CLINTON DEVELOPMENT INITIATIVE CAB DEMONSTRATIONS 2019/20 CROPPING SEASON:

Summary Findings and Recommendations on PlantCatalyst

11 June 2020

1. Background

The Clinton Development Initiative of the Clinton Foundation began its agribusiness operations in Malawi in 2008 with a network of 200 farmers in Mikundi EPA, Mchinji District. Today, CDI has grown to a network of more than 105,000 farmers in Malawi, helping farmers to improve their incomes and livelihoods through agriculture. CDI aims to strengthen farming communities by connecting them to markets, lower-cost farm inputs, and agricultural trainings. CDI does this by bringing together members of public, private, and civil society who share the goal of increasing production and demand as well as spurring local economic development.

CDI works together with farmers in rural areas to provide basic market information, training, and techniques for improved agricultural production, and resources to help them become food secure and live productive and healthy lives. Our work helps farmers **produce** enough food, **secure** that food, and find markets for them to **sell** that food to generate revenue and grow their local economy. CDI's work is driven by three main components:

- **Bringing together a community**: We have seen that the greatest impact is achieved when farmers work in groups, helping them capitalize on new market opportunities. CDI's work is not done in a vacuum. Our efforts start with establishing trust between farmers and our local staff, by focusing on farming as a community. This approach also makes it easier for markets to directly engage with farmers – via one large group, producing larger, higher quality products. Parallel to creating farming groups, CDI also works to develop ecosystems of people from private, public, and civil society that can support farmers as they grow their agricultural operations.

- **Deploying improved agricultural training**: CDI provides direct climate-smart agronomic training to farmers – using demonstration plots and farmer field days – where techniques such as spacing, planting rates, mulching, and soil fertility management are shown to farmers. CDI collaborates with government extension agents and local and international research institutions to determine best-fit practices for farmers. These techniques help individuals build farms that are resilient in the face of climate change, increase their crops yields, and in most cases, maintain or improve the environment and soil fertility.

- **Providing business training**: CDI helps farmers take advantage of commercial opportunities. CDI provides groups of farmers with critical business training and connects them to structured markets instead of selling through informal channels. CDI also helps farmers by creating an ecosystem to support the growth of their farm businesses – including buyers for crops, technology, financial institutions, and infrastructure such as warehousing.

CDI implements the **Community Agribusiness Approach (CAB)** in its program countries of Malawi, Tanzania and Rwanda to create opportunities for economic empowerment of farmers and accelerated transformation of the farming communities.

As part of CAB's strategy of deploying improved agricultural training, and in partnership with Harvest Plus, CIMMYT, and in collaboration with the Ministry of Agriculture, CDI designed and implemented modern agricultural technologies demonstrations in ten districts in the 2019/20 cropping season. Table 1 below presents the overview of the agricultural technology demonstrations which were implemented.

Table 1. Agricultural Technology Demonstrations (2019/20 Cropping Season)

Technology Type	Number of Host Smallholder Farmers		Number of Host Hub Growers		Remarks
	Per District	Total in 10 Districts	Per District	Total in 10 Districts	
1.NUA 45 Beans	2	20	1	10	●All inputs supplied by Harvest Plus
2.Orange Fleshed Maize (MH40A & MH43A)	2	20	1	10	●All inputs supplied by Harvest Plus ●Also known as Vitamin A maize
3.Inocoulants	2	20	1	10	●No inoculant as Check ● 5 inoculants (Hi Stick; Nitrofix; Mandolo; Biofix; Graphex)
4.Plant Catalyst	0	0	1	10	●Same Hub Grower as in 1 & 2
5.Drought tolerant maize	0	0	1	10	●Non-DT maize (DK8053) as check ● 3 DT maize (CAP9001, MH30 & 36)

Footnote: *Participating Districts: Mchinji, Kasungu, Dowa, Nkhotakota, Ntchisi, Salima, Lilongwe, Dedza, Ntcheu and Mangochi*

2. Protocols for the PlantCatalyst Demonstrations

Product Description

PlantCatalyst is the all-natural nontoxic water additive that boosts plant growth and yield (http://www.plantcatalyst.com/what-is-plantcatalyst/). It is made with small amounts of inorganic (silica) salts and extracts from lignite coal. The solution contains 0.006% calcium, 0.00114% magnesium, 0.04% nitrogen, 0.005% SiO_2 and 99% water (Scot Swanson, et al. 2015). The product has no effects on the soil and to the environment in general. The impact on plants is well documented and fairly extensive. The benefits include the following: bigger, healthier and greener plants; early flowering, more and longer flowering; thicker and more robust or extensive root systems; greater resilience in stressful growing environments such as drought; more yield per plant; larger fruits/flowers; and, enhanced flavor and aroma. Although it is not designed to replace farmers' nutrients/fertilizer but rather to serve as an addition to normal nutrient/fertilizer use, it significantly increases the plant's ability to utilize nutrients such that a farmer can reduce the amount of fertilizer used by 30-50%.

The precise mechanism how PlantCatalyst actually operates within the plants' cells remains a bit of a mystery. The core ingredient is a "micelle", an electrical charged colloidal particle. The micelle is an extremely small, very high energy particle with a powerful negative magnetic field. When added to ordinary water, it causes a change in the "ordinary" water molecules. This new water molecule structure serves as a catalyst that seems to accelerate and enhance the body's natural processes.

Treatments:

T1: No plant catalyst; no fertilizer
T2: Standard practice (no plant catalyst; full fertilizer recommendation)
T3: 30mls plant catalyst in 16lt sprayer; full fertilizer recommendation based on soil analysis results)
T4: 30mls plant catalyst in 16lt sprayer at half fertilizer recommendation based on soil analysis results)
T5: 60mls plant catalyst in 16lt sprayer; full fertilizer recommendation based on soil analysis results)
T6: 60mls plant catalyst in 16lt sprayer at half fertilizer recommendation based on soil analysis results)

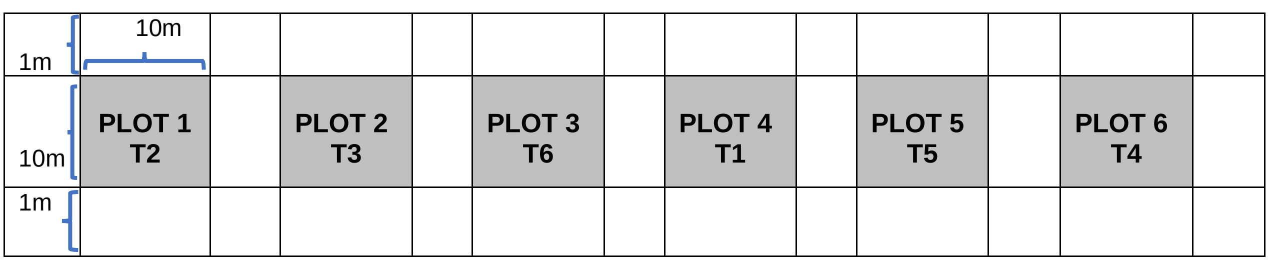
Test crop: Non-drought tolerant maize variety (DKC 8053)

Target Group: Hub Growers (10)

Sub-plot specifications:

- **Sub-plot:** Area/Farmer [(1m x 6+10m*5)]x[(1m*2+10m*1)] = (56m x 12m) = $672m^2$
- **Soil sample:** Collect soil sample from each sub-plot for lab analysis
- **Land preparation:** Clear land and harrow (don't burn biomass)
- **Row spacing:** 75cm apart
- **Planting stations:** 25cm apart (one seed per station)
- **Basal fertilizer:**
  - →NPK 23:10: 5 (apply between planting stations)
  - →Rate: 200kg/ha (3.75g/hole)
  - → Use coke bottle top, **remove** coke and fill flat
- **Top dressing:**
  - →Urea (46%N)
  - →Rate: 100kg/ha (3.75g/hole)
  - → Use coke bottle top, **don't remove** coke and fill flat

- **PlantCatalyst Spray cycles:**
  - →Foliar application
  - →Start soon after germination
  - →Apply once per week up to 2 months (i.e., 8 spraying cycles per plot)
- **Insect Pests:** Control Fall Army Worm using Proclaim Fit
- **Diseases:** Control diseases of economic importance using recommended chemicals
- **Plot Layout:**



3. Summary Results from Demonstration Plots

a) Summary Results of Soil Sample Analysis

*K*ey Finding/ Result	Recommendation/ Remark
●Most soils were strongly acidic, except for Chinguluwe EPA in Salima District. ●Magnesium was above critical values at all demonstration sites ●Deficiency of soil organic matter was in all host EPAs (due to the common slash and burn land clearing tradition in Malawi)	→The 2020/21 demonstrations should include soil liming to create farmer awareness of the problem and the technology for resolving it. →Calcitic lime (Calcium carbonate, **$CaCO_3$**) is recommended due to adequate levels of magnesium. Farmers should avoid using Dolomitic lime (Calcium magnesium carbonate, **$CaCO_3$ + $MgCO_3$)** – can aggravate soil crusting, which hinders seed germination. →CAB to intensify promotion of application of organic manure and incorporation of biomass

b) Summary Results of Effect of PlantCatalyst Technology on Performance of Maize

Key Finding/ Result	Recommendation/ Remark
● In general, grain yield was highest in Lobi EPA (Dedza District) across all treatments, ranging from 4,392kg/ha to 9,721kg/ha. This was attributed to a combination of good rainfall pattern and comparatively better soil fertility status as shown by soil sample analysis results ● In Dedza District, the treatment featuring "half fertilizer recommendation and low dose of 30mls of PlantCatalyst" produced a higher maize yield of 9,721kg/ha, which compared closely with full fertilizer recommendation and no Plant Catalyst at 9,853kg/kg. A similar pattern was observed in Lilongwe and Dowa districts. ● However, in Nkhotakota District, full fertilizer and 60mls PlantCatalyst treatment produced highest yield at 4,340kg/ha. ● In Ntchisi District, the treatment with half fertilizer recommendation and 60mls PlantCatalyst registered the highest grain yield at 4,307kg/ha	→PlantCatalyst does demonstrate that farmers can reduce amount of recommended fertilizer by applying the product →The economic impact can be enhanced further by applying the product as follows: first application (coat to seeds at planting); subsequent applications (mix the product with agrochemicals such as herbicides, insecticides, fungicides, to reduce labour expenses) → PlantCatalyst is yet to be officially released by the Agricultural Technology Clearing Committee. Scientific trials are led by Agricultural Research and Extension Trust, ARET.

3. Detailed Results of Soil Sample Analysis

- As Table 1 shows, most soils were strongly acidic, except for Chinguluwe EPA in Salima. Soil acidity can bring the following challenges: Aluminum (Al) or Manganese (Mn) toxicity; Molybdenum deficiencies; Calcium (Ca), Magnesium (Mg), and Potassium (K) deficiency due to possible leaching; and, reduced microbial activity. Since soil acidity is an issue in many CAB areas, the 2020/21 demonstrations should include soil liming to create farmer awareness of the problem and the technology resolving it.

- In view of the widespread acidic soil conditions, it is not surprising that calcium is below critical values at all demonstration sites.

- Similarly, potassium follows almost the same pattern, except for Mikundi EPA in Mchinji and Zidyana EPA in Nkhotakota.

- However, magnesium has defied this pattern as it was above critical values at all demonstration sites. The implication is that when correcting soil acidity, the agricultural lime should not contain high levels of magnesium. For instance, **dolomitic lime ($CaCO_3$ + $MgCO_3$)** would be inappropriate. Instead, farmers should be applying **calcitic lime ($CaCO_3$).**

- Soil organic carbon, SOC, (which is typically 50 to 60% of soil organic matter, SOM), was below critical levels at all demonstration sites. The same was the case with total nitrogen. Farmers need to be encouraged to continue implementing measures that build soil organic matter, including incorporation of crop residues and manure, and planting fertilizer trees. SOC is crucial in stimulating microbial acidity in soils.

- Deficiency of soil organic matter was ill all host EPAs. This is expected due to the common slash and burn land clearing tradition in Malawi. Thus, there is inadequate organic matter incorporated into the soil. This setback is against the vital role SOM plays in the soil - the formation of soil aggregates which give soil its stability against weathering and erosion, and its ability to hold water and air essential for plants and microbes. The decomposition of SOM further releases mineral nutrients, thereby making them available for plant growth. In addition, SOM increases the cation exchange capacity (CEC) of the soil, i.e. the ability to hold onto positively charged cations such as Ca^{++}, Mg^{++}, K^{+}. Such nutrients are protected from leaching away and are gradually released into the soil solution for plant use. But negatively charged nutrients such as nitrates (NO_3^-) are repelled away from the negatively charged CEC, hence prone to leaching.

- Available phosphorus was above critical values in most EPAs, except for two demo sites in Lilongwe and one demo site in Dedza. Phosphorus is essential for the general health and vigor of all plants. Some specific growth factors that have been associated with phosphorus are: stimulated root development; increased stalk and stem strength; improved flower formation and seed production; more uniform and earlier crop maturity; increased nitrogen N-fixing capacity of legumes; improvements in crop quality; increased resistance to plant diseases; and, supports development throughout entire life cycle

- The dominant soil texture was loamy sand to sandy loam. Demo sites in Kasungu all had sandy soils, implying they were the most vulnerable to leaching of soil nutrients. A soil that has more clay particles is beneficial for plant nutrition in that clay particles also have negative charges on their surfaces hence hold onto positively charged nutrients or cations. But organic matter remains the major source of negative charges (CEC) in coarse to medium textured soils. Farmers are advised to incorporate organic matter in their fields as part of the soil fertility improvement programme.

Table 1. Results of Soil Sample Analysis from Three Demo Sites Per District

Critical Value	**5.5 to 6.5**	**4 to 10**	**2**	**0.20 to 0.50**	**20 to 60**	**100 to 350**	**400 to 6000**	**90 to 300**	
District	**pH** **(in water)**	**Carbon (%)**	**OM (%)**	**Total N (%)**	**Available P (ppm)**	**K (ppm)**	**Ca (ppm)**	**Mg (ppm)**	**Soil Textural Class**
Lilongwe (Mkwinda EPA)	4.89 to 5.16	0.91 to 1.28	1.58 to 2.22	0.07 to 0.13	11.90 to 84.29	33.62 to 161.92	6.27 to 25.88	383.12 to 517.28	Loamy sand and sand clay
Dedza (Lobi EPA)	4.41 to 4.93	0.17 to 2.18	0.30 to 3.76	0.06 to 0.20	14.05 to 68.03	22.82 to 132.21	45.49 to 70.98	201.78 to 224.85	Loamy sand and sand clay
Mchinji (Mikundi EPA)	4.51 to 5.17	0.54 to 0.64	0.94 to 1.11	0.10 to 0.11	44.42 to 58.22	103.85 to 128.16	23.27 to 31.76	167.98 to 224.85	Sand to loamy sand
Kasungu	4.84 to 4.90	0.45 to 0.86	0.77 to 1.48	0.07 to 0.09	30.31 to 64.66	43.01 to 147.06	20.65 to 31.76	319.44 to 360.86	Sand

(Chipala EPA)									
Ntchisi (Malomo EPA)	4.47 to 5.01	0.62 to 0.80	1.07 to 1.38	0.10 to 0.19	30.92 to 84.29	52.53 to 98.45	43.53 to 48.76	353.45 to 359.01	Sandy loan to loamy sand
Dowa (Chivala EPA)	4.22 to 5.35	0.15 to 1.81	0.27 to 3.12	0.08 to 0.23	22.94 to 59.45	32.27 to 133.56	40.26 to 65.75	197.65 to 231.03	Loamy sand to sandy clay loam
Salima (Chinguluwe EPA)	5.38 to 6.10	0.39 to 1.95	0.67 to 3.36	0.11 to 0.26	19.26 to 282.76	36.33 to 164.32	82.09 to 101.05	412.80 to 479.57	Loamy sand to sand
Nkhotakota (Zidyana EPA)	5.04 to 5.36	0.23 to 0.53	0.40 to 0.91	0.08 to 0.10	210.98 to 272.33	141.66 to 194.33	85.36 to 99.08	254.53 to 292.86	Loamy sand to sand
Ntcheu (Kandeu EPA)	4.41 to 5.60	0.14 to 1.29	0.23 to 2.22	0.07 to 0.16	50.24 to 72.02	59.28 to 125.46	53.33 to 68.37	321.92 to 425.16	Sand, loamy sand and sandy clay loam
Mangochi (Mtiya EPA)	4.06 to 4.90	0.82 to 1.38	1.41 to 2.39	0.13 to 0.16	23.25 to 87.36	39.03 to 128.16	21.31 to 46.14	244.64 to 423.93	Sandy loam to sandy clay loam

3. Rainfall During the Growing Period (October 2019 to April 2020)

- The 2019/20 cropping season generally had good rainfall pattern in all the districts where the demonstrations were hosted.

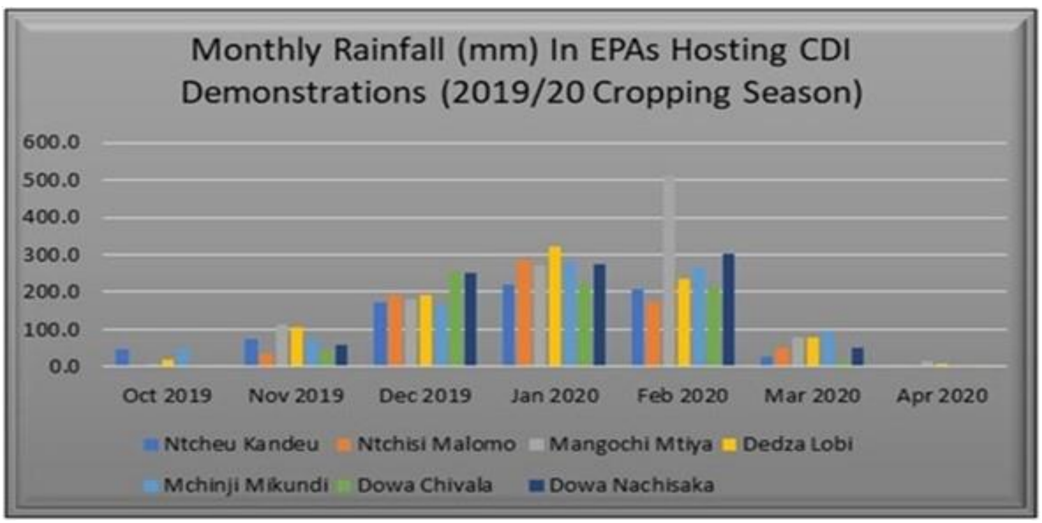
- The rainfall was favourable both in terms of total amount and distribution across the growing period (Table 4). In the critical months of December, January and February, all EPAs had adequate rains.

- Chart 1 shows that monthly rainfall distribution pattern was similar in all the EPAs hosting the demonstration plots.

Table 2. RAINFALL DATA IN EPAS WHICH HOSTED CDI DEMONSTRATIONS IN 2019/20 CROPPING SEASON (MM)

District	EPA	Oct 2019	Nov 2019	Dec 2019	Jan 2020	Feb 2020	Mar 2020	Apr 2020	Total
Ntcheu	Kandeu	46.0	75.2	171.8	220.6	206.0	28.3	2	749.9
Ntchisi	Malomo	3.0	34.40	191.10	285.10	173.20	51.10	3.0	740.9
Mangochi	Mtiya	6.5	114.8	178.6	271.3	508.3	76.6	16.6	1172.7
Dedza	Lobi	20.6	106.0	193.5	322.2	236.0	77.9	9.0	965.2
Mchinji	Mikundi	45.0	73.3	163.8	281.8	266.1	94.4		924.4
Dowa	Chivala	0	41.5	254.14	222.5	211.7	16.6	8.6	755.04
Dowa	Nachisaka	0	57.2	252.1	275.8	302.7	50.3	2.0	940.1

Chart 1. Rainfall in EPAs Hosting CDI Demonstrations (2019/20 Season)



4. PlantCatalyst Technology Demonstrations

a) Hypothesis for on-farm demonstrations. The product value proposition in CAB communities was that use of PlantCatalyst can reduce use of fertilizer by 50% and help the crop withstand drought stress. Fertilizer is one of the major costs in maize production. The test crop in the demonstrations was maize and the non-drought tolerant variety was used (DKC 8053).

b) Performance of maize under different combinations of fertilizer and PlantCatalyst.

Maturity duration. In all combinations of fertilizer and Plant Catalyst, including the control (no fertilizer and no PlantCatalyst), high altitude districts of Dedza (1,100 to 1,300 mabsl) and Ntchisi (Malomo is 1,021mabsl) experienced longest days to 95% maturity, about 115 days (Table 1 and Chart 1a). The low-lying areas such as the lakeshore district, Nkhotakota, maturity duration was shorter at 98 days to 95% maturity. While this may not be attributed to PlantCatalyst alone as differences in agroecological conditions also play a role, differences across different combinations of fertilizer and PlantCatalyst at the same demo site could be attributed to the latter. However, at all sites, there were no differences in days to 95% maturity across different treatments.

Grain yield. This parameter showed striking differences. In general, grain yield was highest in Lobi EPA (Dedza District) across all treatments, ranging from 4,392kg/ha to 9,721kg/ha. This was attributed to a combination of good rainfall pattern and comparatively better soil fertility status as shown by soil sample analysis results in Table 1 above, which showed higher levels of soil organic carbon and organic matter as well as nitrogen. The higher quality of soils in Lobi EPA are also captured by surprisingly high maize grain yield under no fertilizer and no plant catalyst, at 4,392kg/ha.

It was striking to note that in Dedza District, the treatment featuring “half fertilizer recommendation and low dose of 30mls of PlantCatalyst” produced a higher maize yield of 9,721kg/ha, which compared closely with full fertilizer recommendation and no Plant Catalyst at 9,853kg/kg. There seemed to be antagonism between full fertilizer recommendation and high dose of PlantCatalyst as the yield was lower at 8,765kg/ha.

In Ntchisi District, the treatment with half fertilizer recommendation and 60mls PlantCatalyst registered the highest grain yield at 4,307kg/ha, closely followed by the treatment with full fertilizer recommendation and 60ml PlantCatalyst at 4,099kg/ha, and full fertilizer recommendation and no Plant Catalyst at 4,010kg/ha. Half fertilizer and 30ml PlantCatalyst came fourth at 3,888kg/ha.

In Lilongwe District, the treatment half fertilizer recommendation and 30ml PlantCatalyst generated highest maize grain yield at 2,55kg/ha but was at par with full fertilizer recommendation and 30ml PlantCatalyst. Overall, the district had some of the lowest yields as highest yield was below 3mt/ha and lowest was below 1mt/ha. This was attributed to poor soil quality. A similar pattern emerged in Dowa District. Highest yield was 2,907kg/ha, posted by the treatment half fertilizer and 30ml Plant Catalyst. And lowest yield was 1,781kg/ha from no fertilizer and no Plant Catalyst plot.

In Nkhotakota District, half fertilizer and 30ml PlantCatalyst treatment yield at 4,131kg/ha compared closely with full fertilizer and 60mls PlantCatalyst treatment yield at 4,340kg/ha. It was way higher than full fertilizer and no Plant Catalyst at 2,652kg/ha.

Overall, the data has shown that a farmer can obtain good maize yields at half fertilizer recommendation and 30ml PlantCatalyst. The yield obtained is comparable to full fertilizer recommendation and sometimes surpassing it.

Table 3. Performance of Maize (DKC 8053) Under Different Combinations of Fertilizer and PlantCatalyst

District	No Fertilizer; No Plant Catalyst (Control)		Full Fertilizer Recommendation; No Plant Catalyst		Full Fertilizer Recommendation; 30ml Plant Catalyst		Full Fertilizer Recommendation; 60ml Plant Catalyst		Half Fertilizer Recommendation; 30ml Plant Catalyst		Half Fertilizer Recommendation; 60ml Plant Catalyst	
	Days to 95% Maturity	Grain Yield at 12.5% Moisture (kg)	Days to 95% Maturity	Grain Yield at 12.5% Moisture (kg)	Days to 95% Maturity	Grain Yield at 12.5% Moisture (kg)	Days to 95% Maturity	Grain Yield at 12.5% Moisture (kg)	Days to 95% Maturity	Grain Yield at 12.5% Moisture (kg)	Days to 95% Maturity	Grain Yield at 12.5% Moisture (kg)
Lilongwe (Mkwinda EPA)	110	957	110	1,424	110	2,255	110	2,170	110	2,255	110	1,823
Dedza (Lobi EPA)	115	4,392	115	9,853	115	8,506	115	8,680	115	9,721	115	8,765
Ntchisi (Malomo EPA)	115	3,442	115	4,010	115	3,756	115	4,099	115	3,888	115	4,307
Dowa (Nachisaka EPA)	108	1,781	108	2,652	108	2,871	108	2,374	108	2,907	108	2,493
Nkhotakota (Zidyana EPA)	98	950	98	2,652	98	2,187	98	4,340	98	4,131	98	2,849

Chart 2a. Maturity Duration Maize (DKC8053) Different Combos of Fertilizer & PlantCatalyst

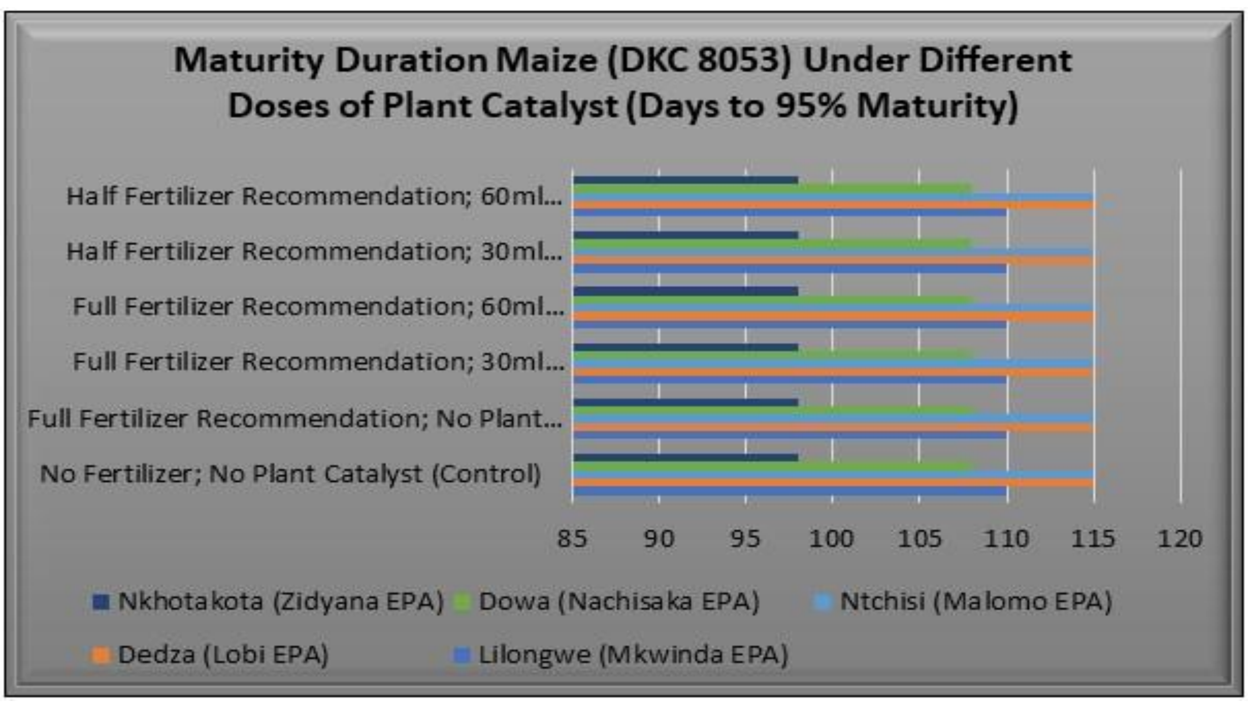
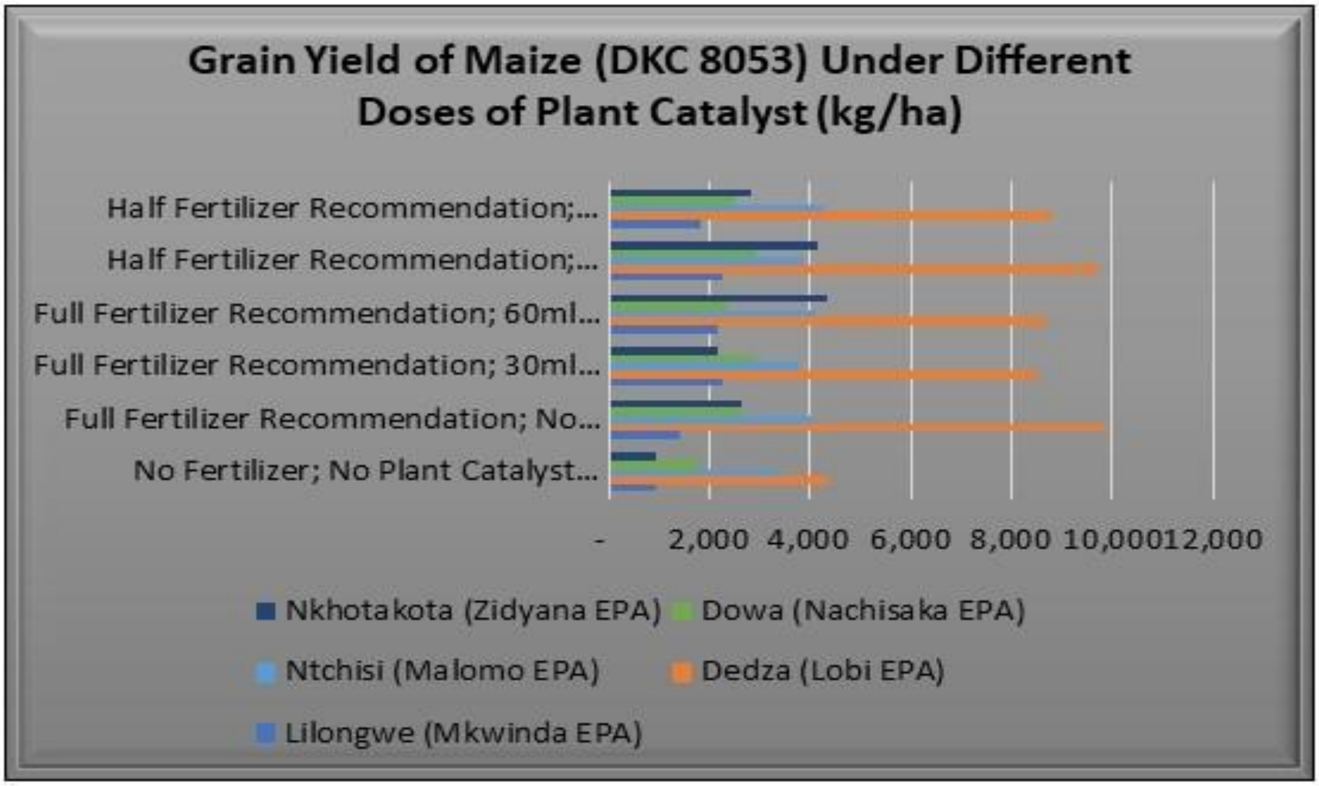


Chart 1b. Grain Yield of Maize (DKC 8053) Under Different Combinations of Fertilizer and PlantCatalyst



- **Economic Analysis of the use of PlantCatalyst**.

  The grain yield data has demonstrated that a farmer can attain the same yield, if not higher, by applying half fertilizer recommendation and 30mls of PlantCatalyst (at least 4 cycles, from one week after crop germination). Below is the economic analysis comparing this technology with full fertilizer without using Plant Catalyst using data from Ntchisi Districts where maize yields were decent, not too high (as in Dedza) nor too low (as in Lilongwe) hence represents a typical scenario (Table 9). The outcome of the preliminary economic analysis shows that although using Plant Catalysis significantly reduces fertilizer cost by 50%, the incremental benefit is marginal. The benefit in reduction of fertilizer cost is absorbed by incremental cost incurred in purchase of the product and labour cost in its application.

Table 4. Economic analysis of including PlantCatalyst in Maize Production

Economic Analysis of Plant Catalyst in Ntchisi District Malomo EPA (Mkweche Village) on 1 Hectare Plot: 2019/2020 Growing Season						
Parameter	**Measure**	**Unit Price (MK)**	**Full fertilizer; No Plant Catalyst**		**Half Fertilizer; 30ML Plant Catalyst)**	
			Quantity	Value (MK)	Quantity	Value (MK)
1/Maize Yield & Value	kg	200	4,010	802,000	3,888	777,600
Sub-total				***802,000***		***777,600***
2/Input Cost:						
a)Basal Fertilizer (NPK: 23:10:5)	Kg	454	200	90,800	100	45,400
b)Top Dressing (Urea: 46%N)	kg	380	100	38,000	50	19,000
b)Plant Catalyst	Liters	13,559	-	-	1.44	19,525
c)Labour (Fertiliser application)	Hectare	8,645	2	17,290	2	17,290
d)Labour (Plant Catalyst application)	Hectare	7,410	-	-	4	29,640
Sub-total				***146,090***		***130,855***
3/Benefit (1-2)				**655,910**		**646,745**
Net Incremental Cost [-]/ Benefit [+] is E14-G14						**9,165**
Footnote:						
1/Wholesale price of Plant Catalyst is US$14/liter						
2/Retail price at farmer cooperative at 30% margin is US$18/liter						
3/Exchange rate at 745						
4/Plant Catalyst application rate is 30ml/16 liter sprayer; 12 sprayers/ha; 4 cycles of spraying						

5. Concluding Remarks

Soil fertility challenges were observed in all districts where demonstrations were mounted. Most soils were strongly acidic, magnesium was above critical values at all demonstration sites and organic matter was deficient was in all host EPAs. It is recommended that future CDI/CAB demonstrations and trials should include soil liming using calcitic lime to create awareness amongst farmers and agricultural extension agents on the effect of soil acidity on crop productivity and how to deal with it. Further, farmers should increase efforts of incorporating organic matter into soils of their fields as this is critical for plant nutrition, soil and water management.

PlantCatalyst has shown that farmers can reduce amount of fertilizer to apply to their crops by about half the required levels. However, future demonstrations and trials should focus on modes of application to reduce labor requirement in application of the product. For instance, apply PlantCatalyst to seed at planting and include it in agrochemicals. This will enhance its economic benefit.