

Food Security: Is Sustainable Intensification the Answer? 粮食安全：可持续的集约化耕作是否解题之道？

Sustainable Intensification:

A New Paradigm for African Agriculture



A 2013 Montpellier Panel Report

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The Global Crises 全球危机

Financial
金融

Civil Strife
内乱

Food security
粮食安全

Energy
能源

'A Perfect Storm' “完美风暴”

Water
水

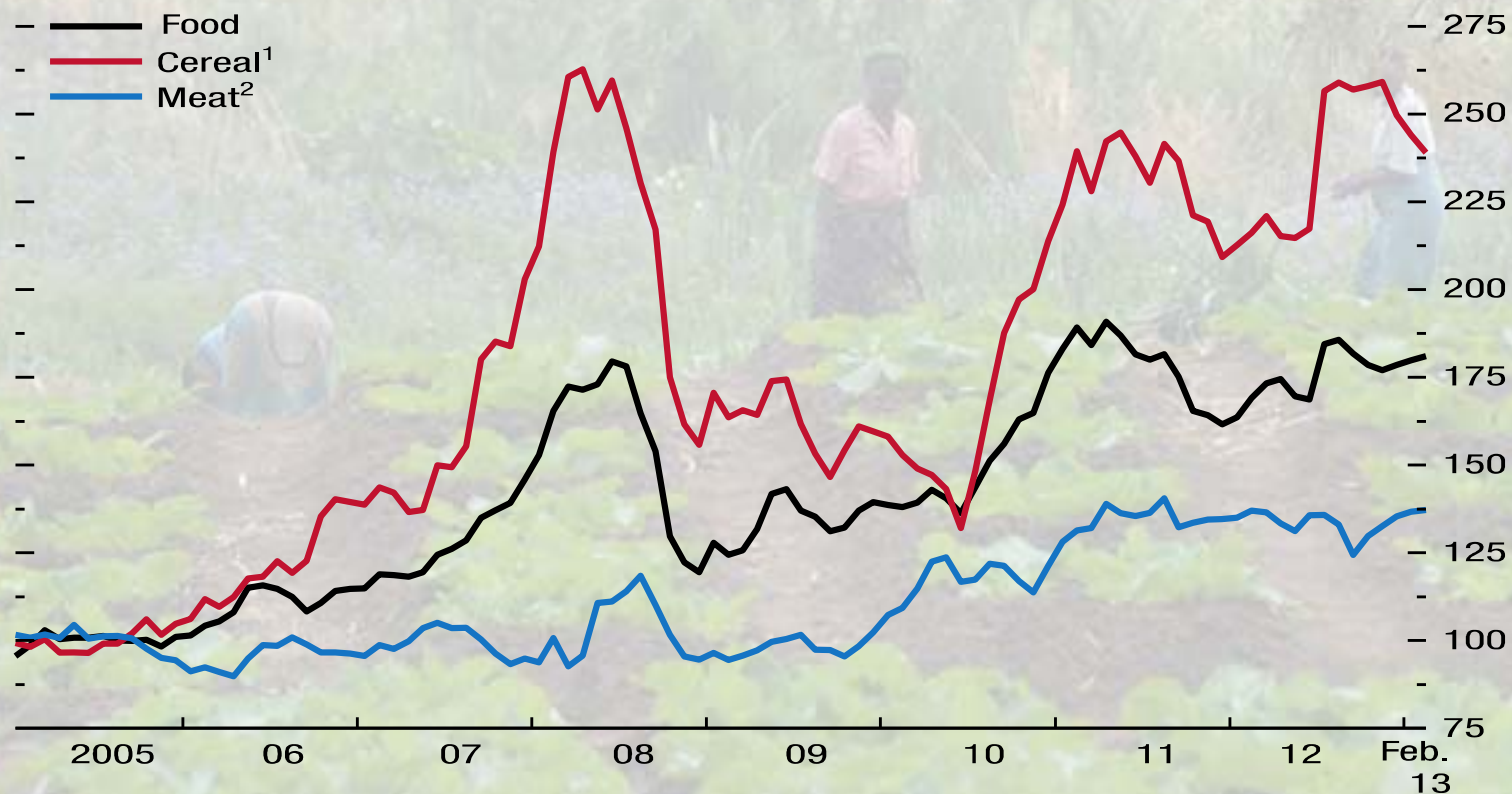
Ecosystem Functions
生态系统功能

Climate Change
气候变化

We Face 3 Interconnected Challenges to Food Security 我们面临三个与粮食安全有关的挑战

- Increasing food prices and recurring food price spikes 粮食价格上涨, 不断出现峰值
- About 1 billion people (1 in 6 of the world's population) are chronically hungry 全球有10亿人(每六个人中就有一个)长期忍饥挨饿。
- We have to increase food production by 60-100% by 2050 到2050年, 粮食产量需要提高60-100%

IMF Food Prices 国际货币基金组织: 粮食价格



Source: IMF, Primary Commodity Price System.
¹A weighted average of wheat, corn, rice, and barley.
²A weighted average of beef, lamb, pork, and poultry.

Globally 1 in 3 children under 5 malnourished – 180m 全球5岁以下的儿童中每三个就有一个营养不良——总计1.8亿



In Africa it is over 40% 非洲营养不良的儿童比例在40%以上

They are under height for their age and suffer from stunted development and possible blindness and death 根据年龄来看，他们身高不足，发育迟缓，可能目盲或死亡

Challenges to feeding the world by 2050

到2050年，养活全世界所面临的挑战

Demand 需求

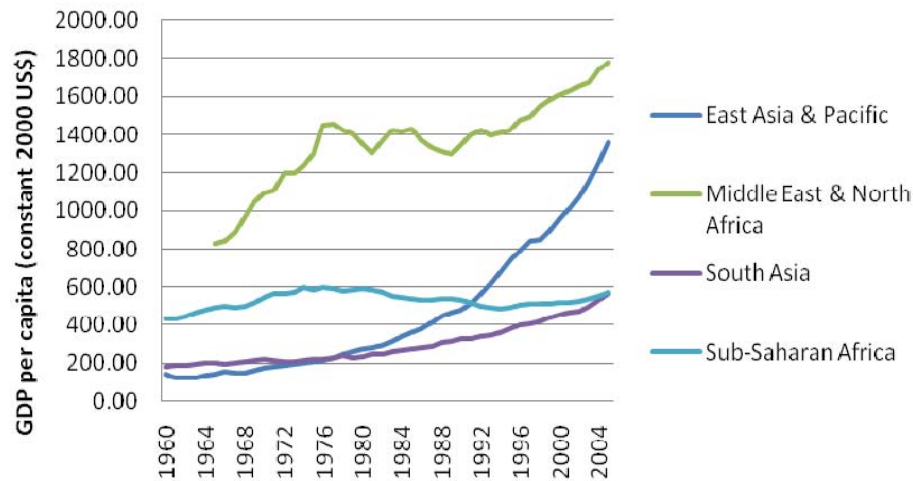
- **Population Growth** 人口增长
- **Changing Diets** 饮食结构改变
- **Biofuel Demand** 对生物燃料的需求

Supply 供给

- **Rising fuel and fertiliser prices** 燃料和化肥价格上涨
- **Climate change** 气候变化
- **Land and water scarcity** 土地和水资源短缺

Rise in Meat Consumption 肉类消费上升

Growth in per capita GDP

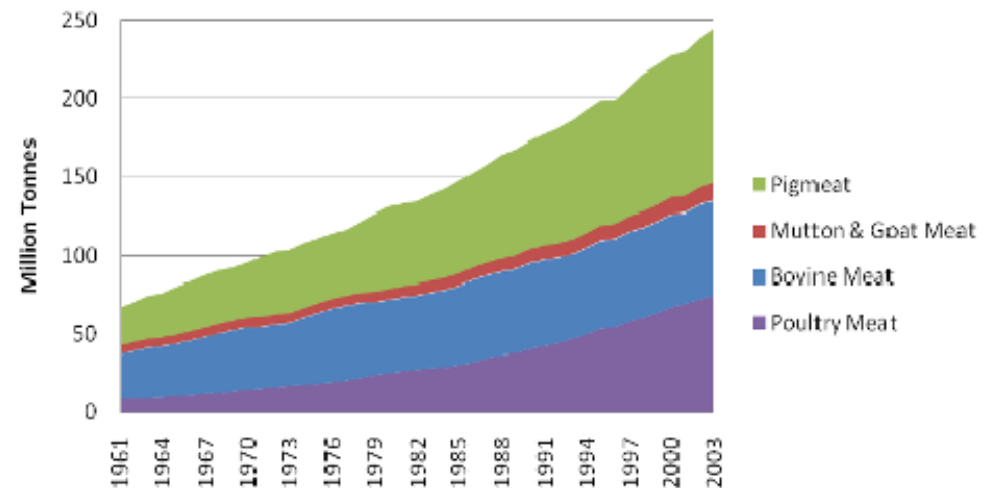


Meat consumption rises with per capita income
随着人均收入上升, 对肉类的消费也增多

World Bank, 2010.
World Development Indicators

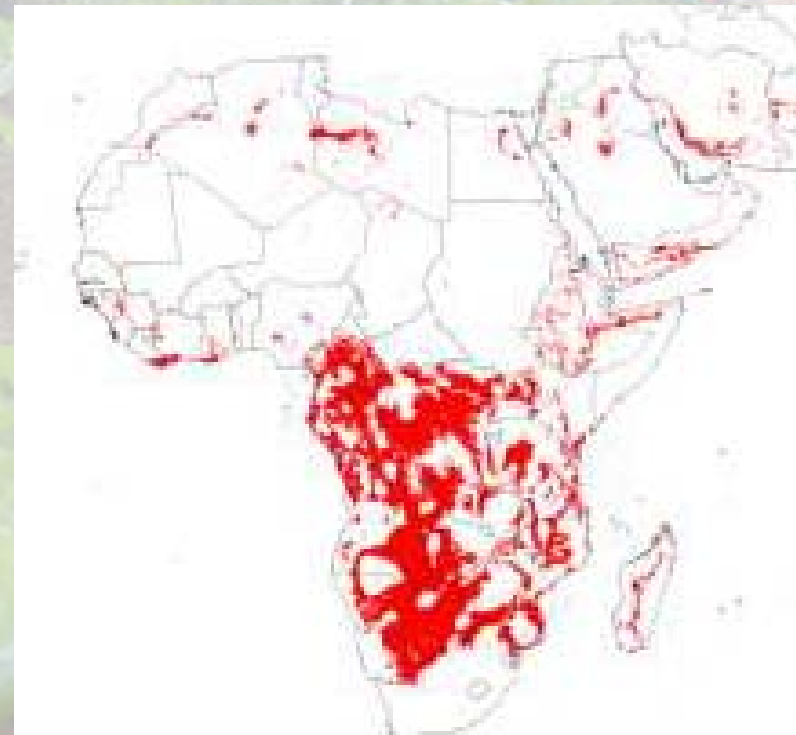
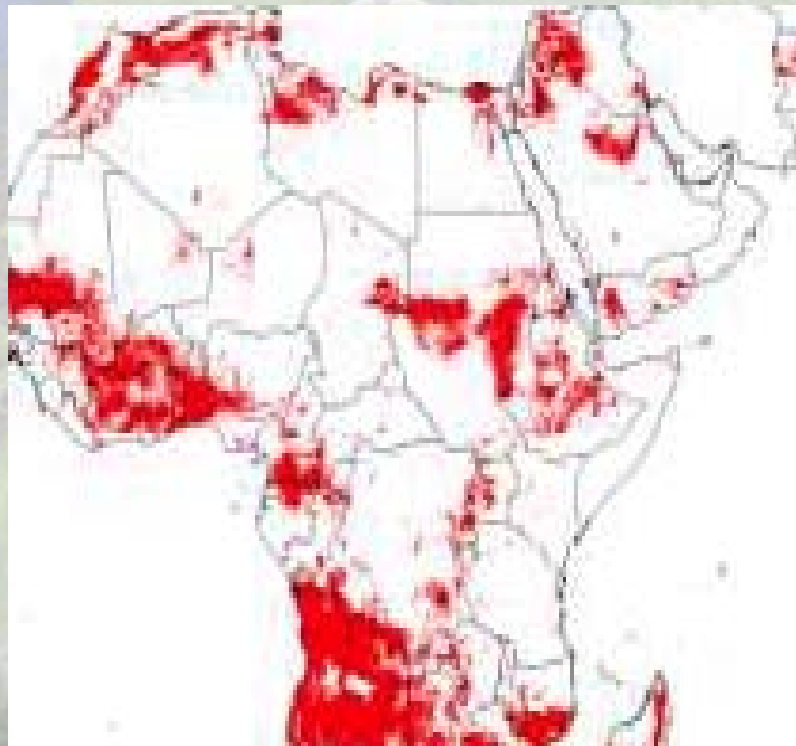
Source: FAO, 2009

Rise in Meat Consumption



Changing Climate in Africa 非洲气候变化

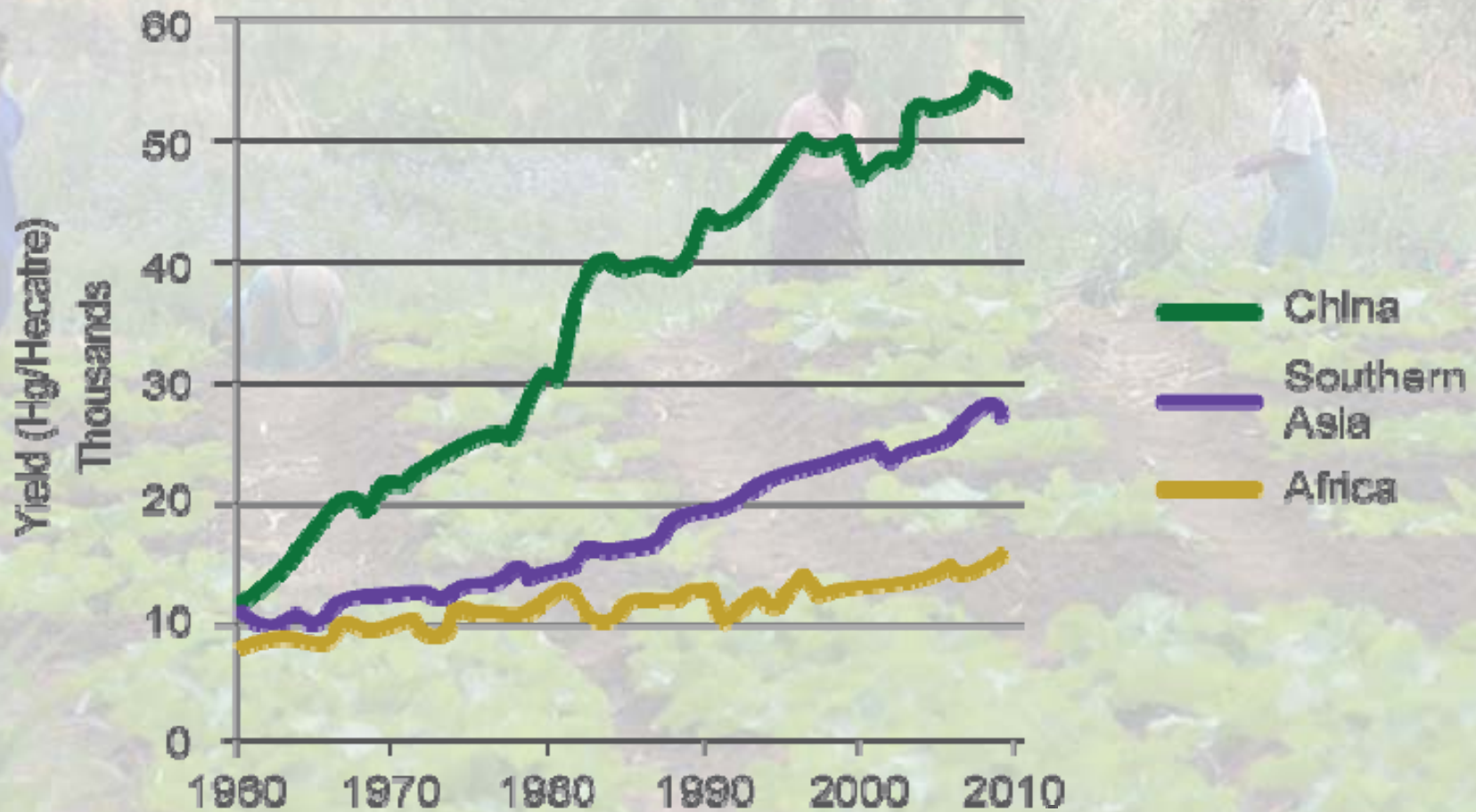
- More than 5% reduction in length of growing period 生长期减少了5%以上
- Average Annual Max Temp > 30°C 年平均最高温度在30度以上



Land and Water Scarcity 土地与水资源短缺

- Physical scarcity 实际短缺
- Overuse 过度使用
- Degradation 退化
- Pollution 污染
- Salinisation 盐碱化

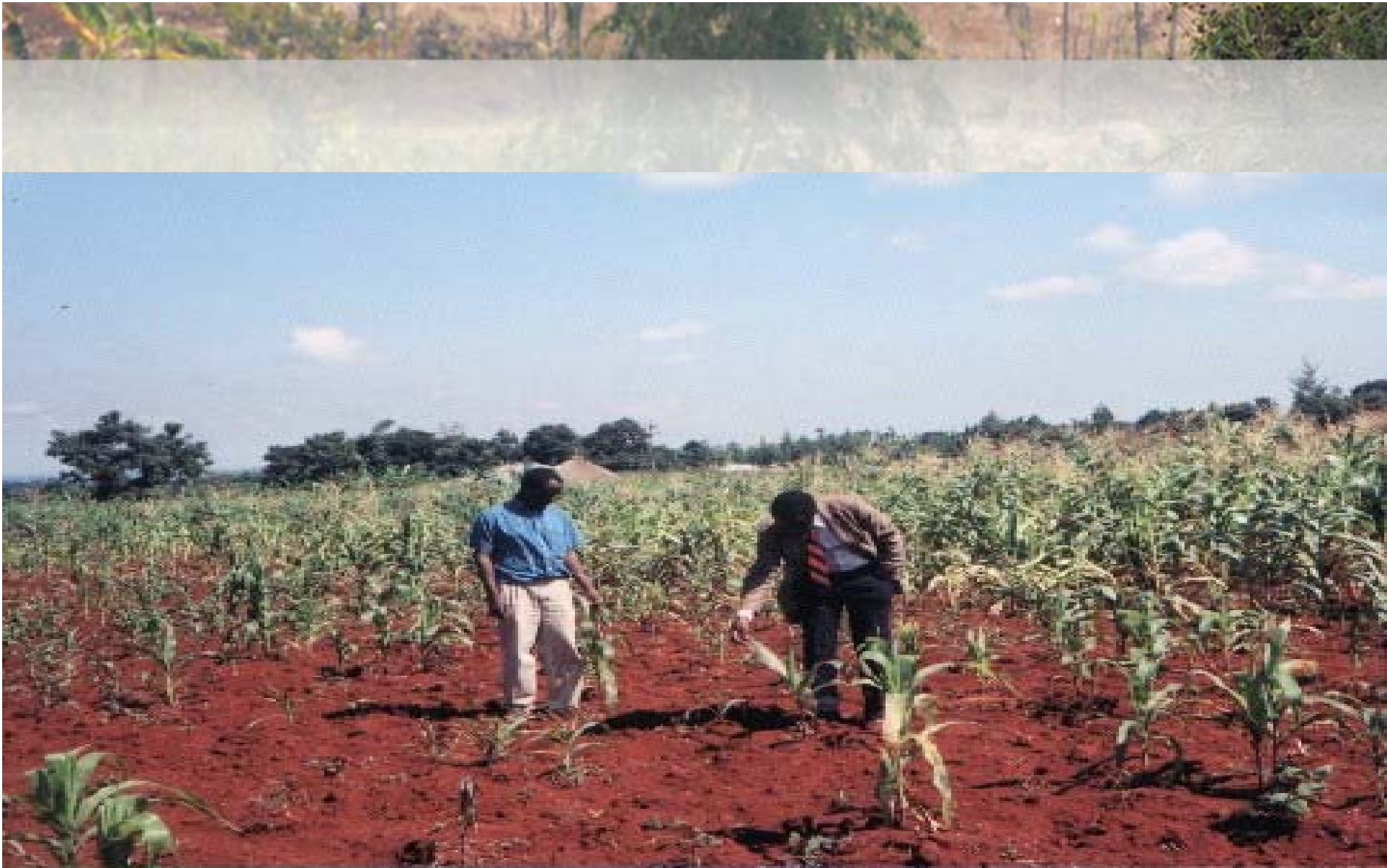
We have to intensify 我们需要集约化



Mrs. Namarunda 纳玛兰达大婶



A single mother
farming a hillside
in western Kenya
肯尼亚西部山村
的一位单身母亲，
务农为生



Cassava 木薯



African Cassava Mosaic Virus
非洲木薯花叶病毒



Mealy bugs 粉蚜

Bananas 香蕉



Wilt 萎焉病

Black Sigatoka 黑斑病



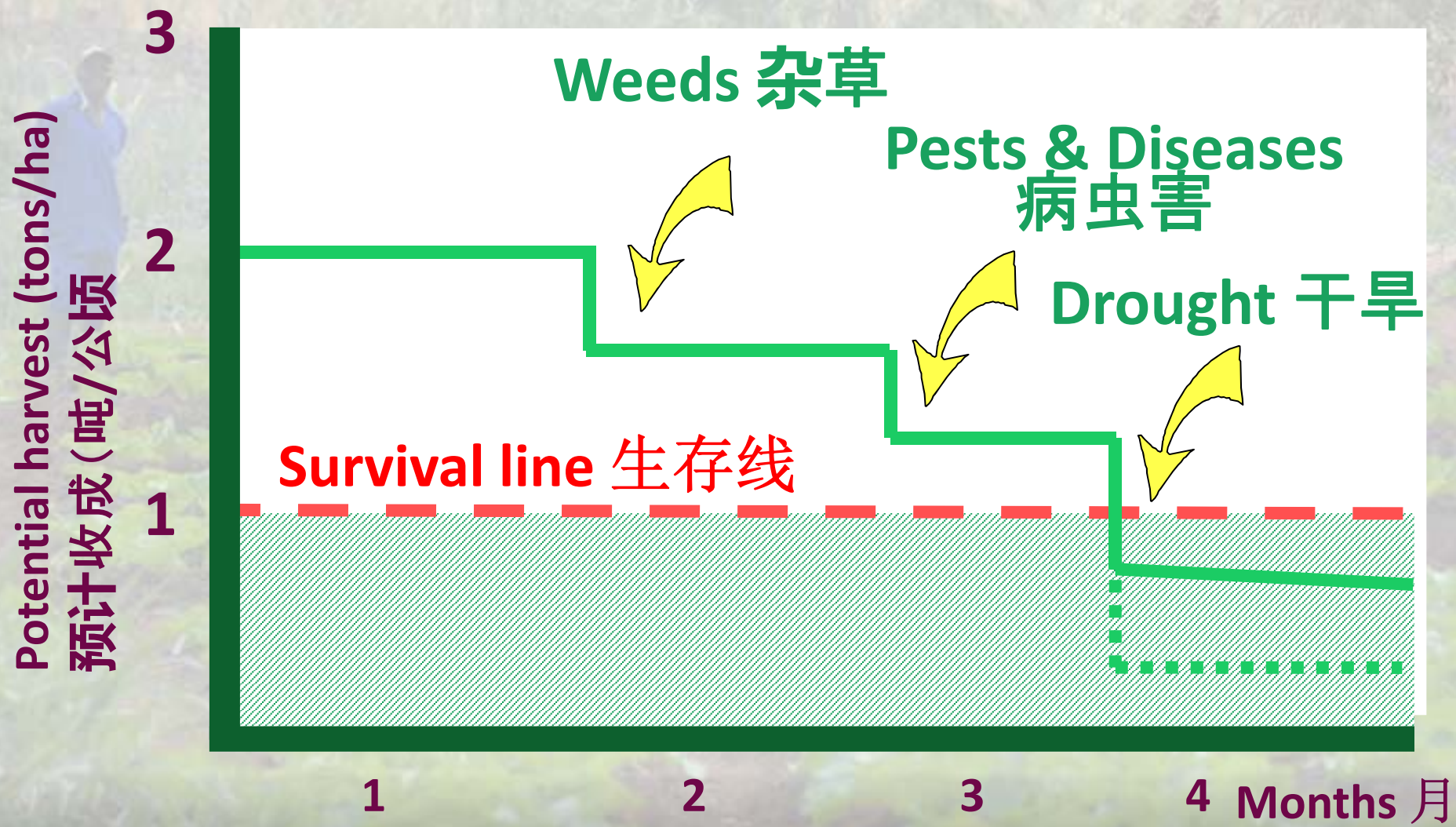
Striga 独脚金（一种寄生草）



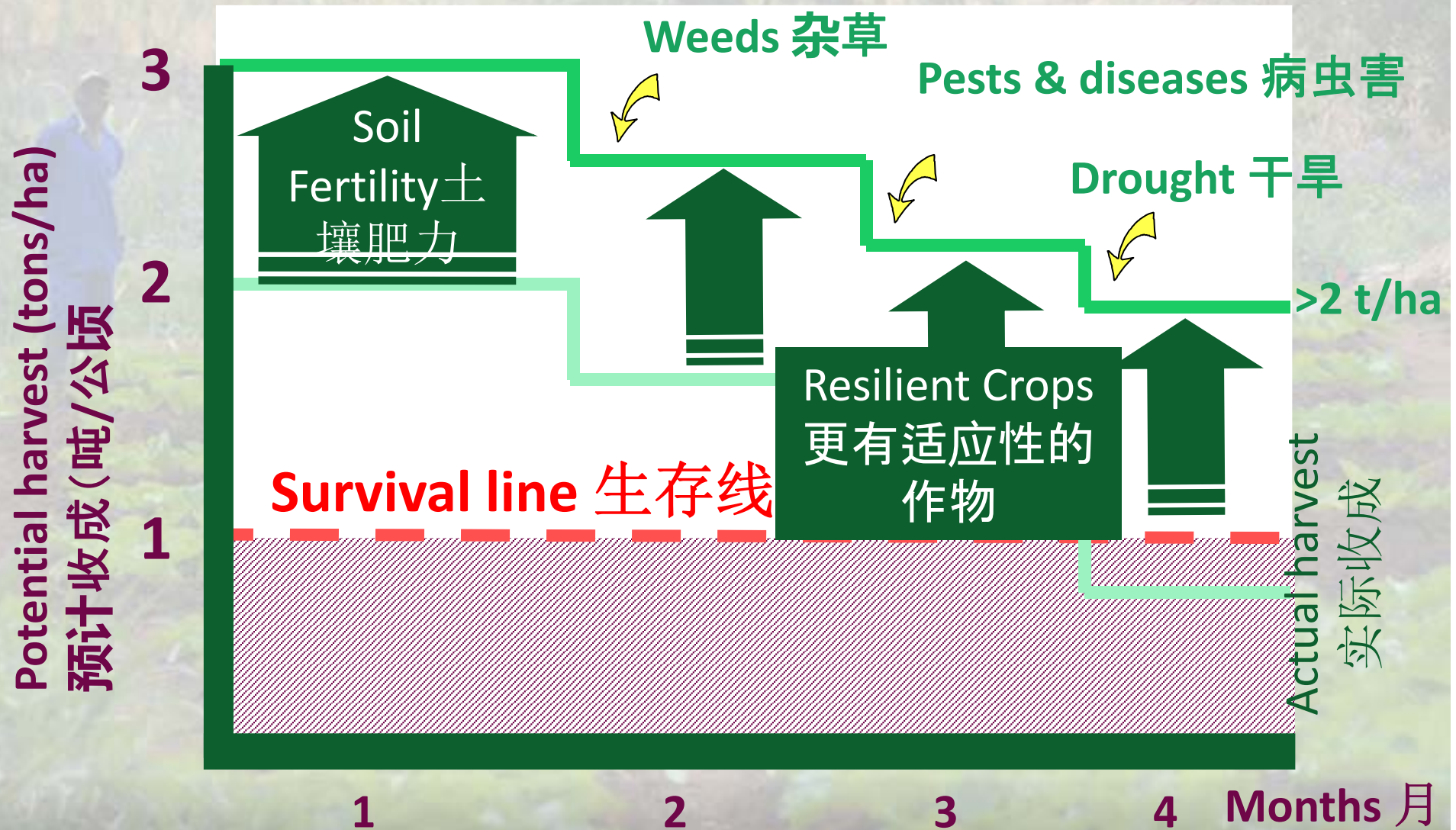
Drought 干旱



Insecure Farm 不安全的农场



A Secure Farm 安全的农场



Sustainable Intensification 可持续的集约化

- **There is not much more new arable land available and water is scarce** 没有太多新增耕地，水资源也短缺
- **We have to intensify: “More with Less”** 必须集约化：用更少的资源生产出更多产品
- **Greater productivity but minimised environmental footprint** 提高生产率，同时减少对环境的影响

Sustainable Intensification 可持续的集约化

- Increased production, income, nutrition 增加产量、收入和营养
- On the same amount, or less, of land and water 在土地和水资源不变或减少的条件下
- With efficient and prudent use of inputs 更有效、更谨慎地使用农业投入
- Minimising emissions of Greenhouse Gases 尽量减少温室气体的排放

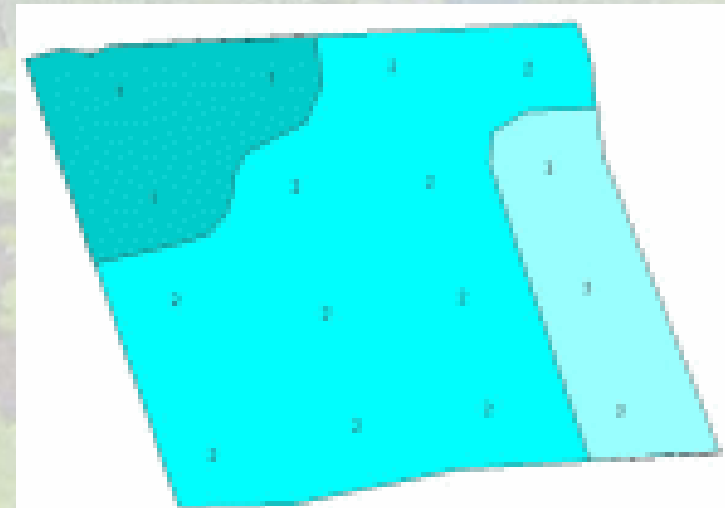
Sustainable Intensification 可持续的集约化

- While increasing natural capital & environmental services
同时增加自然资本和环境服务
- Strengthening resilience 加强适应能力
- Reducing environmental impact 减少对环境的影响

Precision Farming (UK) 精准农业(英国)



Phosphorus Deficiency
磷素缺乏

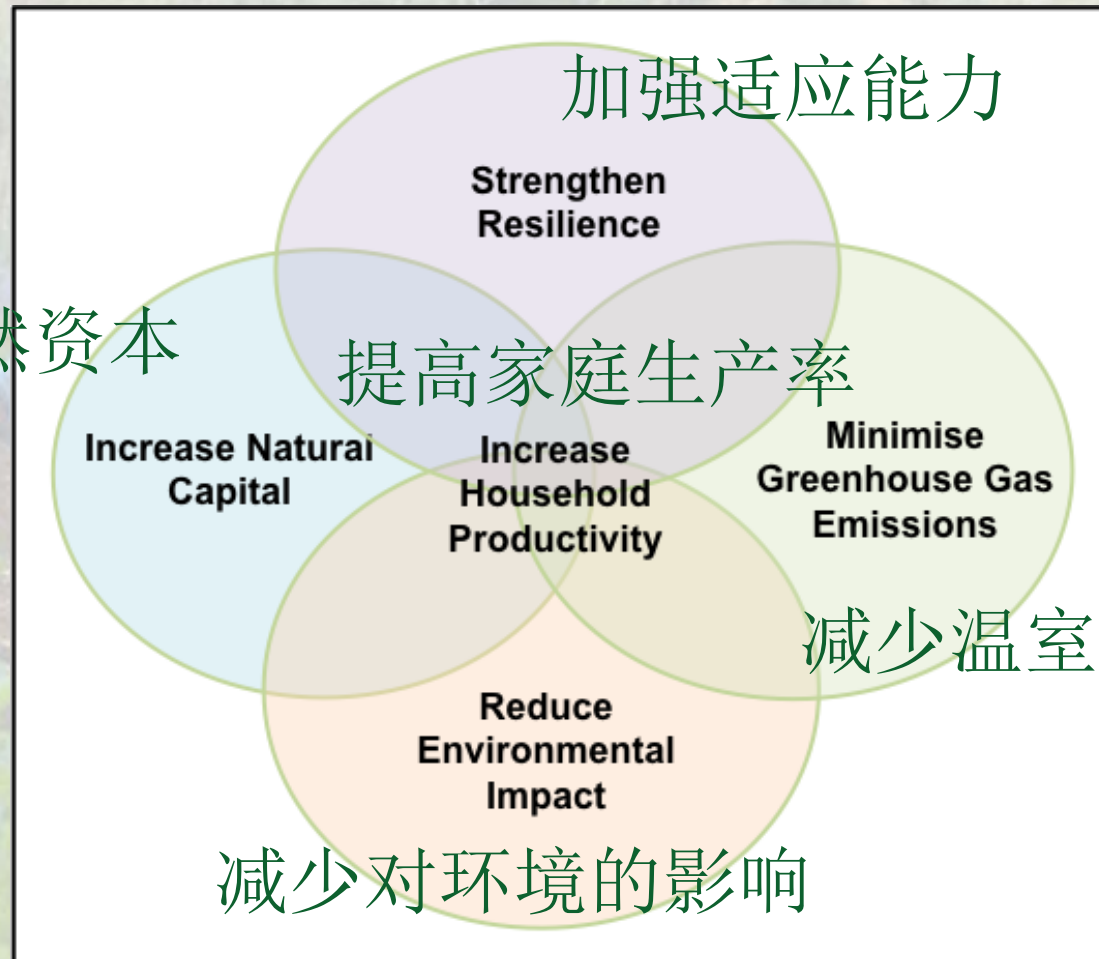


Precision Farming (Africa) 精准农业(非洲)



Microdosing in Niger 尼日尔的微剂量

Multiple Benefits 多重益处



Key Partners in Agricultural Innovation 农业创新的**主要伙伴**

- International Agricultural Research Centres 国际农业研究中心
- National Agricultural Research Systems 国家农业研究体系
- Universities 各高校
- Private sector 私人部门
- NGOs 非政府组织
- Farmers

Multiple Approaches 多重路径

- Agro-ecology 农业生态学
- Genetics 基因工程
- Socio-economics 社会经济学

Ecological Intensification 生态集约化

- Use ecological principles to design agricultural practices, such as: 用生态原则指导农业实践, 如:
 - Agroforestry 混农林
 - Integrated Pest Management 虫害综合治理
 - Organic farming 有机农业



No-Till Agriculture in the UK 英国的免耕农业 (Thurlby Grange in Lincolnshire) (林肯郡舍尔比田庄)

Benefits: 收益:

- 8.75 to 10 ton/ha wheat
每公顷收获8.75到10吨小麦
- Crop establishment cost
£245- £36/ ha 种植成本为每公顷
36到245英镑
- Fuel use 96 to 43 l/ha 每公顷使用43
到96升燃料
- No wind erosion 无风蚀
- No moisture stress 无湿度要求
- Elimination of black grass 根除黑草



Conservation Farming in Zambia 赞比亚的保护性耕作



Terracing 梯田



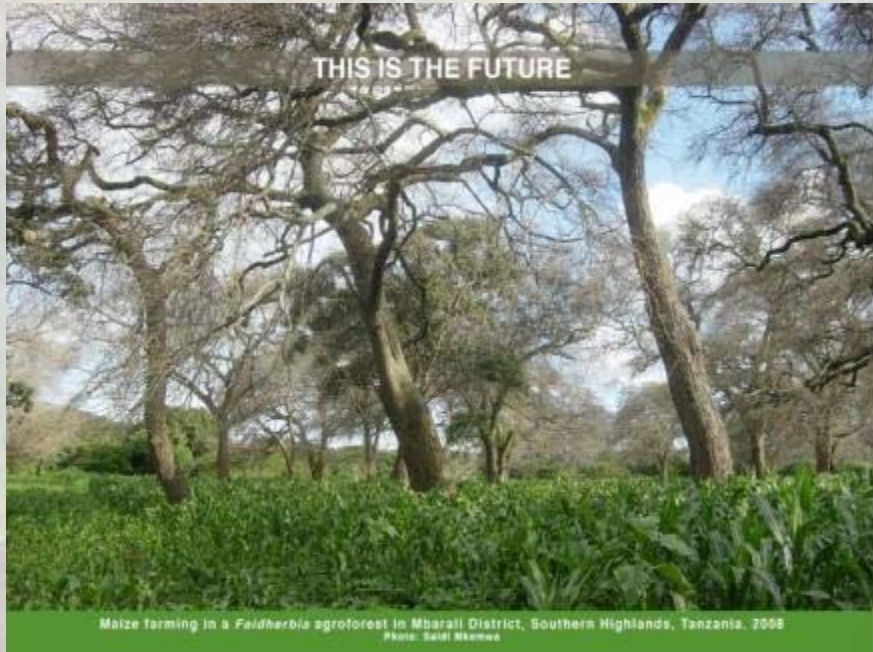
The Sahel 萨赫勒地区

<http://www.farmingfirst.org/2012/09/stone-bunds-as-soil-and-water-conservation-measures-in-sahelian-countries/>

Loess plateau, China 中国黄土高原



Agroecosystems 农业生态系统



Maize under Faidherbia 相思树
下种玉米

2-4 tonnes C /ha/year 每年每公顷
约2-4吨碳固存

30 tons/ha standing crop 未收割
的作物每公顷30吨

Rice over Blue-Green Algae
富含蓝绿藻的稻田



Conventional Breeding 传统育种

Modern Biotechnology 现代生物技术

- **Tissue Culture 组织培养**
- **Marker Aided Selection 应用分子标记辅助选育**
- **Recombinant DNA (GM) 基因重组(转基因)**

Orange Fleshed Sweet Potatoes 橘瓤红薯



Targeted nutrients (Ethiopia) 有针对性的营养成分(埃塞俄比亚)



The New Rices for Africa (NERICAs) 非洲新米 (Nericas)



Bananas Resistant to Wilt in Uganda

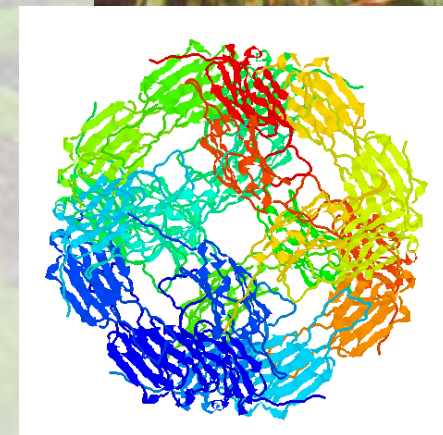
乌干达抗萎缩病香蕉

- \$500 million losses a year in Uganda
乌干达一年损失50亿美元
- Academia Sinica provided sweet pepper gene 中央研究院提供了甜椒基因
- Successfully transferred to bananas
成功地转移到香蕉上
- In Ugandan field trials 乌干达的田间试验
- Entirely government funded 全部由政府赞助



Chaperone Genes for Drought Tolerance 抗旱的伴侣蛋白基因

- Genes from Bacterial RNA that help to repair misfolded proteins resulting from stress 细菌RNA中的基因有助于修复因逆境而产生的异常蛋白
- Plants rapidly recover 植物很快康复了
- No yield penalty when stress free 逆境得到解除, 产量无损
- In African field trials 非洲的田间试验



Socio-economic intensification – Markets 社会经济的集约化-市场



Input Markets 农业投入市场



Certified Seed 良种



Victoria Seeds
维多利亚种业

Output markets 农业产出市场



Farmer Associations
农会

Cooperatives
合作社

Cereal Banks
谷物银行

Contract Farms
合同农场

Outgrowers
承包种植

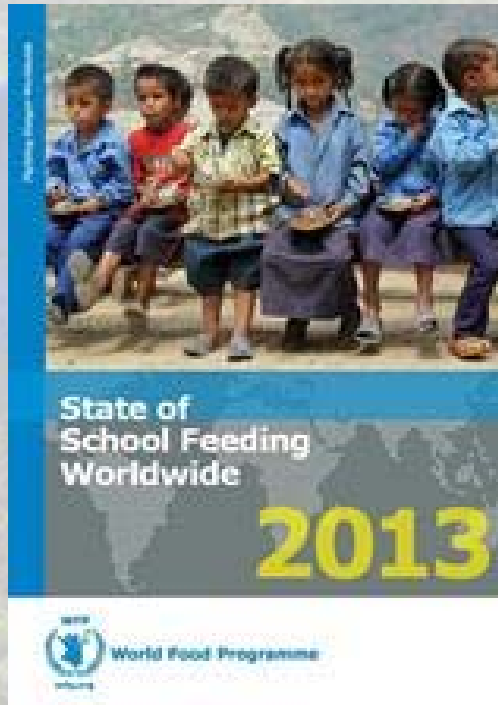
Ethiopian Commodity Exchange 埃塞俄比亚商品交易所



ege

Short Value Chains 短价值链

Farmers' Markets 农夫市场



Home Grown 自家种

School Feeding 学校供餐

Multiple Scales 多重规模

- **Region** – Intra-regional trade 地区-地区间贸易
- **Country** – Ethiopian Commodity Exchange 国家 – 埃塞俄比亚商品交易所
- **Landscape** – Watershed planning 景观-流域规划
- **District** – Farmer Field Schools 行政区-农民田间学校
- **Community** – Cooperative marketing 社区-合作营销
- **Farm** – Zai 农场-挖掘浅地坑种植农作物

Going to Scale 规模化

Sustainable Landscapes

可持续的景观

Sussex, UK 英国苏塞克斯

Ethiopia 埃塞俄比亚



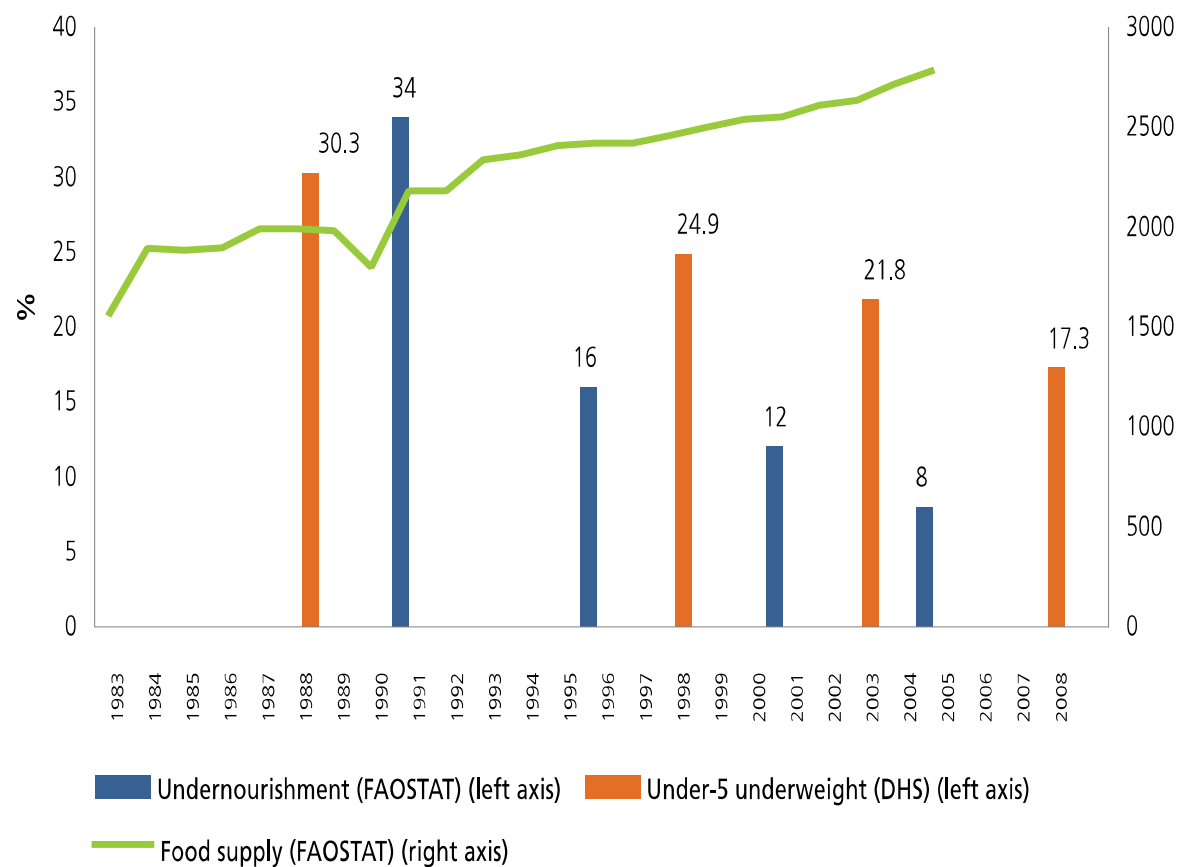
Key Drivers of Going to Scale ? 规模化的主要动力 ?

- **Farmer Associations** 农会
- **Markets** 市场
- **ICT** 信息通讯技术
- **Political Leadership** 政治领袖

Political Leadership 政治领袖



Ghana 加纳



Thank You 谢谢大家



www.ag4impact.org

Twitter: @Ag4Impact

Contact: g.conway@imperial.ac.uk

www.canwefeedtheworld.org

Twitter hashtag: #1billionhungry

