ORGANIC INPUT MANAGEMENT IN AFRICA: CURRENT KNOWLEDGE AND CHALLENGES

BY

PETER OPALA (PhD)

ASSOCIATE PROFESSOR

DEPARTMENT OF CROPS AND SOIL SCIENCE

MASENO UNIVERSITY, KENYA

INTRODUCTION

- Organic inputs in Africa have multiple uses but on smallholder farms, they are used mainly as sources of crop nutrients.
- In particular, they are important sources of nitrogen, which limits crop production in many parts of Africa.
- Proper management of such organic inputs to ensure sustained crop productivity is therefore of critical importance.
- Management of organic inputs in Africa has evolved over the years alongside other paradigms related to soil fertility management in Africa.
- Use of organic inputs was the traditional way of replenishing soil fertility but emphasis shifted to the use of mineral fertilizers in the 1960’s as they became more abundant and economically attractive .

- Increasing costs of fertilizers and concerns for sustainability, however, renewed interest in the use of organic inputs to replenish soil fertility in the 1980’s in the so called low input sustainable agriculture (LISA).

- Later it was realized that the LISA techniques the productivity of organic farming systems was mostly lower than the conventional use of mineral fertilizers.

- This led to a paradigm of soil fertility management that advocated for integrated soil fertility management where both organic and inorganic nutrient sources are combined.

- Intense research has been conducted in an attempt to better understand the role of organic inputs in improving soil quality and crop yields.

- The aim was to arrive at a deeper understanding of the interactions of organic inputs with the soil and crop, which would lead to predictive management of organic inputs similar to that of inorganic fertilizers.

Quality and Quantities of nutrients supplied via organic inputs on the farms

- The traditional organic resources on most farms are crop residues, compost and animal manures
- Determination of quantities of organic inputs and the nutrients they supply has, therefore, always been a pertinent issue.
- Knowledge of the biomass production and nutrient concentration of the nutrients in the plant tissues is essential in calculating the potential nutrient supply from plant residues.
- The biomass and nutrient content within the biomass will vary with the soil properties, climate and the production system under which the organic material is grown.
- Variability of these factors from region to region has hampered efforts to derive a universal predictive model for the amounts of nutrients that could be provided by plant residues.

Table 1: Nutrient contents of some organic resources among smallholder farmers in Kenya

Organic input	% Nitrogen	% Phosphorus
Bean trash	1.20	0.13
Cowpea trash	0.57	0.05
Pigeon pea prunings	1.33	0.10
Cattle boma manure	1.40	0.20
Poultry manure	3.11	0.42
Domestic compost	1.34	0.20
Vermicompost	4.20	0.40
Tithonia diversifolia	3.50	0.29
Calliandra calothyrsus	**3.03**	0.11
Sesbania sesban	4.58	0.24

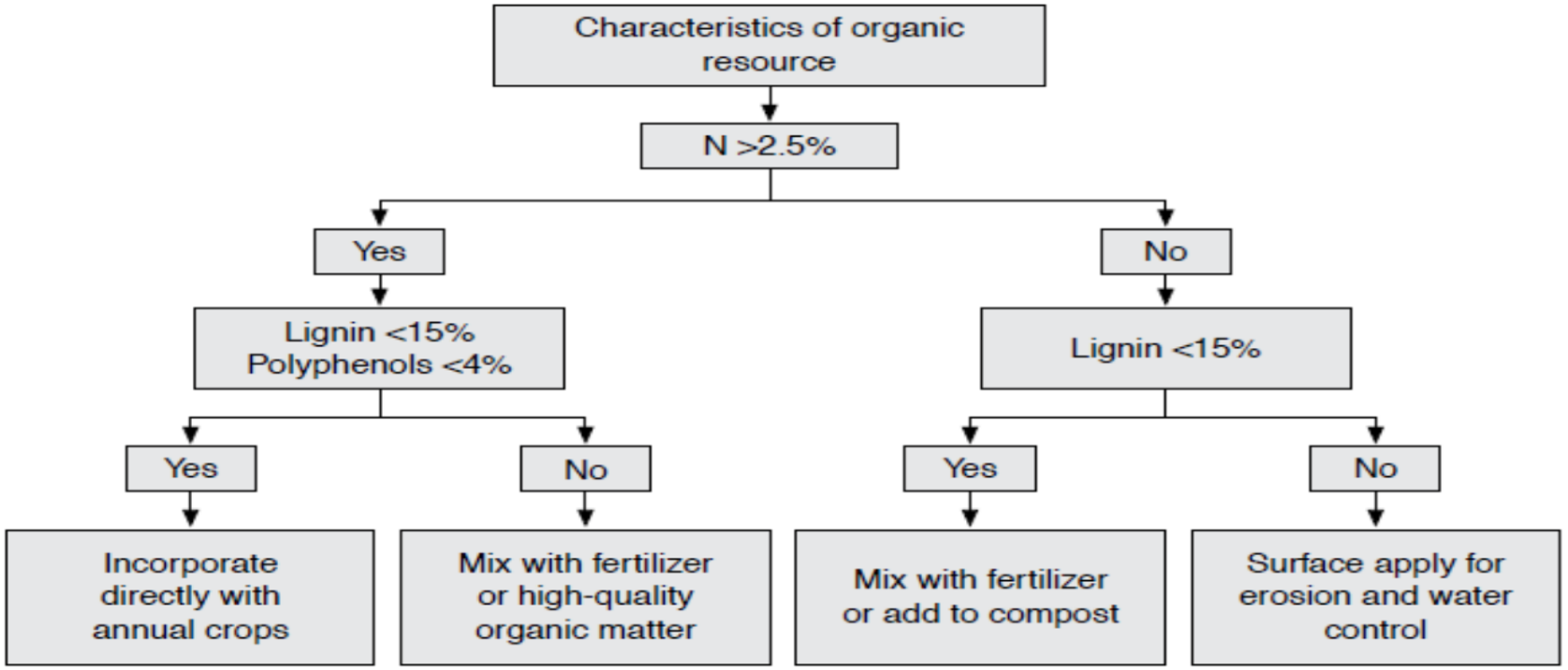
- Most of these organic materials are low in nutrients, particularly P.
- Substantial amounts of these materials would, therefore be required to provide sufficient nutrients for most crops. For example, 10 t/ha of good quality green or animal manure would be required to supply enough nitrogen for most field crops such as maize.
- Organic materials e.g. crop residues have competing uses, primarily as livestock feed and fuel that reduce the amounts that are available for managing soil fertility.
- Production of sufficient organic resources from the commonly available organic resources on farms, to meet crop nutrient demand, thus remains a major challenge in Africa.

Predicting nutrient release from organic inputs

- The bulk of the nutrients in organic materials are in the organic form and thus not available to plants unless mineralization takes place.
- An understanding of the nutrient release patterns of organic inputs is important in assessing their potential to supply nutrients to a crop.
- Several chemical indices have been identified and used to predict mineralization of N from organic materials. These include the C:N ratio, N, lignin and polyphenol contents.
- High quality organic residues are low in lignin and polyphenol content and high in %N and release nutrients rapidly during decomposition.
- Low quality materials release nutrients slowly or immobilize nutrients during early stages of decomposition.
- However for animal manures, the above indices do not accurately predict nutrient release

Decision support system (DSS) for use of organic inputs

- A decision support system (DSS) which makes practical recommendations for the appropriate use of organic materials as sources of N based on whether they mineralize or immobilize N was subsequently developed.



A decision tree to assist management of organic resouces in agriculture.

Synchronizing nitrogen release with crop demand

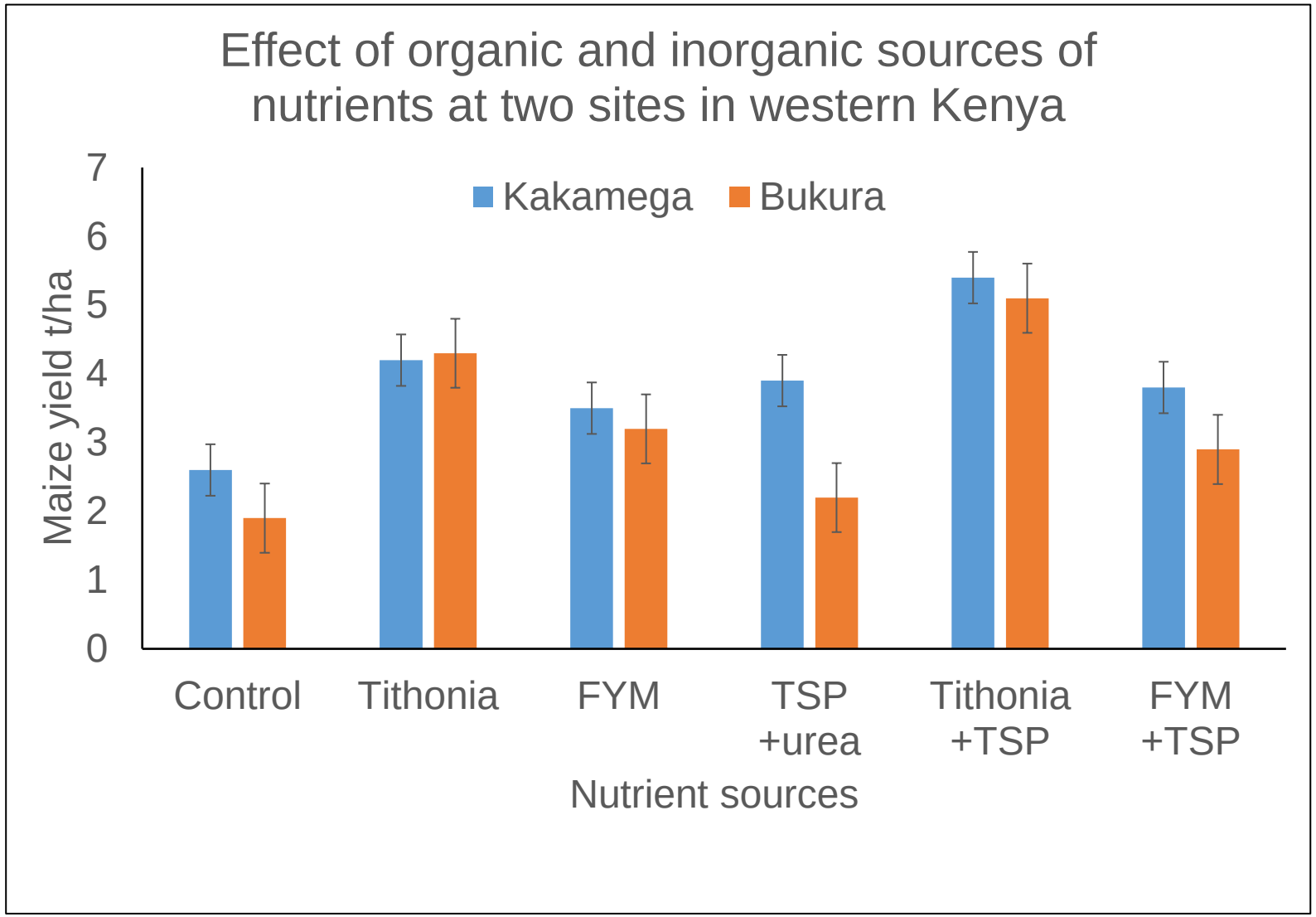
- Synchronizing means matching nutrient release with crop demand. This would ensure efficient use of N while avoiding losses and associated environmental problems.
- A two-pronged approach has usually been used in efforts to achieve N synchrony:

  i. manipulating the decomposition of the organic materials to release nutrients when they are needed by the crop.

  ii. regulating demand by providing a favourable environment for plant growth.
- Low-quality organic inputs, immobilize N leading to short-term deficiencies. With high-quality organic inputs, N is released rapidly, initially in excess of plant demand and it could be lost.
- A mixture of low-quality and high-quality material would result in better synchrony in supply and demand.

Organic inputs in the integrated soil fertility management strategy

- The realization that neither organic inputs nor inorganic fertilizers alone can achieve sustainable productivity of the soil and crop under highly intensive cropping systems has renewed interest in the combined use of organic and inorganic sources of nutrients for crop production.
- This has culminated in the development of the integrated soil fertility management (ISFM) paradigm whose technical backbone is the optimal management of organic resources, mineral fertilizer inputs and soil organic matter pools.
- Combination of mineral fertilizers and organic nutrient sources often results in synergistic effects on crop yields.
- A comparison of organic, inorganic and a combination of the two sources of nitrogen on crop yield is demonstrated in this presentation using an experiment from western Kenya.


Effect of organic and inorganic sources of nutrients at two sites in western Kenya
Kakamega
Bukura
Maize yield t/ha
0
1
2
3
4
5
6
7
Control
Tithonia
FYM
TSP +urea
Tithonia +TSP
FYM +TSP
Nutrient sources

TREATMENT	KAKAMEGA			BUKURA		
	Added costs	**Net benefits**	Benefit cost ratio	**Added costs**	**Net benefits**	Benefit cost ratio
1. Control	-	-	-	-	-	-
2. Tithonia	605	-2	-0.02	605	144	0.23
3. FYM	72	35	0.48	72	323	4.49
4. TSP + urea	300	146	0.49	346	-228	-0.66
5. Tithonia + TSP	728	300	0.41	747	405	0.54
6. FYM + TSP	195	139	0.71	214	138	0.64

Tithonia diversofolia green manure

Main findings from the experiment

- Organic sources of nutrients were superior to inorganic sources on acidic soils because of their availability to ameliorate aluminium toxicity.
- Responses to organic inputs were more stable across sites than inorganic sources.
- Due to high labour costs tithonia was not profitable on maize production although it had the highest yields and is unlikely to be adopted by farmers
- Farmyard manure had the best cost benefit ratios and has the best potential for adoption.

Conclusions

- Tremendous progress has been made over the years towards understanding the biophysical aspects of organic input management in East Africa.
- Many organic input technologies have been generated in the process.
- However, our knowledge of organic input systems still remains imprecise particularly from the socio-economic perspective.
- This has made development of economically, socially and environmentally acceptable guidelines for organic input management difficult. Adoption of organic input technologies by farmers is thus disappointingly low.
- The biggest challenge facing organic input management in Africa is, therefore, to bridge the gap between generation of technologies and their actual uptake by the farmers.