AMG system with elevated barrels for irrigation of cash crops (okra) through drip laterals. (ICRISAT (Niamey, Niger))

African market gardens (Senegal)

DESCRIPTION

The African Market Garden (AMG) is a horticultural production system based on low-pressure drip irrigation.

According to the level of experience, market orientation or social structure of the land users, four different AMG models have been developed. This case study focuses on the "Cluster System" which is suitable for an organized group of independent vegetable producers sharing a common water delivery system. From a central source, water is distributed through a pipe network to a cluster of plots. Each farmer operates a 1,000 m2 unit, and each is equipped with an elevated 200 litre barrel and a standard irrigation kit, including a tap, filter and thick-tube drip laterals. Minimal size of an AMG unit should be 500 m2. Affordable high-quality material is used and the design and operation is simple. The barrel also serves as a fertilizer tank. A float ensures a constant pressure head. Water supply is calculated by the time needed for delivery of the daily water dosage, or through the use of water dosing valves. Producers have individual control of water use. Since the AMG requires only 1 meter pressure for operation, it can draw on low-capacity renewable energy sources such as elevated dams, solar pumps or reservoirs. To supply an area of 50,000 m2 with 8 mm/day in the hot season a 400 m3-reservoir is required. The crops are planted on elevated beds. Water mixed with urea as fertilizer is applied daily. Drip irrigation improves growing conditions for crops while at the same time saving labor, water and other inputs. AMG is promoted as a holistic management package, integrating all aspects of production, post-harvest and marketing in one system. This includes the use of improved vegetable varieties, improved crop husbandry, integrated pest management, as well as improved storage, processing and marketing of products, and improved access to inputs.

Establishment / maintenance activities and inputs: The following establishment activities are connected to this technology: 1. Build concrete reservoir. 2. Drill borehole (110 mm diameter; 12 m deep, hand drilled). 3. Install motor pump and tubes to connect well with reservoir. 4. Install drip kit with tap, filter and drip laterals (8-16 mm in diameter). 5. Establish a fence to protect the garden.
For maintenance the following activities are required: 1. Prepare elevated beds with a basic dressing of 4 kg/m2 manure and 0.1 kg/m2 NPK fertilizer biannually. 2.Add urea to irrigation water (concentration: 50-100 ppm N). 3. Operate water supply system.

Natural / human environment: AMG is spreading fast in Senegal and Burkina Faso. Up-scaling of AMG in dry West Africa will depend on access to technology, inputs, knowledge and organization, and a conducive institutional environment.

LOCATION

Location: Ngoyé Ndioffogor and Mbassis Tadadem, Senegal

No. of Technology sites analysed:

Geo-reference of selected sites
- -16.6972, 14.4135

Spread of the Technology:

In a permanently protected area?:

Date of implementation: less than 10 years ago (recently)

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

CLASSIFICATION OF THE TECHNOLOGY

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

Land use

Cropland
- Annual cropping

Water supply
- [x] rainfed
- [ ] mixed rainfed-irrigated

- [ ] mitigate climate change and its impacts
- [x] create beneficial economic impact
- [ ] create beneficial social impact

- [ ] full irrigation

Purpose related to land degradation

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

Degradation addressed

water degradation - Ha: aridification, Hg: change in groundwater/aquifer level

SLM group

- irrigation management (incl. water supply, drainage)
- post-harvest measures

SLM measures

agronomic measures - A7: Others

management measures - M2: Change of management/ intensity level

TECHNICAL DRAWING

Technical specifications

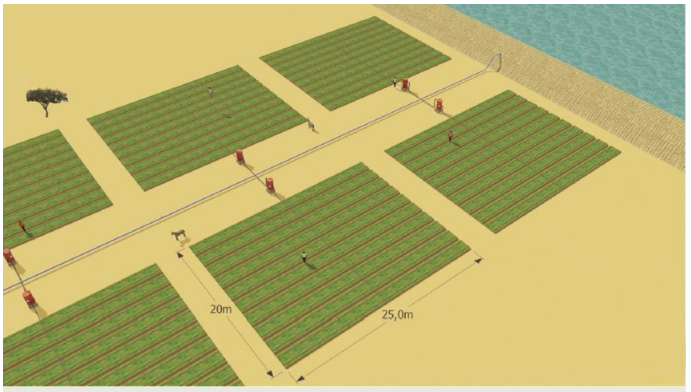
Cluster system with several AMG plots connected to a central water source - in this case a small elevated dam

Technical knowledge required for field staff / advisors: high

Technical knowledge required for land users: high

Main technical functions: increase of groundwater level / recharge of groundwater, water spreading

Agronomic measure: drip irrigation



Author: ICRISAT, Niamey, Niger

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs

- Costs are calculated:
- Currency used for cost calculation: **n.a.**
- Exchange rate (to USD): 1 USD = n.a
- Average wage cost of hired labour per day: 2.00

Most important factors affecting the costs

n.a.

Establishment activities

1. Get inputs (Timing/ frequency: None)

Establishment inputs and costs

Specify input	Unit	Quantity	Costs per Unit (n.a.)	Total costs per input (n.a.)	% of costs borne by land users
Equipment					
Tools	Unit	1.0	65.0	65.0	
Drip system	Unit	1.0	300.0	300.0	
Oil drum	Unit	1.0	56.0	56.0	
Well/borehole	Unit	1.0	16.0	16.0	
Motor pump	Unit	1.0	34.0	34.0	
Construction material					
Fence	Unit	1.0	25.0	25.0	
PVC connections	Unit	1.0	79.0	79.0	
Total costs for establishment of the Technology				**575.0**	
Total costs for establishment of the Technology in USD				*575.0*	

Maintenance activities

1. Prepare elevated beds with a basic dressing of 4 kg/m2 manure and 0.1 kg/m2 NPK fertilizer biannually (Timing/ frequency: biannually)
2. Add urea to irrigation water (concentration: 50-100 ppm N) (Timing/ frequency: None)
3. Operate water supply system (Timing/ frequency: None)

Maintenance inputs and costs

Specify input	Unit	Quantity	Costs per Unit (n.a.)	Total costs per input	% of costs borne by land

				(n.a.)	users
Labour					
Labour	Unit	1.0	510.0	510.0	
Total costs for maintenance of the Technology				**510.0**	
Total costs for maintenance of the Technology in USD				*510.0*	

NATURAL ENVIRONMENT

Average annual rainfall
- [ ] < 250 mm
- [x] 251-500 mm
- [ ] 501-750 mm
- [ ] 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
Thermal climate class: tropics

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

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

Altitude
- [x] 0-100 m a.s.l.
- [ ] 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
- [ ] not relevant

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

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

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

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

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

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

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

Is salinity a problem?
- [ ] Ja
- [ ] Nee

Occurrence of flooding
- [ ] Ja
- [ ] Nee

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

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

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

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

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

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

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

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

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

Gender
- [ ] women
- [ ] men

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

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

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

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

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

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

> 10,000 ha

Access to services and infrastructure

IMPACTS

Socio-economic impacts

land management

hindered — simplified

Effective application of fertilizer with the water

farm income

decreased — increased

Due to doubled profits from vegetable production (compared to traditional irrigation methods)

workload

increased — decreased

Reduced workload: total workload for AMG is 11.5 man-days compared to 30 man-days in traditional irrigation system (allows people to engage in other activities or education)

Production cost

increased — decreased

Costs for drip irrigated gardens are 50% lower than for traditional irrigated gardens due to savings in labour, water and consequently in fuel

Socio-cultural impacts

food security/ self-sufficiency

reduced — improved

community institutions

weakened — strengthened

Improved organisation (farmer associations, user groups)

SLM/ land degradation knowledge

reduced — improved

Improved knowledge on irrigation techniques /horticulture

Ecological impacts

water quantity

decreased — increased

Water availability / reduced pressure on water resources

evaporation

increased — decreased

Effective use of water due to accurate and equal distribution of water at optimal rates

Off-site impacts

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

Payback period is only 6 months. Net income per farmer after all deduction is about US$ 1,000 per year. The profitability of the AMG is around double that of vegetable gardens irrigated with traditional methods

CLIMATE CHANGE

Gradual climate change

annual temperature increase: not well at all — very well

Climate-related extremes (disasters)

drought: not well at all — very well

ADOPTION AND ADAPTATION

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

- single cases/ experimental
- 1-10%
- 11-50%
- > 50%

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

- 0-10%
- 11-50%
- 51-90%
- 91-100%

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

- Ja

Nee

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

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

- AMG is a holistic management package, integrating all aspects of production, post-harvest and marketing in one system

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

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

- Irrigated vegetable production is a capital intensive undertaking sharing infrastructure, land and water through producer groups can cut investment costs by 60% per unit area. Set-up and operation costs further decrease if producer groups can use communally owned infrastructure and/or alternative energy sources (e.g. elevated dams, solar pumps, artesian well).
- The AMG system is not suitable for farmers with limited access to knowledge, marketing and services improve access to markets and training programs (for extensionists and farmers); guarantee technical assistance during 2-3 years; target the system to educated producers who make a living out of vegetable production. Set up AMG service and demonstration centres offering credit, farm inputs, marketing support, training and technical advice.

REFERENCES

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Full description in the WOCAT database
https://qcat.wocat.net/af/wocat/technologies/view/technologies_944/

Linked SLM data
n.a.

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Key references

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