The Good Growth Plan Progress Data - Productivity 2016

1. Summary

Syngenta is committed to increasing crop productivity and to using limited resources such as land, water and inputs more efficiently. Since 2014, we have been measuring trends in agricultural input efficiency on a global network of real farms.

The Productivity 2016 dataset shows aggregated productivity and resource efficiency indicators for three crop seasons, 2014, 2015 and preliminary data for 2016 where available[FEU1]. The data has been collected from more than 3,600 farms and covers more than 20 different crops in 42 countries. The data (except USA data) was collected, consolidated and reported by Market Probe[1], an independent market research agency. It can be used to provide benchmarks for crop yield and input efficiency.

Farms are grouped in clusters, which represent a crop grown in an area with homogenous agro-ecological conditions and include comparable types of farms. The sample includes reference and benchmark farms. The reference farms were selected by Syngenta and the benchmark farms were randomly selected by Market Probe within the same cluster. Data collection was carried out by Market Probe using a structured questionnaire and face-to-face interviews with participating growers. Data was collected on the usage of inputs, such as crop protection products, chemical fertilizer, seeding rates, labor hours, machinery usage hours, and marketable crop yield on a per hectare basis.

2. Metadata

Description of the dataset	The dataset includes 2014 baseline data and 2015 and preliminary 2016 progress data for agricultural efficiency indicators for 3,600 farms in selected agro-ecological zones and market segments in 42 countries in Europe, Africa, Latin America, North America and Asia.
Date of first publication	April 23, 2015
Date of last update	March 2017
Date of next update	September 2017
Frequency of updates	Periodically
Reporting period	October 1, 2013 – September 30, 2016
License for re-using the data	The contents of this dataset and all supporting documentation are licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

[1] http://marketprobeagricultureandanimalhealth.com/

Text to use when citing the data	The Good Growth Plan Progress Data - Productivity 2016
URL to use when citing the data	www.goodgrowthplan.com
Geographic coverage	Algeria; Argentina; Australia; Bangladesh; Belgium; Brazil; China; Colombia; Costa Rica; Ecuador; Egypt; France; Germany; Guatemala; Honduras; Hungary; India; Indonesia; Italy; Ivory Coast; Japan; Jordan; Kenya; Malaysia; Mexico; Morocco; Netherlands; Pakistan; Paraguay; Peru; Philippines; Russia; South Africa; Spain; Tanzania; Thailand; Ukraine; United Kingdom; Venezuela; Vietnam; Zambia
Data language	English
Key words	input efficiency; crop productivity; agriculture; The Good Growth Plan
Subject	Agricultural input efficiency
Copyright year	2017
Copyright holder	Syngenta AG

3. Structure of the data

Data sets are at territory-, country-crop-, and cluster-level.

Variable name	Definition	Unit	Type of data
HarvestYear	Year the crop was harvested	year	Numeric
ReportingYear	Syngenta definition of reporting year for non-financial indicators	year	Numeric
Region	Syngenta definition of region		String
Territory	Syngenta definition of territory (sub-region)		String
Country	Country		String
Crop	Crop		String
Farms	Number of farms	farms	Numeric
Clusters	Number of clusters	clusters	Numeric
Comment	Comment on changes from previous reporting year		String
SmallholderCluster	Farms are defined as smallholder farms		Categorical
SmallholderPercent	Percentage of farms in cluster that are smallholders	%	Numeric

AreaSizeMin	Minimum field size	hectares	Numeric
AreaSizeAvg	Average field size	hectares	Numeric
AreaSizeMax	Maximum field size	hectares	Numeric
CropSizeMin	Minmium crop size in hectares	hectares	Numeric
CropSizeAvg	Average crop size in hectares	hectares	Numeric
CropSizeMax	Maximum crop size in hectares	hectares	Numeric
FarmSizeMin	Minimum farm size in hectares	hectares	Numeric
FarmSizeAvg	Average farm size in hectares	hectares	Numeric
FarmSizeMax	Maximum farm size in hectares	hectares	Numeric
Clreportingstatus	Cluster reporting status		String
ClusterID	Unique cluster identifier		String
LandProductivity	Average land productivity as marketable crop yield per land unit	tons per hectare	Numeric
PesticideApplicationEfficiency	Average number of pesticide applications per metric ton of marketable crop yield	applications per ton	Numeric
NutrientEfficiency	Average amount of nitrogen equivalents in kg per metric ton of marketable crop yield	kg per ton	Numeric
PhosphorusEfficiency	Average amount of phosphorus equivalents in kg per metric ton of marketable crop yield	kg per ton	Numeric
PotassiumEfficiency	Average amount of potassium equivalents in kg per metric ton of marketable crop yield	kg per ton	Numeric
SeedEfficiency	Average amount of seed in kg per metric ton of marketable crop yield	kg per ton	Numeric
PesticideEfficiency	Average amount of crop protection active ingredients in kg per metric ton of marketable crop yield	kg per ton	Numeric
IrrigationWaterEfficiency	Average amount of irrigation water in liters per metric ton of marketable crop yield	liters per ton	Numeric
LaborEfficiency	Average amount of labor in manhours per metric ton of marketable crop yield	hours per ton	Numeric
MachineEfficiency	Average amount of machine hours per metric ton of marketable crop yield	hours per ton	Numeric
LandProductivityIndex	The average percentage change in land productivity measured as marketable crop yield in metric tons per hectare in the reporting year relative to the baseline year	%	Numeric

CPApplicationEfficiencyIndex	The average percentage change in pesticide efficiency measured as the number of pesticide applications per metric ton of marketable crop yield in the reporting year relative to the baseline	%	Numeric
NutrientEfficiencyIndex	The average percentage change in nutrient efficiency measured as nitrogen input from chemical fertilizer applied in kilogram per metric ton marketable crop yield in the reporting year relative to the baseline	%	Numeric
PhosphorusEfficiencyIndex	The average percentage change in phosphorus efficiency measured as nitrogen input from chemical fertilizer applied in kilogram per metric ton marketable crop yield in the reporting year relative to the baseline	%	Numeric
PotassiumEfficiencyIndex	The average percentage change in potassium efficiency measured as nitrogen input from chemical fertilizer applied in kilogram per metric ton marketable crop yield in the reporting year relative to the baseline	%	Numeric
SeedEfficiencyIndex	The average percentage change in seed efficiency measured as kilogram of seeds per metric ton of marketable crop yield in the reporting year relative to the baseline	%	Numeric
PesticideEfficiencyIndex	The average percentage change in crop protection active ingredient (AI) efficiency measured as the amount of pesticide AI input per metric ton of marketable crop output in the reporting year relative to the baseline	%	Numeric
IrrigationWaterEfficiencyIndex	The average percentage change in irrigation efficiency measured as liters of irrigation water input per metric ton of marketable crop yield in the reporting year relative to the baseline	%	Numeric
LaborEfficiencyIndex	The average percentage change in labor efficiency measured as	%	Numeric

	manhours per metric ton of marketable crop yield in the reporting year relative to the baseline		
MachineEfficiencyIndex	The average percentage change in machine efficiency measured as machine hours per metric ton of marketable crop yield in the reporting year relative to the baseline	%	Numeric
AvgSyngentaShare	Rate of adoption of Syngenta offer	%	Numeric

4. Background and methods

The main objective of the farm network is to monitor progress on Syngenta's commitment to increase crop productivity and resource efficiency. Crop output-input ratios are measured against set targets on real farms for selected crops and market segments relevant to Syngenta's commercial strategy. Syngenta considers a real world situation and takes into account preferences and decisions made by its customer farmers.

4.1. Description of the farm network

The farm survey is designed as a longitudinal study that involves repeated observations of crop output-input ratios over several years on the same farms. Farms are grouped into clusters with similar farm types representing a crop grown in similar agro-ecological and market conditions. The reporting scope (countries, crops, customer segments) is determined and reviewed annually by Syngenta in line with its commercial strategies. The countries in scope have established targets which were baselined in 2014 and have to be met in 2020.

The sample includes reference and benchmark farms. The reference farms were selected by Syngenta and the benchmark farms were randomly and independently selected by Market Probe within the same cluster.

4.2. Progress measurement

The basis for progress management is the productivity and efficiency percentage increases measured on reference farms. The global trend is measured against a 20% improvement target to be achieved by 2020. The baseline year for a clusters is 2014, the starting year of the data collection. The key performance indicators (KPIs) represent partial measures of agricultural productivity:

- Land productivity
- Labor efficiency
- Nitrogen efficiency

- Seed efficiency
- Pesticide application efficiency
- Pesticide efficiency
- Irrigation water efficiency
- Machine efficiency

The evolution over time for each KPI is calculated on cluster level. To be included in the progress measurement, growers must have participated in The Good Growth Plan for at least two consecutive waves. Outlier analysis and data cleansing at farm level is used to remove extreme outliers.

Key definitions	• **A reference farm** is managed by a respondent grower selected by Syngenta.
	• **A benchmark farm i**s managed by a respondent grower randomly and independently selected by Market Probe using cluster screening criteria.
	  ○ In USA, benchmark data is generated from USDA and other public data.
	  ○ In UK, Germany, Spain and France, benchmark data for barley in particular is generated on reference farms using conventional practices.
	• **A cluster** represents farms with similar agro-climatic conditions and farm characteristics according to screening criteria.
	• **A farm** is a tract of land cultivated for the purpose of crop production within a specified crop cycle or crop season.

4.3. Key Performance Indicators

a. Number of reference and benchmark farms

Name	**Number of reference/benchmark farms**
Unit of measurement	# (count)
Definition	The number of reference and benchmark farms participating in the harvest year previous to the reporting year.
Calculation	1. Summing up of reference and benchmark farms from cluster to global level

b. Land productivity

Name	**Land productivity**

Unit of measurement	Metric tons per hectare
Definition	Marketable crop yield in metric tons per hectare
Calculation	1. Crop output in metric tons per land unit for the respective crop periods is reported by the grower. 2. The output per land unit is converted to output per hectare.
Discussion/Limitations	Year-on-year observations in agriculture can be problematic: changes in crop yield could be explained by external factors (e.g. weather related stress, pest breakouts and other environmental factors).

c. Land productivity of smallholders

Name	**Land productivity of Smallholders**
Unit of measurement	Metric tons per hectare
Definition	Marketable crop yield in metric tons per hectare of smallholder clusters
Calculation	Smallholder clusters are defined based on farm-size and country-specific definitions set forward in The Good Growth Plan smallholder commitment.
Discussion/Limitations	In several cases, cluster definitions were initially not made based on hectare cut-off sizes. Hence, in some clusters, growers that meet the smallholder definition are in the same cluster as growers somewhat above.

d. Nutrient efficiency

Name	**Nutrient efficiency**
Unit of measurement	Nitrogen in kg/t
Definition	Nitrogen input from chemical fertilizer applied in kilogram per metric ton marketable crop yield in the reporting year relative to the baseline
Calculation	1. Data on nitrogen input in kilogram per land unit from chemical fertilizer applied is reported by respondent growers. 2. The input per land unit is converted to input per hectare.
Discussion/Limitations	KPI does not consider the nitrogen balance in the soil. Hence, any changes over time have to be interpreted carefully. Data for organic fertilizer input is available, but needs to be calculated to N equivalents using assumptions.

e. Phosphorus efficiency

Name	**Phosphorus efficiency**
Unit of measurement	Phosphorus in kg/t
Definition	Phosphorus input from chemical fertilizer applied in kilogram per metric ton marketable crop yield in the reporting year relative to the baseline
Calculation	3. Data on phosphorus input in kilogram per land unit from chemical fertilizer applied is reported by respondent growers. 4. The input per land unit is converted to input per hectare.
Discussion/Limitations	KPI does not consider the phosphorus balance in the soil. Hence, any changes over time have to be interpreted carefully.

f. Potassium efficiency

Name	**Potassium efficiency**
Unit of measurement	Potassium in kg/t
Definition	Potassium input from chemical fertilizer applied in kilogram per metric ton marketable crop yield in the reporting year relative to the baseline
Calculation	5. Data on Potassium input in kilogram per land unit from chemical fertilizer applied is reported by respondent growers. 6. The input per land unit is converted to input per hectare.
Discussion/Limitations	KPI does not consider the Potassium balance in the soil. Hence, any changes over time have to be interpreted carefully.

g. Pesticide Application efficiency

Name	**Pesticide application efficiency**
Unit of measurement	Number of pesticide applications/t
Definition	Pesticide application efficiency measured as the number of pesticide applications per metric ton of marketable crop yield. Included are fungicides, herbicides, and insecticides.
Calculation	1. Each pesticide treatment during the production cycle is recorded and reported by the respondent growers. 2. The number of pesticide applications per land unit is calculated by summing-up the number of treatments. In case two or more pesticides were applied as one application, they are counted as one

	treatment (e.g. tank mix). Seed treatment is calculated as one treatment. 3. To calculate pesticide application efficiency of a farm, the number of pesticide applications is divided by crop yield in ton.
Limitations	Application efficiency depends on biotic pressure.

h. Pesticide AI efficiency

Name	**Pesticide AI efficiency index**
Unit of measurement	kg AI/t
Definition	The average percentage change in pesticide active ingredient (AI) efficiency measured as the amount of pesticide AI input per metric ton of marketable crop output in the reporting year relative to the baseline. Included are active ingredients of fungicides, herbicides, insecticides, and seed treatment products. Not included are active ingredients of fertilizers, miticides, acaricides, rodenticides, nematicides, molluscicides, plant growth regulator, harvest aids, and adjuvants.
Calculation	1. Each pesticide application, including the brand name(s) of the product and dosage rate in gram or milliliter per land unit applied during the production cycle, is reported by the grower. 2. The input per land unit is converted to input per hectare. 3. The database www.homologa-new.com, label information, or other databases are used to obtain information on the active ingredient concentration of each pesticide product. The quantity of active ingredient input is measured as grams per liter or grams per kilogram product solvent. 4. The amount of active ingredient applied per hectare is calculated by multiplying the dosage rate with the active ingredient concentration. 5. The total amount of pesticide active ingredients applied in kilograms per hectare is calculated by taking the sum of active ingredients of all considered pesticide applications. 6. To calculate pesticide active ingredient efficiency, the total amount of pesticide active ingredients is divided by the crop yield in tons for each farm.
Limitations	Due to differences in the mode-of-action, an increase in pesticide AI efficiency may have limited interpretability.

i. Seed efficiency

Name	Seed efficiency
Unit of measurement	kg seeds/ton
Definition	The average percentage change in seed efficiency measured as kilograms of seeds per metric ton of marketable crop yield in the reporting year relative to the baseline year.
Calculation	1. The amount of seeds used in bags or kilograms per land unit is recorded and reported by the grower. 2. The input per land unit is converted to input per hectare. 3. For each farm, the amount of seeds used is divided by the crop yield, resulting in seed efficiency measured in kilograms of seed input per ton of crop output.

j. Labor efficiency

Name	Labor efficiency
Unit of measurement	manhours/ton
Definition	The average percentage change in labor efficiency measured as manhours per metric ton of marketable crop yield in the reporting year relative to the baseline year.
Calculation	1. The number of hours spent by all workers and the number of workers involved are recorded and reported by the grower for 21 different farming activities. The activities include clearing, ploughing, digging, ridging, ripping, land leveling, greenhouse management, applying fertilizers, mulching, sowing or planting, scouting for pests and diseases, applying pesticides, irrigating, pruning, weeding, harvesting, post-harvest handling, and processing (incl. sorting). 2. The number of hours is multiplied by the number of people involved in each activity, resulting in manhours per activity. Manhours from all activities are summed up and divided by the growing area (field) size. 3. The input per land unit is converted to input per hectare. 4. For each farm, the total number of manhours is divided by the crop yield, resulting in labor efficiency measured in manhours per ton of crop output.
Limitations	Record-keeping of labor inputs for different farm activities is complex and time consuming. It may be inconsistent across farms, which can partially be managed through data cleansing. Very large farms were found to

	outsource many of their labor activities. The indicator has to be interpreted with care.

k. Machine efficiency index

Name	Machine efficiency index
Unit of measurement	%
Definition	The average percentage change in machine efficiency measured as machine hours per metric ton of marketable crop yield in the reporting year relative to the baseline year.
Calculation	1. The type of machine and the total hours it is used are recorded and reported by the grower for 21 different farming activities. The considered farm activities include clearing, ploughing, digging, ridging, ripping, land leveling, greenhouse management, applying fertilizers, mulching, sowing or planting, scouting for pests and diseases, applying pesticides, irrigating, pruning, weeding, harvesting, post-harvest handling, processing (incl. sorting), and other activities. 2. Machine-hours from all activities are summed up and divided by the growing area (field) size in hectare. 3. The input per land unit is converted to input per hectare. 4. For each farm, the total number of machine-hours is divided by crop yield, resulting in labor efficiency measured in machine-hours per ton of crop output.
Limitations	Record-keeping of machine inputs for different farm activities is complex and time consuming. Machine hours from different activities may be difficult to compare against each other. The indicator has to be interpreted with care.

l. Irrigation water efficiency

Name	Irrigation water efficiency
Unit of measurement	Liter/t
Definition	The average percentage change in irrigation efficiency measured as liters of irrigation water input per metric ton of marketable crop yield in the reporting year relative to the baseline year.
Calculation	1. If a grower uses irrigation to grow crops, the amount of irrigation water used per land unit is estimated and reported by the grower 2. The input per land unit is converted to input per hectare.

Limitations	Tracking systems for use of irrigation water may be different across farms (e.g. water meters or sourcing from a river for free) and amounts used have to be compared with care. Climate conditions penalize farms with little rain that will need to irrigate more.

4.4. Data collection tools and process

The monitoring scope is determined in line with business priorities and reviewed annually. Reference farm sign-up was organized through Syngenta's commercial organization in the countries. Reference grower characteristics were used to describe a cluster-specific profile, and based on which Market Probe independently and randomly selected comparable benchmark growers to provide a control group within each cluster.

Sample sizes for each cluster were determined in order to measure significant increases in crop efficiency over time. These were determined by Market Probe based on target productivity increases and assumptions regarding the variation of yields in each cluster. The smaller the expected increase, the larger the sample size needed to measure significant differences over time. Variations within clusters were based on previous research from the countries. Additionally, growers were also organized into clusters as a means of keeping variances under control, as well as distinguishing between growers in terms of crop size, region and technological level.

- A minimum sample size of 20 interviews per cluster is needed. The minimum number of reference farms is 5 of 20. The optimal number of reference farms is 10 of 20 (balanced sample).
- For results to be statistically significant when assessed over time, the minimum and optimum sample sizes need to be determined based on target increase and yield variation in each cluster.

The farm questionnaire was developed jointly by Syngenta and Market Probe. As each crop requires different practices and has different indicators, the final questionnaire was therefore split into crop modules. The master questionnaire was translated into local languages, which were reviewed and approved. The questionnaire covered: farm activities (e.g. crops grown), soil management and safe-use practices, detailed use of chemical fertilizer, pesticide quantity by application and pest pressure, seed variety and seeding rates, labor and machinery hours, irrigation water use, abiotic stresses (such as heavy rain, cold or lack of rainfall), crop yield, harvest time, post-harvest losses, crop sales and prices.

Data collection took place according to the planting and harvesting times in each cluster. The first section of the questionnaire was administered during the crop season. The second section was administered after the harvest. Per respondent, information for up to two cultivation areas (e.g. plots, fields) was collected. The farmer interviews were conducted face-to-face in the local language by Market Probe interviewers using structured questionnaires. Respondents were introduced to the objectives of The Good Growth Plan and, if necessary, trained on recording input use and crop outputs. The local help desk support was provided by Market Probe throughout the season in case of questions.

Market Probe uses SPSS (Statistical Package for the Social Sciences) for data entry, cleaning, analysis, and reporting. After collection, the farm data is entered into a local database, reviewed, and quality-checked by the local Market Probe agency. In the case of missing values or inconsistencies, farmers are re-contacted. In some cases, grower data was verified with local experts (e.g. retailers) to ensure data accuracy and validity. After country-level cleaning, the farm-level data is submitted to the global Market Probe headquarters for processing. In the case of missing values or inconsistences, the local Market Probe office was re-contacted to clarify and solve issues.

The results were shared with reference and benchmark respondents in the farm network. Farmers were able to compare their individual performance to the respective cluster average, building an important starting point for future productivity increases.

4.5. Sources of data

The data were generated by the respondent reference and benchmark farmers who measure and report on their input use and crop outputs over the respective crop season.

Data	Data source	Data processing
Farm-level data for reference and benchmark farms in Algeria, Argentina, Australia, Bangladesh, Belgium, Brazil, China, Colombia, Costa Rica, Ecuador, Egypt, Guatemala, Honduras, Hungary, India, Indonesia, Italy, Ivory Coast, Japan, Jordan, Kenya, Malaysia, Mexico, Morocco, Pakistan, Paraguay, Peru, Philippines, Russia, South Africa, Spain, Tanzania, Thailand, The Netherlands, Ukraine, Venezuela, Vietnam, Zambia	Market Probe[2]	Market Probe
Farm-level data for reference farms in France	Datagri[3]	Market Probe
Farm-level data for benchmark farms in France	Market Probe	Market Probe
Farm-level reference data for farms in the USA	Syngenta	Syngenta
Cluster-level benchmark data for farms in the USA	– USDA/NASS crop yields – USDA/ARMS crop input data – USDA/Farm & Ranch Irrigation Survey – State Extension crop budgets – USDA/NASS crop acreage	Syngenta
Farm-level data for reference and benchmark farms in Germany	Syngenta	Market Probe
Farm-level data for reference and benchmark farms in the UK	Syngenta	Market Probe

[2] http://www.marketprobeagricultureandanimalhealth.com/
[3] http://www.datagri.com/gestion/front/main/

Pesticide active ingredient concentration	Homologa – The Global Crop Protection Database[4] Label information from internal sources (e.g. regulatory functions) or internet search	Market Probe
Smallholder definitions based on farm size	Syngenta	Market Probe

4.6. Progress calculation

All KPIs are aggregated from individual farm to cluster level.

$$Y_j = \frac{\sum Y_{ij}}{n}$$

Where

- Y_j is the cluster average
- Y_{ij} is input efficiency of farm *i* in cluster j
- n is the number of farms within cluster j

The aggregated cluster-level KPIs is compared with those of the previous wave to determine progress in efficiency. The percentage change is used as unit of measurement:

$$\Delta Y_j^{2015} = \left(\frac{Y_j^{2015}}{Y_j^{2014}} - 1\right) * 100$$

Where

- ΔY_j^{2015} is the percentage change for cluster J
- Y_j^{2015} is the cluster aggregate in 2015 for cluster j
- Y_j^{2014} is the cluster aggregate in 2014 for cluster j

The evolution of the KPIs is calculated the same way for reference and benchmark farms.

For efficiency indicators (input/output), the inverse (output/input) is used to ensure a lower input use is represented as a positive increase.

$$\Delta Y_j^{2015} = \left(\left(\frac{1}{\frac{\sum_{i=1}^{n} y_i^{2015}}{n}} - \frac{1}{\frac{\sum_{i=1}^{n} y_i^{2014}}{n}}\right) * \frac{\sum_{i=1}^{n} y_i^{2014}}{n}\right) * 100 = \left(\frac{\sum_{i=1}^{n} y_i^{2014}}{\sum_{i=1}^{n} y_i^{2015}} - 1\right) * 100$$

For evolutions of land-productivity of smallholder we report the weighted average of all evolutions. Weights will be applied as a function of the number of observations in a particular cluster. For example,

[4] www.homologa-new.com

if a cluster has 5 reference smallholders and 100 reference smallholders take part in the entire sample, their evolution receives a weight of 5%. Smallholders' evolutions are weighted because the number of observations within a particular cluster can be limited. Technically, it is possible to have only one smallholder in a particular cluster. Therefore, we chose to weight the evolutions to prevent that one single smallholder gets to play a too important role in the calculation of the evolution.

Globally (as represented in the Annual Report), for the evolution in nutrient efficiency and pesticide application efficiency we report the median of the cluster evolutions. This is due to the higher variability of the efficiency estimate. Year by year, both output and input may change due to environmental and market conditions.

Moving forward in reporting years, progress across more than three consecutive waves will be calculated by accumulating the percentage evolutions. 2014 will be considered as the baseline in the accumulation process:

$$\%\, progress\ in\ 2016 = \left(\left(\left(\frac{Y_j^{2015}}{Y_j^{2014}}\right) * \left(\frac{Y_j^{2016}}{Y_j^{2015}}\right)\right) - 1\right) * 100$$

When sufficient years of data are available, Market Probe will use statistical tools, such as panel analysis, to derive more precise estimates about the increase in crop productivity and input efficiency.

4.7. Publication

The selected KPIs "Land Productivity Index", "Nutrient Efficiency Index[5]", and "Pesticide Application Efficiency Index" are published in the Annual Review. The percentage increase for both reference and benchmark farms is displayed as the average of yield changes and the median for input efficiency changes over all clusters. The included progress data is by harvest year and reported with a time lag to ensure data quality. The 2016 reporting year includes progress data from 2014 to 2015.

Cluster-level efficiency indicators are published as total values on www.goodgrowthplan.com for each cluster. This excludes cluster-level data for the USA. Results from reference and benchmark farms are anonymized and aggregated to ensure data confidentiality of individual growers in clusters with small samples of reference farms. Progress data from 2016 has not yet been independently audited and is published as preliminary only. [FEU2]

5. Changes versus previous release

August 3rd 2016:

- KPIs were updated with available data.

[5] Nutrient here refers to nitrogen.

March 17th 2017:

- KPIs were updated with available data
- KPI descriptions were simplified and updated in the background document
- Territory and country data format was revised
- See appendix for overview on cluster changes

6. Approval of non-financial performance

The Good Growth Plan data is published as a global aggregate in the Non-financial performance summary on page 55 of the Annual Review 2016. This summary was approved by the Board of Directors on February 7, 2017. Syngenta's Board of Directors and management are responsible for establishing and maintaining adequate internal controls over non-financial reporting. Syngenta's internal controls over non-financial reporting are designed to provide assurance to Syngenta's Board of Directors and management regarding the reliability of non-financial reporting and the preparation and fair presentation of the information published in the Non-financial performance summary. All internal controls, no matter how well designed, have inherent limitations and therefore may not prevent or detect misstatements. In designing internal controls over non-financial reporting, Syngenta used the criteria established in Internal Control – Integrated Framework (2013) issued by the Committee of Sponsoring Organizations of the Treadway Commission (COSO). PricewaterhouseCoopers AG, Switzerland, an independent registered public accounting firm, has issued an opinion on Syngenta's Non-financial performance summary, which is included in the Annual Review 2016 on page 61.

7. Contact information

For questions and inquiries regarding this dataset and documentation, please contact goodgrowthplan.data@syngenta.com.

8. Appendix

8.1. Overview on clusters and respective changes. [FEU3]

	2014	2015	2016
Total number of clusters	170	162	144

Change in clusters
Deleted from sample
new in sample

2014		2015		2016	
code	**label**	**code**	**label**	**code**	**label**
12101	AlgeriaWheat1	12101	AlgeriaWheat1	12101	OUT
20701	ArgentinaMaize1	20701	ArgentinaMaize1	20701	ArgentinaMaize1
20702	ArgentinaMaize2	20702	ArgentinaMaize2	20702	ArgentinaMaize2
215101	ArgentinaSoybeanMaize1	215101	ArgentinaSoybeanMaize1	215101	ArgentinaSoybeanMaize1
215102	ArgentinaSoybeanMaize2	215102	ArgentinaSoybeanMaize2	215102	ArgentinaSoybeanMaize2
215202	ArgentinaSoybeanSunflower2	215202	ArgentinaSoybeanSunflower2	215202	ArgentinaSoybeanSunflower2
21802	ArgentinaSunflowerSeed2	21802	ArgentinaSunflowerSeed2	21802	ArgentinaSunflowerSeed2
22101	ArgentinaWheat1	22101	ArgentinaWheat1	22101	ArgentinaWheat1
22102	ArgentinaWheat2	22102	ArgentinaWheat2	22102	ArgentinaWheat2
30301	AustraliaBarley1	30301	AustraliaBarley1	30301	AustraliaBarley1
32101	AustraliaWheat1	32101	AustraliaWheat1	32101	AustraliaWheat1
41401	BangladeshRice1	41401	BangladeshRice1	41401	BangladeshRice1
50401	BelgiumCauliflower1	50401	BelgiumCauliflower1	50401	BelgiumCauliflower1

60601	BrazilCoffee1	60601	BrazilCoffee1	60601	BrazilCoffee1
60602	BrazilCoffee2	60602	BrazilCoffee2	60602	BrazilCoffee2
60701	BrazilMaize1	60701	BrazilMaize1	60701	BrazilMaize1
61501	BrazilSoybean1	61501	BrazilSoybean1	61501	BrazilSoybean1
61502	BrazilSoybean2	61502	BrazilSoybean2	61502	BrazilSoybean2
61503	BrazilSoybean3	61503	BrazilSoybean3	61503	BrazilSoybean3
61701	BrazilSugarcane1	61701	BrazilSugarcane1	61701	BrazilSugarcane1
61702	BrazilSugarcane2	61702	BrazilSugarcane2	61702	BrazilSugarcane2
61901	BrazilTomato1	61905	BrazilTomato1+2	61905	BrazilTomato1+2
61902	BrazilTomato2				
61903	BrazilTomato3	61903	BrazilTomato3	61903	BrazilTomato3
68803	BrazilTomato4	68803	BrazilTomato4	68803	BrazilTomato4
70701	ChinaMaize1	70706	ChinaMaize1+2	70706	ChinaMaize1+2
70702	ChinaMaize2				
70703	ChinaMaize3	70703	ChinaMaize3	70703	ChinaMaize3
70704	ChinaMaize4	70704	ChinaMaize4	70704	ChinaMaize4
70705	ChinaMaize5	70705	ChinaMaize5	70705	ChinaMaize5
				70707	ChinaMaize6
				70708	ChinaMaize7
71301	ChinaPotato1	71303	ChinaPotato1+2	71303	ChinaPotato1+2
71302	ChinaPotato2				
714101	ChinaRice1early	714101	ChinaRice1early	714101	ChinaRice1early
714201	ChinaRice1late	714201	ChinaRice1late	714201	ChinaRice1late
714102	ChinaRice2early	714102	ChinaRice2early	714102	ChinaRice2early
714202	ChinaRice2late	714202	ChinaRice2late	714202	ChinaRice2late
71403	ChinaRice3	71403	ChinaRice3	71403	ChinaRice3

71404	ChinaRice4	71404	ChinaRice4	71404	ChinaRice4
71405	ChinaRice5	71405	ChinaRice5	71405	ChinaRice5
80601	ColombiaCoffee1	80601	ColombiaCoffee1	80601	ColombiaCoffee1
80701	ColombiaMaize1	80721	ColombiaMaize1	80721	ColombiaMaize1
80702	ColombiaMaize2	80722	ColombiaMaize2	80722	ColombiaMaize2
81301	ColombiaPotato1	81301	ColombiaPotato1	81301	ColombiaPotato1
81401	ColombiaRice1	81401	ColombiaRice1	81401	ColombiaRice1
81901	ColombiaTomato1	81901	ColombiaTomato1	81901	ColombiaTomato1
90201	Costa RicaBanana1	90201	Costa RicaBanana1	90201	CostaRicaBanana1
110201	EcuadorBanana1	110201	EcuadorBanana1	110201	EcuadorBanana1
110701	EcuadorMaize1	110701	EcuadorMaize1	110701	EcuadorMaize1
111301	EcuadorPotato1	111301	EcuadorPotato1	111301	EcuadorPotato1
111401	EcuadorRice1	111401	EcuadorRice1	111401	EcuadorRice1
121301	EgyptPotato1	121301	EgyptPotato1	121301	OUT
121302	EgyptPotato2	121302	EgyptPotato2	121302	OUT
121303	EgyptPotato3	121303	EgyptPotato3	121303	OUT
121901	EgyptTomato1	121901	EgyptTomato1	121901	EgyptTomato1
122101	EgyptWheat1	122101	EgyptWheat1	122101	EgyptWheat1+2
122102	EgyptWheat2	122102	EgyptWheat2		
130301	FranceBarley1	130301	FranceBarley1	130301	FranceBarley1
130302	FranceBarley2	130302	FranceBarley2	130302	FranceBarley2
130303	FranceBarley3	130303	FranceBarley3	130303	FranceBarley3
				130304	FranceBarleyHyvido4
130701	FranceMaize1	137201	FranceMaize1	137201	FranceMaize1
130702	FranceMaize2	137202	FranceMaize2	137202	FranceMaize2
130901	FranceGrape1	130901	FranceGrape1	130901	FranceGrapes1

130902	FranceGrape2	130902	FranceGrape2	130902	FranceGrapes2
130903	FranceGrape3	130903	FranceGrape3	130903	FranceGrapes3
131001	FranceOilseed rape1	131001	FranceOilseed rape1	131001	FranceOilseedrape1
131801	FranceSunflowerSeed1	131801	FranceSunflowerSeed1	131801	FranceSunflowerSeed1
141401	GhanaRice1	141401	OUT	141401	OUT
150601	GuatemalaCoffee1	150601	GuatemalaCoffee1	150601	GuatemalaCoffee1
150701	GuatemalaMaize1	150701	GuatemalaMaize1Grain	150701	GuatemalaMaize1
151701	GuatemalaSugarcane1	151701	GuatemalaSugarcane1	151701	GuatemalaSugarcane1
160601	HondurasCoffee1	160601	HondurasCoffee1	160601	HondurasCoffee1
170701	HungaryMaize1	170721	HungaryMaize1	170721	HungaryMaize1
171001	HungaryOilseed rape1	171001	HungaryOilseed rape1	171001	HungaryOilseedrape1
171801	HungarySunflowerSeed1	171801	HungarySunflowerSeed1	171801	HungarySunflowerseed1
172101	HungaryWheat1	172101	HungaryWheat1	172101	HungaryWheat1
180701	IndiaMaize1	180721	IndiaMaize1	180721	IndiaMaize1
180801	IndiaCotton1	180801	IndiaCotton1	180801	IndiaCotton1
181401	IndiaRice1	181401	IndiaRice1	181401	IndiaRice1
181402	IndiaRice2	181402	IndiaRice2	181402	IndiaRice2
181403	IndiaRice3	181403	IndiaRice3	181403	IndiaRice3
181501	IndiaSoybean1	181501	IndiaSoybean1	181501	IndiaSoybean1
181901	IndiaTomato1	181901	IndiaTomato1	181901	IndiaTomato1
190501	IndonesiaCocoa1	190501	IndonesiaCocoa1	190501	IndonesiaCocoa1
190502	IndonesiaCocoa2	190502	IndonesiaCocoa2	190502	OUT
190701	IndonesiaMaize1	190701	IndonesiaMaize1	190701	IndonesiaMaize1
190702	IndonesiaMaize2grain	190702	IndonesiaMaize2grain	190702	IndonesiaMaize2
191401	IndonesiaRice1	191401	IndonesiaRice1	191401	IndonesiaRice1
191402	IndonesiaRice2	191402	IndonesiaRice2	191402	IndonesiaRice2

200301	ItalyBarley1	200301	ItalyBarley1	200301	ItalyBarley1
200302	ItalyBarley2	200302	ItalyBarley2	200302	ItalyBarley2
200303	ItalyBarley3	200303	ItalyBarley3	200303	ItalyBarley3
200901	ItalyGrape1	200901	ItalyGrape1	200901	ItalyGrapes1
200902	ItalyGrape2	200902	ItalyGrape2	200902	ItalyGrapes2
200903	ItalyGrape3	200903	ItalyGrape3	200903	ItalyGrapes3
201901	ItalyTomato1	201901	ItalyTomato1	201901	ItalyTomato1
201902	ItalyTomato2	201902	ItalyTomato2	201902	ItalyTomato2
202101	ItalyWheat1	202101	ItalyWheat1	202101	ItalyWheat1
202102	ItalyWheat2	202102	ItalyWheat2	202102	ItalyWheat2
202103	ItalyWheat3	202103	ItalyWheat3	202103	ItalyWheat3
207201	ItalyMaize1grain	207201	ItalyMaize1grain	207201	ItalyMaize1grain
207101	ItalyMaize1silage	207101	ItalyMaize1silage		
210501	IvoryCoastCocoa1	210501	IvoryCoastCocoa1	210501	IvoryCoastCocoa1
221301	JapanPotato1	221301	JapanPotato1	221301	JapanPotato1
221302	JapanPotato2	221302	JapanPotato2	221302	JapanPotato2
221303	JapanPotato3	221303	OUT	221303	OUT
231901	JordanTomato1	231905	JordanTomato1+3	231905	OUT
231903	JordanTomato3				
231902	JordanTomato2	231902	JordanTomato2	231902	OUT
231904	JordanTomato4	231904	OUT	231904	OUT
241301	KenyaPotato1	241301	KenyaPotato1	241301	KenyaPotato1
241302	KenyaPotato2	241302	KenyaPotato2		
241901	KenyaTomato1	241901	KenyaTomato1	241901	KenyaTomato1
241902	KenyaTomato2	241902	KenyaTomato2		
242101	KenyaWheat1	242101	KenyaWheat1	242101	OUT

242102	KenyaWheat2	242102	KenyaWheat2	242102	OUT
261401	MalaysiaRice1	261401	MalaysiaRice1	261401	MalaysiaRice1
270701	MexicoMaize1	270721	MexicoMaize1	270721	MexicoMaize1
270702	MexicoMaize2	270722	MexicoMaize2	270722	MexicoMaize2
271301	MexicoPotato1	271301	MexicoPotato1	271301	MexicoPotato1
271701	MexicoSugarcane1	271701	MexicoSugarcane1	271701	MexicoSugarcane1
271901	MexicoTomato1	271901	MexicoTomato1	271901	MexicoTomato1
280701	MoroccoMaize1+2	280721	MoroccoMaize1+2	280721	OUT
281301	MoroccoPotato1+2	281301	MoroccoPotato1+2	281301	MoroccoPotato1+2
281901	MoroccoTomato1	281901	OUT	281901	OUT
282101	MoroccoWheat1+2	282101	MoroccoWheat1+2	282101	MoroccoWheat1+2
290101	TheNetherlandsApples1	290101	TheNetherlandsApples1	290101	TheNetherlandsApples1
291101	TheNetherlandsPear1	291101	TheNetherlandsPear1	291101	TheNetherlandsPear1
302101	PakistanWheat1	302101	PakistanWheat1	302101	PakistanWheat1
310701	ParaguayMaize1	317201	ParaguayMaize1	317201	ParaguayMaize1
310702	ParaguayMaize2	310702	ParaguayMaize2	310702	ParaguayMaize2
311501	ParaguaySoybean1	311501	ParaguaySoybean1	311501	ParaguaySoybean1
311502	ParaguaySoybean2	311502	ParaguaySoybean2	311502	ParaguaySoybean2
321301	PeruPotato1	321301	PeruPotato1	321301	PeruPotato1
327201	PeruMaize1grain	327201	PeruMaize1grain	327201	PeruMaize1
3314101	PhilippinesRice1dry	3314101	PhilippinesRice1dry	3314101	OUT
3314102	PhilippinesRice2dry	3314102	PhilippinesRice2dry	3314102	PhilippinesRice2dry
3314103	PhilippinesRice3dry	3314103	PhilippinesRice3dry	3314103	PhilippinesRice3dry
3314201	PhilippinesRice1wet	3314201	PhilippinesRice1wet	3314201	OUT
3314202	PhilippinesRice2wet	3314202	PhilippinesRice2wet	3314202	PhilippinesRice2wet
3314203	PhilippinesRice3wet	3314203	PhilippinesRice3wet	3314203	PhilippinesRice3wet

350701	RussiaMaize1	357203	RussiaMaize1+2grain	357203	RussiaMaize1+2
350702	RussiaMaize2				
351801	RussiaSunflowerSeed1	351803	RussiaSunflowerSeed1+2	351803	RussiaSunflowerseed1+2
351802	RussiaSunflowerSeed2				
360701	SouthafricaMaize1	360701	SouthafricaMaize1	360701	OUT
		360722	SouthafricaMaize2	360722	OUT
		360712	SouthafricaMaize2silage	360712	OUT
		360703	SouthafricaMaize3	360703	OUT
		360704	SouthafricaMaize4	360704	OUT
361301	SouthafricaPotato1	361301	SouthafricaPotato1	361301	OUT
		361302	SouthafricaPotato2	361302	OUT
370301	SpainBarley1	370301	SpainBarley1	370301	SpainBarley1
371201	SpainPepper1	371201	SpainPepper1	371201	SpainPepper1
371801	SpainSunflowerSeed1	371801	SpainSunflowerSeed1	371801	SpainSunflowerseed1
371902	SpainTomato2	371902	SpainTomato2	371902	SpainTomato2
		371601	SpainStonefruit1	371601	SpainStonefruit1
3914101	ThailandRice1dry	3914103	ThailandRice1+2dry	3914103	ThailandRice1+2dry
3914102	ThailandRice2dry				
3914201	ThailandRice1wet	3914203	ThailandRice1+2wet	3914203	ThailandRice1+2wet
3914202	ThailandRice2wet				
400701	UkraineMaize1	400701	UkraineMaize1	400701	UkraineMaize1
400702	UkraineMaize2	400702	UkraineMaize2	400702	UkraineMaize2
401801	UkraineSunflowerSeed1	401801	UkraineSunflowerSeed1	401801	UkraineSunflowerseed1
401802	UkraineSunflowerSeed2	401802	UkraineSunflowerSeed2	401802	UkraineSunflowerseed2
401803	UkraineSunflowerSeed3	401803	UkraineSunflowerSeed3	401803	UkraineSunflowerseed3
420701	VenezuelaMaize1	420721	VenezuelaMaize1	420721	VenezuelaMaize1

420702	VenezuelaMaize2	420702	VenezuelaMaize2	420702	VenezuelaMaize2
430601	VietnamCoffee1	430603	VietnamCoffee1+2	430603	VietnamCoffee 1+2
430602	VietnamCoffee2				
430701	VietnamMaize1	430701	VietnamMaize1	430701	VietnamMaize1
430702	VietnamMaize2	430702	VietnamMaize2	430702	VietnamMaize2
440701	ZambiaMaize1	440701	ZambiaMaize1	440701	ZambiaMaize1
440702	ZambiaMaize2	440702	ZambiaMaize2		
440703	ZambiaMaize3	440703	ZambiaMaize3		
450301	UKBarley1	450301	UKBarley1	450301	UKBarley1
460301	GermanyBarley1	460301	GermanyBarley1	460301	GermanyBarley1
		470301	TanzaniaBarley1	470301	OUT
				470701	TanzaniaMaize1
				471901	TanzaniaTomato1
				480701	ZimbabweMaize1
	USAWheat1		USAWheat1		USAWheat1
	USAWheat2		USAWheat2		USAWheat2
	USAPotato1		USAPotato1		USAPotato1
	USAWheat3		USAWheat3		USAWheat3
	USAWheat4		USAWheat4		USAWheat4
	USAWheat5		USAWheat5		USAWheat5
	USAOilseedrape1		USAOilseedrape1		USAOilseedrape1
	USASugarbeet1		USASugarbeet1		USASugarbeet1
	USASugarbeet2		USASugarbeet2		USASugarbeet2
	USAOranges1		OUT		
	USASoybeans1		OUT		
	USASunflowers1		USASunflowers1		USASunflowers1

	USASweetcorn1		OUT		
	USACorngrain1		OUT		USASweetcorn1
			USAMaize1		USAMaize1
			USAWheat6		USAWheat6
			USAPotato2		USAPotato2
			USABarley1		USABarley1
			USABarley2		USABarley2
			USASugarbeet3		USASugarbeet3
					USASeedmaize1