syngenta

Enabling a step change in farm efficiency

Make crops more efficient

the good growth plan

Six commitments to make a difference

- Make crops more efficient
- Rescue more farmland
- Help biodiversity flourish
- Empower smallholders
- Help people stay safe
- Look after every worker

"Our ambition is helping to safely feed the world and take care of our planet. The Good Growth Plan is a way of measuring how we are progressing."

Juan Gonzalez-Valero
Head Public Policy and Sustainability

"Good job! The Good Growth Plan report has allowed me to know my farm's potential, which leads to more efficient practices."

Good Growth Plan cocoa farmer, Ivory Coast

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"We have some great products, but we need even greater ones. So we're bringing more information sources into play, getting into the real world to gain deeper understanding of what farmers really need and what works best in their environment."

Rob Neill
Head of Asset & Platform Management

Good for business, good for farmers, good for the planet, good for everyone

The Good Growth Plan is central to our business strategy. It keeps us focused on our customers' most pressing needs. And it aims to make Syngenta an indispensable part of the solution to global food challenges, now and in the future.

A key part of this is our #1 commitment: to make crops and inputs more productive. Specifically, we've committed to increase the average productivity of the world's major crops by 20 percent without using more land, water or inputs.

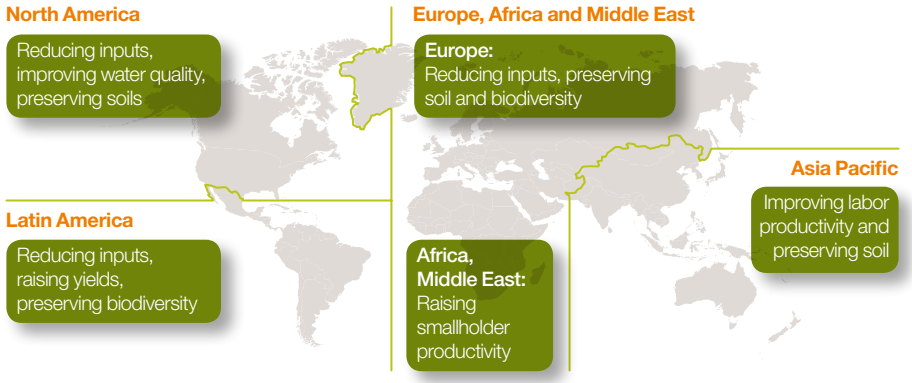
The data we collect from our 3,700+ reference and benchmark farms will be crucial to achieving that goal.

Making 22 crops more productive…

Apple, banana, barley, cauliflower, cocoa, coffee, corn, cotton, grape, oilseed rape, pear, pepper, potato, rice, seed corn, soybean, stonefruit, sugar beet, sugar cane, sunflower, tomato, wheat.

…in 42 countries

Australia, China, Japan, Bangladesh, India, Pakistan, Indonesia, Malaysia, Philippines, Thailand, Vietnam, Algeria, Egypt, Ivory Coast, Jordan, Kenya, Morocco, South Africa, Tanzania, Zambia, Germany, Russia, Ukraine, France, Spain, Italy, Belgium, Netherlands, UK, Hungary, Brazil, Colombia, Costa Rica, Ecuador, Guatemala, Honduras, Mexico, Peru, Venezuela, Argentina, Paraguay, USA.



Rising to our century's greatest challenge

The world's farmers are doing a great job. Over the past half-century, they've increased total production by an average of almost 2.25 percent a year. But the human population has grown exponentially, and the challenge of feeding a hungry world is becoming increasingly critical.

Once, there was a simple way to grow more: farm more land. But today, suitable new land is scarce. In 1950, a hectare could feed two people. By 2030, it will have to feed five. Yet 40 percent of today's farmland is already seriously degraded.

From 1960 to 1990, most of the growth in farm output was driven by input intensification. We used more water, fertilizer and chemicals to drive yields higher. But these inputs are precious resources, and must be used sparingly if we want to sustain production long-term.

2.25%

Over the past half-century, the world's farmers have increased total production by an average of almost 2.25 percent a year.

Farming more efficiently

In the 21st century, food production has continued to rise and farmers are beginning to use agricultural inputs and resources more efficiently. The key to this has been science: new seed varieties, better crop protection technology, and smarter, more sustainable practices. For example, adoption of GM in soybean, maize and cotton has increased yields by 22 percent globally while cutting pesticide use by 37 percent, according to a 2014 study. And that's boosted farm profits – by 68 percent; gains that were highest for farmers in developing countries.

The challenge is to maintain this pace of improvement. For all the successes of recent decades, the world still has to find ways of growing more from less – without using more inputs and without clearing more land for farming. And we need to reduce the huge gaps in farm productivity between different regions. At Syngenta, we're confident it can be done – but we still have to figure out how.

How will we make it happen?

We need tougher, better-yielding seed varieties – developed through marker-assisted breeding, biotechnology, hybridization or conventional breeding. We need more specific pesticides to protect crops from pests and stresses, and to strengthen their own resistance to challenges such as weather extremes and climate change. We need better protection for seeds and seedlings; and the best possible farming practices.

All this will come from continuing R&D. Governments' spending on agricultural R&D has been falling since the 1990s. Private enterprise has been taking up the slack, driven primarily by large multi-national companies such as Syngenta. With a new emphasis on sustainable food security, global initiatives such as the United Nations Sustainable Development Goals call for multi-stakeholder collaboration and are very explicit about the role of the private sector.

The big picture

The Good Growth Plan is more than just a set of goals. It's about ways of working: the challenges of global food security are too big for any company to solve on its own, so we're actively building partnerships with governments, universities and other companies. And most importantly, we're developing a new level of partnership with farmers – because they're at the center of the change we aim to achieve.

the good growth plan

Understanding the challenges

Farmers have always faced up to pests, weeds and weather. But today the challenges of feeding the world equitably and sustainably are making their job ever more complex: their big picture now includes climate change, declining biodiversity and soil quality, water scarcity, food price volatility and shrinking profit margins. We can't just work with farmers to boost yields – we have to achieve sustainable use of all a farmer's inputs, protect resources and eco-systems, minimize adverse environmental impacts and sustain vulnerable rural populations with a positive bottom line for farmers.

R&D – better products and protocols

How? By applying science and technology to develop better solutions. That's the job of our R&D teams. But they rely on farmers, our partners and customers, to put those solutions to work in the fields. Farmers must be able to choose the right technology and inputs for their local conditions, and apply them at the right time and in the right way. So through our Commercial teams we invest in educating farmers to ensure they use our products effectively, profitably and safely. We also provide advice and support in tailoring protocols to local conditions.

Evaluating performance at the end of the season is providing important feedback to continuously improve year by year.

Read more on page 09:
How we're using it

Continuous improvement

Besides their land, farmers use a range of inputs and resources other than land, such as irrigation water, fertilizer, crop protection products, fuel and labor. Crop production also generates greenhouse gases deemed responsible for global climate change, the consequences of which farmers often are the first to experience.

New technology and improved practices make farming easier, more efficient and reduces emissions. Using the right pesticide helps save fertilizer, labor and water, which would be wasted if the damage due to pests is high. To reflect these gains the amounts of all inputs and resources need to be considered when assessing performance relative to crop yield or quality. With The Good Growth Plan, we started to use a more holistic set of indicators that reflects growing more from less.

Read more on page 05:
What we are measuring

Real-world experience

We can only learn so much from test plots. At the end of the day, it's what happens in the field that counts – in everyday life, on everyday farms. That's why we've set up our networks of over 1,000 reference farms and almost 2,700 benchmark farms to learn more about what farmers are experiencing in real-life growing conditions – what works, what doesn't, and why.

Read more on page 04:
Gathering data on an unprecedented scale

Data gathering and analysis

R&D and commercial teams need hard data to support their work. So at the heart of The Good Growth Plan is a global farm data-gathering program that's more detailed and comprehensive than anything that's been attempted before. The data it's generating is independent, audited, transparent – and we're sharing much of it with the scientific community worldwide, to help accelerate the pace of innovation.

Read more on page 06:
The data collection process

Sharing with farmers

Sharing with farmers is a two-way process. We want to hear and learn about their ambitions and experience, their needs and challenges, to help us in our work. And to help them in theirs, we can now bring them privileged information about how their farm is performing in relation to its peer group.

Read more on page 08:
How we report it

Gathering data on an unprecedented scale

We need farm data for two reasons. Firstly, to track our progress in helping farmers turn technology into efficiency-led productivity growth. And secondly, to support the development of better products and techniques.

We want to look beyond the lab, to see what happens when farmers follow their own preferences and judgements. We want to see what works locally, in a diversity of conditions around the world. And we want to track the nature and pace of change over seven years, to see the real trends behind the fluctuations of individual years' weather and harvests.

So who are we tracking?

Working with the independent data expert Kynetec*, we've created a network of over 3,700 farms in 42 countries. The network includes:

Reference farms**

1,039 at end-2016

Customer farms, managed by farmers with a direct link to Syngenta or value chain partner and selected by us. They've been signed up through our Commercial organization.

Benchmark farms

2,694 at end-2016

Independently and randomly selected by Kynetec to match the types of farms in the reference network. These farms act as a control group to ensure statistical rigor.

The farm network covers more than 20 crops selected because they're important to our commercial strategy.

The reference farmers are our real-world laboratory. They're hand-picked by our local teams – or in some cases indirectly through our product retailers. Direct engagement works best, because the quality of our contacts and relationships with reference farmers will have a big impact on the results we achieve and the success of The Good Growth Plan.

Good communication between our local teams and reference farms ensures that the farmers buy into The Good Growth Plan, understand what we are doing and see why we collect certain data. In return, they get the best advice and protocols we can offer – and better feedback on what works best for them. Where the initial selection is through retailers, it helps if local teams work closely with both retailers and farmers, to build strong relationships and ensure maximum buy-in from everyone involved.

How do we make sure results are meaningful?

These networks include farms of all types and sizes – from large agricultural businesses in the USA to cooperatives in Spain, small-scale commercial farmers in China, and smallholders in Latin America.

To get meaningful results from them, we group them into clusters of similar sizes and types of farm, growing the same crop using similar levels of technology in an area with similar agro-ecological conditions. When new farmers are selected, they should meet the profile criteria of the cluster.

Each cluster includes both reference and benchmark farms. Cluster sizes have been carefully determined to ensure the quality and relevance of data: for example, where previous local research indicates that productivity improvements are small or variances between farms are high, the cluster size has to be larger to reveal significant differences more clearly over time. A cluster has about 20 to 25 farms. A minimum of five reference farms is needed, but ideally there's a balance between reference and benchmark farms.

We selected the clusters to represent relevant markets where we believe our technology will be able to increase productivity and input efficiency. Each cluster is based on a detailed set of screening criteria, to ensure that it consists of highly-comparable farms. And in the event that a farm has to drop out, it enables us to find a very similar replacement so that the impact on data consistency is minimized.

What is Kynetec?

Farm data collection, consolidation, and analysis is conducted independently by Kynetec. This Belgium-based market research institute has over 25 years' experience in agricultural market data gathering and analysis worldwide.

kynetec

* Previously Market Probe Agriculture & Animal Health, which is now part of the Kynetec Group

** A farm is defined as a tract of land cultivated for the purpose of agricultural production within a specified crop cycle or crop season

What are we measuring?

The sheer number of farms we're looking at is unprecedented – and so is the amount of detail we're gathering. We're focusing our attention on these four KPIs:

Our four main KPIs:

But we're also tracking other important measures of farm performance:

Nutrient efficiency: All chemical fertilizers contain nitrogen, phosphorus and potassium. So as well as measuring use of nitrogen (one of our four main KPIs), we're also measuring the kg of phosphorus and potassium used per tonne of crop output.

Seed-use efficiency: The weight of seeds that farmers plant to generate their yield. Our goal: less seed planted without reducing yield.

Irrigation water efficiency: We're aiming to reduce the number of liters of irrigation water required for each tonne of crop.

Labor efficiency: We're tracking the amount of manual labor involved in seeding, tillage, fertilizer application, pesticide application, irrigation and harvesting. Our goal: fewer hours per tonne of crop.

Greenhouse gas efficiency: With sufficient data on inputs and field activities we calculate the overall GHG emissions in CO2 equivalents per tonne of crop.

Water use efficiency: We're also calculating the water footprint, which measures the amount of rainfall and irrigation water added in Liters per tonne of crop relative to the water need.

We've committed to achieving gradual improvement in all these areas, so we need to measure our progress over time. We established baseline levels for most clusters in 2014, against which we measure the improvement year-by-year. That's why keeping the clusters and farmers consistent from year to year is important.

The key improvements we're looking for are not between one group and another but in the same group progressively: our commitment is to improve performance on reference farms over time, while benchmark farms act as a control to help us understand how performance was affected by weather and market conditions: they help us interpret the data and performance correctly.

For each cluster, we aggregate farmer inputs and output as averages. This enables us to calculate the change in productivity and efficiency for each cluster, and the performance evolution is then aggregated globally.

The data collection process

So what does a farmer commit to, when they sign up to join one of our reference or benchmark clusters?

- Training on agronomic record keeping
- Training on optimized crop protocol
- Planting
- Check after planting
- Check before harvest
- Harvest
- Final interview
- Farm performance report

They get training:
– From a Kynetec representative on recording their activities, inputs and outputs
– From a Syngenta expert on using agronomy protocols optimized for their conditions

Agronomic data recording
– They record their data for two selected growing areas on their farm:
  – Logging inputs between planting and harvest
  – Logging outputs after harvest
– Support from a Kynetec representative includes face-to-face interviews, and checking the records

Final interview
A final interview to pull all the data together and check it with the Kynetec representative

Farm perfomance report
They receive a farm performance report – normally as part of a visit from their Syngenta representative to discuss plans for the next season, including any extra training they might need

Support from Syngenta
Throughout the whole process, they can get support from Syngenta experts and the Kynetec helpdesk

We don't expect our farmers to be data experts. That's why the data collection process includes interviews (normally two) with a Kynetec representative to help them compile the figures correctly. The Kynetec interviewers are all local people with academic agricultural backgrounds.

Farmers can also get expert help from Syngenta or Kynetec at any time. We're asking a lot from them, in time spent on record keeping and data collection, so it's important to keep them engaged and ensure they feel supported.

What's in it for the farmer?

To succeed in our objective, we depend absolutely on the cooperation of our farmers and the quality of the data they give us. So we want to make sure that they feel it's worth their while.

Above all, they'll have our help and support in optimizing their output. They'll have the attention of a local Syngenta expert, who will help them make best use of our recommended products and protocols. And they'll benefit further as we use their data to further refine their protocols and tailor our offer to their needs each season.

They'll also benefit from feedback reports analyzing their performance and comparing it with (anonymized) data on their peer group – for more on this see page 08: How we report it.

There are also business benefits. The farm performance reports provide objective proof of yields, resource efficiency performance and compliance with environmental standards – useful in communication with business partners, regulators, lenders and customers. We're keen to respond to farmers' needs in this area by providing tailored documentation – for example, to provide certification of sustainability to sustainable sourcing buyers.

> "You guys come every year to ask and give me advice. I'm very satisfied with it!"
>
> Good Growth Plan corn farmer, Vietnam

What data do we collect?

Typically, our data collection forms and interviews will cover these areas:

The data we collect...

You and your farm	– Geolocation coordinates – Agricultural activities (eg crops grown, full time or part time) – About the farmer: age, education, gender, coop membership etc)
Farm outputs	– Crop (marketable) yield – Crop quality – Harvest periods
Agricultural practices	– Crop rotations – Soil conservation practices – Safe use of pesticide
Farm inputs	– Farm size – Application rates and dates for fungicides, herbicides, pesticides – Seed quantity and dates – Seed treatment – Fertilizers – Machinery use (type & hours) – Labor hours – Irrigation water (if used) – Satisfaction with services and recommended protocol
Economics	– Output price – Input cost shares – Expected profitability

There may be a few other questions depending on the crop and local conditions. The questionnaires were developed jointly by Syngenta and Kynetec, and are available in 29 languages.

Data collection interviews typically take 1-2 hours, and farmers can save time by keeping their records up to date. All questions have a purpose: some are needed to calculate Good Growth Plan KPIs, while others will help us to analyze the drivers of sustainable change and interpret the results. Open-ended questions often reveal interesting insights about a farmer's challenges and expectations that might otherwise be missed.

Ensuring data quality

Getting accurate, high-quality data is important. So after farm data has been collected, it's checked and validated by Kynetec. First, it is loaded onto a local database for review, and checked by the local Kynetec agency. Where values are missing or inconsistent, farmers are re-contacted. In some cases, Kynetec will anonymized farmers responses with local experts such as retailers to ensure its validity. After country-level cleaning, the data is passed to Kynetec's global headquarters for processing, and any further inconsistences are clarified with the local Kynetec office.

Local Syngenta teams also have a vital role to play in maintaining data quality. They help to define the clusters, which Kynetec regularly reappraises against KPIs for retention rate, sample size, relevance of baseline data, and screening criteria. If farmers drop out or clusters need to be expanded, we look to local teams to identify additional recruits to the network. Minimizing drop-outs supports data quality, and we find that the more local teams engage with their reference farmers, the higher the retention rate tends to be.

Generating data from farm systems

In the USA, many farmers use computerized Farm Management Systems to optimize their businesses and measure sustainability performance.

Our Land.db sotware helps them capture data on land use, soil conservation, soil carbon, water quality and greenhouse gas emissions. The sotware then helps them optimize farm operations, for example by scheduling field spraying, and calculates sustainability.

The sustainability reports are shared with their customers and other stakeholders in the food value chain. Such information is often used to inform consumers about the sustainability performance of the food they eat.

How we report it

The Good Growth Plan is a learning process, for us and the people who work with us. Its value will depend to a large extent on how successfully we pass on what we know, and what we learn – to small- and large-scale farmers, the farmworkers we train, to our Commercial teams, and to the partners who use our openly published data to add further value.

Reporting to colleagues

Our Commercial teams are our first line of contact with farmers and farmworkers. It's vital to keep them up to speed on what we're learning from reference and benchmark farms in their own country.

Each year we're now producing detailed country dashboards showing performance against our four main KPIs. Users can select data for a range of factors such as soil types or crop varieties. This basic analysis helps Commercial teams identify the best performers and learn from what they do.

When Kynetec's specialists analyze the data, they're looking out for the trends and stories it reveals. These will form part of each country's team briefing, where they provide a report with key data and trends. The dashboard for each country includes custom filters designed to shed light on locally relevant trends – for example, to show the difference made by variations in planting dates.

Country report dashboard for Ecuador, 2016

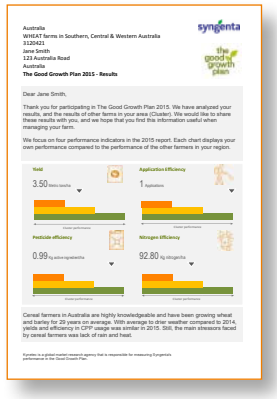
Reporting to farmers

For farmers we've developed a clear, simple report format focused on the results most relevant to them.

It enables them to compare their individual performance to the average for their cluster, for each KPI. Below the KPI charts there's a summary overview of the cluster performance, highlighting any factors that significantly influenced the past season's results, such as planting dates.

This report will normally be delivered by the Syngenta field expert who comes to discuss protocols for the next growing season, and forms an important reference point in setting targets and planning how to achieve them.

Eventually, we'd like to provide reporting on demand – so a farmer could say, for example: "Get me a Market Data report on my use of x, y and z inputs over the past three years." While this capability is under development, we're exploring what kind of reporting would be most useful to farmers.



A typical farmer report Australia, 2016

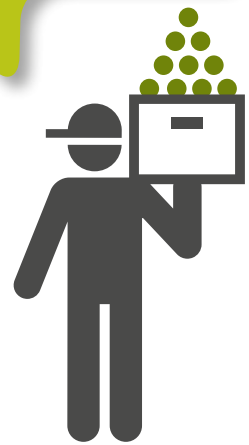
Reporting to the public

We've published our targets for each Good Growth Plan commitment, and report our progress against these KPIs each year, both in our annual review and online at www.goodgrowthplan.com.

This measurement and reporting falls within the scope of Syngenta's non-financial reporting, which is guided by the UN's Global Reporting Initiative principles and externally assured by the audit firm PricewaterhouseCoopers.

"Seeing my yield and treatments compared to other farmers can enable me to improve on my yield."

Good Growth Plan cocoa farmer, Ivory Coast



How we're using it

What we're learning from our data

In collaboration with external partners we've been conducting a wide range of analyses, using computers to mine our data and testing environmental models. Using machine intelligence will help us gain previously unavailable insight into patterns and correlations. Given the huge numbers of variables involved, it's too early to draw firm conclusions about the keys to sustainable productivity increases. But we are beginning to see interesting patterns that merit further investigation.

For example, smallholders are achieving the hoped-for higher rate of increase in productivity compared with larger farms – and also tend to use pesticides more sparingly. Higher yields and chemical efficiency generally seem to correlate with factors such as access to training, our own agronomic advice, and use of pre-treated seeds that reduce the need for spraying.

Farmers who learn from one another through membership of cooperatives and other groups also tend to achieve higher yields. In cereals, there is a good correlation between higher yields and use of drift-reducing spray nozzles – a healthy option for crop, farmer and environment.

The real value of our data comes from the sheer scale of it. As we build up a database of global results over time, measured against our initial baselines and the results of our network of benchmark farms, the important trends will become increasingly clear, and local variations will be cancelled out. Over time, we'll be able to gather more data from sources such as remote sensing and satellites, so that farmers bear less of the burden.

Sharing with the scientific community

The data we collect provides realistic insights into the performance of agronomic practices and technologies in real-life conditions. This evidence of their effectiveness and potential is invaluable to us in improving our products and services for farmers – and, indeed, to scientists worldwide who are working towards efficiency-led productivity growth and global food security.

Farm performance is affected by many factors, both controllable and uncontrollable, and what works for one farmer, crop or location may not work for another: the more data we can analyze, the greater our chances of understanding why. We now have unprecedented quantities of detailed farm-level information, which we are supplementing with available 'big data' that provides consistent, global information on factors such as weather, soil and growing conditions.

Global food security is too big a challenge for any one organization, and we've declared our willingness to share a large proportion of our data with the global scientific community. We fully respect the privacy of our participating farmers: the data we share is anonymized and aggregated at cluster level.

It is published on the web in collaboration with the Open Data Institute – free to download, accessible to anyone and licensed to be re-used using creative commons licenses. Importantly, we also publish details of how we collect the data and calculate the metrics. Where there are limitations in our methodologies, we explain these transparently and seek ways to improve our methods and data.

But without an efficient global infrastructure for agricultural data, our openness is of limited value. The pace of innovation will depend on how easily people and organizations can share data. That's why we've joined GODAN, the Global Open Data for Agriculture and Nutrition initiative, which now has over 375 partners including governments, NGOs and commercial organizations. At GODAN's 2016 Summit we presented a discussion paper setting out priorities for creating an effective data ecosystem for the industry: this paper is now helping to drive an open data revolution in our industry.

Find out more online:
You can view the full paper at http://www.godan.info/documents/data-ecosystem-agriculture-and-food and learn more about GODAN at http://www.godan.info.

What's next?

Each growing season provides us with more data to help us and our partners to identify keys to more productive agriculture.

Meanwhile, a particular focus is to create more value for farmers participating in our reference network: for example, by using their data to generate more useful analytics, attract conservation funding from governments or support multi-stakeholder partnerships that provide better access to markets.

And while building trust externally by publishing data openly and transparently, we will take care to earn farmers' trust by protecting their privacy, so that they stay in control of their own data and results.

We're also looking for more ways to enhance our data gathering and add value for our reference farmers. For example, we're investigating ways of using satellite monitoring and imagery to track crop growth every couple of days through the growing season. Using 'big data' in ways like this could help us to spot challenges that our reference farmers might be facing much more quickly. We could also report valuable progress information to farmers more frequently.

Getting together to share ideas and experience

One exciting aspect of The Good Growth Plan is the opportunity it provides for people to learn from one another. In the USA, we've been creating new opportunities by holding a series of Farmer Engagement Workshops around the country each spring.

These bring reference farmers together with our Commercial teams and agronomists, and partners in the food value chain. They've proved valuable in sparking discussions between groups who don't often have a chance to talk. Farmers exchange experiences with agronomists and fellow farmers, and build mutual understanding with value chain customers. We also introduce speakers with local expertise in areas such as crop rotation and reduced tillage. The result: greater farmer commitment to The Good Growth Plan and deeper engagement with our local teams.

Help us to add value for farmers

We're open to ideas
We'd welcome your thoughts and feedback on how to add farmer value by using Good Growth Plan data, 'big data' or digital solutions.

Please contact
goodgrowthplan.data@syngenta.com
or visit www.goodgrowthplan.com

Edition: April 2017

www.syngenta.com

"It is a fantastic plan and I am looking forward to its continuity and more education on different sectors of farming."

Good Growth Plan potato farmer, Kenya