



# Odisha and ICRISAT

*'Partnership for Technological Empowerment and Sustainable Livelihood for Smallholder Farmers in the Rainfed Upland Ecosystems of Odisha'*

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## Overview

The project '**Introduction and Expansion of Improved Pigeonpea (Arhar) Production Technology in Rainfed Upland Ecosystems of Odisha**' is funded by the Government of Odisha under the Rashtriya Krishi Vikas Yojana (RKVY) sub-scheme 353 No. 15(03)/19/2011. This was approved on 23 May 2011 for a period of 4 years (2011-2014) with a total budget of Rs 10.253 crores (US \$ 2.29 million) to cover five districts (Bolinger, Boudh, Kalahandi, Nauparha and Rayagada). The project was officially launched on 9 August 2011 at the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) headquarters in Patancheru, Andhra Pradesh, India.

There is an enormous potential for the expansion of high-yielding short- and medium-duration pigeonpea varieties and hybrids in the rainfed areas of Odisha. However, majority of farmers in these rainfed upland ecosystems do not have access to improved pigeonpea cultivars and management practices. Thus, this project is being implemented through a farmer participatory approach towards developing sustainable livelihoods in the State through improved pigeonpea production.

The overall goal of this project is to enhance food and nutrition security and income generation of underprivileged farmers of Odisha's rainfed areas. Specifically, the project aims to:

1. Evaluate and identify newly developed high- yielding disease resistant varieties and hybrids of pigeonpea for further introduction and expansion;
2. Promote cultivation of high-yielding pigeonpea varieties and hybrids in the marginal soils;
3. Develop village-level seed delivery systems to achieve self-sufficiency in seed of farmer-preferred improved varieties and hybrids of pigeonpea;
4. Conduct capacity building of farmers, NGOs, and Self-Help Groups in sustainable pigeonpea production technology components;
5. Enhance profitability by linking production with dal processing and marketing; and
6. Provide research backstopping for refinement and research on pigeonpea and Improved Pigeonpea Production Technology (IPPT) components as identified by researchers and farmers in the target area.

This work has been undertaken as part of the



RESEARCH PROGRAM ON GrainLegumes



International Crops Research Institute for the Semi-Arid Tropics

## Organizational Flow Chart

Figure 1 shows the organizational set up of the project's relationships and procedures to obtain maximum benefits from partners. The chart illustrates the structure of the project in terms of interactions among personnel or departments.

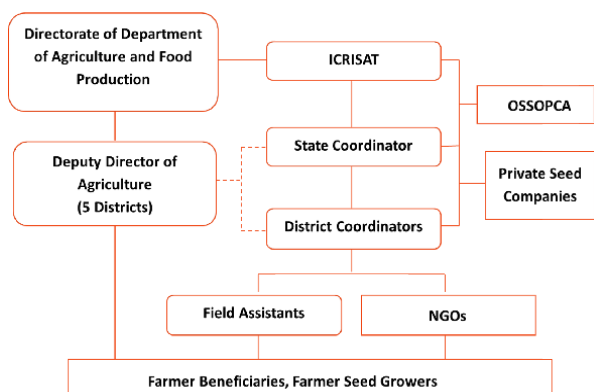


Figure 1. Project Organizational Flow Chart.

## Background Information

Odisha (17.49°N to 22.34°N and 81.27°E to 87.29°E) is located in the eastern coast of India (Figure 2). There are three main seasons in the state: summer (March to June), rainy (July to October), and winter (September-February). The annual rainfall varies from 1140 mm to 1716 mm, and the rainfall increases from west to east. Maximum and minimum temperatures during the year ranged from 24°C to 45°C and from 17°C to 22°C, respectively.

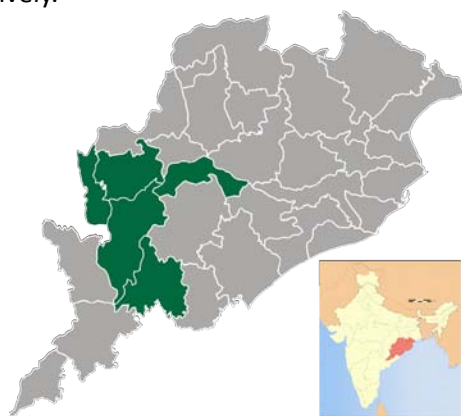


Figure 2. Map of Odisha.

The total agricultural land area of Odisha is about 8.7 million hectares of which 1.9 million hectares are irrigated and the rest is rainfed. About 70% of the population lives in villages, and 85% of the total workforce depends on agriculture. Around 70% of the cultivated area in Odisha is acidic soil which is a major impediment to crop production due to nutrient imbalances such as:

1. Deficiencies of calcium and magnesium in light textured acidic soils;
2. Low availability of phosphorus and molybdenum and fixation of applied phosphate;
3. Low nitrogen fixation by symbiotic and non-symbiotic bacteria; and
4. Aluminum and manganese toxicity in upland situation.

Odisha is one of the states most affected by climate change. Its ecology and weather have undergone noticeable changes such as extreme weather conditions where the pattern of droughts and floods is becoming a recurring scenario, affecting 11 million people in 25 out of 30 districts. This has already shown impact on agriculture in the state in the last 10 years whereby, there has been a decrease in production of paddy rice (6.8%), pulses (56.4%), oilseeds (44%), potato (20.7%), onion (14.4%) and other vegetables (24.8%).

## Pulses in Odisha

Pigeonpea, chickpea and black gram are the major pulses grown in Odisha covering 10.9% (0.953 million hectares) of the total agricultural land area with very low seed replacement ratio of 2-3% because the proportion of quality seeds available each year is 10-12%. Productivity is only 415 kg/ha which is well below the national average of 700 kg/ha. Irrigated tracts like the Mahanadi Delta, the Rushikulya plains and Hirakud and Badimula regions are the prominent pulse growing areas. Production of pulses is concentrated in districts like Cuttack, Puri, Kalahandi, Koraput Dhenkanal, Bolangir, Rayagada, Nauparha and Sambalpur.

## Pigeonpea in Odisha

Pigeonpea is one of the most important pulse crops of Odisha. It is an affordable source of protein (22-24%) and contains a good source of essential amino acids, carbohydrates, vitamins and minerals, making it an excellent crop to promote food and nutrition security in Odisha. Aside from the benefits derived as food, 15-20 tons/ha of fuel wood from pigeonpea plants can provide energy at 4,000 Kcal/kg wood; pigeonpea can fix nitrogen of about 40 kg/ha; and, it can effectively protect the soil from erosion. Pigeonpea can withstand drought, requires minimal inputs, and can be utilized as quality fodder and feeds for livestock. Pigeonpea, therefore, has several qualities, which can fulfill various social, nutritional, and economic needs of Odisha farmers. It is expected that the integration of its production along with soil and nutrient conservation will pave the way for agricultural prosperity of rainfed upland ecosystems in Odisha.

ICRISAT scientists have developed new short (for example ICPL 88039), and medium duration (*Asha and Maruti*) pigeonpea varieties that can fit into various cropping systems and diverse agro-ecological systems without disturbing traditional agriculture in the rainfed upland ecosystems of Odisha.

## Target Areas

ICRISAT in collaboration with the Department of Agriculture (DoA) has identified five potential districts (Kalahandi, Rayagada, Nauparha, Boudh and Bolinger) for introduction and promotion of IPPT (Table 1) in Odisha. The total tillable area of the five districts is 53,350 hectares, which is suitable to new high-yielding pigeonpea varieties and hybrids. Selection of blocks and villages was done in collaboration with partners and finalized during workplan meetings. The total target area is 25,000 hectares.

**Table 1. Details of the project area to be covered in Odisha**

Districts	Total Area (ha)	Total Villages (no.)	Total Block (no.)	Target Area (ha)				
				2011	2012	2013	2014	Total
Rayagada	20,800	2,667	11	1,500	708	1,000	2,500	5,708
Kalahandi	13,190	2,236	13	1,000	2,026	2,240	3,000	8,266
Nauparha	5,870	663	5	500	1,520	2,000	2,500	6,520
Boudh	4,410	1,186	3		503	750	1,000	2,253
Bolangir	9,080	1,794	14		503	750	1,000	2,253
<b>Total</b>	<b>53,350</b>	<b>7,546</b>	<b>46</b>	<b>3,000</b>	<b>5,260</b>	<b>6,740</b>	<b>10,000</b>	<b>25,000</b>

Notes: - IPPT will cover 4,000 ha in 2012; 5,500 ha in 2013; and 8,750 ha in 2014.  
 - Seed production will cover 1,260 ha in 2012; 1,240 ha in 2013; and 1,250 ha in 2014.

### Strategy and Approach

To harness the potential of rainfed upland ecosystem calls for a science-led farmer centric approach. One example is the identification of a niche for introducing and expanding pigeonpea cultivation to increase and sustain its production in Odisha, which is envisioned to increase productivity, minimize land degradation, and increase incomes of subsistence farmers. The project is farmer-driven, farmer-implemented, and farmer-owned. The researchers and extensionists play a catalytic and guiding role through the provision of technical options to farmers and by helping them to make appropriate choices. The research and development process aims to integrate locally-adapted improved cultivars of pigeonpea, improved crop production technologies, and crop management practices.

### Project Implementation

The project is managed and implemented by ICRISAT in collaboration with DoA, NGOs and selected farmer seed growers. A work plan for each year is prepared before the sowing season. Local staff organizes aspects related to field supervision, seed distribution to identified growers, monitoring of crop and dissemination of information. Appropriate sites and cultivars are selected for evaluation in consultation with local farming communities using a participatory approach. Training and awareness activities in pigeonpea production and utilization technologies are also organized. The project coordinator is responsible for implementing various activities and preparing project reports. While ICRISAT has the necessary infrastructure and facilities and seed materials, and provides training and logistical support for pigeonpea research and development, facilities of DoA are utilized for executing the project activities.

### Seed Delivery System: A must in agricultural development project

In Odisha, there is a need to continuously enhance and strengthen the formal and informal seed sector because of the participation of other equally important seed growers and institutes (private and government). Approximately 80-90% of all planting materials used are largely sourced from farmers' own-saved seed. Farmers save seeds of local landrace and use this continuously for about 3-4 years (Figure 3).

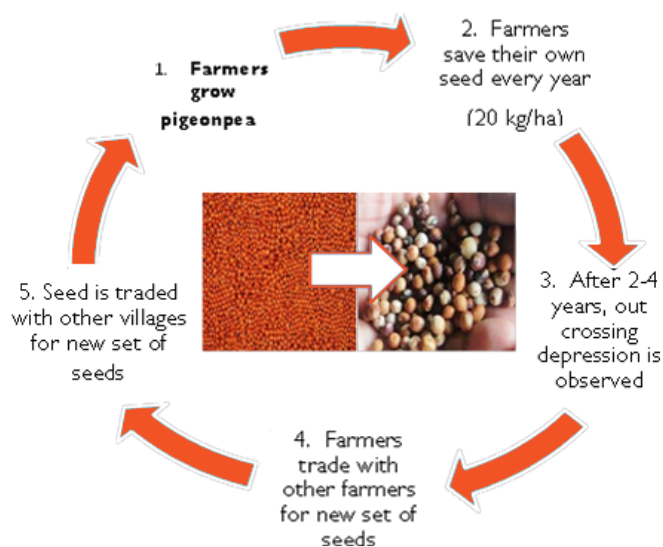


Figure 3. Existing pigeonpea smallholder farmers seed system model.

### Project Impact

**Odisha Seed Delivery System Model.** In this project, the seed system model was conceptualized and institutionalized where the concept of 'one village-one variety' is strengthened (Figure 4). The project started

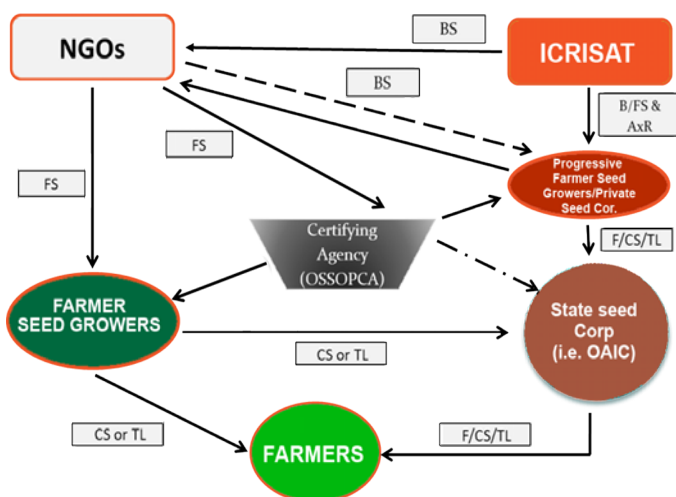


Figure 4. Seed system institutionalized in the Odisha pigeonpea project.

with the identification of villages and the provision of one farmer preferred variety suited to a specific soil type. The participation of OSSOPCA in the project was crucial in maintaining good quality seeds of farmer preferred varieties and hybrids. An isolation distance of 300 m between varieties and 500 m for hybrid seed production was initiated.

The 'one village – one variety' concept was initiated because the formal seed sector cannot supply huge quantity of quality seeds. In 2012-2013 cropping season, the seed village concept solved the problem on the lack of quality seeds to sustain the requirements of the farmers. The benefit of partnering with the Seed Certifying Agency, OSSOPCA, necessitated the strengthening and institutionalizing of the informal seed production system in districts Kalahandi, Nauparha and Rayagada. This concept resulted in the production of 589.84 tons of Foundation and Certified seeds of varieties (*Asha*, *Maruti*, ICP 7035 and ICPL 88039) and Truthful Labeled seeds of hybrids (ICPH 2671 and ICPH 2740) making seed production system viable and remunerative to smallholder farmers.

A continuous delivery of pure seeds to farmers enhances seed production and maintenance of quality seeds. ICRISAT will continuously supply Breeder seeds of farmer preferred varieties and parental lines of hybrids to selected progressive farmer seed growers, private seed companies and NGOs to multiply into various seed class. The State Seed Corporation through the directive of the DoA is tasked to secure all the remaining good quality seeds from farmer seed growers. All seed production processes is under the watchful eye of OSSOPCA for monitoring and certification.

**Pigeonpea in the Rice-Fallow Cropping System.** The year 2012 opened the window for introducing pigeonpea in the rice-fallow cropping system of Odisha. ICRISAT scientists observed that vast lands remained unplanted after rice. Hence, the objective of this new initiative is to utilize the available moisture present in the field after harvesting rice. The sowing method is dibbling with zero tillage. ICPL 88039, an early duration cultivar, is introduced into this new niche as a source of additional food and income for smallholder farmers, to improve soil structure for the succeeding rice cropping season, and as



Seed distribution.



Line sowing in ridges.



Cotton intercrop with pigeonpea.



Groundnut intercrop with pigeonpea.



Upland rice intercrop with pigeonpea.



Pigeonpea in mountain slopes.



Flowering stage.



Harvesting.



Threshing.



Drying.



Seed procurement.



Woman farmer seed grower receiving payment of her seeds.

a source of feeds or fodder for livestock and fuel wood. Results showed that ICPL 88039 yielded 729-924 kg/ha. ICPL 88039 performed well in heavy black soil (Vertisols) than in red soils (Alfisols).

**Improved Pigeonpea Production Technology (IPPT).** Pigeonpea is a major crop in the rainfed upland ecosystem of Odisha. Farmers do not apply any inputs (fertilizer and pesticides) nor do weeding after sowing if pigeonpea is cultivated as sole crop. Around 80-85% of smallholder farmers plant pigeonpea (local cultivars are widely cultivated) as an intercrop either with cotton, groundnut, maize, upland rice and finger millet, and grown along rice bunds and around fish ponds. The introduction of improved technologies such as line sowing in ridges, spacing, and integrated disease and pest management are crucial in the management of pigeonpea farming system. Yield performance of farmer preferred varieties (*Asha and Maruti*) surpasses the productivity of local cultivars by 41% due to their resistance from diseases (sterility mosaic and Fusarium wilt) and drought, and are excellent for intercropping (also relying on the fertilizer applied to the main crop).

It was found that pigeonpea when intercropped with other crops has higher production level than as a sole crop. This is because of the availability of fertilizer applied to the main crop and good cultural management such as spraying against pests and diseases and weeding. When grown as a sole crop, the use of quality seeds of high yielding varieties of pigeonpea (*Asha and Maruti*) gave better yield of 25% even in the absence of fertilizer than its local counterpart. During 2012-2013 cropping season, the project realized a total yield of 2,101.54 tons of commercial pigeonpea in the five districts.

**Farmer Participatory Varietal Selection Trial (FPVST).** To showcase the different high-yielding cultivars using improved production practices, the project provided five high-yielding cultivars (3 varieties and 2 hybrids) to determine adaptability and performance in comparison to existing local varieties. Fertilizer at the rate of 100 kg/ha of DAP and insecticide were supplied. The straight line method of planting on ridges was followed for all the FPVST. A total 140 sites was established during 2011 and 2012 cropping season and results showed that newly introduced varieties and hybrids such as ICPH 2671 (1,692 kg/ha) and

ICPH 2740 (1,461 kg/ha) and ICP 7035 (1,338 kg/ha) were having highest yield than the local cultivars (615 kg/ha).

**Variety and Hybrid Seed Production and Reconstitution at ICRISAT.** To sustain the requirements of quality seeds in the Odisha seed delivery system, ICRISAT continuously produces Nucleus/Breeder seeds of farmer preferred varieties and parental lines of hybrids.

**Capacity Building.** In a span of two years (2011 and 2012), over 6,683 participants including 954 women (farmers, DA Officers and Technicians, NGOs, and ICRISAT staff) attended various meetings, seminar-workshops, and trainings on crop seed production of hybrid and varieties, IPM/IDM, *dal* mill operation and farmers' field days.

### Farmer Awareness Activities through Print and Electronic Media

1. **Booklets and Pamphlets.** To complement the trainings, meetings, and seminar-workshops conducted at the different locations, the project distributed various farmer-friendly literatures in Oriya language. A total of 5,750 and 5,800 smallholder farmers benefitted from the booklets on cultural management practices of pigeonpea and integrated pest and disease management, respectively. In addition, 6,750 copies of pamphlets featuring effective and efficient seed production system of pigeonpea varieties and hybrids were distributed to farmers during the seed distribution for the conduct of IPPT and seed production.

2. **Local print and electronic media.** An effective way to advocate the various activities of the project is through local print and the use of electronic media. Training programs and farmers field days were covered by local radio stations and two local TV stations for wider circulation of the project activities, progress, and gains. In addition, local newspapers (Sambad and Samay) and even the ICRISAT *Happenings* (an international weekly news bulletin) continuously provide support in the advocacy of the project.

**Post Harvest Facility.** Through ICRISAT's Inclusive Market-Oriented Development (IMOD) approach, farmers including self-help groups (SHG) and NGOs benefitted from the *dal* mill machine and equipment provided by the project. The operationalization of *dal* mills in Rayagada, Kalahandi, and Nauparha brought about cheap source of processed pigeonpea dal at the doorsteps of smallholder farmers not only in village sites but also in adjacent villages. The construction of godown helped farmers store their seeds appropriately. An ongoing construction of godown at Rayagada and Nauparha (25 metric tons) and Kalahandi (100 metric tons) will benefit smallholder farmers. Along with this, eight spiral seed cleaners were purchased for farmers to use in cleaning their pigeonpea seeds.



Hybrid training for farmer seed growers.



Farmers awareness meeting.



Farmer's field day.



Seed inspection by ICRISAT staff.

## Post-harvest Facility



Dal mill machine.



Godown.

## Attendance at the State Agricultural Trade Fair, Bhubaneswar, Odisha



## Project Orientation cum Training



## Farmers Specialized Training Program on Seed Production




## 2012 Project Review Meeting cum 2013 Planning Workshop Chaired by Director RS Gopalan (green polo), Department of Agriculture and Food Production with Participants from ICRISAT, NGO, DoA and OSSOPCA




Group photo of participants.

About ICRISAT



**International Crops Research Institute for the Semi-Arid Tropics**



ICRISAT is a member of the CGIAR Consortium

The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) is a non-profit, non-political organization that conducts agricultural research for development in Asia and sub-Saharan Africa with a wide array of partners throughout the world. Covering 6.5 million square kilometers of land in 55 countries, the semi-arid tropics have over 2 billion people, of whom 644 million are the poorest of the poor. ICRISAT innovations help the dryland poor move from poverty to prosperity by harnessing markets while managing risks – a strategy called Inclusive Market-Oriented Development (IMOD).

ICRISAT is headquartered in Patancheru near Hyderabad, Andhra Pradesh, India, with two regional hubs and five country offices in sub-Saharan Africa. It is a member of the CGIAR Consortium. CGIAR is a global research partnership for a food secure future.

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