

Agroforestry Systems: **for *food security, environment & climate***

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**Presented at the 9th Conference on “Policies against Hunger”
21-23 November 2011, Berlin, Germany**



World Agroforestry Centre
TRANSFORMING LIVES AND LANDSCAPES

The dilemma

- Challenges in some developing countries:
 - dilemma: food deficit of today vs environmental debt of tomorrow?
 - conventional land use/soil fertility not affordable to farmers, or respond poorly to environ concerns
 - Result: “Eating the future”!
- Appropriate production systems that are affordable, enhance food security, promote environmental stewardship? Policy approaches to promote them?



Continuous cropping



Features

- **Fixes N from the air to the soil (“fertilizer trees”)**
- **Trees don’t discriminate in N fixation- male vs female**
- **Produces fuelwood on-farm- reduce pressure on communal forests**
- **Multi-purpose (improves soil + fodder for animals)**
- **Carbon sequestration**

10th maize crop after *G. sepium* at 7 weeks





Short- and long-term agroforestry options for replenishing soil fertility

10th Crop



Relay Fallow intercropping (2-3 tons)



Improved Fallows (3-4 tons)



Gliricidia / maize intercropping (3-5 tons)

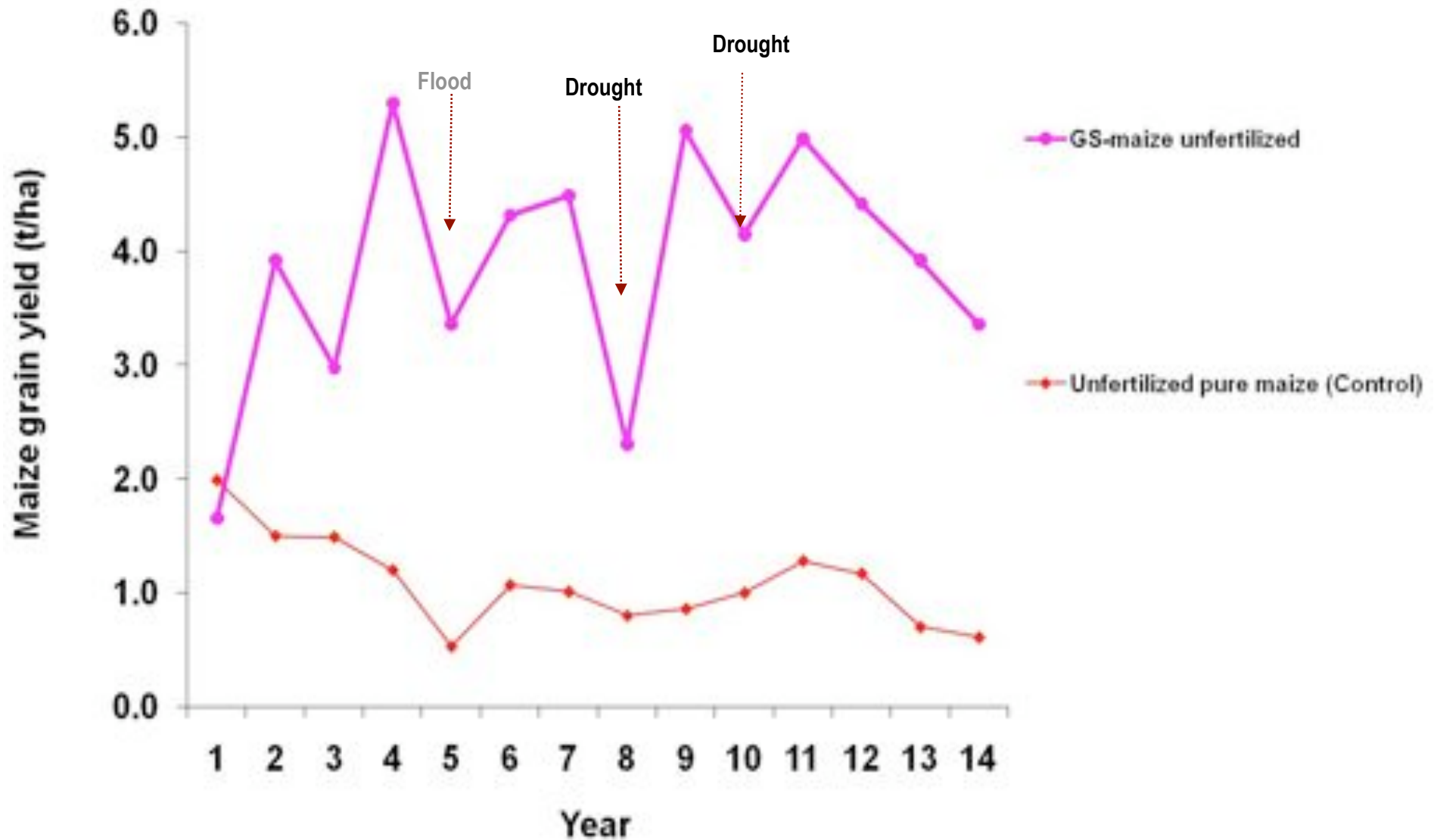
1 year

1-2 years

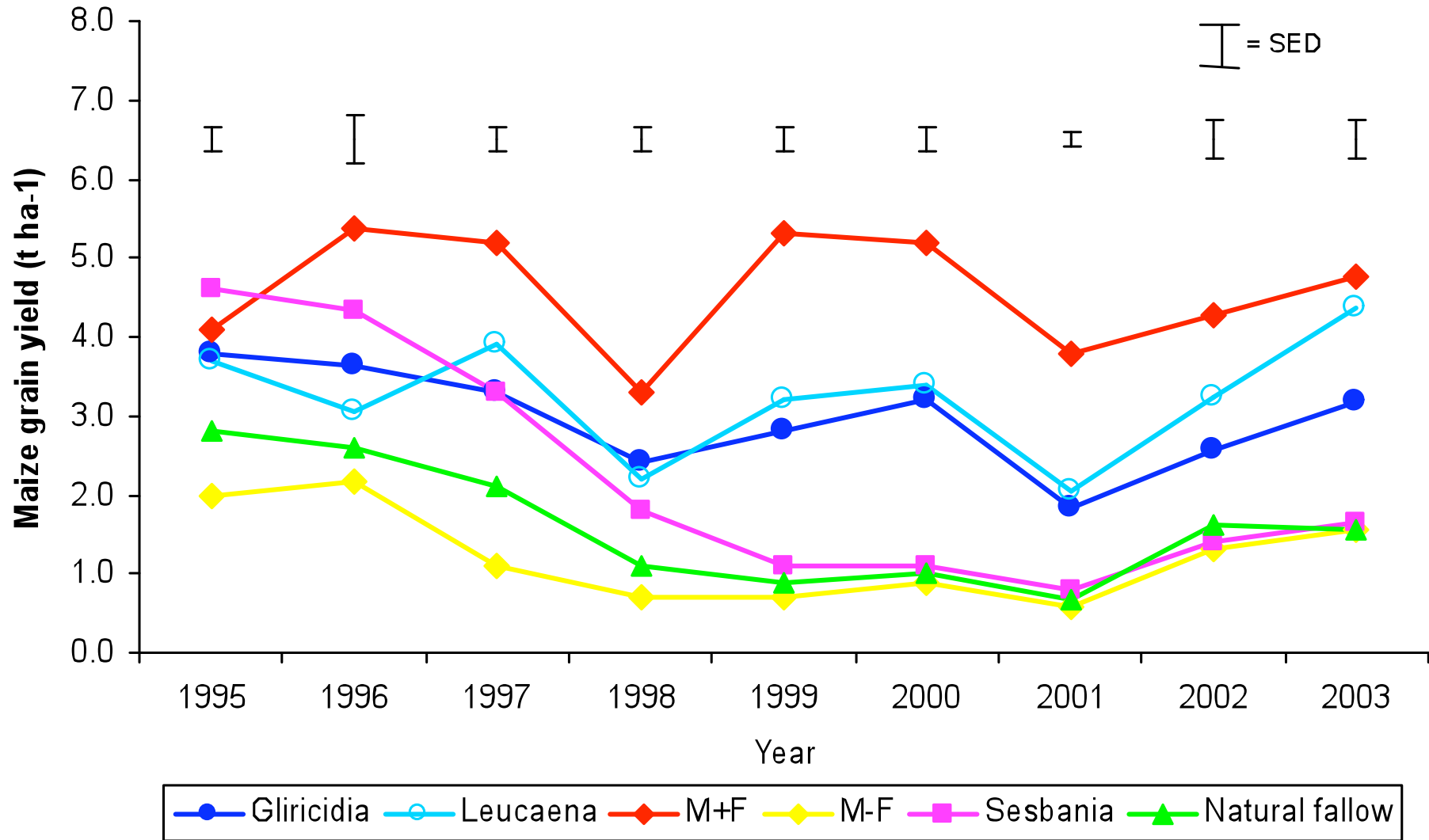
2-3 years

Waiting Period before benefit accrual

Long-term maize yield without fertilizer in a *Gliricidia* system in Malawi over 14 years



Maize yield (t/ha) obtained from various fallow species for nine seasons in Zambia



“Fertilizer trees”

Net profit between from \$269 - S\$307/ha compared with \$130/ha control

Benefit-Cost Ratio ranges 2.77 - 3.13

Provide between 57 and 114 extra person days of maize consumption per year



Evergreen agriculture

Also known as Conservation agriculture with trees



***Faidherbia* Trial Results in Zambia**

Maize yield - zero fertiliser

	2008	2009	2010
<i>With Faidherbia</i>	4.1	5.1	5.6
<i>Without Faidherbia</i>	1.3	2.6	2.6
Number of trials	15	40	40

Source: CFU Zambia, 2010

Water-stressed maize after 21 days of dry spell in Zambia (mid season)



Maize, no fert

- Some yield in drought years from AF
- Soil moisture retention
- Dry season land cover (evergreen)



Maize in AF field

Long term Rain Water Use Efficiency (RUE) in different maize production systems in Nigeria and Zambia

<u>Type of production system</u>	<u>Increase in RUE over control (no fert)</u>
Agroforestry trees only	139%
Mineral fertilizer only	85%
Agroforestry trees+ half dosage of recommended fertilizer	202%

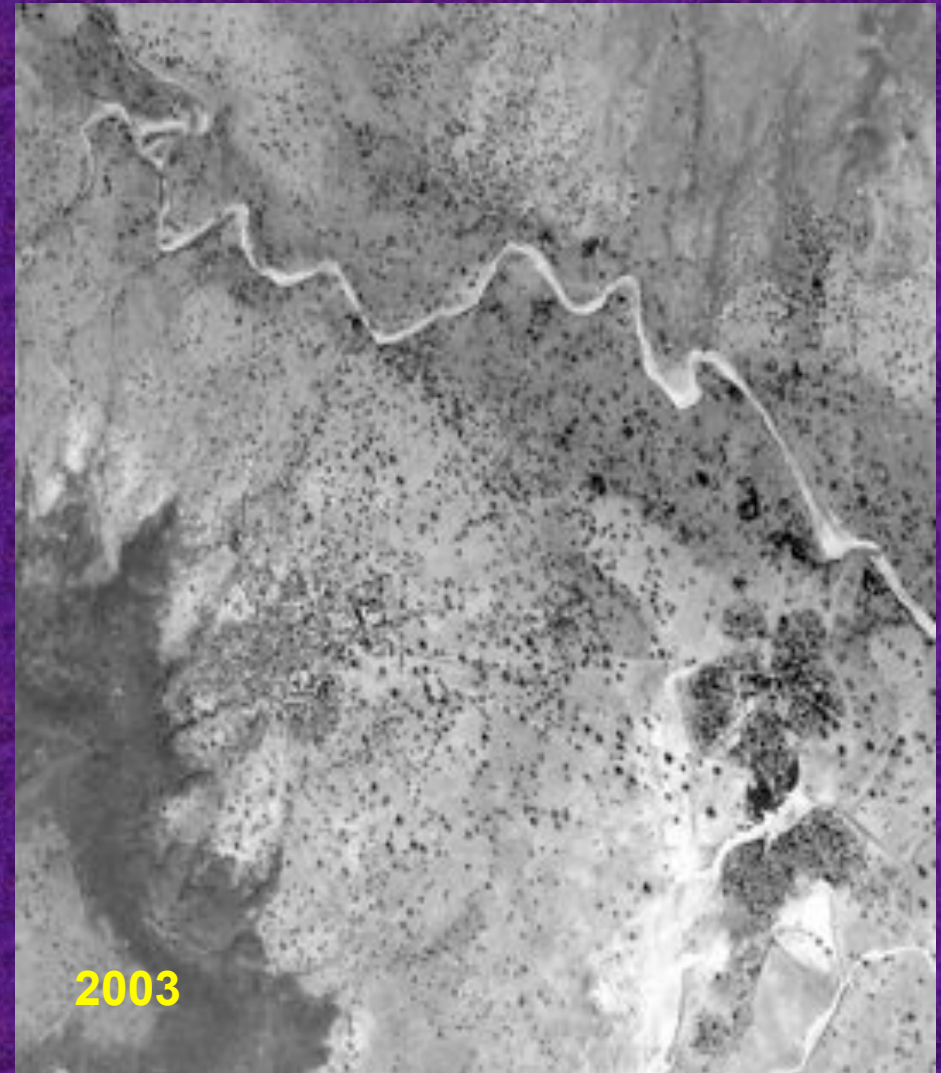
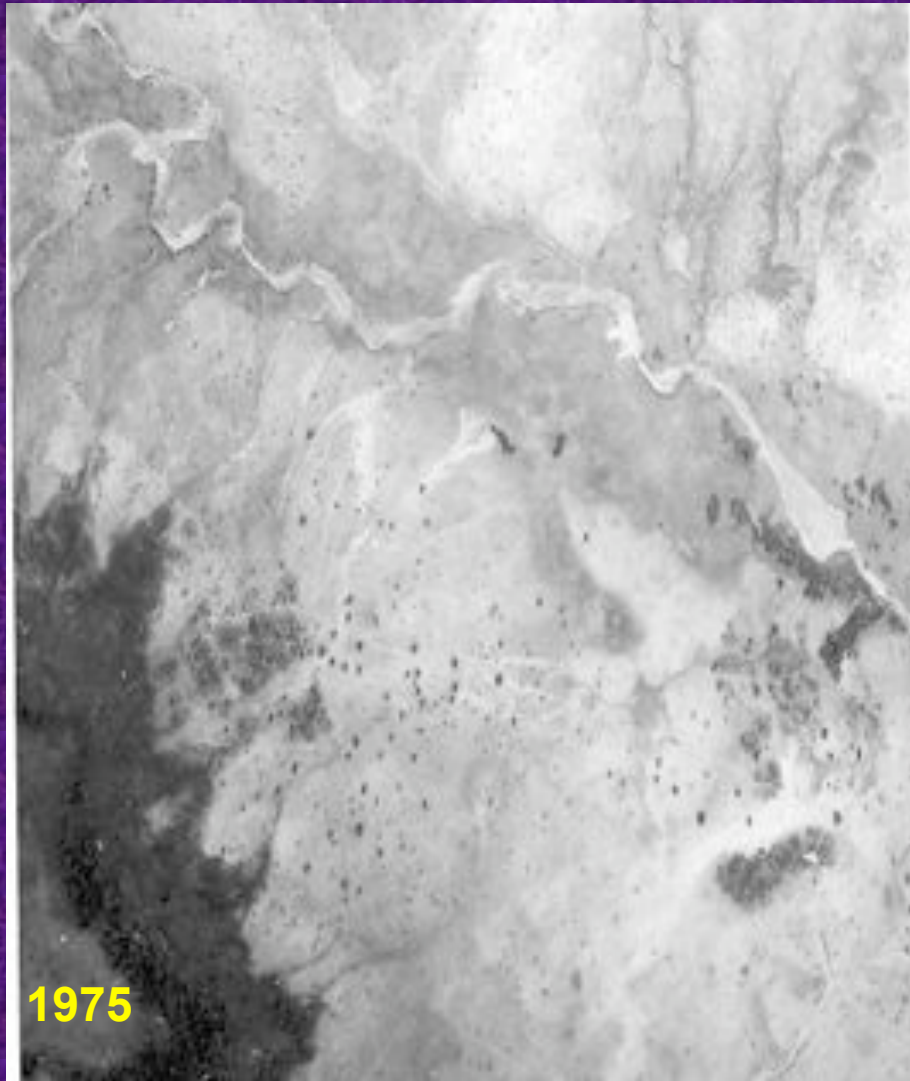
Source: Sileshi, Akinnifesi, Ajayi & Muys 2011

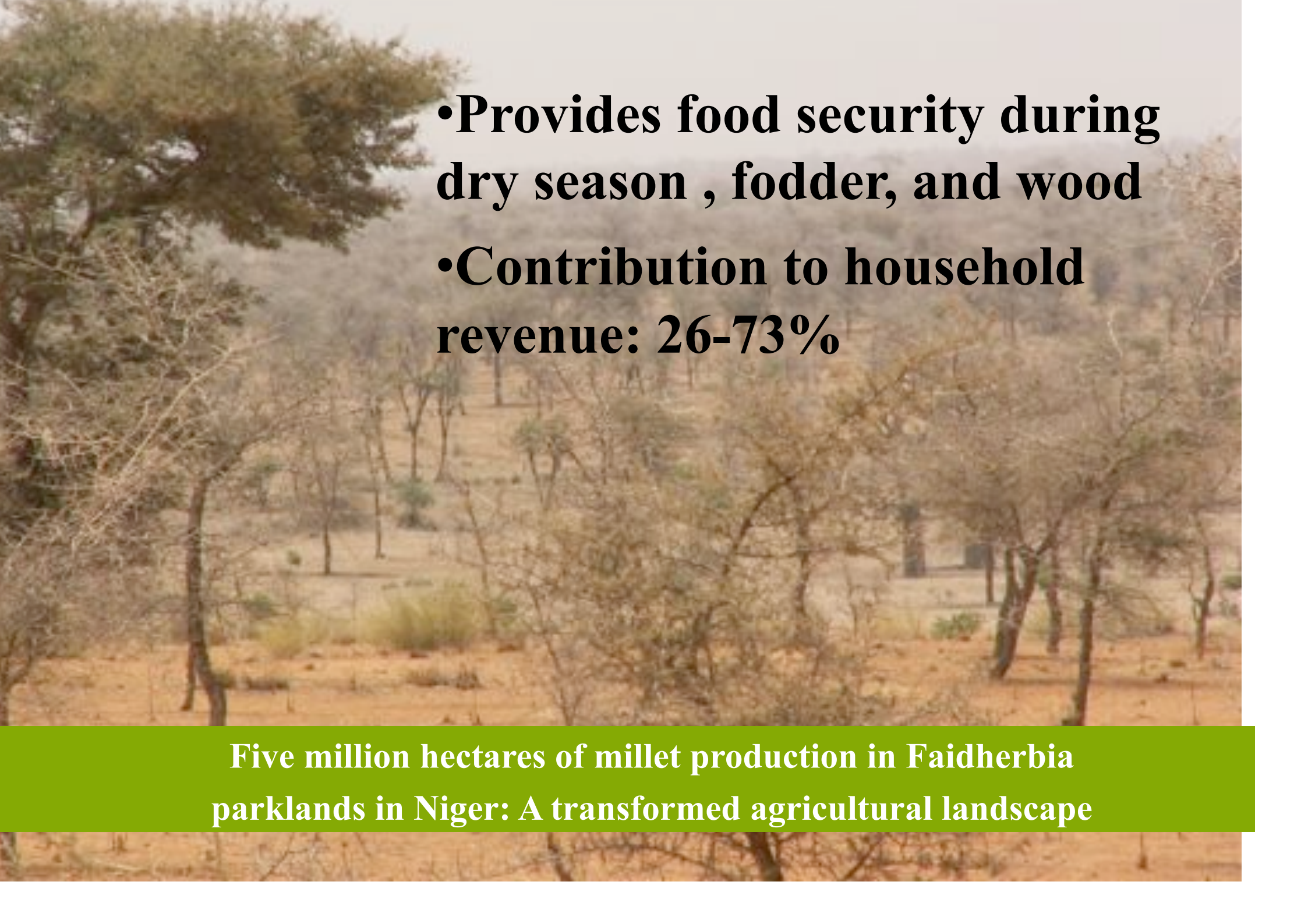
Multi purpose: Fodder Banks

- Protein-rich legumes for livestock in dry season
- Possible blending with commercial feeds
- Raise milk yield by 1.5-2 kg of milk/day/ farmer
- Extra revenue \$100/cow/year.



Remote sensing analyses of Former Managed Natural Regeneration (FMNR) and re-greening across 5 m hectares in Niger Republic



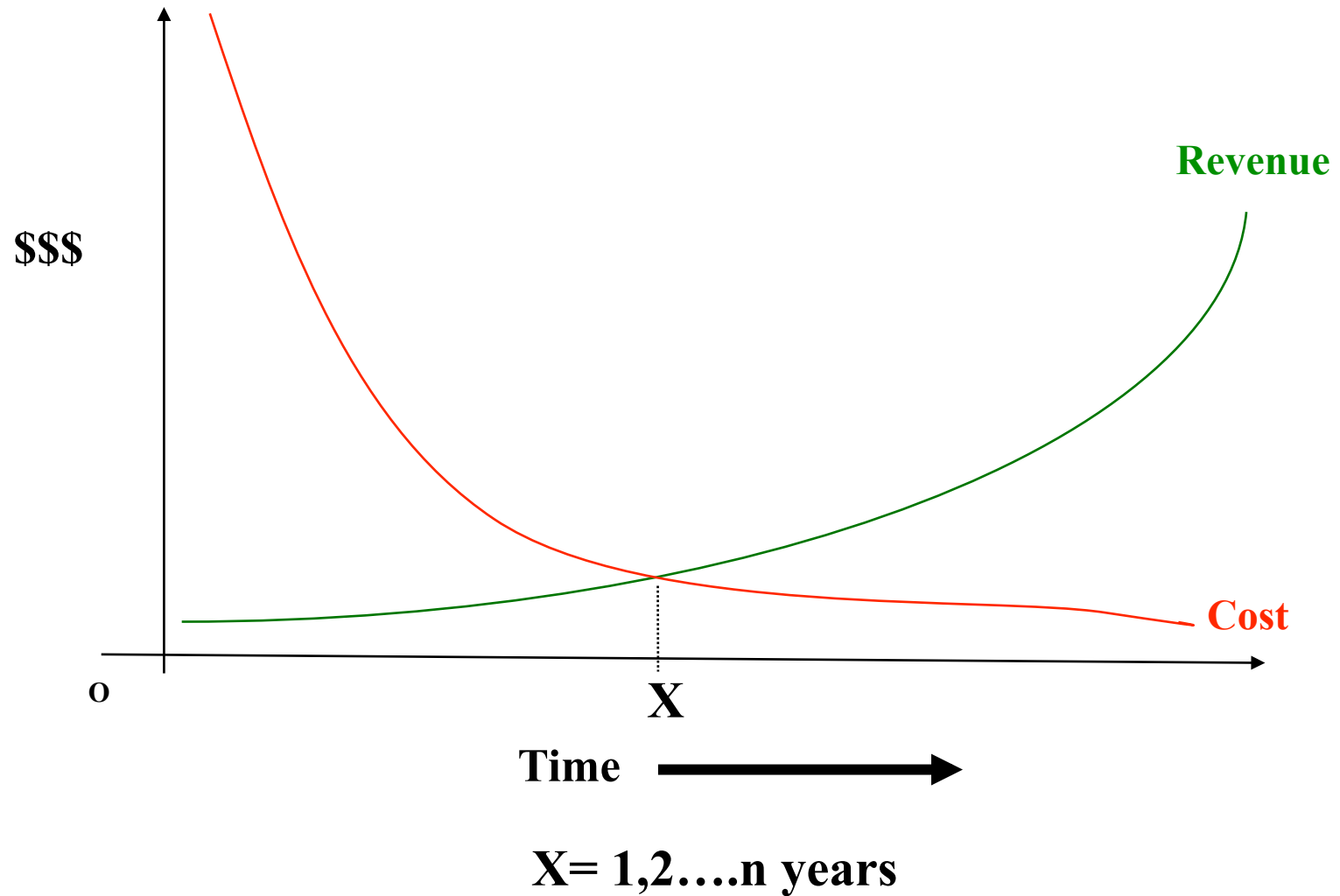
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- **Provides food security during dry season , fodder, and wood**
 - **Contribution to household revenue: 26-73%**

Five million hectares of millet production in Faidherbia parklands in Niger: A transformed agricultural landscape

Scaling up

- **Property rights- land and tree tenure regimes**
 - Access to land/tree and appropriate benefits of investment
 - State ownership of trees on farm! E.g. Sahel
- **Long term nature of agroforestry**
 - Profitable ...but long “waiting period”
 - Poverty-induced high discounting of longer term benefits
 - Credits- absent or short-term

Cost and benefit structure of AF over temporal period



Scaling up

- Low national capacity-
 - Human capacity- AF in education curricula
 - Supportive infrastructure and services- e.g seed system
- Policy & market failures ► ► ► underinvestment in AF
 - Policies favour conventional production system
 - Positive externalities and environmental benefits not rewarded
 - Options to encourage small-holder farmers? PES?

Scaling up

- Science-policy dialogue and information brokerage
 - synthesize existing knowledge for policy makers.
 - Address policies, market, customary & institutional practices that create unnecessary *barriers* or *dis-incentives* to investment in planting trees in agricultural landscape

More details

- Ajayi OC, Place F, Akinnifesi FK, Sileshi GW 2011 Agricultural Success from Africa – Case of Fertilizer Tree Systems in Southern Africa. *International Journal of Agricultural Sustainability* 9(1): 129-136
- Sileshi GW, Akinnifesi FK, Ajayi OC, Muys B 2011 Integration of legume trees in maize-based cropping systems improves rain use efficiency and yield stability under rain-fed agriculture. *Agricultural Water Management* 98: 1364– 1372
- Garrity DP, Akinnifesi FK, Ajayi OC, Sileshi G, Mowo J, Kalinganire A, Larwanou M 2010 Evergreen Agriculture: A robust approach to sustainable food security in Africa. *Food Security* 2(3):197–214
- Akinnifesi FK, Ajayi OC, Sileshi G, Chirwa P, Chianu J 2010 Fertilizer trees for sustainable food security in the maize-based production systems of East and Southern Africa Region: A review. *Agronomy for Sustainable Development* 30: 615-629
- Ajayi OC, Place F, Kwesiga F, and Mafongoya P 2007 Impacts of Improved Tree Fallow Technology in Zambia. In: Waibel H. and Zilberman D (eds) *International Research on Natural Resource Management: Advances in Impact Assessment* CABI Wallingford, UK and Science Council/CGIAR, Rome pp.147-168 ISBN: 976-1-84593-283-1

Summary

- Focus on not just food production exclusively, but also sustainability of the system
- Beyond generating the “right technology”, we also need to get the institutions, market & policy right

A photograph of a young bamboo forest. The bamboo stalks are thin and green, growing in rows. The ground is covered with brown soil and some dried bamboo leaves. In the background, there are more bamboo plants and a clear blue sky. The text "Thank you" is written in large, white, sans-serif font across the center of the image. A red timestamp "17 12:07 AM" is visible in the bottom right corner of the photo.

Thank you

17 12:07 AM