Assessment of Fertilizer Distribution Systems and Opportunities for Developing Fertilizer Blends MALAWI

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Executed by:

IFDC
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This assessment was conducted by the International Fertilizer Development Center (IFDC) and the African Fertilizer and Agribusiness Partnership (AFAP) for the Alliance for a Green Revolution in Africa (AGRA) as part of a consultancy for Assessment of Fertilizer Distribution Systems and Opportunities for Developing Fertilizer Blends. The views, information, and opinions expressed in this assessment are those of IFDC and AFAP and do not necessarily reflect the official policy or position of AGRA.

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Acronyms & Abbreviations

ADMARC	Agricultural Development and Marketing Corporation
AFAP	African Fertilizer and Agribusiness Partnership
AfSIS	Africa Soil Information Service
AGRA	Alliance for a Green Revolution in Africa
ARET	Agricultural Research and Extension Trust
B	boron
CAN	calcium ammonium nitrate
CNLS	Crop Nutrition Laboratory Services, Kenya
DAP	di-ammonium phosphate
DARS	Department of Agriculture Research Services
DPTA	diethylene triamine penta-acetic acid
EPA	Extension Planning Area
ETDA	ethylene diamine tetra-acetic acid
ETG	Export Trading Group
FISP	Farm Input Subsidy Programme
FSU	Farm Services Unit
Ha	hectare
ICRAF	World Agroforestry Center
IFAD	International Fund for Agricultural Development
IFDC	International Fertilizer Development Center
IFPRI	International Food Policy Research Instutte
IPNI	International Plant Nutrition Institute
ISFM	integrated soil fertility management
LUANAR	Lilongwe University of Agriculture and Natural Resources
MFC	Malawi Fertilizer Company
Mt	metric ton
NFP	National Fertilizer Policy
NGO	non governmental organization
NPK	nitrogen phosphorus potassium
OCP	Office Chérifien des Phosphates
RUMARK	Rural Market Development Trust
SFFRFM	Smallholder Farmers Fertilizer Revolving Fund of Malawi
SHF	smallholder farmer
SSA	sub-Saharan Africa
SSP	single superphosphate
SWOT	Strengths Weaknesses Opportunities Threats
TSP	triple super phosphate
USAID	United States Agency for International Development

Assessment of Fertilizer Distribution and Opportunities for Developing Fertilizer Blends in Malawi

Introduction

In the performance of this assessment, we conducted interviews with key informants in Malawi, including the AGRA country team, the AFAP country representative, several fertilizer suppliers (Malawi Fertilizer Company, Optichem, ETG, and Agricultural Resources Limited), personnel from Lilongwe University of Agriculture and Natural Resources (LUANAR), the Farm Services Unit (FSU) of Farmers World, One Acre Fund, the Rural Market Development Trust (RUMARK) and from Department of Agricultural Research Services (DARS), Agricultural Research Scientist Lester Botoman, the national rice agronomist Wiseman Kanyika, and Director of Agricultural Research Services Wilkson Makumba, the CEO of Agricultural Research and Extension Trust Andy Khumbanyiwa, and analytical laboratory manager Mr. Mwanyongo. We reviewed documents relating to policy and regulations, the national maize recommendation, and soybean and groundnut agronomic recommendations, which are referred to in the assessment. One team member attended the National Fertilizer Policy Validation Workshop on 28 March 2017.

Available Soil Information

AGRA is spearheading efforts to accumulate available soils information and convert it to maps. This information includes historical basic soils information (mainly pH, total N, organic C, extractable P, and exchangeable K from national labs at Chitedze, Bvumbwe, and ARET (Agricultural Research and Extension Trust), as well as information taken from various projects and fertilizer providers. Already, areas of extensive soil acidity as well as high pH are indicated. The map in Figure 1 is based sub-surface pH, but we should note that surface soil pH is usually less, and might be a more accurate indicator of areas likely to be lime responsive. Higher pH areas may be susceptible to iron (Fe) and manganese (Mn) deficiencies, as well as high sodium. Analytical methods that correlate well with Fe and Mn response should be used for mapping higher pH areas. These include DPTA and ETDA extractants.

Important in synchronizing available soils information is understanding that the Mehlich-3 analysis used at Chitedze and Bvumbwe has different critical levels than procedures used historically at the ARET laboratories. A study has already been conducted relating critical values from the different methods in Malawi. Soil pH values need to be adjusted according to method (water, CaCl2, KCl) to a common method.

The micronutrients have yet to be mapped. Labs at Chitedze, Bvumbwe, and ARET seemed to have limited information on Ca, Mg, S, Zn, Cu, B, Fe, and Mn. We obtained some information from analyses run by SGS laboratories and Crop Nutrition Laboratory Services

Ltd. (Kenya), most of which indicated serious S, Zn, and B deficiencies and likely deficiencies of Cu.

In sum, while it will not be known until available data are accumulated, considerable gaps will likely be found in secondary (Ca, Mg, S) and micronutrient (Zn, B, Cu, Mn and Fe) soil analyses in particular.

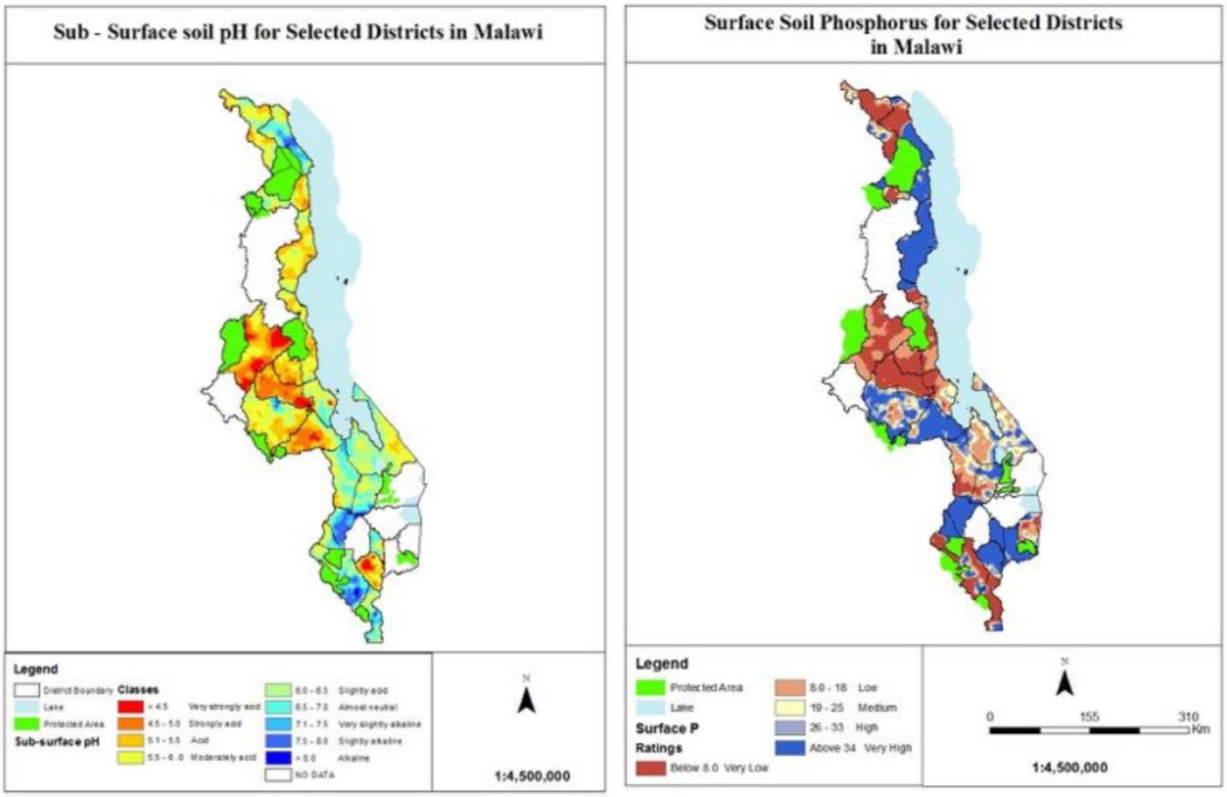


Figure 1. Extent of soil pH and P constraints in Malawi

Source: information presented at the National Fertilizer Policy Validation Workshop, March 28, 2018.

Inventories of Fertilizers Available in the Markets

Table 1 is the most updated list of the main fertilizer straights, compounds, and blends available in Malawi. Some additional multi-nutrient specialty products primarily targeted to specific vegetables are supplied by ETG.

Table 1. Main fertilizer straights, compounds and blends available in Malawi.

Product name	Trade name	Target crops
Urea		All - purpose top dressing
Di-Ammonium Phosphate (DAP)		Used in Malawi for basal fertilizer blends
Calcium Ammonium Nitrate (CAN)		Maize, wheat, barley, sugarcane, flowers coffee, tobacco, potato, pineapple, pea, paprika
Muriate of Potash (MOP)		Used in Malawi for basal fertilizer blends
Sulphate of Potash (SOP)		Used in Malawi for basal fertilizer blends

Ammonium Sulphate (AS)		Flowers, rice, cotton, cassava, groundnut, wheat; used in Malawi for basal fertilizer blends
Magnesuim Sulphate		Tomatoes, Irish potatoes, flowers, fruit trees
Zinc sulphate monohydrate (granular)		micronutrient source for multiple crops
Ulexite (slow-release granular B product)		micronutrient source for multiple crops
Micronutrient sprays containing Zn and B		micronutrient source for multiple crops, used as micronutrient coating for granular NPKs
NPK 06:18:06	Compound S	Tobacco, vegetables
8:18:15+6S+0.1B	Compound D/Super D	Tobacco, paprika, flowers
NPK 10:24:20 + 6S + 0.1B	Super D	Tobacco
10:24:20+6S+0.1B		Tobacco
10:18:24+6S+0.1B		Tobacco
NPK 23:21:00 +4S		Maize, rice, Irish potatoes, vegetables
NPK 23:10:05 +6S+ 1Zn		Maize, rice, Irish potatoes, vegetables
NPK 25:05:05 and similar high-N		Tea
NPK 14:18:18 + 6S + 0.1B		Cotton
15:23:16 + 6S + 0.5Zn + 0.3B		Maize
6:20:24 + 3S + 0.5Zn		Soybean, groundnut
10:20:20 + 6S		Sweet potato
30:0:16		Maize topdress

Rationale for why Fertilizer Blended Products were Developed

Fertilizers in Malawi are blended by Malawi Fertilizer Company (MFC), and both blended and granulated by Optichem. ETG imports products primarily from Mozambique. Many estates tender products directly through agents or indirectly through the two blenders.

The main rationale for product development are as follows:

1. To address specific commercial farmer requirements, based on a soil test, crop, and yield target. This mainly applies to estates and larger farms.
2. Based on government tenders for the Farm Input Subsidy Program (FISP). This is currently 23:10:5 +6S +1Zn (supplied as a compound) and is intended for maize production.
3. To meet general soil and crop-specific demands, without respect to specific soil analysis, but with regards to perceived widespread nutrient deficiencies. This includes formulations for maize, soybeans, groundnuts, and sweet potato produced by MFC. For each of these commodities, they are only producing and field-validating one blend, due to the lack of soils information required to formulate blends better regionally.

Optichem has filler products based on clay which have had stability problems in the past, but they have recently upgraded the quality of their filler products. These fillers are used by both Optichem and Malawi Fertilizer Company when responding to tenders that request a specific formulation that is familiar to farmers or estates.

With respect to trace element addition rates, the 0.5% Zn rates added to MFC maize, soybean and groundnut fertilizers may be slightly on the low side since the Zn is added as granular zinc sulfate. Zinc deficiencies, from the available data, are severe, and the relatively poor distribution of this low quantity of Zn in granular products may affect its availability. However, this can only be known for certain through omission trials. For boron, we consider the 0.3% B included in their maize product, supplied as slowly soluble granular ulexite, likely sufficient.

We interviewed both MFC and Optichem personnel, as well as ETG, which imports and distributes from Mozambique. The lack of soils information was considered a key constraint, as was lack of clarity on government regulations regarding fertilizer field evaluation before product registration. Some in the government believe that a 3-year evaluation period is required, though this does not seem to be a requirement that has been documented—only an internal DARS requirement for technology release in general, which they have in the past applied to fertilizers. Such a requirement, if extended to blends, would effectively negate the ability of blenders to evolve crop- and region-specific fertilizers effectively.

The rationale given for the development of the new government-approved fertilizer 23:10:5 +6S +1Zn is based on 4 factors: 1. Its better performance in trials vs. the former government fertilizer 23:21:0 +4S, 2. an assumption that much of Malawi has sufficient soil P stocks, and therefore P can be reduced; 3. the lower cost of the new formulation, due to lower P content and the higher cost of P relative the additional K+S+Zn in the compound; and 4. high N content because Malawi often suffers a drought period after early rains, the added N would result in early rapid growth and sustain the young maize through the drought. Some of these rationales are examined below.

Types of Fertilizer Recommendations Available, and their Suitability for Crops and Agro-Ecological Zones that are Targeted by AGRA

Table 2 shows the nutrients extracted for given yield targets we believe routinely achievable for AGRA priority crops in Malawi, along with nutrients supplied in government and MFC fertilizer recommendations.

Maize recommendations and their suitability

The new government fertilizer recommendation for maize is 200 kg/ha of a basal formulation 23:10:5 +6S +1Zn, and a top dress of 100 kg/ha urea (46:0:0). This recommendation is based on a field assessment at 32 sites in Malawi, compared to 23:21:0 +4S, the previous Malawi maize fertilizer. It is well-balanced for N, but contains very little K and P. It has sufficient quantities of Zn and S. Variations down to the Extension Planning Area (EPA) level consisting at varying rates of the previous basal subsidy fertilizer 23:21:0+4S and urea exist, and it is unknown how these prior recommendations will be adjusted, given the lower P concentration of the new basal fertilizer. Since the new recommended formula has about half the P of the previous recommendation, offsetting P crop removal will require double the quantity of fertilizer of the former formulation to maintain P application. OFRA optimization curves indicate that some 29 kg of P2O5/ha should be applied to maize, but are not optimized with Zn and S, so the likely quantity for optimization is more, and probably closer to the 40

kg P2O5 , which would require 400 kg/ha of the new government recommendation (but only 200 kg of the previous government recommendation. Such a P quantity will sustain P off-take by a 4-5 Mt/ha maize harvest long-term.

Table 2. Nutrients extracted for given yield targets and nutrients supplied in government and MFC recommendations for AGRA priority crops.

Crop	Yield	Application Rate		N	P_2O_5	K_2O	Ca	Mg	S	Zn	B	Cu	Mn	Fe
		Basal	Topdress											
	Mt/ha	kg/ha		----------Nutrients removed in crop and residue, kg ha^{-1}----------										
Maize	5			100	46	121	13	21	13	0.23	0.24	0.07	0.73	0.36
				----------Nutrients supplied in recommendation, kg ha^{-1}----------										
Government recommendation		200	100	92	20	10	0	0	12	2	0	0	0	0
MFC maize fertilizer/MFC topdress		175	125	71	40	52	0	0	11	0.9	0.5	0	0	0
	Mt/ha			----------Nutrients supplied in recommendation, kg ha^{-1}----------										
RIce	7			150	46	217	30	30	7	0.28	0.21	0.20	4.73	1.05
				----------Nutrients supplied in recommendation, kg ha^{-1}----------										
Government recommendation		100	varies	40-240	25	0	0	0	7	0	0	0	0	0
MFC maize fertilizer/urea topdress		200	100	76	46	32	0	0	12	1	0.6	0	0	0
	Mt/ha			----------Nutrients removed in crop and residue, kg ha^{-1}----------										
Soybeans	3			88	46	53	19	10	7	0.13	0.14	0.03	0.20	0.61
				----------Nutrients supplied in recommendation, kg ha^{-1}----------										
Government recommendation		50		11.5	11.5	0	0	0	2	0	0	0	0	0
MFC soybean/groundnut fertilizer		150		9	30	36	0	0	4.5	0.75	0	0	0	0
	Mt/ha			----------Nutrients removed in crop and residue, kg ha^{-1}----------										
Groundnut	3			174	34	65	34	27	13	0.24	0.16	***	0.29	6.00
				----------Nutrients supplied in recommendation, kg ha^{-1}----------										
Government recommendation		**200-400 (gypsum)**		0	0	0	45-90	0	37-75	0	0	0	0	0
MFC soybean/groundnut fertilizer		200		12	40	48	0	0	6	2	0	0	0	0

To understand why this formula was successful vs. 23:21:0 +4S, we examined the original field test data that was used to support its approval. We found of the 32 sites it was tested on, 30 (94%) were adequate to high in P, and 31 of 32 (96%) were adequate in K. Thus, the low P and K quantities supplied by the fertilizer did not affect the fertilizer performance. Most sites were deficient in Zn, with 25 of 32 sites below the critical value of 2 ppm for the Mehlich-3 procedure, and others in the range where we have often observed response. The primary differences between the old formulation and the new one in terms of nutrient addition were a small amount of K and a considerable dose of Zn.

Our conclusion is that the superior response of the new formulation is due to Zn and not K. This is somewhat supported by data presented at the National Fertilizer Policy meeting in April, where results of an omission trial showed very little response to K but a tremendous response to Zn (about 1 Mt/ha), equivalent to that of P. However, despite several inquiries, we were not able to obtain any data or manuscript that supported the presentation. It was, however, typical of Zn response we have observed in Zn-deficient soils.

In spite of the soils data, omission trials, and logic supporting Zn response, the manuscript used to support the release of the new formulation concluded that Zn could not have been deficient, because they used a mistaken Zn critical value, which better applies to the DPTA extract instead of the Mehlich-3 extract used. They rather interpreted that the response was due to K (in spite of soil K sufficiency). In other aspects, the trial was well run and the proper

data were collected; the weakness was in interpretation. Soils in general appeared atypical, most having pH values between 5.5 and 6.5, which do not represent many acidic Malawi soils (Figure 1).

While the new formulation may have performed well in soils with adequate P and K, there is reason to believe that it will not perform well in soils low in the same, and that it will quickly draw down P reserves in P-adequate soils. From Figure 1, it appears that extensive areas of low-P soils exist in high-potential maize-growing areas. These low-P soils were not well represented in the field evaluations that resulted in formula approval.

MFC has trial recommendations they are testing this season. Those that they previously tested in 2016-17 did not appear successful; substantially greater yields were only achieved with lime (2.5 Mt/ha) and very high fertilizer rates (350 kg/ha basal formulation; 300 kg/ha topdress formulation), which resulted in average yields of 7.1 Mt/ha, vs. 4.6 Mt/ha vs. the previous government recommendation. The MFC 2017-18 "recommendations" are dependent on yield target and are based on two formulations applied at increasing rates: a basal formulation of 15:23:16 +6S +0.5Zn +0.3B, and a topdress of a urea-KCl blend of formulation 30:0:16. We do not consider a formulation a true recommendation until it has been successfully validated. For the purposes of this assessment, we consider only the fertilizer rate being field-trialed in 2017-18, which corresponds in absolute quantity to Malawi fertilizer recommendations (considering basal + top dress fertilizer). From the nutrients applied in this formulation and additional information from MFC, they developed their maize formulation to meet crop removal for N, P, K and S, and as well to address Zn and B deficiencies apparent in the previous season's trials.

The MFC recommendation appears to be well-balanced for all nutrients applied, except for N. The quantity of K is quite high (due to both K in the basal and top dress), which is similar to its previous season's maize fertilizer, which had a mediocre performance. Simply using urea instead of a urea-KCl blend for top dress would better balance the total application for N (adding an extra 19 kg/ha) and probably have negligible impact on K supply. While the B in this fertilizer appears high, it is supplied as granular ulexite, which is a slow-release B source, so it is probably appropriate.

We believe that MFC and their Farm Support Unit received sub-optimal technical support through their donor and have spent two seasons without arriving at key information that could have helped them diversify products regionally and optimize formulations. Their first-year formula B percentage was 3% (cut to 0.3% second season), which may have resulted in toxic application rates. In both seasons, they tested only one fertilizer formula, whereas had they tested different formulations representing omission treatments initially, they would have been able to better formulate after the first year. Instead they tested a single formulation at different rates, with/without lime, and continue to test a very similar formulation, and remain uninformed regarding which nutrients are responsible for economic response or lack thereof, and any regional variations resulting.

Rice recommendations and their suitability

Also shown in Table 2 are rice recommendations and rice crop removal for a 7 Mt/ha yield, which is obtainable (and has been obtained in Malawi for irrigated rice).

There is in fact no national rice formulation, but rather recommendations for N and P only. The P recommendation is 25 kg P2O5/ha for all rice production systems. The N recommendations vary according to variety, with long season, tall Kilombero rice having

lower N rates (as low as 40 kg N/ha under SRI (Sustainable Rice Intensification) systems to as high as 240 kg N/ha using short-stature, short-season high yielding varieties under irrigation—an extremely high rate that reflects poor N use efficiency.

One unintended consequence of the switch to the new maize fertilizer is that it is the primary fertilizer used by rice farmers. Thus, if farmers continue to apply the new fertilizer at the same rate as the previous fertilizer, they will be halving the already-low P application rate, but also adding Zn and a small amount of K. If they match the P recommendations, farmers will be applying twice the basal fertilizer as previously.

Brief investigations indicated very little information available on K, S, Zn or other micronutrient deficiencies in rice-growing areas, though the national rice agronomist has observed what he thought to be Zn deficiency symptoms. The agronomist noted that rice soils differ markedly across the country, from high pH soils in the Shire Valley to low pH soils in the north. To optimize rice formulations, full soil analyses of major rice-growing regions are required.

Rice is a K-demanding crop. There was not a good understanding of the critical K value for rice, which was assumed to be the same as maize. In fact, it is 2.5x as much. Rice lodging, a symptom of K deficiency, was noted by the rice agronomist in the Kilombero variety, and one reason it receives less N. Given that rice has not received K fertilizers and has in the past been fertilized consistently with N and P, it is highly likely that at least some and perhaps many rice cultivation areas are K-deficient.

While there is no rice formulation recommended by MFC, we speculate that their maize formulation is well-suited for rice when applied at 200 kg/ha, followed by 100 kg/ha urea. This application comes close to formulations in several countries that have substantially increased rice production through balanced fertilizer application. The nutrients supplied in this application also shown in Table 2.

Urea briquettes are a very efficient way of applying N and reducing N application rates while reducing yields. The rice agronomist informed us that these were trialed for 2 years in Malawi and much appreciated by farmers, but funds ran out before the 3-year testing required for technology release by in Malawi could be completed.

Soybean recommendations and their suitability

The only soybean recommendation we were able to access, which was confirmed as well by a national scientist, was 50 kg/ha of 23:21:0 +4S. Now that importation of this fertilizer has been banned, farmers applying the government fertilizer (as in rice and maize) will switch to 23:10:5 +6S +1Zn, again with the disadvantages of lower P supply but with the benefits of added Zn and very small increases in S and K. This recommendation originated from “A Guide to Soybean Production in Malawi” (Sept 2013). There was no trial information supporting this recommendation, which seems to be based on providing a P source from the only formulation containing P that was broadly available in Malawi at the time.

The MFC trial recommendation is 150 kg/ha of 6:20:24 +3S +0.5Zn resulted in a 700 kg/ha soybean yield increase in its initial evaluation vs. a control. Yields were further improved by lime; soybeans perform best in a moderate pH range (6-7). This seems to be a profitable recommendation, but we question the high K content, which adds to cost, volume, and application rate. Testing of some lower K alternatives is advisable.

Groundnut recommendations and their suitability

National groundnut fertilizer recommendations come from the "Harmonized Groundnut Production Manual for Malawi" (April 2014). Only gypsum (calcium sulfate), applied at a rate of 200-400 kg/ha, is recommended for acid soils. Groundnuts, particularly the running Virginia types, are sensitive to Ca deficiency.

The groundnut trial recommendation employed by MFC, 200 kg/ha of 6:20:24 +6S, did not perform well in initial trials, and was altered to 6:20:24 +3S +0.5Zn for trials this season. However, in the trials, yield increased by about 1 Mt/ha with the addition of 2.5 Mt/ha lime. Gypsum is probably a more efficient Ca source than lime, as it is more soluble and more quickly available, and MFC also recommends a gypsum application on acid soils at the pegging phase.

In reality, groundnut response to K is rarely noted, except at extremely low K levels. Boron deficiencies in groundnut cause a condition known as "hollow heart", which is characterized by a darkened void in the center of the seeds, reducing both yield and quality, but B is not in the current formulation. Zinc deficiencies may also occur in groundnut, and appear to be a general problem in Malawi, so it is heartening to see that the new MFC formulation includes Zn. Some soluble Ca sources such as Calciprill may be able to replace gypsum, which is assessed high tariffs and is generally unavailable to Malawi farmers. Overall, we believe that a better groundnut formulation could be achieved, which would include Zn, B, and less or no K, which would result in reduced application rates.

For all multi-nutrient products, therefore, there are only blanket recommendations, though MFC fertilizers are diversified to crops. All of the government recommendations are based on one fertilizer (now 23:10:5 +6S +1Zn). The MFC formulations are specific to maize, groundnut, and soybean, based primarily on nutrient removal; they have no rice formula, though their maize formula should work as a general recommendation in rice until specific soils information is obtained.

Gaps that Need to be Addressed to come up with Area and Crop Specific Blends

The lack of soils information is hampering the development of area- and crop-specific blends. Both government formulations and the MFC formulations, though very different, are blanket recommendations that cannot be diversified by region until soil mapping is completed, and the host of potential deficiencies in Malawi are understood at scale.

An additional gap is a lack of government awareness on the impact of micronutrients on yield. Resolving apparent Zn and B deficiencies, if verified once these are analyzed and mapped, will likely increase yields by at least 1 Mt/ha based on prior experience, at a cost of <$10 per ha. No B analyses are available from government laboratories, and likely limited Zn and Cu information. Very little micronutrient research has been done by the government as well. Laboratories lack interpretation skills with regards to critical levels for different crops.

This lack of soils information is diminishing the value of other investments. The two blenders are capable of meeting all of Malawi's diverse fertilizer needs in terms of capacity, and ETG can easily obtain blended products from Beira, Mozambique. All companies have proper equipment and access to ingredients to make any formulation potentially required and have a

good knowledge base in formulation. The distribution network of these companies is well-developed, and MFC is creating farmer awareness through hundreds of demonstrations on maize, soybean, groundnut, and sweet potato. Their products are already being trialed by large projects such as One Acre Fund, Total LandCare, and World Vision. They have yet to demonstrate their fertilizers on rice, but this is a clear opportunity. In brief, many of the pieces are in place in Malawi, but are constrained by a lack of soils information, and limited capacity to design demonstrations and trials to further fertilizer refinement.

Fertilizer Companies and/or SME Blenders Existing in the Country and the Geographies Targeted by AGRA

Optichem (Lilongwe) and Malawi Fertilizer Company (MFC) (Liwonde) are the two operational blenders. ETG can supply blended product through Beira, Mozambique. These 3 companies have capacity to meet all of Malawi's balanced fertilizer needs based on current fertilizer consumption. While other companies may want to enter this market, it should be appreciated that new players need certain skillsets to compete (particularly capacity to formulate based on soil analysis and crop requirement), access to blending ingredients, and distribution channels.

Inventory of Partners and Ongoing Efforts or Investments that are Promoting the Availability of Appropriate Blended Fertilizers that AGRA can Leverage in the Target Countries

A list of potential partners and key country contacts is in Appendix I. Several development partners are already trialing blended fertilizers, so there is scope for rapid scale-up of effective diverse fertilizer products, once developed.

Recommendations and Interventions that AGRA could Implement to Address the Availability of Quality Fertilizers

1. **Create soil maps of nutrient deficiencies and soil acidity constraints:** This is the primary information gap in Malawi preventing the creation of targeted fertilizers. This should be done, step-by-step, putting first things first, as follows:
   a. **Assessment of the laboratories:** Mapping poor analytical results is ultimately a disservice, as maps can misguide regarding sufficiency and deficiency. Data quality assurance is therefore the first step. If laboratories have a record of using international standardized check samples, these can serve as a validation of the laboratory results. Otherwise, a short validation must be done using standardized soil samples for all elements of interest. The importance of this needs to be appreciated. Contamination from lab soap and poor labware washing procedures, for example, can cause errors of serious magnitude for most elements. If internal capacity is lacking, this assessment can be done by a qualified laboratory consultant. CNLS (Nairobi) can potentially provide this service.

It should be born in mind that for many of the secondary and micronutrients which are vital to this assessment, laboratories may not even have recent experience in their analysis. No national lab, for example, could provide any recent boron data, yet boron deficiencies appear to be widespread from what little data we could find. In bringing on unfamiliar procedures, quality assurance is important.

b. **Filling in analytical gaps:** AGRA can work with laboratories and ongoing projects to fill gaps in nutrient analysis. IFAD has made some investments but is currently using laboratories whose quality has not been validated. For elements such as B and likely other micronutrients, this will be much more than gap-filling. It should be appreciated that multiple element gaps still remain in Malawi—likely S, Ca, Mg, Fe, Mn, B, and Cu. Many of these nutrients may not be on the radar as potentially deficient, but should be considered, as their relevance is very crop-specific. In the Malawi context, extensive areas of both high and low pH exist, which can present unique and unexpected deficiencies and imbalances. Higher pH areas may also sodium excess and should also be analyzed for electrical conductivity. Lower pH areas require a determination of exchangeable acidity, as this, and not pH, is used to assess liming rate. Proven procedures for Mn and Fe need to be considered, particularly for high pH areas; in this respect, the Mehlich-3 is not appropriate, and neither is it appropriate for P, Ca and Mg analysis in high pH soils (>7.6), which are extensive in the Shire Valley in particular (see Figure 1).

   For a country the size of Malawi, at least 2000 samples may be required to get even a coarse resolution of deficiencies. Rice marshlands, which in many cases occupy small areas, often have nutrient deficiencies unique to their landscape positions and anaerobic state and will require specific sampling schemes to address. AfSIS is qualified to set up an efficient sampling scheme, as they are able to over-lay geological, crop cover, and soil type data. CNLS may also be able to perform this task. All data taken should be geo-referenced. This may not be possible using historical data; the maps so far generated indicate distinct boundaries in some cases, such as at EPA or even ADD resolution.

   If it is determined that for reasons of quality and/or speed, national laboratories cannot complete this task in a timely manner, we suggest Omnia (S.A.) should be considered. Their capacity is high (peak capacity 5000 samples per day for a full analysis), their methods are well-established, and their quality of data interpretation is well-appreciated. Price-wise, they are much less than other laboratories (though exact costings will need to be negotiated). It should be appreciated that the biggest cost in soil analysis is not the analysis itself, but the soil sampling, and it makes little sense to skimp on quality analyses.

c. **Harmonization of the analytical results:** Different methods have been used by various laboratories, which have different interpretive criteria that can usually be related by a simple factor. As such, all available information can potentially be used when adjusted to agreed criteria. Ideally, this should be followed by a harmonization of the methods used in-country, and if necessary, laboratory technician training to improve accuracy and increase output. Investments in training for spectral analyses, which can replace some but not all wet methods, will greatly increase laboratory output.

Ordinarily, we prefer to map country deficiencies using professional laboratories with a capacity to analyze samples quickly for all elements and acidity constraints. This is a short process (< 1 year from analysis to mapping). In the case of Malawi, quality verification and gap-filling may turn out to be a time-consuming and costly exercise, whose end result ultimately depends on an unknown--the quality of available national data, and the capacity of those laboratories, should they be chosen (they are currently charged with this task). **In order to take full advantage of the coming growing season, quality maps for properties mentioned above need to be completed in no later than 4 months, at least in target regions for AGRA priority crops.** We cannot over-emphasize the importance of getting accurate and maps as a first step. Very little can be done in terms of creating targeted fertilizer products without mapping. It is the cornerstone of other activities.

2. **Promote liming in acidic regions:** Lime is available and reasonably priced in Malawi, but its importance is not well-understood. Many countries subsidize it; a single application can last 3-5 years, but this requires an initial capital investment (approx. $120 for 2 Mt/ha application in the Malawi context) that may be beyond the means of many smallholders. Lime promotion can take the form of subsidy promotion, financing arrangements, and supporting demonstrations where lime is required, in partnership with fertilizer companies and lime suppliers.

   Because implementation of a liming program can take many forms, it is important to devise interventions with potential stakeholders in the value chain. This includes the government (including those involved in subsidies), the private sector (lime suppliers and potential lime suppliers such as cement companies), fertilizer providers, those that have agro-dealer hubs (ETG, MFC, and others) representatives of farmers' unions, and those who can support financing arrangements such as AFAP. A project needs to be devised from supply to application, which may involve private service providers using lime spreaders (lime is a bulky material, and a key constraint is how to apply it). Some scientific expertise regarding lime rates and sources is also required, which may need to come from an external consultant with expertise in liming.

3. **Invest in national research capacity and support private blenders rapidly develop crop- and region-specific blends:** AGRA has already invested in Malawi in advanced education several prominent agronomists and soil scientists, which makes this cadre well-positioned for advanced training in balanced crop nutrition. Agronomic and soil science training does not equate to expertise in fertilizer formulating and evaluation, but forms a solid basis. While fertilizer companies have some of this expertise, national agronomic staff have much local knowledge regarding varieties, crops, and market constraints, and have some track record in quality trial implementation in Malawi. Advanced skills can be used to efficiently develop/validate new formulations and determine the agronomic effectiveness of different nutrients (omission trials) for AGRA-targeted crops. Solid partnerships with the private sector are required to share costs and maximize benefits to both sectors.

   Our communications with IPNI indicate that technical support to date has not been sufficiently effective in Malawi, as they noted many implementation errors on follow-up visits. Good technical back-stopping requires intense on-the-ground involvement in both project planning and implementation. At the planning phase, this will require planning best-bet and omission trials to be implemented for AGRA-priority crops. This could

involve IFDC for proper trial design and ingredients selection, national blenders willing to invest in the trials at some level including ingredients provision, and national research staff, who can provide vital information on production areas and farmer practices. We believe that substantial progress can be in evolving better formulations on all AGRA priority commodities in a single season of proper implementation, which should be the upcoming growing season (no later than October 2018; project development to begin as soon as possible). In the implementation phase, AGRA must be willing to invest in quality implementers, who are available to supervise the implementation at key steps, including site selection, soil sampling and fertilizer mixing, to be sure treatments are properly implemented. The FSU and national extension services can support implementation. A professional project coordinator who is devoted to this project alone should be recruited.

4. **Farmers need sensitization to blended fertilizers, which have a very different appearance from fertilizer compounds they are used to.** Even blenders know this and are importing the government-subsidized recommendation as a compound (uniform color) rather than self-made blends (multi-color). Yet, blended products are the only efficient means of producing for specific crops and soils in the Malawi context, where smaller volumes cannot be efficiently produced as compounds. Sensitization can involve radio, public billboards, or handouts at points of sales, and through agricultural extension services, and could be in conjunction with blenders and the government.

5. **AGRA should consider whether to invest in national soils laboratories, or rather promote a private-sector approach.** In many countries, national soils laboratories have not been successful. The consistently best laboratory is the ARET lab, as it is financially sustainable, due to the fact that ARET is a trust, with more financial flexibility. Financially, any laboratory needs to operate sustainably, price its services accordingly, be able to maintain its equipment without constant donor infusions, and retain highly qualified staff—in brief, operate as a business. If the national laboratories at Bvumbwe and Chitedze can develop a strong business plan similar to the ARET model, then AGRA may consider supporting them. At the time of our visit, Bvumbwe and Chitedze laboratories were in a state of renovation following another infusion of government funding. The Chitedze facility had no running water, and my brief observation of the labware and equipment indicated upgrades were needed. They are also considerably behind the times, even with new procurement, on high-capacity equipment that would be required to serve the country quickly, and no national laboratory had spectral equipment, which could reduce costs and increase output for several (but not all) routine analyses reliably. Spectral equipment is particularly good for plant tissue analysis, but as with soil analysis, requires qualified technical staff and rigorous quality control.

   We believe that a private sector model has a greater possibiity for success. As a professional and accountable business, it is motivated to do analyses correctly, to hire and retain qualified, well-paid personnel, which is not characteristic of some government services. While we appreciate that government has an obligation to assure quality analyses to smallholders, the reality is that serious farmers are taking their analytical business outside of the country, turnaround time and accuracy are more assured. In real cost terms to get quality analyses, it may be less expensive to subsidize smallholder samples to be run at a professional laboratory either inside or outside Malawi.

Government could conceivably take the role of initial sample processing (drying and grinding), packaging, and shipping; if done well, this would facilitate smallholder access to fast, quality laboratory results.

As an initial step, consultations with professional laboratory services are advised. These could include Omnia (S.A.), which runs time-tested methods and has fast turn-around and competitive prices, and CNLS (Nairobi), who is developing some cutting-edge methods based on a combination of spectral and wet chemistry analysis. We advise caution with some laboratory service providers who are pushing spectral products and soil test kits but will not disclose details of performance or accuracy. IFDC and ICRAF are well-positioned to give objective assessments on analytical products on offer and provide evaluation of the accuracy of the same.

Bottlenecks in Fertilizer Distribution, and Interventions that AGRA and its Partners Can Implement to Improve Farmer Access to Quality Fertilizers

The Malawi Fertilizer Distribution Structure and Value Chain SWOT analysis are presented in Figures 1 and 2, respectively.

The fertilizer distribution system

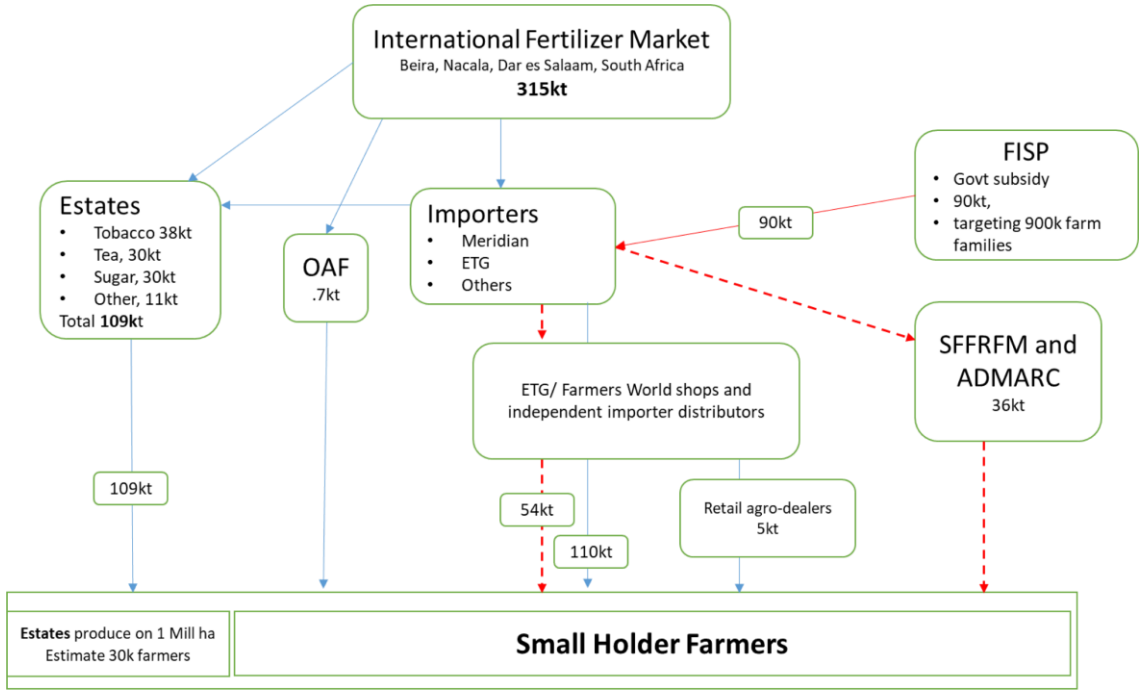
Malawi has one of the highest fertilizer use rates in Sub Saharan Africa at 82 kg/ha (calculated from total fertilizer volume use on cultivated land and 73 kg/ha on arable land). Historically the subsidy program targeted 1.9m of the estimated 2.6 million SHF and although the effectiveness of the program initially achieved its goal, inefficiencies/leakages in recent years have detracted from its potential achievements

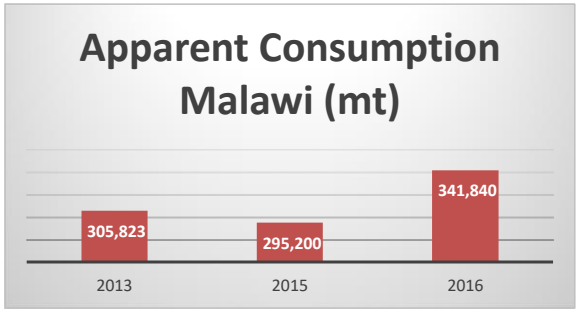
Of the 300 to 350kt market, estates have historically used 110 to 150kt, subsidies 150kt and the open market 50kt, so subsidies have had a strong role in the market structure. The subsidy volume has reduced from 150kt to 90kt in the last two years, but subsidy procurement and distribution shaped the distribution channel, as both were controlled and inefficient in terms of cost and competitive participation. For the first time in 2017, limited private sector actors were allowed to partake in the subsidy distribution.

Within the private sector, there are two predominant distribution systems (Farmers World and ETG) and six smaller ones. The majority of fertilizer goes through importer owned channels that seem to have effective distribution tied to general store sales, seed provision and/or crop procurement. This system has developed for a number of reasons:

- In the last 10 years the distortions in the channel were due to the volume of fertilizer and the procurement (limited small volumes by multiple players and non-players) and distribution method (predominantly the public entities SFFRFM and ADMARC) of fertilizer in the subsidy program. There has been limited incentive to be involved. (For the first time, the 2017 subsidy program allowed limited numbers of large private sector distribution partners to participate).
- Failures in the credit system necessitated control of the distribution channel.

MALAWI FERTILIZER DISTRIBUTION SYSTEM





	Fertilizer system	Volume (mt)	%
Estates	Bulk Plantation	109,000	35%
	Bulk Anchor		
FISP	Bulk Government	90,000	28%
Importers	Private	116,000	37%
		315,000	

Figure 1. Malawi fertilizer market structure, apparent consumption, and fertilizer volumes by distribution system

VALUE CHAIN SWOT SUMMARY – MALAWI

	Strengths	Weaknesses	Opportunities	Threats
Manufacturer			• Optichem have small granulation capacity. Looking to build lime granulation capacity to use as a filler. • Small phosphate deposits and coal based opportunities.	
Importer	• Established importers/agents • Access to finance • Supplier network • Relationship with wholesalers	• Focused on volume • Competing needs of various importers to maintain business model—ie commodity vs targeted blends	• Lever off international experience to expedite product choice, formulations and best practice in fertilizer use • Lever trade finance from manufacturers/Development funds and export banks • Encourage manufacturers to provide flexible buying arrangements	• Entry of manufacturers into the market • Expansion of subsidy program at exclusion of private sector
Blender	• Traditionally a compound market but blends are widely accepted. • Adequate supply from Meridian, ETG and Yara (building blender at Beira)	• Need directional guidance at the regulatory level that supports blend development in a positive way. The current DARs regulation dictating all formulations for use by SHF appears conflicting. • Number of institutions involved fertilizer regulations leads to confusion—one fertilizer regulatory body	• Build capacity in fertilizer sector. • Build functioning platforms—this does not appear the case at the moment.	• Stronger quality regulations that ensure best product and process. • Unfavourable subsidy support
Distributor	• The 2 major importers own the major distribution channels . • Malawi has one of the highest fertilizer use rates per cultivated ha in SSA	• Main importer blenders have developed own distribution channels-history of poor credit in the value chain • Poor relationship between Public and private actors (large fertilizer actors)	• Government and blender/importer demand creation activities to "pull " product through. • Develop finance instruments that can provide flexible terms.	
Agro Dealer	• Wholesaler relationship • Farmer interaction / relationships	• Lack of working capital- minimum stock holding. • Dependent on wholesaler • Lack of management and technical competence • High percentage margin	• Credit instruments • Create demand (Govt/blender/importer)	• Competitive models like OAF that will service a customer base in Kenya of 450k farmers in 2018/19

Key Takeaways:

1. Distribution capacity appears deep and broad accessing the majority of SHF.
2. Weakness in relationship between public and private sectors. Needs bridging. Need to revisit the proposed fertilizer act to ensure it is supportive of blend growth and not restrictive.
3. Programs need to ensure they target a clearly defined end goal—providing benefit to end users. Ensure projects do not disrupt distribution channels without achieving the defined goal.
4. MFC have in country blending capacity, ETG can bring blends from SA, Beira or Zambia as needed. (they want to build the capacity of their stores with Kynoch staff using ETG Foundation funding). Yara will open a blender in Mozambique in 2018 to supply Malawi and Zambia. Private importers can bring in targeted compounds
5. Define best bet formulations and incorporate them in the subsidy program

Figure 2. Value chain SWOT analysis for Malawi.

Anecdotally, evidence suggests that the volume reaching smallholder farmers in the last couple of years has not decreased, in spite of the decrease in subsidy volume. This means that there is adoption, awareness and availability amongst smallholders to continue use, although this has been disputed. The downside the system has is that its customer is the Government and there has been continued rent seeking and little incentive to provide increased benefit to the farmer - new products etc.

Productivity data analysis could support the initial impact of the subsidy program, but inefficiencies and weather extremes have resulted production declines. Claims were made that there is about 30% leakage from the subsidy program and significant rent seeking along the value chain, which are all impacting on optimum fertilizer use and productivity results at the farmer level (Figure 3)

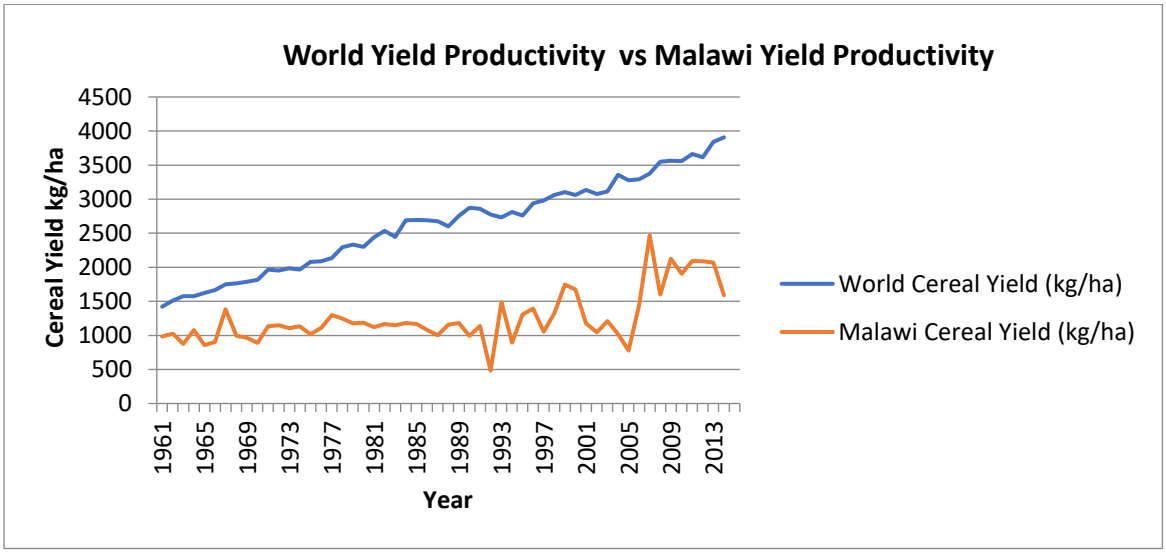


Figure 3: Malawi cereal productivity over time

Supply points into Malawi are not restricted with many supply points existing (Beira, Nacala, Durban, Dar es Salaam). There are both infrastructural and operational inefficiencies that lead to delays at the main import point of Beira, with port congestion and draft restrictions, transport restrictions at peak times and regulations that impact on export requirement for fertilizers that have resulted in

- Increased handling costs of about $30-$40/ton across the wharf.
- A low difference between bulk imports and container imports through Biera, probably the lowest on the African east coast. This allows many estates to bring in containerized product competitively direct from international manufacturers.
- The development of private sector bulk import capacity in the Beira port area.

Partners

Capacity of blenders either in or to supply the Malawi market is not a constraint (blender positioning is usually a factor decided by logistical and working capital constraints). There are two blenders physically in Malawi:

- Malawi Fertilizer Company (MFC) – they are part of the Meridian group and have one blender (100 t/hr). They also have blenders in Zimbabwe and Mozambique. This

year they have incorporated Farm Services Unit (FSU) into Farmers World, providing agronomic services to 60 stores.
- Optichem have both a blender (50t/hr) and small granulator to make lime fillers. They also provide fillers for MFC.

There are two blenders in Beira that are well positioned to supply as well:

- ETG - This year in Malawi, ETG will start to develop the Kynoch agronomist model to train depot staff and undertake demonstrations. They will also undertake a program in parallel with the ETG Foundation to support the development of 40-50k Farmers.
- Omnia – Omnia have a 50t/hour blender in Beira and are not looking at Malawi until subsidy program future is better understood.
- Yara will replace its Beira blender this year and is looking to re-develop their Malawi business, with farmer education programs.

Policy Bottlenecks Affecting the Availability of Blended Fertilizers in Malawi, and Interventions that AGRA and its Partners could Design and Advocate for Implementation

Policy interventions and outcomes

While it has been mentioned in other country documents, the Malawi government also struggles between intervention and regulation. Policy has largely been driven to satisfy food security and ensuring fertilizer availability through the implementation of the FISP subsidy scheme. While it could be argued that access and availability has been delivered in Malawi, there needs to be a step change to optimize the outputs from the targeted commodities, bring back efficiency to the system and to lever off private sector capacity to develop more soil and crop-specific fertilizers. Ongoing interventions will likely see a continuing need for the public sector to develop these products, when it could be argued this is not their core skill.

The following documents were reviewed for this assessment, and supplemented with interviews from a cross section of public and private actors in the value chain:

- Fertilizer Policy Draft-2018
- Fertilizer Policy Draft 2007
- Fertilizer Act 2003
- A review of National Fertilizer Regulatory Authorities in Malawi-AFAP (2016)
- Support for the Establishment of a Regional Policy and regulatory Framework for East and Southern Africa—AFAP (2016)

While blenders are currently producing for private clients, estates, and for specific crop requirements, a perception still exists within DARS that fertilizers sold that are not specifically directed to individual clients must be registered. The registration process is controlled by DARS, which has an internal rule for technology release, requiring 3 years of trials, which they also apply to fertilizers, but is not specifically mentioned in any legislation. The latest draft of the National Fertilizer Policy (NFP) mentioned the long registration period (average of 917 days, one of the longest in Africa) as a serious constraint. The rice agronomist also explained that this was the reason briquettes were never introduced into rice systems, in spite of 2 years of research and much farmer appreciation.

The government has made it clear that registration will not apply to private sales, but for fertilizers that are sold generally through distribution networks. Yet, this will be the bulk of sales to smallholders for soil and crop-targeted fertilizers. A 3-year testing period will effectively kill the ability of the fertilizer industry to develop and market targeted fertilizers and evolve new products quickly, as it did in Tanzania until recently revoked. Many African countries have no fertilizer registration requirements based on field evaluation, which we believe reasonable, as the response characteristics to nutrients are well-understood by competent blenders. For many diversified fertilizer markets, only truth-in-labeling (that is, correspondence between the declared fertilizer composition and what is in the bag) is required.

This is but one example of issues that need to be resolved as Malawi transits from commodity fertilizers to soil- and crop-specific fertilizers. The government has a historic perspective based on commodity fertilizers and sees itself protecting farmers from poor products. They however have limited knowledge of the fertilizer industry and its potential contribution. The private sector has a perspective based on knowledge of how blends are developed, targeted, and marketed, but perhaps a limited appreciation for government's traditional regulatory roles and responsibilities, as well as its challenges in a transitioning environment. The two need to work together, but currently, there is little space for dialogue, with some resulting tension.

AGRA support for a public-private fertilizer platform is vital at this transition from commodity fertilizers to diverse fertilizer products. A fertilizer platform creates a space for dialogue and collaboration between all parties, in furtherance of improved fertilizer development and use. The knowledge and skills of all actors are vital in achieving their mutual objectives. Functioning platforms in Mozambique and Ethiopia have been vital to achieving trust, coordination and knowledge sharing to resolve a host of issues.

Some topics of immediate concern that the platform can address include:

1. Creating a faster fertilizer registration procedure, and agreement on which fertilizers it applies to.
2. Cooperation on a validation procedure for subsidized fertilizers, so that diverse products to address Malawi's varying soils and crops can be brought into the subsidy program.
3. Joint creation of a fertilizer roadmap to accelerate fertilizer use, particularly of balanced fertilizer products.
4. Sharing of soil analysis results, harmonization of procedures where possible, and evaluation of rapid soil analysis methods (particularly those involving spectral) which can accelerate sample analysis for several soil properties.
5. Public-private collaboration in fertilizer demonstrations and trials
6. Resolving taxation issues on gypsum; developing a gypsum supply chain for groundnuts
7. Dealing with unique truth-in-labelling requirements for blends, and agreement on fast and accurate procedures and laboratories to deal with greater analytical load and complexity of analysis in multi-nutrient fertilizers.
8. Developing and executing a plan to accelerate lime use.

AGRA can assist in platform establishment and support external experts in platform formation in initial stages. AGRA can also invest in external expertise to assist the platform in particular issues as required.

The fertilizer platform is recommended, because it is difficult if not impossible for AGRA to influence and address complex issues on its own. A platform provides an informed forum,

and involves all participants required to address issues that are best addressed through knowledge exchange and collaborative effort.

Appendix I. Potential Partners and Key Individuals for AGRA Collaboration

Organization and contact details of key personnel	Agricultural Development Districts (ADDs) of activities	Brief description of activities as related to AGRA priority crops
AFAP: Shiela Keino, Country Director, Lilongwe +265 995 117 410 skeino@afap-partnership.org	Non-specific	Facilitation of the fertilizer industry through R&D, supply and demand creation, policy advocacy, finance, and public-private sector dialogue.
One Acre Fund: Chris Suzdak, Country Director, Zomba +265 992 942 953 chris.suzdak@oneacrefund.org	Mulanje, Chiradzulu, Blantyre, Zomba, Phalombe and Machinga	OAF focuses on maize and groundnuts in Malawi. They also offer extension services as a way of supporting the government. OAF provides hybrid maize seeds and fertilizer to SHF to increase and sustain their production. Blended fertilizer is currently at farmer trial level.
Total Landcare: Trent Bunderson, Co-Founder / Executive Director, Lilongwe +265 1 770 904 / 905, +265 999 838 072 trentbunderson@yahoo.com	Karonga, Chitipa, Rumphi, Mzimba, Nkhata Bay, Kasungu, Nkhotakota, Ntchisi, Dowa, Mchinji, Salima, Lilongwe, Dedza, Ntcheu, Balaka, Mangochi, Machinga, Zomba, Mulanje, Thyolo, Blantyre, Chiladzuru, Chikwawa and Nsanje	TLC collaborates with communities to develop community based solutions based on their needs. The solutions are community based action plans that revolve around land use practices, crops and agro ecological zones.
Agricultural Research and Extension Trust (ARET): Andy Khumbanyiwa, Director and CEO, Lilongwe +265 1 265 761 148	Throughout the country	ARET works with Tobacco crop. Through technology research, extension services, seed and seedling sales and information dissemination they offer formal farmer training courses to improve on production of the crop and maximize on returns.
Rural Market Development Trust (RUMARK): Dr. Godfrey Chapola, Managing Director, Lilongwe +265 999 792 070 gchapola@rumark.org	All districts in Malawi except Likoma District which is an island	Agrodealer training/registration.RUMARK facilitates availability and affordability of agro inputs through agro dealers to smallholder farmers so as to improve their yields and incomes.
Seed Trade Association of Malawi: Dellings Phiri, Chairman, Lilongwe dphiri.seedco@malawi.net. +265 999 102 968	Throughout the country	Seeds and agrodealer development. STAM promotes rural development in Malawi by contribution to relevant agricultural policies that affect the seed industry.
Fertilizer Association of Malawi: Dimitri Giannakis, Chairman, Lilongwe +265 1 710 518 dgiannakis@farmersworld.net	All districts in the southern and central region and a few in the northern region (Dhitipa, Karonga, Zimba, Mzuzu, Nkhata bay and Rhumphi)	Association of fertilizer suppliers and manufacturers
Malawi Fertilizer Company: Christos Giannakis, Director, Lilongwe +265 999 821 155 chris.giannakis@farmersworld.net	Central and northern Malawi. The southern region is covered by their sister company Agora	Farmers World Ltd services the needs of smallholder farmers with a range of farming inputs such as fertilizers, through 75 stores across central and northern Malawi.

National Association of Smallholder Farmers of Malawi: Dr. Betty Chinyamunyamu, CEO, Lilongwe +265 1 772 866 ceo@nasfam.org	Ubale, Mulanje, Zomba, Namwera, Balaka, Rumphi, Karonga, Ntcheu, LL South, LL North, Mchinji, Nkhotakota, Ntchisi, Kasungu, South Mzimba	Through a sustainable network of smallholder-owned business organizations, NASFAM promotes farming as a business in order to develop the commercial capacity of its members, and delivers programs which enhance member productivity
Farmer's Union of Malawi: Prince Kapondamgaga, CEO +265 1 750 222 info@farmersunion.mw.	Throughout the country	Umbrella group for farmer associations. Good starting point for contacting farmer groups on individual commodities. FUM encourages farmers to participate in designing, formulating, implementing, monitoring and evaluation of agricultural programs and policies.
IFPRI: Ousmane Badiane, Director for Africa, Lilongwe o.badiane@cgiar.org 1-202 862-5650, +265 1 771 780	Throughout the country	IFPRI provides research-based policy solutions to sustainably reduce poverty and end hunger and malnutrition in developing countries.
Department of Agriculture Research Services (DARS), Lilongwe Wilkson Makumba, Director +265 (0) 1 788 738 wilk.makumba@gmail.com David Kamangira, Deputy Director +265 (0) 1 788 738 david.kamangira1@gmail.com	Throughout the country	DARS conducts research for agricultural technology development. The department also disseminates regulatory, technological and specialist services on all crops and livestock, except tobacco, tea and sugarcane.
Lilongwe University of Agriculture and Natural Resources: Prof. Vernon Kabambe, ISFM Project Supervisor +(265) 01 277 222/260 ext 1085 kabambev@yahoo.com vkabambe@bunda.luanar.mw.	Throughout the country	Soil health agenda in Malawi; train soil scientists and agronomists
Farm Services Unit: Caitlin Shaw, Coordinator, Lilongwe +265 991 694 452 caitlin.shaw@farmersworld.net	Dedza, Dowa, Kasungu, Lilongwe, Mchinji, Ntcheu, Ntchisi, Salima, Balaka, Chikwawa, Chiradzulu, Machinga, Mangochi, Mulanje, Mwanza, Nsanje, Thyolo, Phalombe, Zomba, and Neno.	FSU works through the retail networks of two large agribusiness companies: Farmers World & Agora. They have 60 extension officers who operate out of retail outlets and reach 15-20 farmer groups, an average total of 200 farmers. In 2017-18 they worked with over 13,400 farmers in the Central and Southern Regions.
Alliance for African Partnership, supported by Michigan State University: Richard Mkandawire, Africa Director, Lilongwe +265 881 380 104 Skype: richard.mkandawire5 mkandaw2msu.edu	Throughout the country	Through innovative research-to-practice methodologies, (AAP) seeks to promote partnerships among African institutions, Michigan State University, and other international collaborators.
FISP Program, Ministry of Agriculture Osborne Tsoka, National FISP Coordinator, Lilongwe ozietsoka@yahoo.co.uk +265 993 897 911 Justin Kagona, FISP Coordinating Unit, Lilongwe justinkagona@gmail.com +265 999 161 590	Central and southern Malawi.	Farm Input Subsidy Program (FISP) improves smallholder access to agricultural inputs such as fertilizer and improved seed, thereby increasing quality and quantity of yield and by extension boosting the incomes of resource-poor farmers. FIPS works on the staple maize as their main crop.