Pigeon pea intercropped with maize (ProSOL Bénin)

Intercropping Pigeon Pea with Maize (Benin)

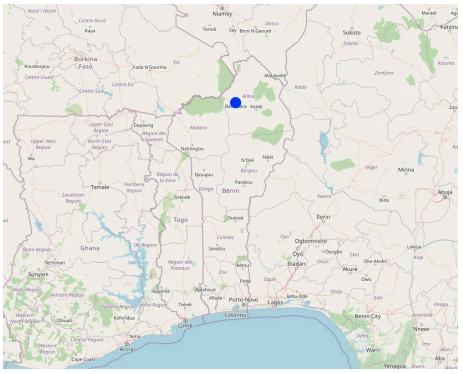
Otri

DESCRIPTION

Pigeon pea, a leguminous shrub, enhances the physical and chemical characteristics of the soil. Through symbiotic nitrogen fixation, it can fix approximately 70 kg of nitrogen per hectare per season. When intercropped with maize, pigeon pea has the potential to double both maize yields and pigeon pea grain production.

Pigeon pea, a leguminous shrub, is renowned for its capacity to enhance the physical and chemical characteristics of the soil. Through symbiotic nitrogen fixation, it can fix approximately 70 kg of nitrogen per hectare per season, extending until pod formation. When intercropped with maize, pigeon pea has the potential to double both maize yields and pigeon pea grain production, the latter being a valuable protein source. This technology boosts producers' income and contributes to food security. This combination utilized widely, excluding hydromorphic soils.
To implement this method, producers sow 20 kg/ha of maize seed and 20 kg/ha of pigeon pea, with 2 seeds per hole. Maize is sown using band sowing techniques, with a row spacing of 0.80 m and 1.60 m between plants at a depth of 3 to 5 cm. A row of maize is planted between two rows of pigeon peas, resulting in a density of 15,625 to 25,000 pigeon pea plants per hectare.
The combination of maize and pigeon pea is considered a climate change adaptation measure, as it allows for direct nitrogen input and helps improve soil productivity and fertility, thereby helping to guarantee food security and protect the soil in the long term.
Implementation and maintenance involve a succession of operations: soil preparation, seed purchase, ploughing, sowing of maize 2 to 4 weeks before pigeon pea sowing, followed by weed management as needed. Harvesting begins with maize, which matures earlier than pigeon peas. Threshing operations are then carried out. After the harvest, pigeon pea plants are pruned, and firewalls are installed to support the growth of new flowering stems.
Combining pigeon pea with maize also helps control maize pests, especially maize leaf pests. The foliage of pigeon pea provides ample biomass, which aids in soil fertilization, reduces soil evapotranspiration, and enhances microbial activity.
For producers, this technology is simple and easy to implement, often regarded as a valuable "treasure." There is a noticeable contrast for producers between fields where maize is combined with pigeon pea and those without. Control plots without pigeon pea typically yield 0.5 to 1 ton/ha of maize, while plots with pigeon pea have shown yields of up to 3 tons/ha of maize.

LOCATION



Location: Banikoara, Alibori, Benin

No. of Technology sites analysed: 2-10 sites

Geo-reference of selected sites
- 2.43227, 11.30681

Spread of the Technology: evenly spread over an area (1.0 km²)

In a permanently protected area?: No

Date of implementation: 2016

Type of introduction
- ☐ through land users' innovation
- ☐ as part of a traditional system (> 50 years)
- ☐ during experiments/ research
- ☑ through projects/ external interventions

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CLASSIFICATION OF THE TECHNOLOGY

Main purpose

- [x] improve production
- [x] reduce, prevent, restore land degradation
- [x] conserve ecosystem
- [ ] protect a watershed/ downstream areas – in combination with other Technologies
- [x] preserve/ improve biodiversity
- [ ] reduce risk of disasters
- [ ] adapt to climate change/ extremes and its impacts
- [ ] mitigate climate change and its impacts
- [x] create beneficial economic impact
- [ ] create beneficial social impact

Land use

Land use mixed within the same land unit: No

Cropland

- Annual cropping: cereals - maize, legumes and pulses - peas
- Perennial (non-woody) cropping

Number of growing seasons per year: 1
Is intercropping practiced? No
Is crop rotation practiced? No

Water supply

- [x] rainfed
- [ ] mixed rainfed-irrigated
- [ ] full irrigation

Purpose related to land degradation

- [ ] prevent land degradation
- [x] reduce land degradation
- [x] restore/ rehabilitate severely degraded land
- [ ] adapt to land degradation
- [ ] not applicable

Degradation addressed

chemical soil deterioration - Cn: fertility decline and reduced organic matter content (not caused by erosion)

biological degradation - Bh: loss of habitats, Bq: quantity/ biomass decline

SLM group

- improved ground/ vegetation cover
- integrated soil fertility management

SLM measures

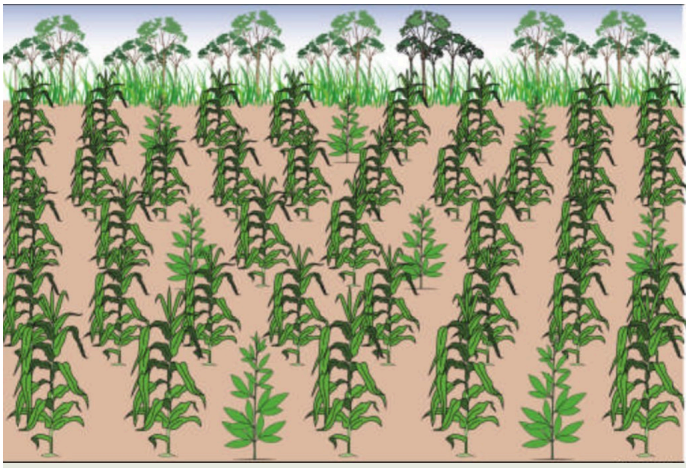
agronomic measures - A1: Vegetation/ soil cover, A2: Organic matter/ soil fertility, A3: Soil surface treatment (A 3.1: No tillage), A6: Residue management (A 6.4: retained)

management measures - M6: Waste management (recycling, re-use or reduce)

TECHNICAL DRAWING

Technical specifications

Maize seeding:
Maize is sown with a spacing of 40 cm between plants within the rows and 80 cm between rows. The seeds are sown at a depth of 3 to 5 cm, with 2 maize seeds per plot. A quantity of 20 kg of high-quality seeds is recommended for one hectare.
Pigeon pea seeding: Pigeon pea (Cajanus cajan) is sown with 2 seeds per plot, commencing two weeks after the maize is sown. The sowing spacing is set at 80 cm between rows of maize and 160 cm between rows (consisting of 2 rows of pigeon pea separated by 1 row of maize), at a depth of 3 to 5 cm. For 1 hectare, it is advisable to use 20 kg of high-quality pigeon pea seeds.



Author: Marcellin Allagbe and Adolphe Adjanohoun

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs

- Costs are calculated: per Technology area (size and area unit: **1ha**)
- Currency used for cost calculation: **CFA F**
- Exchange rate (to USD): 1 USD = 615.0 CFA F
- Average wage cost of hired labour per day: 2500

Most important factors affecting the costs

Labour scarcity

Establishment activities

1. Clearing (Timing/ frequency: March-April)
2. Plowing (Timing/ frequency: May to June)
3. Maize seeding (Timing/ frequency: June to July)
4. Pigeon pea seeding (Timing/ frequency: June to July)
5. Weeding (Timing/ frequency: June to July)
6. Maize harvesting (Timing/ frequency: December)
7. Pigeon pea harvesting (Timing/ frequency: January to February)

Establishment inputs and costs (per 1ha)

Specify input	Unit	Quantity	Costs per Unit (CFA F)	Total costs per input (CFA F)	% of costs borne by land users
Labour					
Clearing	ha	1.0	15000.0	15000.0	100.0
Ploughing	ha	1.0	30000.0	30000.0	100.0
Maize seeding	ha	1.0	10000.0	10000.0	100.0
Pigeon pea seeding	ha	1.0	10000.0	10000.0	100.0
Equipment					
Weeding	ha	1.0	12000.0	12000.0	100.0
Maize harvesting	ha	1.0	15000.0	15000.0	100.0
Pigeon pea harvesting	ha	1.0	10000.0	10000.0	100.0
Plant material					
Maize seeds	Kg	20.0	300.0	6000.0	100.0
Pigeon pea seeds	kg	20.0	500.0	10000.0	
Total costs for establishment of the Technology				**118'000.0**	
Total costs for establishment of the Technology in USD				*191.87*	

Maintenance activities

1. Coppicing (Timing/ frequency: January to February)
2. Firebreaking (Timing/ frequency: November to December)

Maintenance inputs and costs (per 1ha)

Specify input	Unit	Quantity	Costs per Unit (CFA F)	Total costs per input (CFA F)	% of costs borne by land users
Labour					
Coppicing	ha	1.0	10000.0	10000.0	100.0
Firebreaking	ha	1.0	5000.0	5000.0	100.0
Total costs for maintenance of the Technology				**15'000.0**	
Total costs for maintenance of the Technology in USD				*24.39*	

NATURAL ENVIRONMENT

Average annual rainfall
- [ ] < 250 mm
- [ ] 251-500 mm
- [ ] 501-750 mm
- [x] 751-1,000 mm
- [ ] 1,001-1,500 mm
- [ ] 1,501-2,000 mm
- [ ] 2,001-3,000 mm
- [ ] 3,001-4,000 mm
- [ ] > 4,000 mm

Agro-climatic zone
- [ ] humid
- [ ] sub-humid
- [x] semi-arid
- [ ] arid

Specifications on climate
Average annual rainfall in mm: 853.0

Slope
- [x] flat (0-2%)
- [x] gentle (3-5%)
- [ ] moderate (6-10%)
- [ ] rolling (11-15%)
- [ ] hilly (16-30%)
- [ ] steep (31-60%)
- [ ] very steep (>60%)

Landforms
- [ ] plateau/plains
- [x] ridges
- [ ] mountain slopes
- [ ] hill slopes
- [ ] footslopes
- [ ] valley floors

Altitude
- [ ] 0-100 m a.s.l.
- [x] 101-500 m a.s.l.
- [ ] 501-1,000 m a.s.l.
- [ ] 1,001-1,500 m a.s.l.
- [ ] 1,501-2,000 m a.s.l.
- [ ] 2,001-2,500 m a.s.l.
- [ ] 2,501-3,000 m a.s.l.
- [ ] 3,001-4,000 m a.s.l.
- [ ] > 4,000 m a.s.l.

Technology is applied in
- [ ] convex situations
- [ ] concave situations
- [x] not relevant

Soil depth
- [x] very shallow (0-20 cm)
- [x] shallow (21-50 cm)
- [ ] moderately deep (51-80 cm)
- [ ] deep (81-120 cm)
- [ ] very deep (> 120 cm)

Soil texture (topsoil)
- [ ] coarse/ light (sandy)
- [x] medium (loamy, silty)
- [x] fine/ heavy (clay)

Soil texture (> 20 cm below surface)
- [ ] coarse/ light (sandy)
- [x] medium (loamy, silty)
- [x] fine/ heavy (clay)

Topsoil organic matter content
- [ ] high (>3%)
- [ ] medium (1-3%)
- [x] low (<1%)

Groundwater table
- [ ] on surface
- [ ] < 5 m
- [x] 5-50 m
- [ ] > 50 m

Availability of surface water
- [ ] excess
- [ ] good
- [x] medium
- [ ] poor/ none

Water quality (untreated)
- [ ] good drinking water
- [x] poor drinking water (treatment required)
- [ ] for agricultural use only (irrigation)
- [ ] unusable

Water quality refers to: ground water

Is salinity a problem?
- [ ] Yes
- [x] No

Occurrence of flooding
- [x] Yes
- [ ] No

Species diversity
- [ ] high
- [ ] medium
- [x] low

Habitat diversity
- [ ] high
- [ ] medium
- [x] low

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

Market orientation
- [ ] subsistence (self-supply)
- [x] mixed (subsistence/ commercial)
- [ ] commercial/ market

Off-farm income
- [x] less than 10% of all income
- [ ] 10-50% of all income
- [ ] > 50% of all income

Relative level of wealth
- [ ] very poor
- [x] poor
- [x] average
- [ ] rich
- [ ] very rich

Level of mechanization
- [ ] manual work
- [x] animal traction
- [x] mechanized/ motorized

Sedentary or nomadic
- [x] Sedentary
- [ ] Semi-nomadic
- [ ] Nomadic

Individuals or groups
- [ ] individual/ household
- [x] groups/ community
- [ ] cooperative
- [ ] employee (company, government)

Gender
- [x] women
- [x] men

Age
- [ ] children
- [x] youth
- [x] middle-aged
- [ ] elderly

Area used per household
- [ ] < 0.5 ha
- [ ] 0.5-1 ha
- [ ] 1-2 ha
- [x] 2-5 ha
- [x] 5-15 ha
- [ ] 15-50 ha
- [ ] 50-100 ha
- [ ] 100-500 ha
- [ ] 500-1,000 ha
- [ ] 1,000-10,000 ha
- [ ] > 10,000 ha

Scale
- [x] small-scale
- [x] medium-scale
- [ ] large-scale

Land ownership
- [ ] state
- [ ] company
- [x] communal/ village
- [ ] group
- [ ] individual, not titled
- [ ] individual, titled

Land use rights
- [ ] open access (unorganized)
- [x] communal (organized)
- [ ] leased
- [ ] individual

Water use rights
- [ ] open access (unorganized)
- [x] communal (organized)
- [ ] leased
- [ ] individual

Access to services and infrastructure

	poor			good
health		✓		
education			✓	
technical assistance			✓	
employment (e.g. off-farm)		✓		

markets poor good
energy poor ✓ good
roads and transport poor ✓ good
drinking water and sanitation poor ✓ good
financial services poor ✓ good

IMPACTS

Socio-economic impacts

Crop production: decreased — increased ✓

Quantity before SLM: 1.5 t per hectare
Quantity after SLM: 2.5 t per hectare
Combining corn with pigeon pea doubles maize yields

crop quality: decreased — increased ✓

Once the crops have been combined over two seasons, chemical fertilizers are no longer required. The combination makes it easier to obtain organic products.

wood production: decreased — increased ✓

After coppicing, the stems are used as firewood by women.

product diversity: decreased — increased ✓

Pigeon pea seeds are edible.

land management: hindered — simplified ✓

expenses on agricultural inputs: increased — decreased ✓

Pigeon pea leaves yield sufficient biomass. This biomass facilitates soil fertilization.

farm income: decreased — increased ✓

Improved yields translate into higher agricultural incomes.

economic disparities: increased — decreased ✓

workload: increased — decreased ✓

Socio-cultural impacts

food security/ self-sufficiency: reduced — improved ✓

Improving maize yields and sourcing pigeon pea seeds help improve food security for producers

recreational opportunities: reduced — improved ✓

By improving their income, producers can afford to spend more time on leisure activities.

SLM/ land degradation knowledge: reduced — improved ✓

Ecological impacts

evaporation: increased — decreased ✓

soil organic matter/ below ground C: decreased — increased ✓

micro-climate: worsened — improved ✓

Off-site impacts

buffering/ filtering capacity (by soil, vegetation, wetlands): reduced — improved ✓

COST-BENEFIT ANALYSIS

Benefits compared with establishment costs

Short-term returns: very negative — very positive ✓

Long-term returns: very negative — very positive ✓

Benefits compared with maintenance costs

Short-term returns: very negative — very positive ✓

Long-term returns: very negative — very positive ✓

CLIMATE CHANGE

Gradual climate change

annual temperature increase: not well at all — very well ✓

seasonal temperature decrease: not well at all — very well ✓ Season: dry season

annual rainfall decrease: not well at all — very well ✓

seasonal rainfall increase: not well at all — very well ✓ Season: dry season

ADOPTION AND ADAPTATION

Percentage of land users in the area who have adopted the Technology

Of all those who have adopted the Technology, how many have done so without receiving material incentives?

- [ ] single cases/ experimental
- [ ] 1-10%
- [ ] 11-50%
- [x] > 50%

- [ ] 0-10%
- [x] 11-50%
- [ ] 51-90%
- [ ] 91-100%

Has the Technology been modified recently to adapt to changing conditions?

- [ ] Yes
- [x] No

To which changing conditions?

- [ ] climatic change/ extremes
- [ ] changing markets
- [ ] labour availability (e.g. due to migration)

CONCLUSIONS AND LESSONS LEARNT

Strengths: land user's view

- Increased crop yields
- Regeneration of soil fertility
- Edibility of the seeds

Strengths: compiler's or other key resource person's view

- Enhanced soil fertility
- High nitrogen fixation capacity
- Increased crop yields
- Weed control capability

Weaknesses/ disadvantages/ risks: land user's viewhow to overcome

- Maintenance difficulties, sudden bursting of pods Carry out maintenance when seedlings are not too developed; harvest as pods turn brown.

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's viewhow to overcome

- The market for pigeon pea grain is virtually non-existent. Create warehouses for the sale of pigeon pea seeds; display pigeon pea seeds at agricultural fairs to promote their environmental, health and food safety benefits.

REFERENCES

Compiler
Gatien AGBOKOUN CHRISTOPHE

Editors
Siagbé Golli
Abdoul Karim MIEN
DOSSOU-YOVO bernardin
Tabitha Nekesa
Ahmadou Gaye

Reviewer
Sally Bunning
William Critchley

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Resource persons
Roland DOSSOUMON - SLM specialist
Moumouni ALIOU - SLM specialist

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_6518/

Linked SLM data
n.a.

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