



Potassium Status and Crop Response to Potash Fertilizer Application on Ethiopian Soils - **A review**

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The role of Potassium in Balanced Fertilization**

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Hawassa University, Hawassa, Ethiopia

Ethiopian  **ATA**
Agricultural Transformation Agency
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Introduction and Background

Various research efforts have shown that potassium

Stimulates early growth,

Increases protein production,

Improves the efficiency of water use,

Is vital for stand persistence, longevity, and winter hardiness of alfalfa,

Improves resistance to diseases and insects.

Introduction and Background

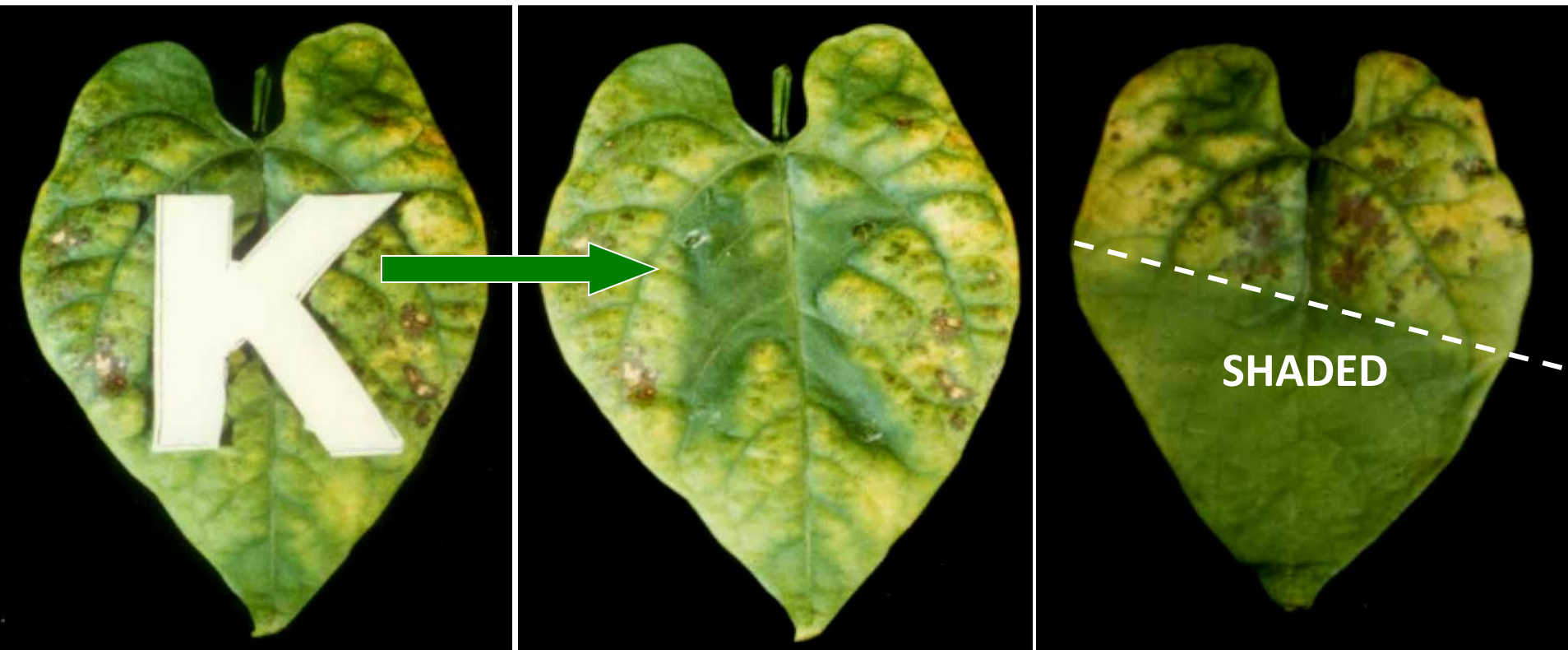


Control: Solution containing all minerals

Experimental: Solution without potassium

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Introduction and Background



Photooxidative damage in K-deficient leaves

Introduction and Background



0 K₂O+ Balanced

90 K₂O+ Balanced

Effect of K nutrition on moisture resistance, Senkata Kebele, Seasi tsada amba woreda, Tigray

Introduction and Background



Blanket recommendation of only two nutrients has been practiced since 1950s

The history of fertilizer use dates back to the early 1950s

(Murphy, 1959) -79% medium to high in av. P and more than 90% high in Av. K

From 1961 to 1971 FAO (FFHC), the MoA, and the IA conducted fertilizer trials throughout the country on teff, wheat, barley, sorghum and maize.

During this campaign the number of trials conducted were **522**, in 1967/68, **987** in 1968/69 **1,165** in 1969/70.

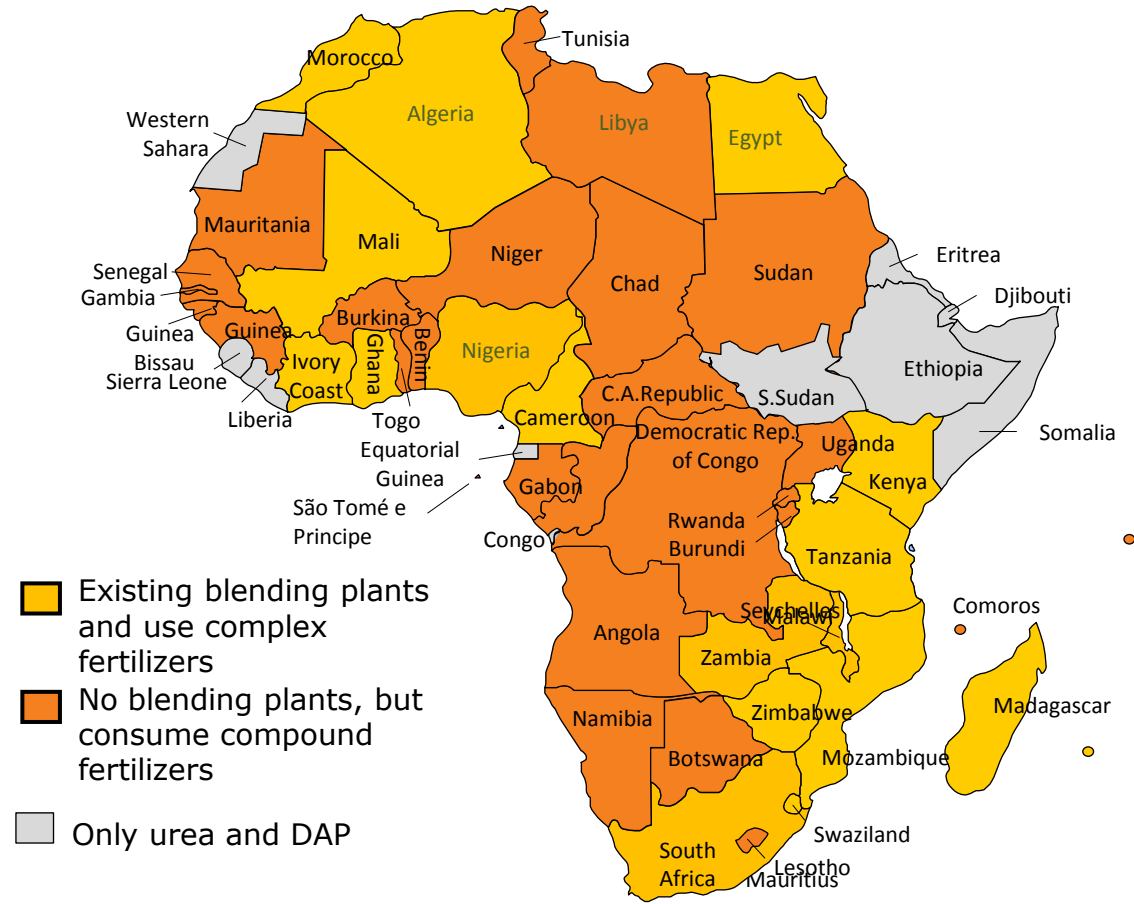
Blanket recommendation of only two nutrients has been practiced since 1950s

The majority of the soils gave high response to N, about 25% to P and in a few instances was a response to potassium

MoA then gave a blanket recommendation of 100 kg/ha DAP for all crops, which was later on refined to 100 kg/ha each urea and DAP

Until 2002, a common belief that "potassium fertilizers are not necessary" was adopted by many researchers

Ethiopia remained one of the 8 countries not applying balanced fertilizers



Source: AfricaFertilizer.org; WB-ARD; IFPRI; Media; FAO – Fertilizer and Plant Nutrition Bulletin



Got attention in 2002

In recent years, there are reports that indicate sharp increases in wheat, barley, teff, potato and sorghum yields

From 2002-04, Abiy and Tekalign – 10 q/ha average yield increase on Vertisols due to 50 kg/ha K_2SO_4 application

Wassie Haile (2011, potato yield increase of 114-341% on Nitosols using KCl

MoA/ATA trials(2011/12)- 14 %(barley) to 38 % teff yield increase on vertisols

A soil fertility inventory conducted in some woredas from 2012-15 also showed that K is deficient in most of the woredas of the country (EthioSIS, 2013).

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Result from potassium sulfate trial conducted at Chefe Donsa in 2002 (the fertilizer was applied at 50kg/ha)

Plot with K_2SO_4 ,Yield difference=10q/ha



Plot with out K_2SO_4

Response to K fertilizer at Hagera Selam



(Source; SARI)

Response of barley (local variety) to potassium application, Debrebirhan, 2011



NP

NPK

The growth difference in barley (local variety) in the absence and presence of potassium on a plot fertilized with NPS compound fertilizer (August 2013, Basona Worana)



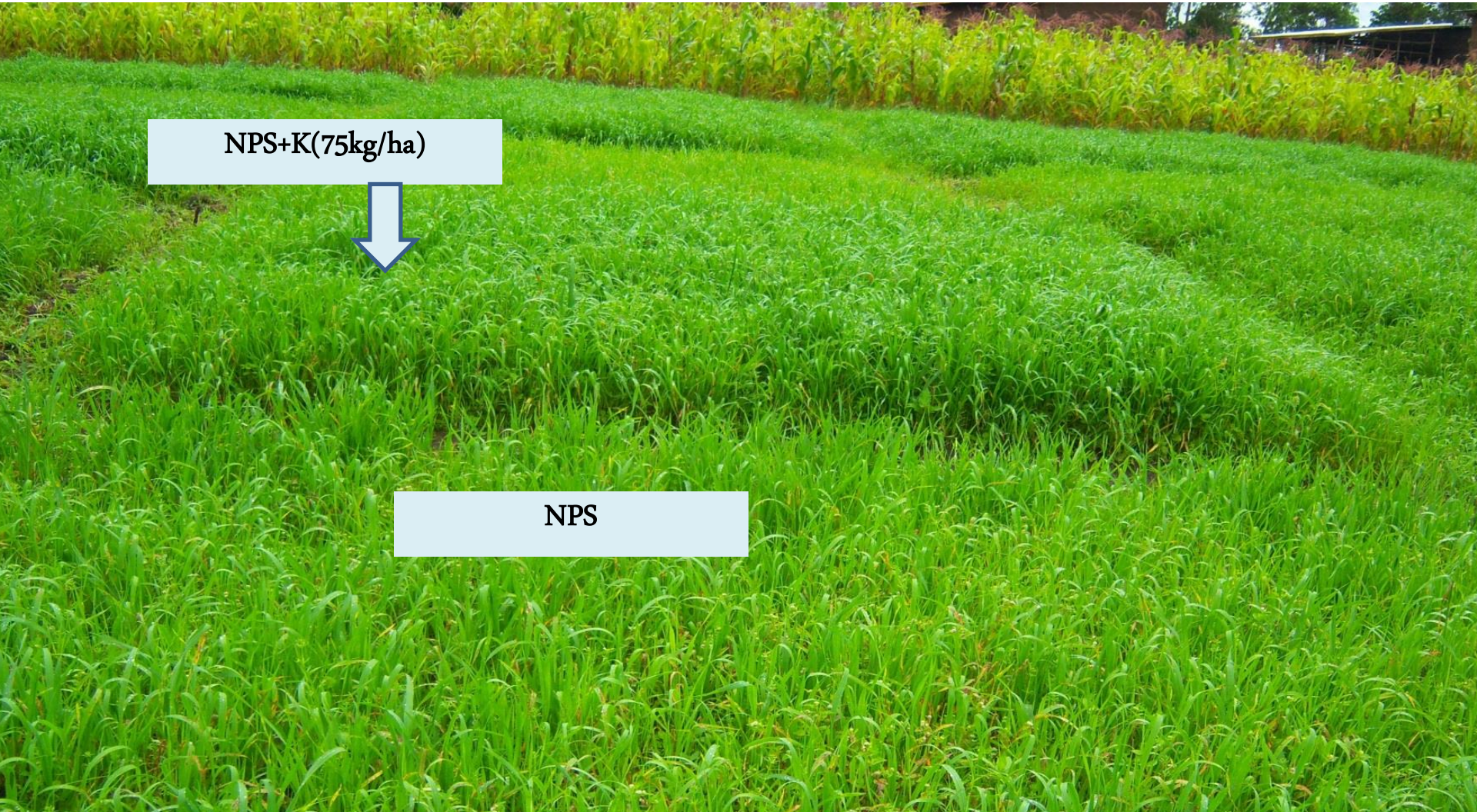
Response of barley to Potassium application under NPS fertilization , Debrebirhan area, (2014)



Ministry of Agriculture – Hawassa University – Ethiopian Agricultural Transformation Agency (ATA) joint symposium - The Role of Potassium in Balanced Fertilization. November 2015, Hawassa University, Hawassa, Ethiopia

Barley response to different levels of K application in Debre Birhan

Response of barley to Potassium application under NPS fertilization, (2014)



NPS+K(75kg/ha)



NPS

Response of wheat to Potassium application under NPSZnB fertilization, Enewari area (2014)



-K

+K

Response to potassium applications has been observed in different locations, crops, and years

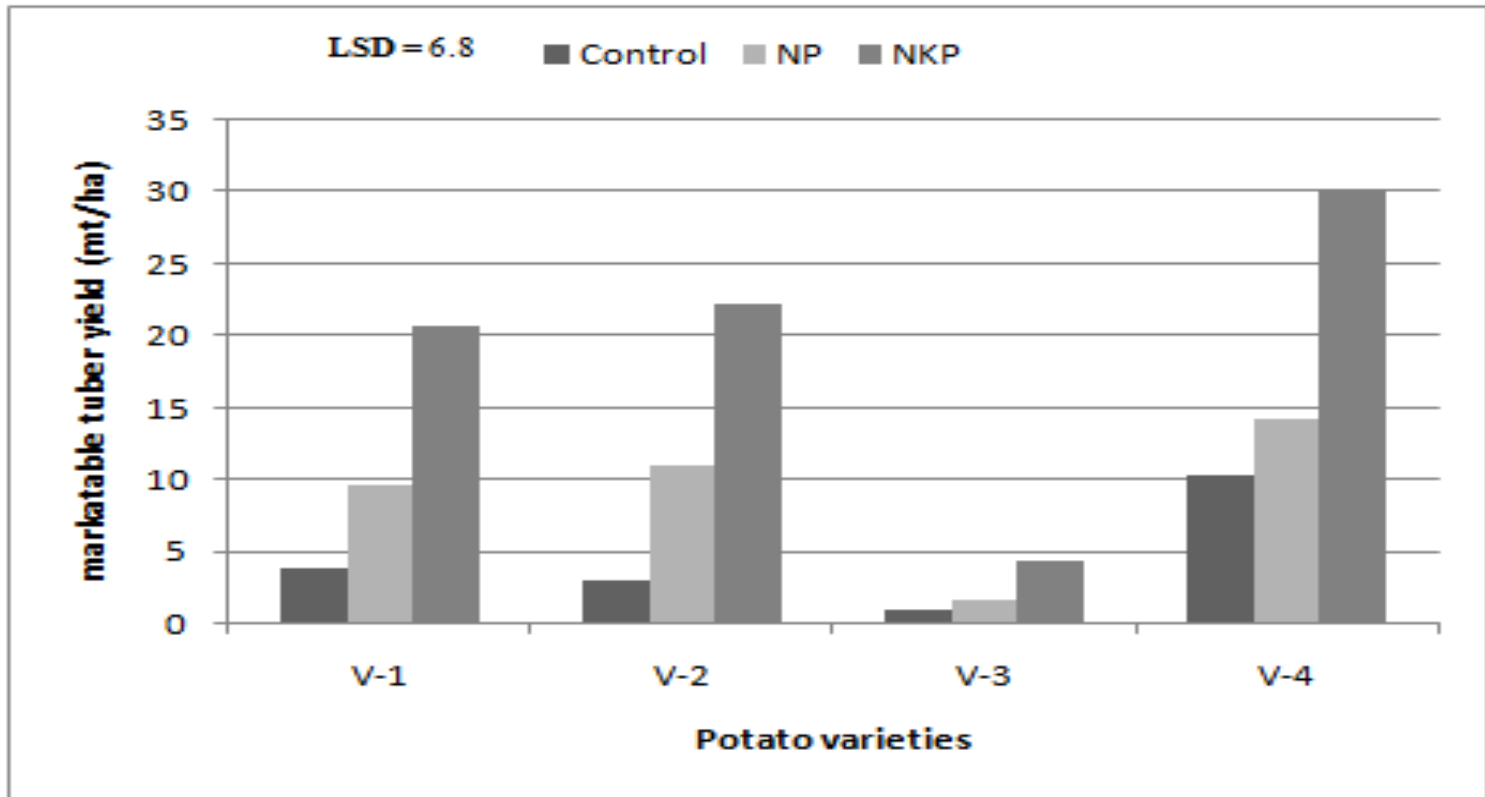
| Tillage System | Grain Yields(t/ha) | | Straw Yield(t/ha) | |
|-----------------------------|--------------------|------|-------------------|------|
| | -K | +K | -K | +K |
| Traditional | 2.44 | 2.76 | 3.68 | 4.29 |
| Newly constructed BBFs | 2.32 | 3.37 | 5.54 | 6.91 |
| BBFs permanently maintained | 2.09 | 2.64 | 5.47 | 6.52 |

Source: Abiy, Tekalign and Pendon 2004

Grain Yield increase of 0.32- 1.05 t/ha grain yield

Straw Yield increase of 0.61- 1.37 t/ha grain yield

Response to potassium applications has been observed in different locations, crops, and years



Registered yield increment(%): 114 - 341%

Wassie, H. and Shiferaw. B (2011).

Response to potassium applications has been observed in different locations, crops, and years

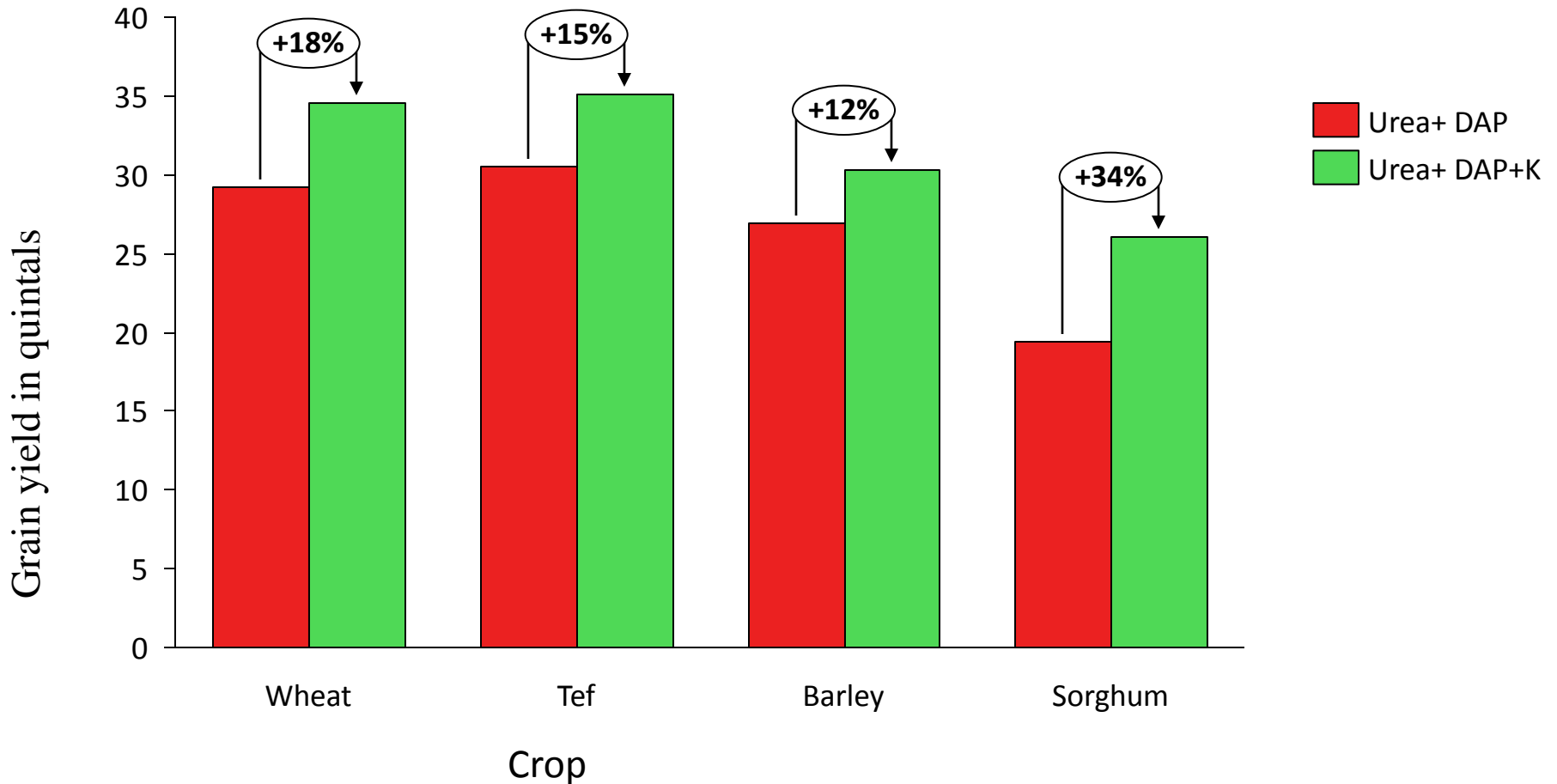
| Rates of K (kg K ha ⁻¹) | Tuber yield (t ha ⁻¹) | Stem number/plot |
|-------------------------------------|-----------------------------------|------------------|
| 0 | 47.86abc | 72ab |
| 40 | 47.14abc | 68ab |
| 80 | 48.06abc | 74a |
| 120 | 47.89abc | 68ab |
| 160 | 50.98ab | 71ab |
| 200 | 43.97c | 56b |
| 240 | 46.44bc | 56b |
| 280 | 53.33 a | 83a |
| 320 | 50.23abc | 71ab |
| CV (%) | 9.29 | 16.87 |
| LSD (5%) | 6.577 | 17.00 |

Source : Abay and Sheleme, 2011. Trial conducted at Angacha, SNNPR

- **Higher tuber yield at 280 Kg/ha K, tuber and leaf K concentration**

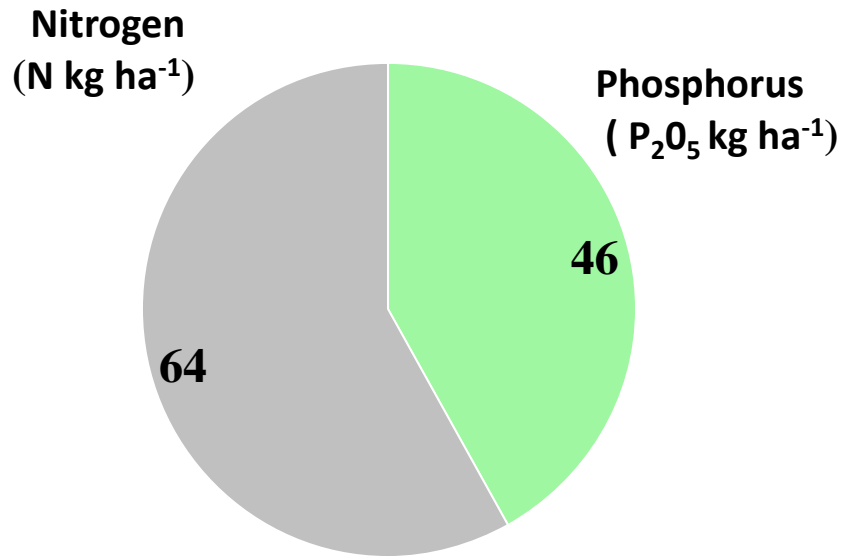
The highest tuber yield (53.33 t ha⁻¹) obtained from application of 280 kg K ha⁻¹ had 5.47 t ha⁻¹ (11.4%) yield advantage over the control (47.86 t ha⁻¹), although the difference was not statistically significant.

Response to potassium applications has been observed in different locations, crops, and years

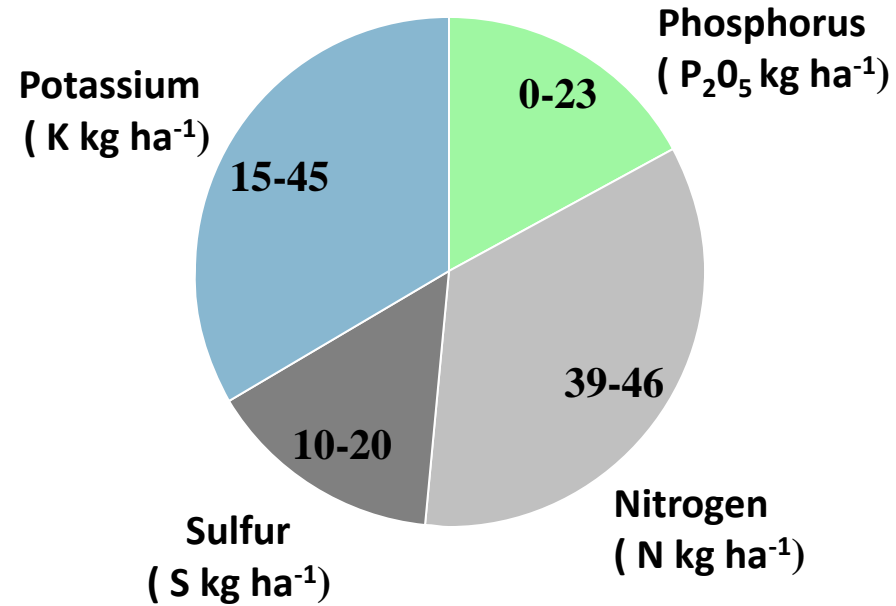


Results indicate that current fertilizer recommendation should be improved to include additional nutrients that result in an efficient fertilizer use system

Current state of fertilizer use and trial findings



Economically optimum fertilizer doses determined using the local grain market value in wheat/barley production systems per hectare



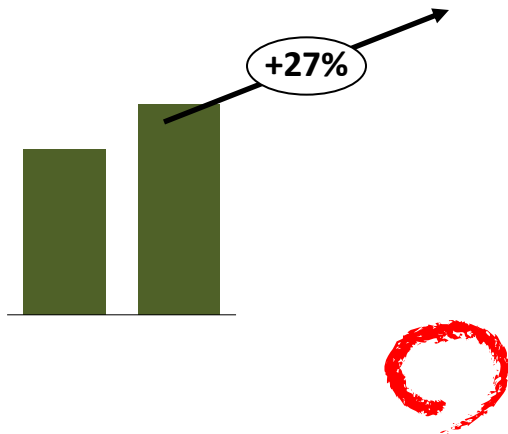
Blanket fertilizer recommendation for all crops

Results indicate that current fertilizer recommendation should be improved to include additional nutrients that result in an efficient fertilizer use system

- ✓ Application of potassium and sulfur fertilizers In an area increased **nitrogen and phosphorus use efficiency by 80 to 100%**,
- ✓ **N and P fertilizers saved** from blanket recommendation alone could be sufficient to pay the **extra cost that farmers incurred due to application of S and K.**
- ✓ Returns to balanced fertilizer investment is considerably high (**VCR ratio were ranging between 3.1 and 5.1**)- small-scale farmers accept and adopt technologies only if the **VCR is ≥ 1.5**).
- ✓ These findings facilitated to design a five year national fertilizer program to:
 - **Improve blende formulas in terms of application rate and nutrient combination** fro four major crops in four regions
 - Develop tailored balanced **fertilizer recommendation system**

Current fertilizer recommendation should be improved to include additional nutrients that result in efficient fertilizer use system

Wheat yield gain due balanced fertilizer application (Tones/ Hectare)



Recommended
(NP)

Balanced (NPKSZnB)

The net profit margin gained due to the right amount of balanced fertilizer use is higher compared to the blanket recommendation

| | NPKSZnB | NP (Blanket recommendation) |
|---------------------------------------|---------------|-----------------------------|
| Yield (t ha ⁻¹) | 5.2 | 4.1 |
| Cost of fertilizer ha ⁻¹ | 2,817 | 2623 |
| Grain price (birr kg ⁻¹) | 5 | 5 |
| Toal revenu (birr) | 26,000 | 20,500 |
| Net Profit (birr) | 23,181 | 17,867 |
| | 5,306 | |

20 biir = 1UD\$

Note: The price is taken from local grain market and fertilizer retailer price (in Addis, study area) 2013

Source: Soil test based fertilizer recommendation, 2013

Response of tef to Potassium application under balanced fertilization, (2015)



Response of tef to Potassium application under balanced fertilization, (2015)



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Response of tef to Potassium application under balanced fertilization, (2015)



Response of tef to Potassium application under balanced fertilization, (2015)



Response of tef to Potassium application under balanced fertilization, Derba area (2015)

Farmers' practice



K₀

K₃₀

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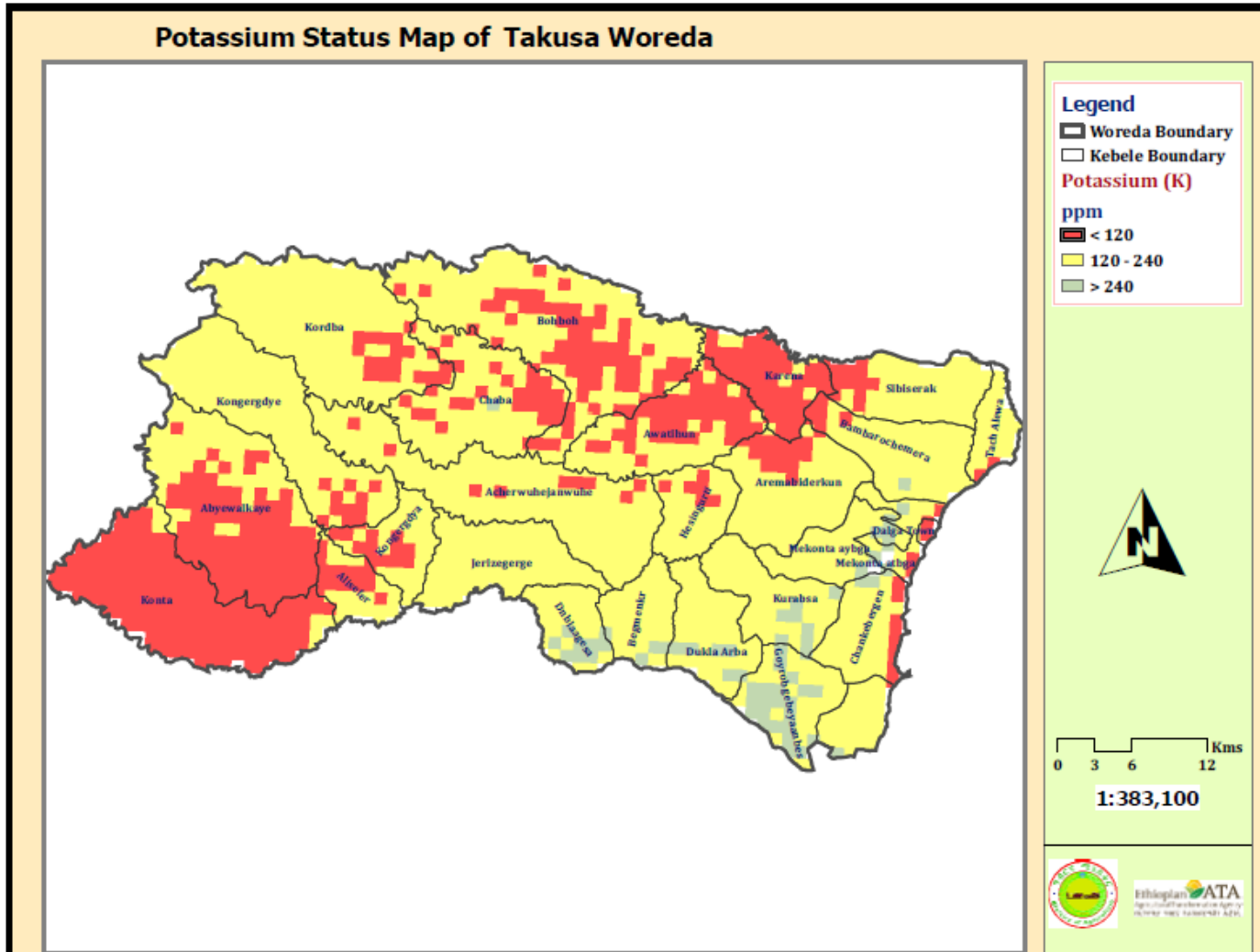
Introduction and background

Trial results review

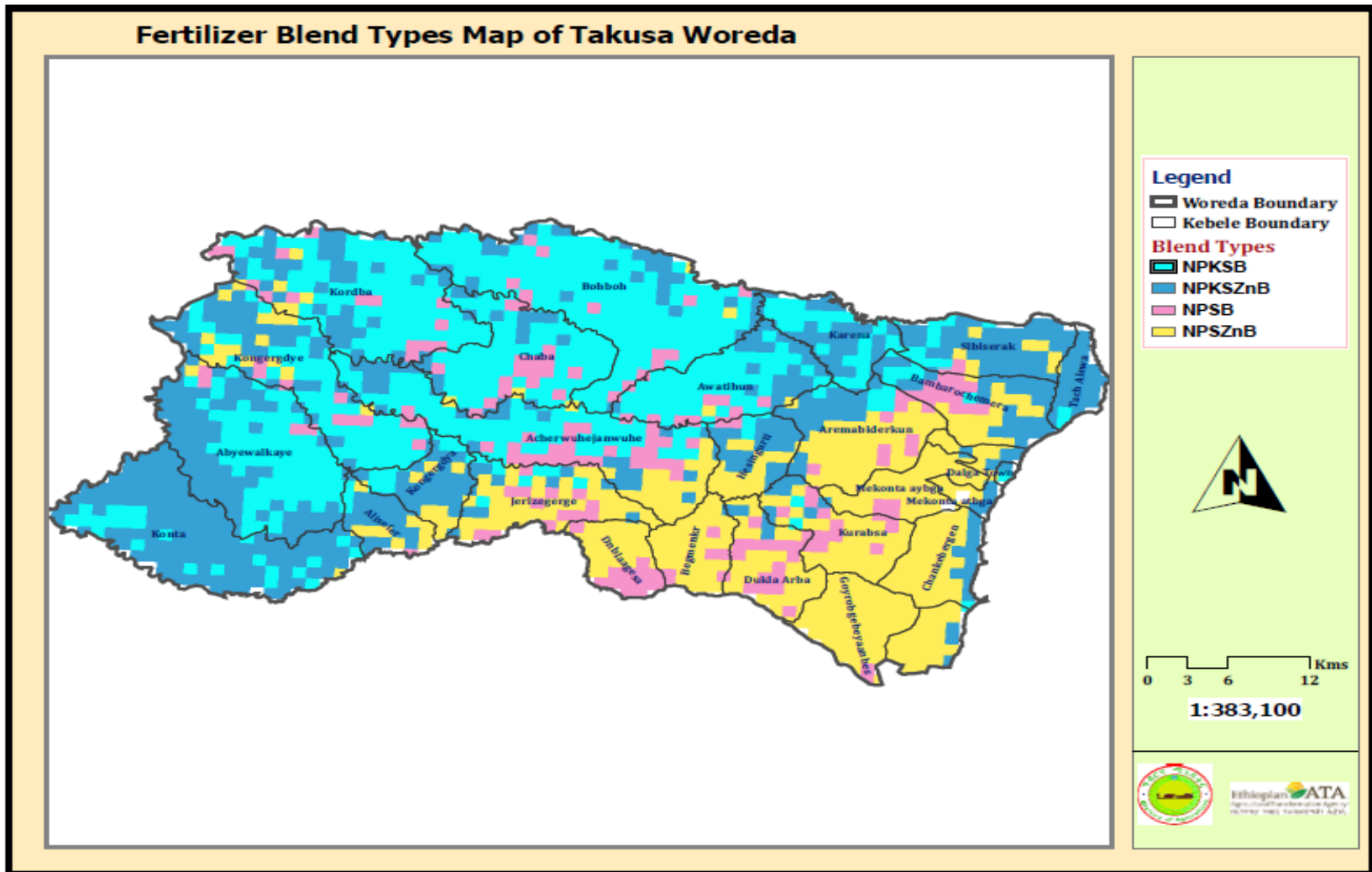
Soil analysis results review

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Mapping K status of the soils at woreda indicated the deficiency of K at different levels



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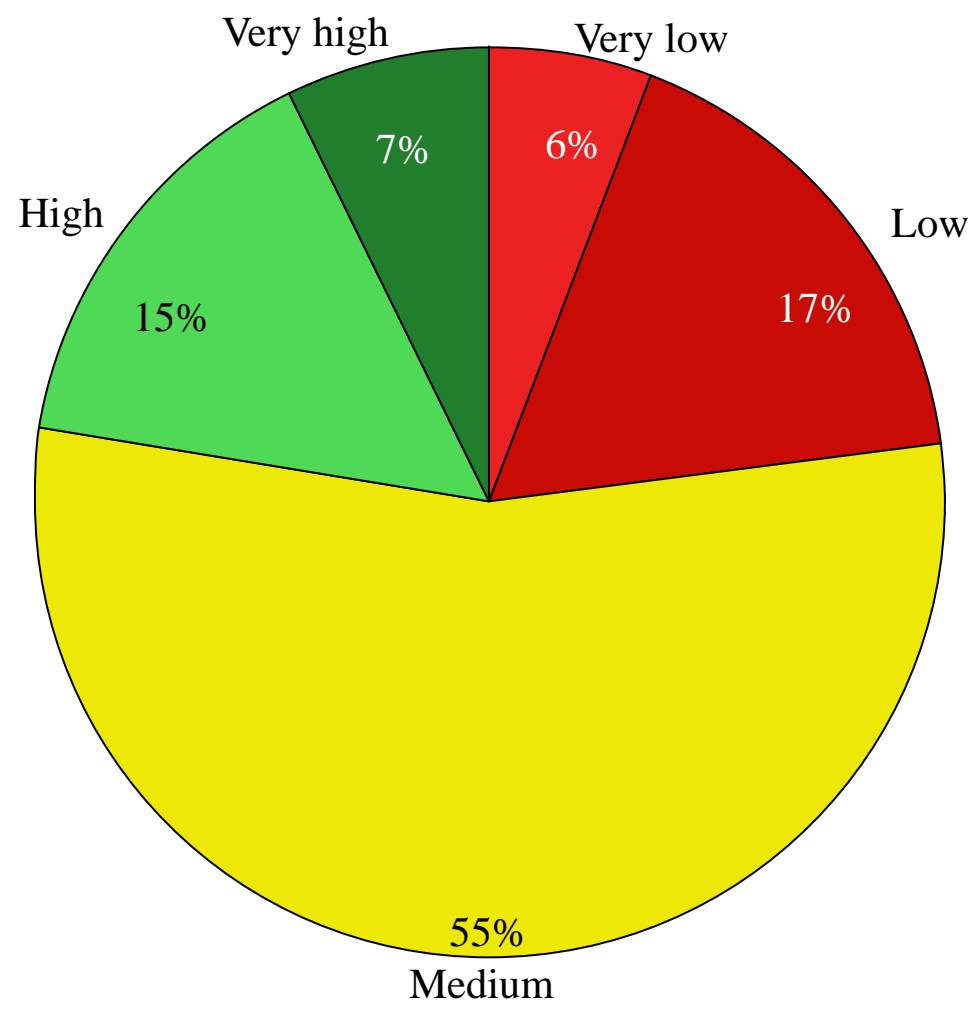


Mapping K status of the soils at woreda indicated the deficiency of K at different levels

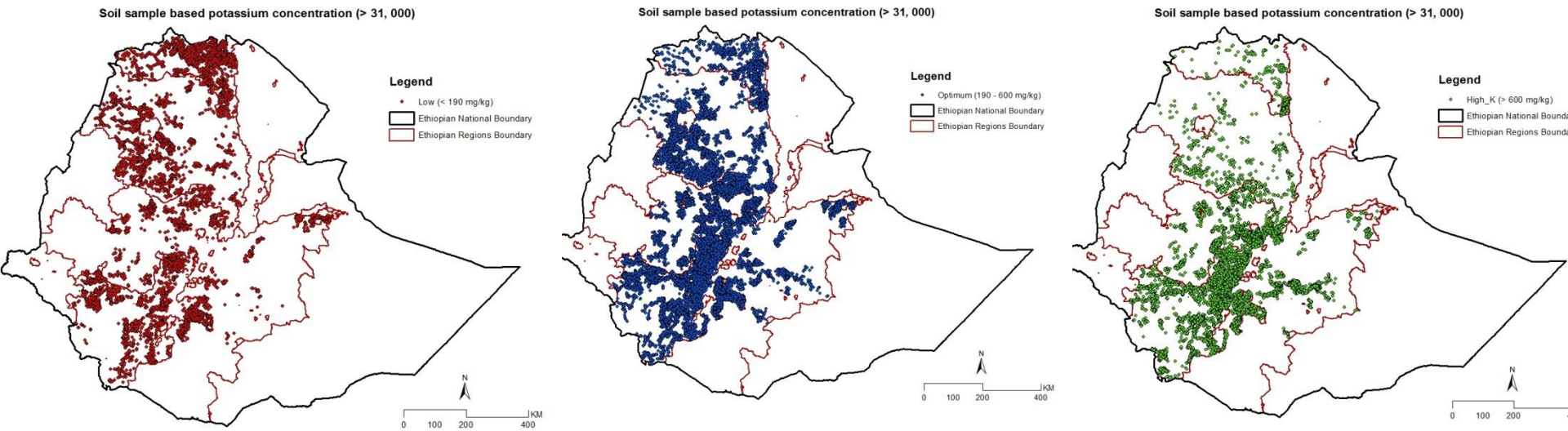
| Soil Test Potassium | Relative Level | No of samples | Percentage |
|---------------------|----------------|---------------|------------|
| 0-90 | Very low | 1,845 | 5.8 |
| 91-190 | Low | 5,407 | 17.1 |
| 191-600 | Medium | 17,195 | 54.5 |
| 601-900 | High | 4,869 | 15.4 |
| >901 | Very high | 2,247 | 7.1 |
| Total | | 31,563 | 100 |

When sampling from the whole country is finalized, status will change

Mapping K status of the soils at woreda indicated the deficiency of K at different levels

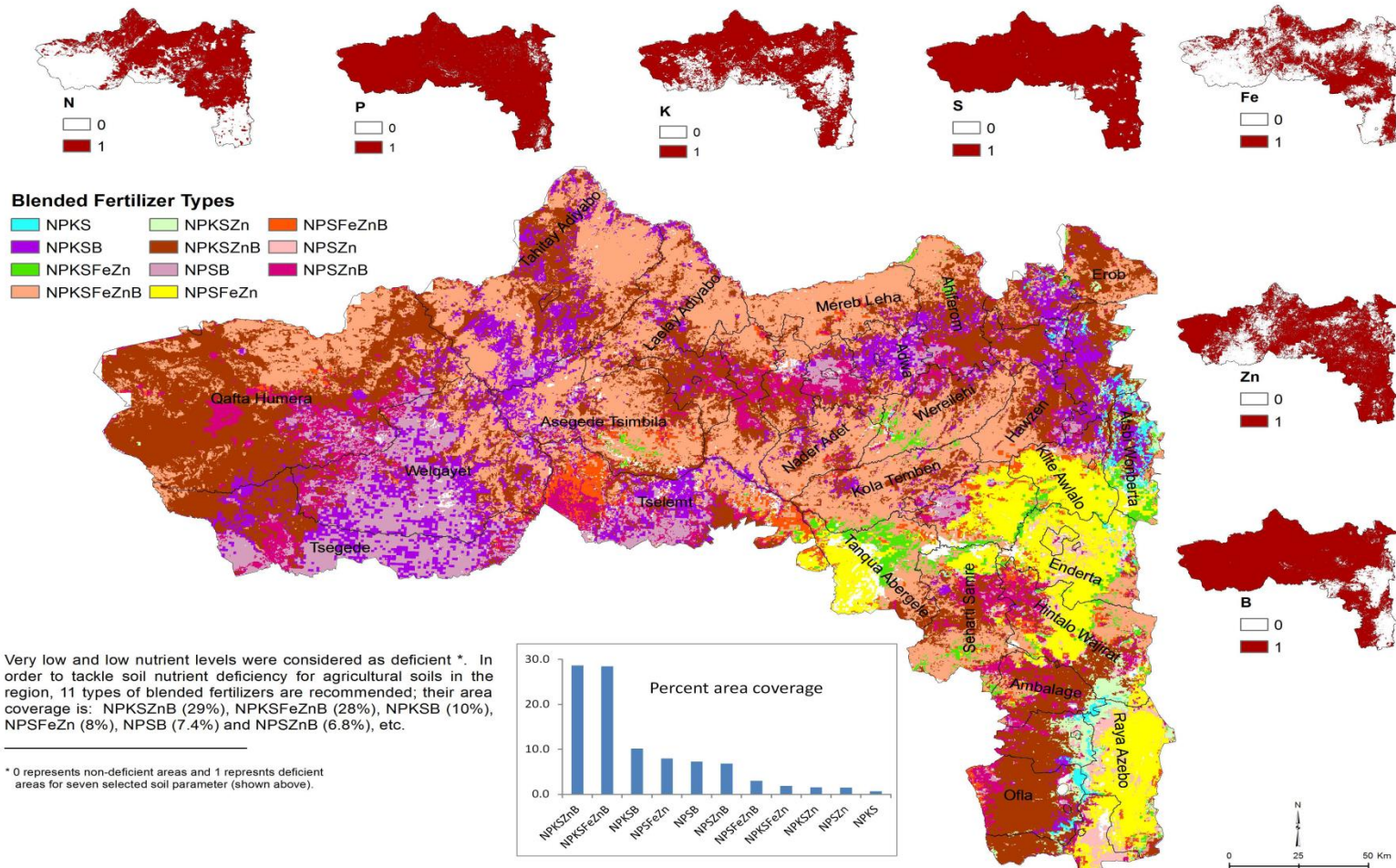


Results of the sampled points showed that 23 % of them are low and 55% moderate status



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Fertilizer Type Requirement of Tigray Region



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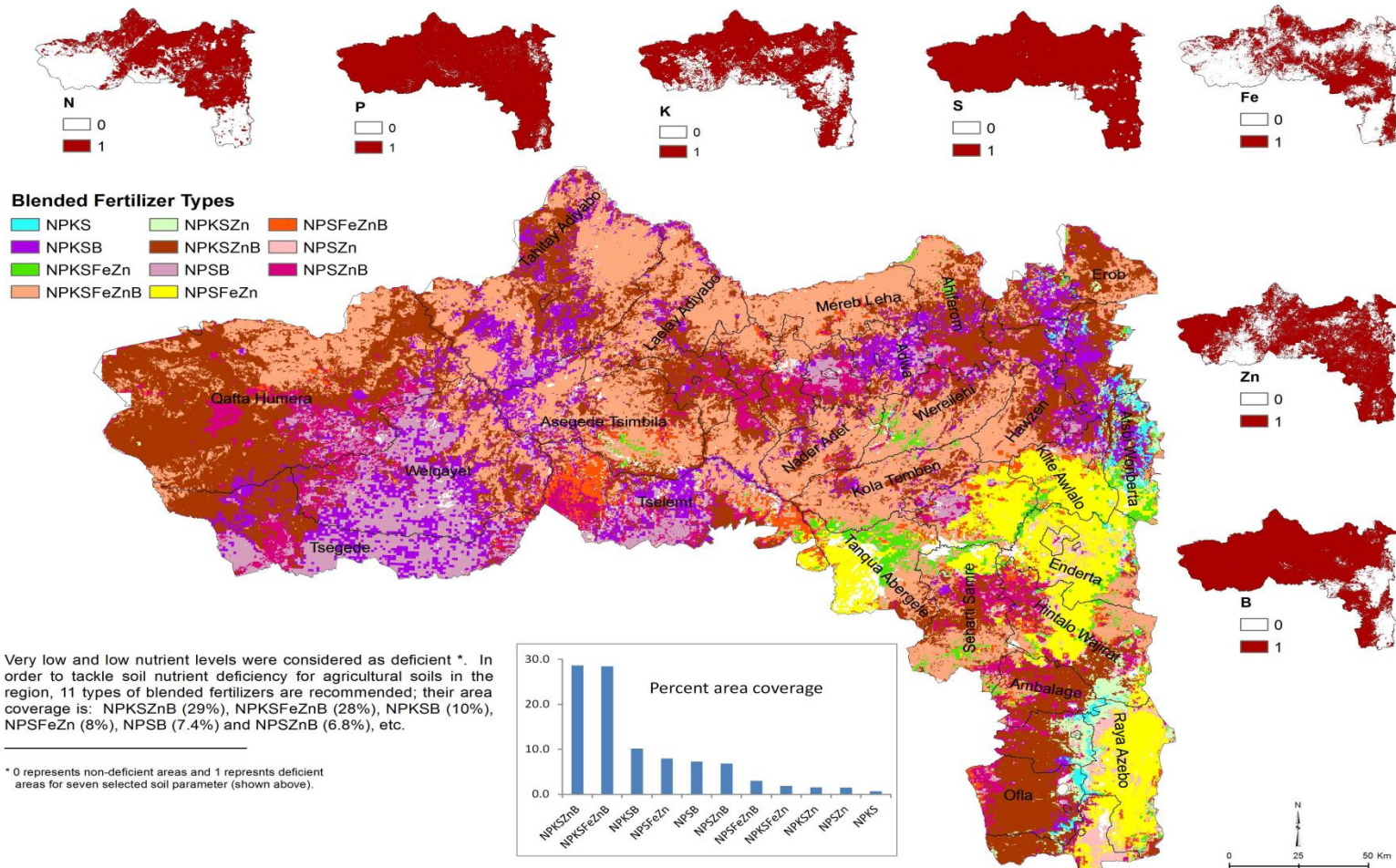
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Fertilizer Type Requirement of Tigray Region



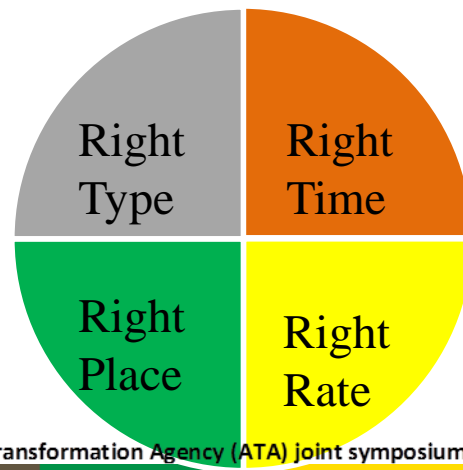
Results indicate that current fertilizer recommendation should be improved to include additional nutrients that result in an efficient fertilizer use system

20,000 demonstrations to be conducted next year with funding support from AGRA

Mapping will be completed and the status in the country mapped

Improve blended formulas in terms of application rate and nutrient combination for four major crops in four Regions

Develop tailored, balanced fertilizer recommendation system to address the 4 nutrient stewardships





Innovations to help our country grow