

# **The Law of Minimum: Linking Potash fertilizer utilization, farm level production and economic losses in Tanzania**

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# Introduction.....

- In recent years utilization of inorganic fertilizers in Tanzania has more than doubled
- Due to Government subsidies through the National Input Voucher Scheme (NAIVS).
- The growth is more pronounced (>60%)
  - Urea,
  - Di-Ammonium Phosphate (DAP) and
  - Calcium Ammonium Nitrate (CAN)
- Potash fertilizer through NPK and other compound fertilizers recorded very low growth

# Value of potash fertilizer

- Potash fertilizer is an essential ingredient in farming
- Linked with numbers of yield components & economic value.
  - Potash helps to increase the use of other nutrients
  - helps to cope with drought situations
  - Increased ability to survive in frosty conditions.
  - Help grains and fruits to increase the protein oil and vitamin C in their harvest,
  - Gives food a better color and flavor.
  - It retains its nutritional value for longer when packed for storage or travelling purposes
  - Fighting disease and resisting pests
  - Plants grow faster and healthier

# Quality, Quantity, shelf life

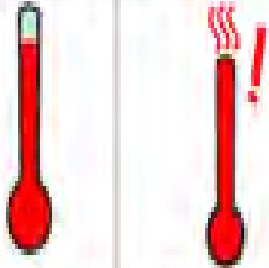





# Climate smart potash fertilizer




# Climate risks & Potash



Warming trend    Extreme temperature




Precipitation




Extreme precipitation




Drying trend



Flooding



Hypoxia



Sea level

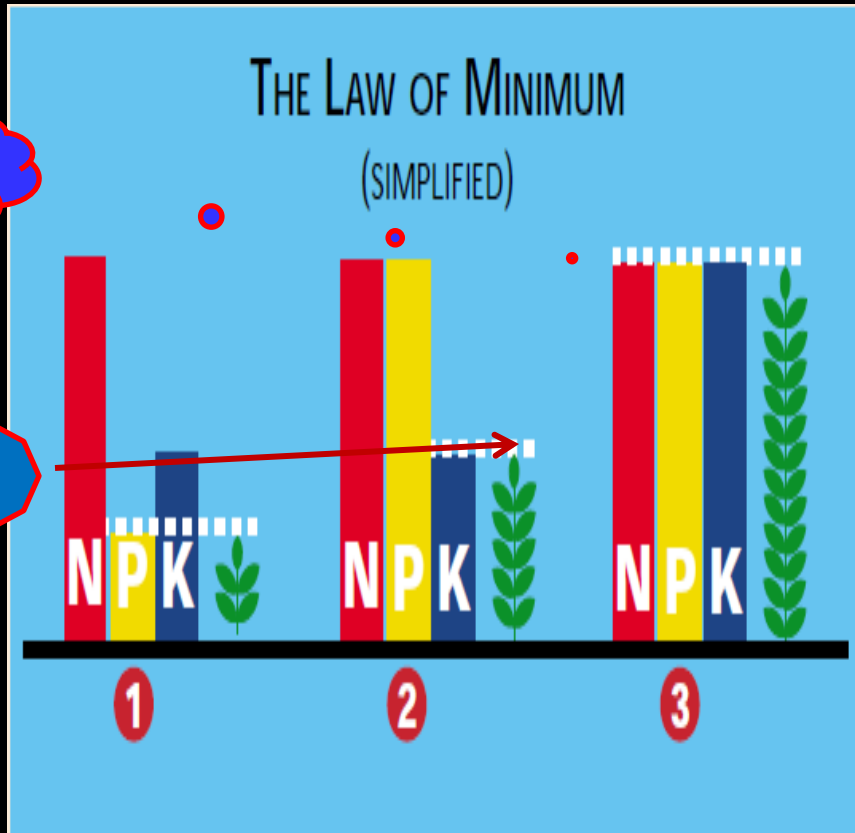


Ocean acidification

# Law of minimum

- Based on historical aspects of plant nutrition by Liebig in 1840.
- State that:
  - The crop on the field **diminishes or increases** extract proportion to the **diminution or increase** of the nutrient substances conveyed to it in manure (inorganic fertilizer)
- Deficiencies of all nutrients must be corrected to achieve maximum benefits of all nutrients

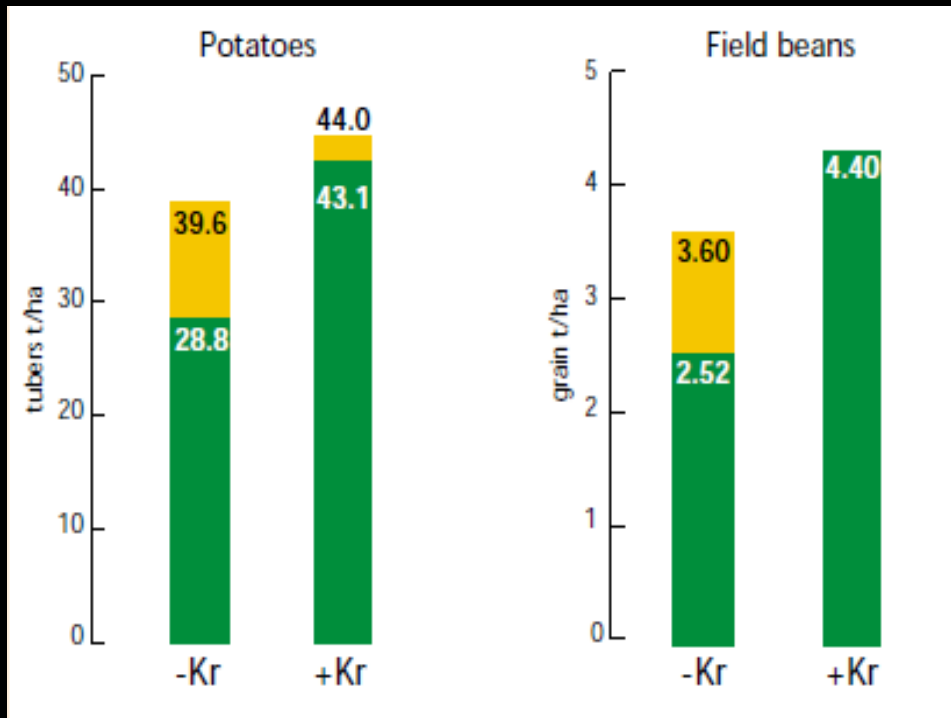
# Law of Minimum (Illustration)



1. Sufficient N and K but too little P
2. Sufficient N and P but K is too little
3. K deficiency is corrected



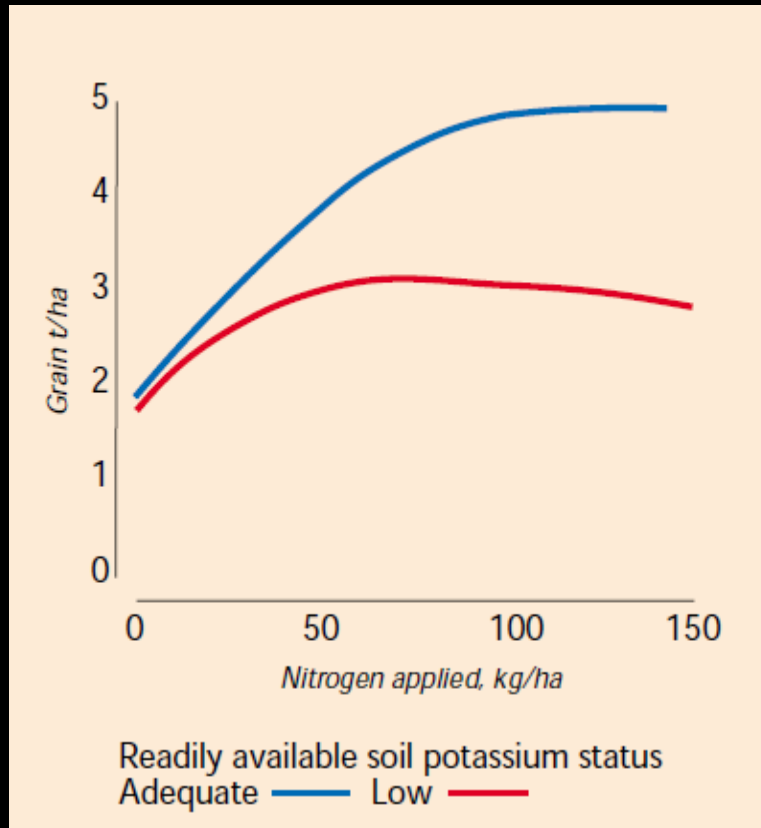
# Role of potash fertilizer



■ Yield on soil : -Kr small reserves, +Kr adequate reserves  
■ Extra yield from applying potassium fertilizer

- Source: EFMA (2003)

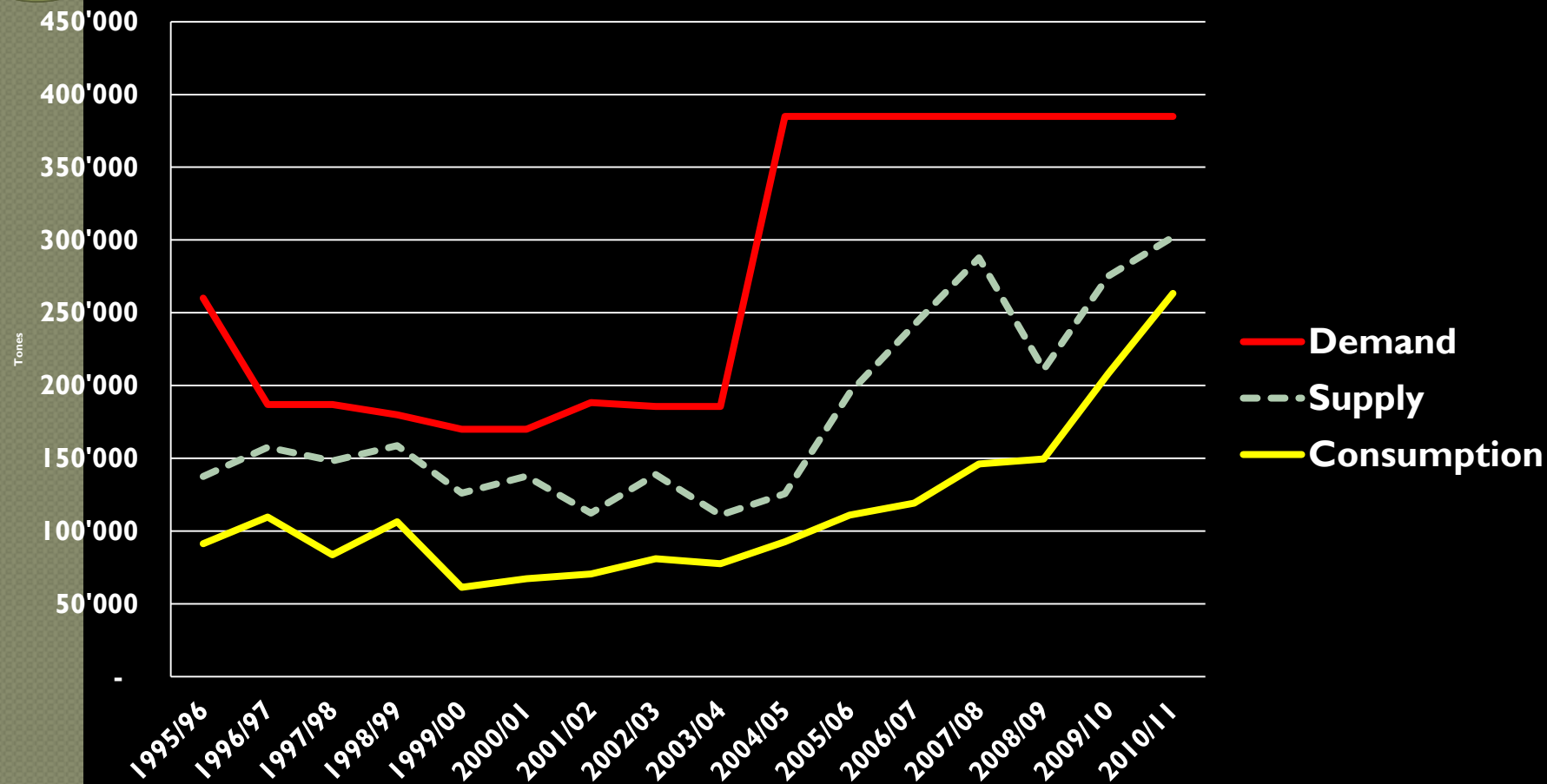
# Role of potash fertilizer



- With too little available potassium is justifiable to apply only 50kg N/ha (diminishing return sets in)
- With adequate Potassium 100 kg N/ha give optimal yields
- Source: EFMA (2003)

# Fertilizer utilization in Tanzania

Fertilizer Demand, Supply and Consumption from 1994/5 to 2010/2011



# Type of fertilizer used in Tanzania

- Top dressing fertilizer (120,000 MT/annum)
  - Urea (46%N) – 120,000 MT/year
  - SA (21%N) – 10,000 MT/year
  - CAN (26%) – 40,000 MT/year
- Basal fertilizers (50 MT/annum)
  - DAP - 50,000 MT/year
- MRP (30%) 10,000MT/year
- NPK (10-18-24) – 40,000MT/annum mainly in tobacco



# Simplified yield model with less Potassium

- The relationship btw yield and nutrient substances
- Yield (Y) = f(N, P, K, **other independent**)
- Yield (Y) = f(N, P, K)
  - Based on the Law of minimum this relationship will give optimal yield (i.e. 40 bags/ha)
- Without readily available Potash
  - Yield  $Y = Y/2 = f(N, P)$  (i.e. 20 bags/ha)

# Profit ( $\pi$ ) function

- Profit ( $\pi$ ) = Revenue - Cost
- Profit ( $\pi$ ) =  $Q_o y \cdot P_y - P_x \cdot Q_{ix}$ 
  - But revenue
    - Quantity of output:  $Q_o y = f(N, P, K)$  yield is halved if K is not used
    - Price of output:  $P_y = f(\text{quality, colour, shelf life, appearance, less diseased})$
  - But costs
    - Quantity of inputs  $Q_{ix} = f(\text{fertilizer NP-K; pesticides. Labour,})$
    - Price of inputs  $P_x =$
    - Cost for using  $N, \& P$  with low levels K: No response to yield
- AIM should be —**increased revenue** and **reduce cost**. Potash play major role in both

**• Input Voucher Scheme  
without potash return is only 30%**

<b>Year</b>	<b>Phosphates</b>	<b>Nitrogenous</b>
2010/11		
2011/12	<b>52,286,026,000</b>	<b>40,424,248,000</b>
2011/13	<b>47,629,362,000</b>	<b>33,605,589,000</b>

Source: World Bank, 2014

# Yield with input voucher

Year	Yield/acre		% increase	% increase with Potash
<b>MAIZE</b>	Beneficiaries	Non beneficiaries		
2009/10	830.2	435.0	91	136
2010/11	926.0	435.6	112	168
New	732.3	365.5	100	150
<b>RICE</b>				
2009/10	965.9	818.3	18	27
2010/11	1113.4	733.5	52	78



# Conclusion

- Potash fertilizer is the most important fertilizers especially for increasing efficiency of other fertilizers
- However it is of little interest to users and policy makers resulting to high economic loss due
  - failing to realize optimal yield &
  - decreased potential of other costly fertilizers

# Recommendation

- Deliberation action through policy directives to blend fertilizer inclusion of potash fertile
- Awareness on the value of potash fertilizers to yield, quality and health



**Thank you for listening**