon	19.998543	83.008047	0.4	3
	Th.Rampur	Kaniguma	19.586352	83.055542	0.6	16
	Th.Rampur	Thuamal	19.574609	83.051085	0.4	25
	Th.Rampur	Gunupur	19.584753	83.106657	0.4	1
	Th. Rampur	Kantabanji	19.574758	83.051127	0.0194	4
	Bhawanipatna	Dadpur	20.013079	83.219136	1	4
Koraput	Dasamantapur	Gadiaguda	18.913705	82.854795	1	4
	Dasamantapur	Mujanga	18.812072	82.884435	1	3
	Koraput	Kendar	18.887412	82.709205	1.5	4
	Koraput	Mahadeiput	18.880557	82.720262	1.96	2
	Laxmipur	Tunpar	18.951242	82.948677	1.96	4
Mayurbhanj	Khunta	Sapanchua	21.809101	86.564743	1	8
	Khunta	Bangara	21.773389	86.604098	1	8
	Khunta	Basipitha	21.77832	86.618925	1	5
	Shamakunta	Balijoda	21.620115	86.926883	1	8
Rayagada	Kolnara	Tandipur	19.289724	83.370775	1	7
	K. Singpur	Laxmipur	19.445983	83.358646	1	8
	K. Singpur	Khajuriguda	19.476926	83.345256	1	6
	Rayagada	Mantrajhola	19.213674	83.4616	1	5
	Rayagada	Khilapadar	19.183315	83.487328	1	7
Total					31.72	



GP Nursery Sargadapalli, Bolangir



GP Nursery Bhupad, Mayurbhanj



GP Nursery Mujang, Koraput



GP Nursery Sanatanpur, Mayurbhanj

2.5 Polythene based propagation

To optimize the use of planting materials, the project has attempted to propagate the semi-matured cladodes in polythene. The polypropagated pads have been further planted in the community fields and nurseries after they developed a good root system. This improved the survival rates as compared to conventional planting methods where the treated and seasoned mature pads are directly put into the soil. The well-grown root systems helped the plants to establish themselves even in the very poor soils.



Figure 12: Polythene-based propagation of pads

Under this experiment, around 5000 semi-mature pads have been kept under a polythene-based propagation system.



2.6 Biometric Performance of Accessions

The performances of various accessions were assessed by analysing the biometric parameters like average length, width, thickness, & fresh weight. The following graph indicates the overall biometric performance of species.

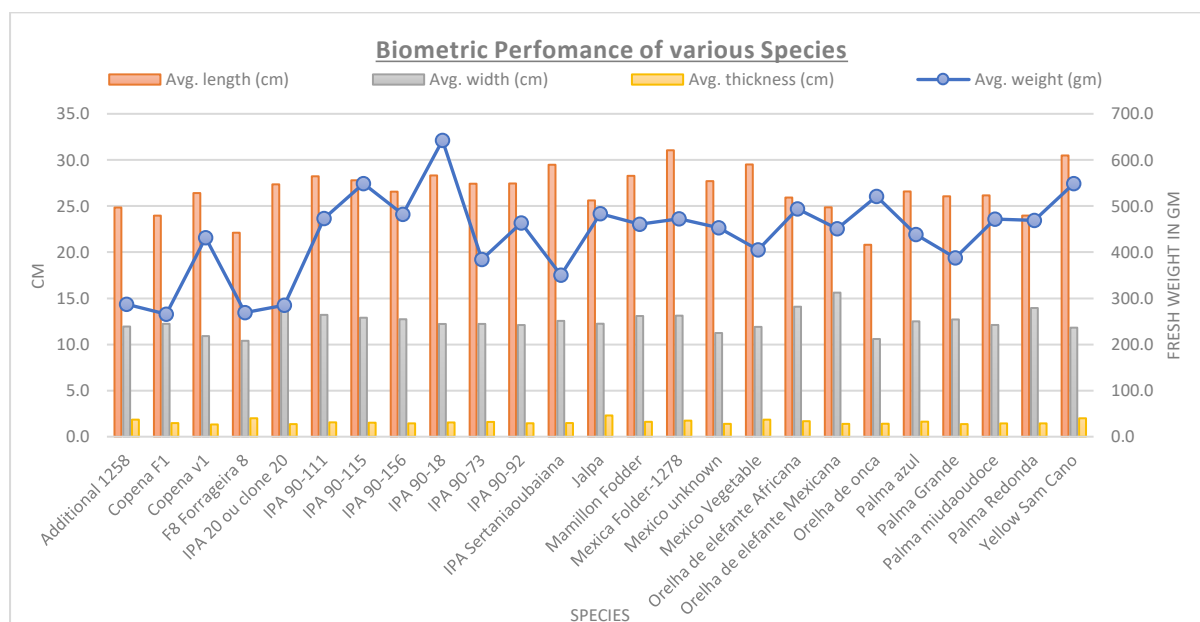


Figure 13: Biometric Performance of Species

The ranking of species performance across various intervention districts was done by analyzing the fresh weight of mature pads which were harvested multiple times from 13,226 plants of various CFNs. The species like *Orelha de elefante Mexicana* has performed well in 7 districts followed by *F8 Forrageira 8* in 6 districts, *IPA 90-18* in 5 districts, *IPA 90-115* & *Orelha de onca* in 4 districts.

Name of the species	Balasore	Bolangir	Ganjam	Kalahandi	Kandhamal	Khordha	Koraput	Mayurbhanj	Nayagarh	Rayagada
Additional 1258	16.6	69.3	29.0		27.9	3.0	34.5	96.0	27.7	39.2
Copena F1	23.5		95.0		64.5	8.4	16.0	136.0	315.0	
Copena v1	27.3	93.8	27.0	63.5	31.3	12.0	40.9	121.0	50.7	60.0
F8 Forrageira 8	28.8	132.5	43.0		85.3	13.7	18.1	146.0	94.0	
IPA 20 ou clone 20	11.2	81.6	25.0	101.6	61.1	7.0	11.5	142.0	74.8	45.0
IPA 90-111	20.4	181.8	41.0	40.0	5.7	7.8	135.0	80.0	23.4	82.5
IPA 90-115	20.9	190.0	50.0	22.6	80.5	5.5	94.4	25.0	38.3	28.9
IPA 90-156	15.4	158.1	40.5		35.2	4.7	55.8	68.0	28.0	
IPA 90-18	17.3	97.7	35.0	20.5	90.7	13.4	67.1	146.0	19.5	482.8
IPA 90-73	17.3	64.9	30.0	41.8	74.9	7.3	60.2	77.0	22.1	
IPA 90-92	18.4	188.4	37.0	44.5	58.8	6.5	39.3	101.5	42.5	
IPA Sertaniaoubaiana	12.2	54.1	30.0	40.9	37.5	3.6	28.4	125.0	34.7	27.9
Jalpa	13.4	53.4	35.0	29.0		12.0	11.6	42.5	16.7	127.2
Mamillon Fodder	12.5	138.9	2.0		19.6	5.0	10.3	108.0	15.6	115.5
Mexica Folder-1278	16.9	91.8	23.5	14.4	22.4	5.7	27.2	73.5	26.3	96.0
Mexico unknown	29.9	142.0	41.0	28.7	23.4	7.0	27.5	82.0	171.5	
Mexico Vegetable	15.2	85.0	15.8	16.7	13.2	6.2	31.4	71.0	19.8	
Orelha de elefante Africana	11.2	159.4	30.0		21.6	3.5	12.3	90.0	38.9	
Orelha de elefante Mexicana	31.9	226.2	45.0	44.8	72.4	9.5	36.4	166.0	151.1	236.3
Orelha de onca	13.4	175.5	20.0	51.9	20.4	11.2	16.1	115.0	97.2	247.0
Palma azul	9.5	127.0	10.0	18.6	50.7	3.9	20.6	76.5	26.9	
Palma Grande	27.7	138.0	18.5		17.4	14.5	28.4	16.4	20.0	
Palma miudaooudoce	23.2	44.7	52.0	165.5	27.1	10.4	52.5	113.0	28.8	32.3
Palma Redonda	21.6	118.6	17.0	150.7	22.7	12.8	47.4	132.0	43.8	18.9

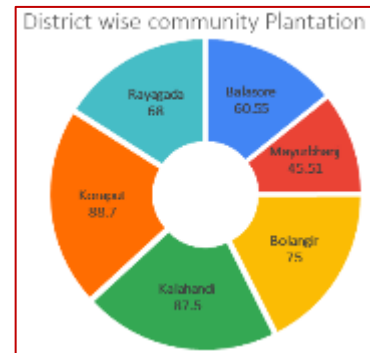


3.0 Demonstration and Dissemination in Degraded Lands

The best performing species have been identified based on their biometric performance in various nurseries and the same have been upscaled in hilly/ degraded lands with specific objectives like soil & water conservation as well as creating sustainable fodder sources for the local livestock.

To meet the planting requirements, ICARDA sourced cladodes from Food Legume Research Platform (FLRP), Amlaha, Madhya Pradesh; Indian Grassland and Fodder Research Institute (IGFRI), Jhansi, Uttar Pradesh, and Central Soil Salinity Research Institute, Karnal, Haryana.

Apart from these, the project has successfully harvested mature pads from its nurseries and used those for plantation.



The details of district-wise community plantation are given in the chart. During this financial year, 208.7 ha and cumulatively as of June 2021, 391.76 ha of community plantation has been established in 6 districts to bring hilly/ degraded lands under vegetation, reduce soil erosion, and to create perennial sources of fodder for local livestock.



Figure 14: Community plantation at Chhota begunia, Balasore

In the process of establishing the nurseries and community plantation more than 75,500 job-days have been created for the local population.



Figure 15: Community plantation in Tanainiauda, Koraput



3.1 Outreach of the Spineless cactus

The spineless cactus as an alternate fodder has been gaining popularity across various agencies, researchers and individual livestock farmers. The Krishi Vigyan Kendra (KVK) Keonjhar has procured 1000 mature pads from the GP nurseries of Mayurbhanj and upscaled it in 100 diary farmers' land as a part of their extension activity. Similarly, Utkalika NGO of Jajpur has procured 700 no of mature pads from CFN Balasore and has established a nursery near Kuakhia of Jajpur district. Further, 32 dairy farmers of Kalika GP of Jaleswar block have been supplied with 10 no of mature pads each to grow as a fodder crop.



Figure 16: Handing over of mature pads to the dairy farmers, Balasore

3.2 Intercrop in cactus fields

In many places, farmers and communities have either grown various crops in the inter-row spaces of existing cactus fields or have introduced cactus into existing crop fields. It has been found that this kind of initiatives have improved land use pattern and simultaneously added to the economic returns from the land parcels.

Field evidences show that this approach has resulted in an additional income of Rs. 8,000 per ha (by selling mature pads @ Rs. 4 per pad) which is around 60% of the total income they used to get from the same land before introduction of spineless cactus. Similarly, by doing intensive vegetable cultivation in the inter-row spaces of the cactus nursery, the income has increased by 80% from a land of 600 sq. m.



Maize as intercrop in cactus, Golamunda, Kalahandi



Barley as inter crop in cactus, Amlaha



Vegetables in cactus field, Balasore



200001
Copernicia



3.3 Visits of Officials and Dignitaries



Collector cum DM Koraput visits CFN



Addl. Secy (Agril.) visits cactus field in Bolangir



Joint Director (Agril.) visits CFN Balasore



Visitors at Krishi Mela 2021



Collector cum DM Koraput visits CFN

The Organizers



Directorate of Soil Conservation & Watershed Development (DSC&WD), Odisha has its headquarters in Bhubaneswar, Odisha. It is the state level nodal agency for implementing Watershed Development component of Pradhan Mantri Krishi Sinchayee Yojana (PMKSY), and is dedicated towards the soil, water and natural resources conservation, management, education, research and extension in the state of Odisha, India. The efforts and programs of the Department are aimed not only at providing soil cover to mitigate accumulated soil erosion, but also at providing the rural and farming communities with basic amenities, infrastructures and incentives for creating sustainable alternative farming systems with a view to wean them away from the destructive traditional methods of cultivation as well as uplifting the socio-economic status at large. Convergence with MGNREGS and various schematic programs of the line departments also provides opportunities for comprehensive area development and wider impacts across the sectors. For more information, visit, <http://www.soilconservationorissa.gov.in/>



Government of Odisha (ଓଡ଼ିଶା ସରକାର) governs the state of Odisha in the Republic of India. The state government has various well established departments to undertake the integral development of the state. The head of state of Odisha is the Governor, appointed by the President of India on the advice of the Central government, who heads the council of ministers, a judiciary, and a legislative branch.. The Chief Minister is the head of the council of the ministers and is vested with most of the executive powers. The State High Court is located in Cuttack. The legislative assembly of Odisha is unicameral, consisting of 147 members of the legislative assembly (MLA); (for details on various government initiatives, please visit, <http://www.odisha.gov.in/portal/default.asp>).



ICARDA (International Centre for Agricultural Research in the Dry Areas) established in 1977 is one of the 15 such centres supported by the CGIAR and mandated to promote agricultural development in the dry areas of the developing countries. The centre works on the problem-solving needs of resource-poor farmers through development and delivery of new technologies for sustainable growth in agriculture, in a partnership and multi-stakeholder approach, working in 50 countries. Its research and training activities cover crop improvement, water and land management, integrated crop-livestock-range land management, and climate change adaptation. The ICARDA gene bank holds over 155000 accessions from over 110 countries: traditional varieties, improved germ plasm, and a unique set of wild crop relatives of food legumes such as chickpea, lentil, fieldpea and fababean, wheat, barley, oats and other cereals, forage crops, range land plants, and wild relatives of each these species. ICARDA works in strong partnership with national agricultural research systems, Government Ministries, Community Linked Institutions; (For details, please visit: <http://www.icarda.org/>).