

CAPACITY4FOOD PROJECT

Principles of Integrated Soil Fertility Management



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PRINCIPLES OF INTEGRATED SOIL FERTILITY MANAGEMENT

- Introduction
- Integrated Soil Fertility Management (ISFM) is defined as a set of fertility **MANAGEMENT** practices that include the use of **FERTILIZER**, **ORGANIC INPUTS** and **IMPROVED GERMPLASM** combined with **KNOWLEDGE** on how to adapt these practices to local conditions, aiming at optimizing agronomic use efficiency of applied nutrients and improving **CROP PRODUCTIVITY**.



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DEFINITION OF ISFM CON'T.

ISFM embraces the principle of plant production ecology where yield is a function of the interaction btw genotype, environment & mgt.

Yield = G (genotype) x E (environment) x M (mgt.)

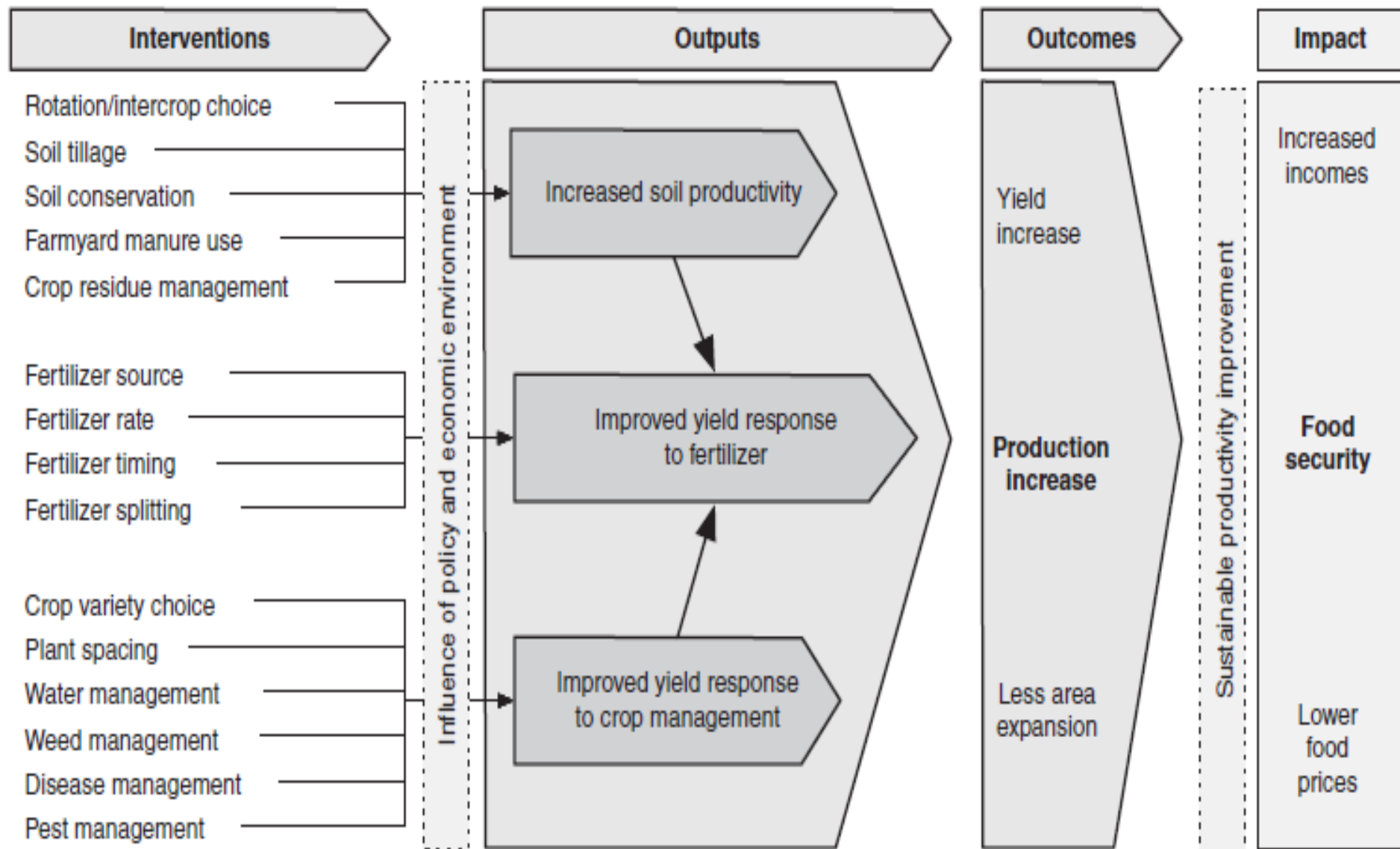
G = seed or plants used

E = soil & climate in location

M = farmer's ability & skills in managing crops



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HISTORICAL APPROACHES TO SOIL FERTILITY MANAGEMENT

- In the 1960s and 70s major emphasis was placed on the use of MINERAL FERTILIZERS to achieve proper crop nutrition and improved crop yield.
- In the 1980s more emphasis was given to the use of ORGANIC RESOURCES, partly because of fertilizer access SSA.
- In 2000s research shown the importance of combining the use of MINERAL FERTILIZERS and ORGANIC RESOURCES in order to achieve satisfactory crop yields and efficient fertilizer use.



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Period	Approach	Role of fertilizer	Role of organic inputs	Experience
1960s to 1970s	External input use.	Use of fertilizer alone thought sufficient to improve and sustain yields.	Organic resources play a minimal role.	Limited success due to shortfalls in infrastructure, policy and farming systems.
1980s	Organic input use.	Fertilizer plays a minimal role.	Organic resources are the main source of nutrients.	Limited adoption. Organic matter production requires livestock ownership, excessive land and labour.
1990s	Combined use of fertilizer and organic residues.	Fertilizer use is essential to alleviate the main nutrient constraints.	Organic resources are the major 'entry point' to soil fertility improvement and serve other functions besides nutrient supply.	Localized adoption around specific crops.
2000s	Integrated Soil Fertility Management.	Fertilizer is a major entry point to increase yields and supply needed organic resources.	Organic resources can improve the use efficiency of fertilizer.	Goal of large-scope adoption!

MINERAL FERTILIZER USE

- Since the invention of mineral fertilizers, their combined use with improved seeds and planting materials have been the major drivers of increased productivity
- Research on selected crops have shown it has potentials to be a powerful tool for enhancing productivity in SSA
- in SSA farmers considered fertilizer to be too costly or unaffordable following the removal of subsidies
- Rates of application in SSA is 5-10 kg/ha far below 50 kg/ha set by the Abuja Declaration of June 2006.



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MINERAL FERTILIZER USE CON'T.

- Soil may become depleted of some nutrients when fertilizer use is unbalanced. This can be corrected or prevented by ISFM
- Fertilizer use has created ecological and agronomic concerns which has been eliminated through judicious use in combination with organic inputs eg agroforestry, herbaceous legumes or dual-purpose grain legumes



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MINERAL FERTILIZER USE CON'T.

Fertilizers have performed poorly in hostile environments where top soil has been lost due to erosion and surface water runoff.

In addition drought, weed infestation, soil acidity and alkalinity make fertilizer use uneconomical due to poor fertilizer nutrient uptake and conversion into crop products.

Research has endorsed the combined use of fertilizers and organic materials for higher yields



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MINERAL FERTILIZER USE CON'T.

Fertilizers are concentrated sources of essential elements in forms readily available for plant uptake

They are less costly than animal manures in terms of the cost of the nutrients that they contain (\$/kg nutrient)

ISFM emphasises the use of mineral fertilizers where they will provide the greatest beneficial effect



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LOW-INPUT METHOD FOR SOIL FERTILITY IMPROVEMENT

The high cost of fertilizer led to the promotion of Low External Input Sustainable Agriculture (LEISA)

This is anchored on the premise that organic resources are available in sufficient quantity to improve productivity

Legume crops, trees and shrubs may add sufficient amounts of N by biological N₂-fixation, and deep-rooting trees recycle to the soil surface nutrient from below the root zone of annuals



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LOW-INPUT METHOD FOR SOIL FERTILITY IMPROVEMENT CON'T.

If nutrient capital on farm is insufficient, yields stagnate, farmers are trapped in a downward spiral of decreasing nutrient reserve and yields. Farmers circumvent this problem by expanding area under cultivation. Organic materials contain less nutrients compared with mineral fertilizers, more costly to store and transport.



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LOW-INPUT METHOD FOR SOIL FERTILITY IMPROVEMENT CON'T.

Livestock systems in West Africa are used to apply 0.5-2.0 t/ha of manure which transfers 2.5 kg N and 0.6 kg P to cropland which is insufficient.

Despite its vital role the quantity of manure needed is often not available due to insufficient animals to produce the manure, drought leading to less livestock due to fodder shortage



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LOW-INPUT METHOD FOR SOIL FERTILITY IMPROVEMENT CON'T.

Compost from straw which is strongly advocated have competing uses eg feed

Producing organic inputs by planting cover crops (eg *Mucuna pruriens*) suggested but farmers seldom practice it because they are: labour intensive; cannot provide sufficient nutrients to sustain productivity; products not edible or sold.



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USE OF ORGANIC INPUTS

Organic inputs are an important source of nutrients N, P Mg. Ca.....

Functions:

Increase nutrient utilisation

Increase water holding capacity of soil

Improve availability of P and uptake

etc



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USE OF IMPROVED GERMPLASM

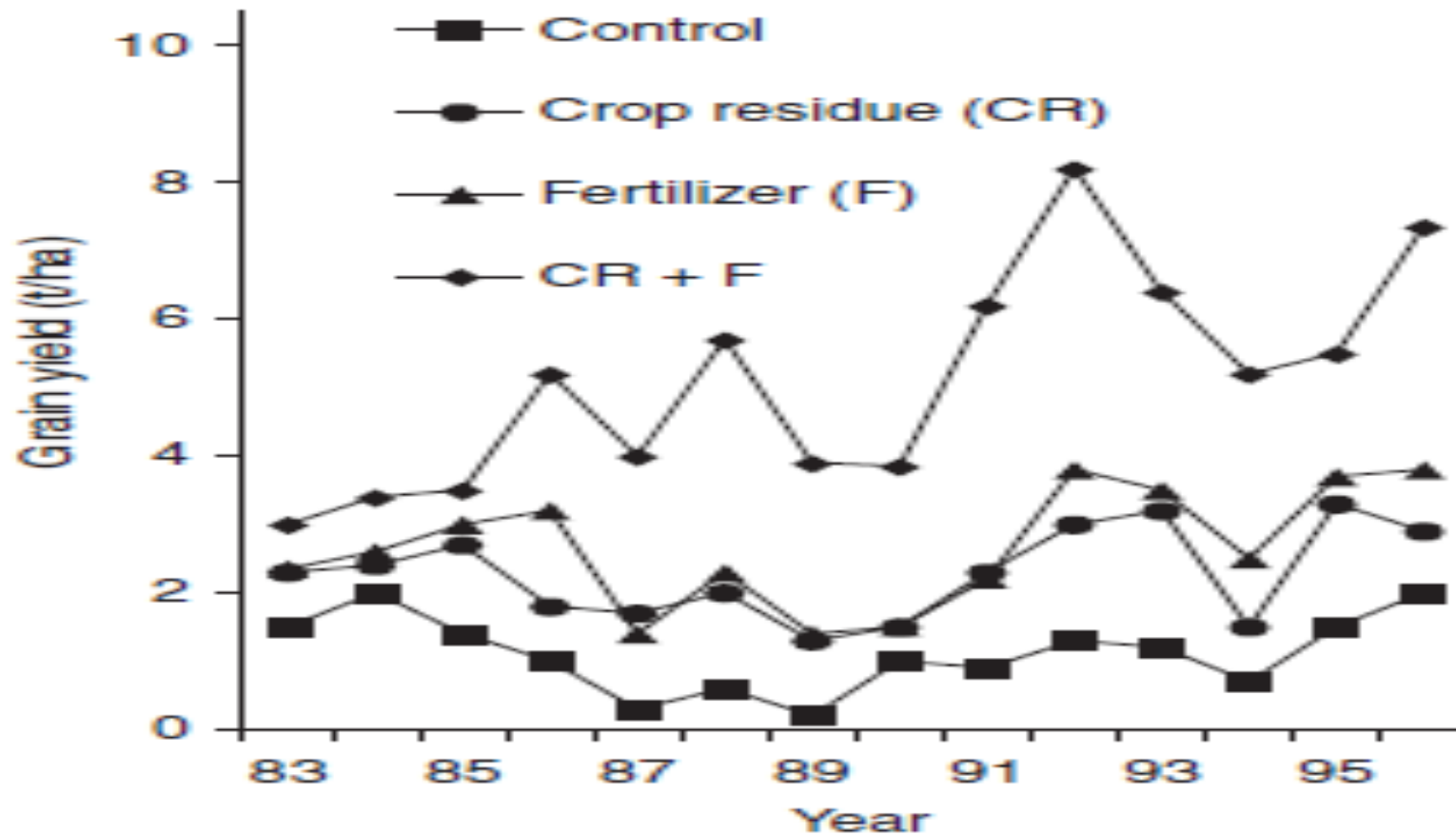
Improved germplasm usually has a higher harvest index (HI) ie- ratio of crop product to total biomass production, because more of total biomass is converted into harvested product than in unimproved varieties

Legume with lower HI are sometimes selected by farmers for being multi-purpose ie used for: food, feed and soil fertility



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COMBINED USE OF FERTILIZER, ORGANIC INPUTS AND GERmplasm



CONCLUSIONS

ISFM contributes to sustainability because the agronomic & soil fertility mgt. practices sustain soil fertility by:

Focusing on efficient nutrient use

Minimizing the loss of indigenous & added nutrients by use of appropriate soil conservation techniques

Improving soil fertility across the farmscape.



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Material based mainly in:

Fairhurst, T. (ed.) (2012) Handbook for Integrated Soil Fertility Management. Africa Soil Health Consortium, Nairobi. Accessible from this [link](#)



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**I THANK YOU FOR YOUR KIND
ATTENTION**



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