



PULA



Shell Foundation | 

Learning
Report

How can **agri-insurance** reduce the risk associated with Solar PayGo?

Table of contents

| | |
|--|----|
| Executive summary | 3 |
| 1. Project background | 4 |
| 2. PayGo background | 4 |
| 2.1. PayGo model | 5 |
| 2.2. PayGo market trends & impact | 6 |
| 2.3. Zambia off-grid sector trends | 6 |
| 2.4. Default rates in Zambia | 7 |
| 3. The need for embedding insurance with SHS | 8 |
| 3.1. Embedding insurance with SHS - an investor perspective | 9 |
| 4. PayGo insurance product | 10 |
| 4.1. PayGo pilot with Vitalite | 11 |
| 4.1.1. Pilot background | 11 |
| 4.1.2. Claim settlement | 12 |
| 4.1.3. Yield comparison | 12 |
| 4.1.4. Payout computation | 13 |
| 5. PayGo product recommendations | 14 |

Acronyms and abbreviations

| | | | |
|--------------|----------------------------|-------------|------------------------|
| AEZ | Agro-ecological zone | Pula | Pula Advisors GmbH |
| APH | Average Production History | SHS | Solar Home Systems |
| CCEs | Crop Cut Experiments | TSI | Total Sum Insured |
| PayGo | Pay-As-You-Go | UAI | Unit Area of Insurance |

Executive summary

Pula Advisors GmbH (Pula), in partnership with Shell Foundation and the UK Government, developed this research report to understand the impact of bundling crop insurance with energy assets provided on credit (solar PayGo products) to both enterprises and customers. The report discusses the challenges PayGo companies face, the insurance cover Pula developed to resolve these challenges, the results of the insurance pilot carried out, and the recommendations based on the pilot results.

The report leverages the research conducted by Pula under the International Fund for Agricultural Development (IFAD) contract. Insurance for Rural Resilience & Economic Development (INSURED) is a Technical Assistance Programme financed by the Swedish International Development Cooperation Agency (Sida) and implemented by the International Fund for Agricultural Development (IFAD) through the Platform for Agricultural Risk Management (PARM). INSURED is partnering with the Government of Zambia's Rural Finance Expansion Programme (RUFEP)

From interviews with PayGo solar companies and investors in Zambia, Pula found that while the PayGo model enables PayGo companies to increase their sales and penetration in the market, the model also faces great challenges due to high customer default rates driven by school fees payment schedule, low yields and dry season. Farmers make up about 40% of their customer base and are also the highest risk customers in terms of repayments. Natural calamities that cause low farmer yields are one of the major reasons for

defaults by farmers. For example, in a drought in 2018/2019 in Zambia, PayGo companies saw their late repayments rise by up to 20% compared to good repayment periods. This, in turn, greatly affected their cash flow cycle and working capital needs.

PayGo companies have tried to address these challenges through tailoring their repayment schedule to the country's agricultural season. While this has helped reduce the default rates, it has not guaranteed monthly repayments leading to irregular cash flow cycles which have a negative impact on the working capital of many PayGo companies. As the PayGo market is viewed as high risk, banks are either reluctant to give loans or charge interest rates as high as 20 – 23%. This has forced PayGo companies to turn to investors for soft money by selling their accounts receivables and paying back the investors after about a year with a 4 to 5% mark up. While this solution temporarily works for PayGo companies, it is not sustainable.

Through agricultural insurance, PayGo companies can mitigate the current risk they face with repayments.

Through bundling insurance with PayGo products, these companies can protect themselves from customer defaults and ensure they are liquid enough to continue operations and increase penetration in the market. The insurance will reduce the risk of increased default rates caused by catastrophic events as even in such cases, the company will still have guaranteed repayments to offset its customers' PayGo loans. Additionally, it would increase PayGo companies' customer lifetime value; when a customer defaults, PayGo companies generally do not sell them products in the future. Insurance would be valuable

as it would prevent default and increase subsequent renewals and lifetime value.

From the interviews, Pula found that investors in the SHS ecosystem are likely to support widespread implementation of an agricultural crop insurance product for PayGo companies. Investors are concerned about the default rates as well as the cost of repossession in case of a default. In case of repossessions, they are unable to measure their environmental impact (CO₂ emission reduction, health) and also their financial returns are drastically affected. A case scenario would be during the 2016/2017 drought that ravaged Tanzania, a leading PayGo company's default rates increased by over 50%. As they were on the verge of raising their Series B investment, the act of repossession reduced their valuation greatly and they experienced a drop in their projected fundraising. Investors are also keen to see the effect of climate risks (e.g. drought and floods) on PayGo companies' portfolios and how insurance would solve this problem.

Agricultural insurance can enable PayGo investors to offer lower interest rates to PayGo companies.

Agricultural insurance would enable investors to mitigate the risk they currently face investing in PayGo companies due to the high default rates they face, thus making these companies more stable. More stability for PayGo companies would mean less need for investors to price this risk into their interest rates.

To solve this problem faced by PayGo companies and investors, Pula developed a comprehensive insurance product to cover PayGo companies' portfolio. This portfolio covers all smallholder farmers under the PayGo company. The cover protects the companies against defaults by smallholder

farmers due to perils the farmers may have faced during the season which negatively impacted their yields. The perils the insurance product covers are: windstorm, frost, excessive rainfall, heatwave, hail, flood, drought, pest, and diseases.

Pula piloted the insurance cover with Vitalite's customers who are smallholder farmers engaged in maize cultivation in the 2019/2020 season. The main objective of the cover was to de-risk Vitalite's loan portfolio, minimize costly repossessions that come with default post poor harvest season and ensure farmers can continue investing in their farms unabated. The insurance product was set at a trigger of 50%, exit of 30% and total sum insured (TSI) at exit of 100%. The cover was limited to 8,838 maize smallholder farmers spread in twenty-four (24) districts in Eastern, Muchinga, Central, Copperbelt, Southern, Lusaka, Northern, Luapula, and North-Western provinces of Zambia.

To assess the claim settlement, Pula carried out harvest measurements at the end of the season to determine whether there would be a payout or not. The assessment revealed there were no payouts. From further assessment, Pula concluded that the current product structure of 50% trigger is likely very low for the smallholder farmers in Zambia and may need to be revised. Based on this, Pula recommends revising the PayGo insurance product to a trigger of 70%, exit of 0% and total sum insured (TSI) at exit of 100%. Additionally, if farmers suffer loss and are unable to pay their debt to Vitalite, once Vitalite has been paid the amount due to them, if any amount remains based on the payout calculation, it should be distributed to the farmers. Pula will provide the revised insurance product to Vitalite farmers in the 2021/2021 season and will analyze the results of the revised product once farmers harvest and claim settlements are assessed.

1. Project background

Pula Advisors GmbH (Pula), in partnership with Shell Foundation and the UK government, developed this research report showing the impact of bundling crop insurance with energy assets provided on credit (solar PayGo products) to both enterprises and customers.

To determine the impact of bundling crop insurance with solar PayGo products, the report discusses the challenges PayGo companies face (collected from primary research through interviews with PayGo companies in Zambia), the insurance cover Pula developed to resolve these challenges, the results of the insurance pilot carried out, and the recommendations based on the pilot results. The report leverages the research conducted by Pula under the International Fund for Agricultural Development (IFAD) contract. To note, the interviews were conducted with PayGo companies in Zambia to better understand the Zambia market, as the first pilot of the insurance product was to be conducted in Zambia.

For the insurance pilot results, the report will focus on the pilot carried out by Pula during the 2019/2020 season in Zambia through partnership with Vitalite, a solar energy company established in Zambia that was created to increase rural electrification by selling affordable (PayGo) solar products to rural households.

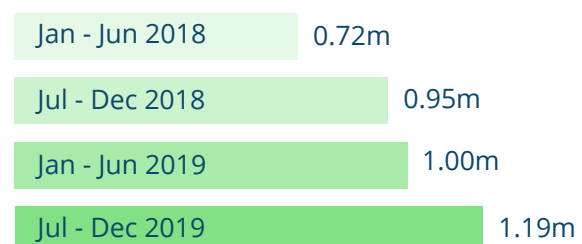
2. PayGo background

2.1. PayGo model

The PayGo model is a payment model that allows customers to either purchase solar products through payment instalments per an agreed plan with a retailer or pay to use the product as a service. The customer usually makes an initial down payment and, thereafter, pays the remaining amount in instalments. These instalments are usually paid within a 6 month to 8-year period and are made using various methods e.g., mobile money, airtime, scratch cards or cash. Mobile money is currently the most popular PayGo payment method used.

Through this model, many PayGo companies strive to build a strong relationship with their customers to grow their sales by continuing to sell more products to them. For example, if a customer purchases a SHS and is required to have fully repaid it in 24 months, the PayGo company will offer a new product to the customer within these 24 months, thus extending the customer relationship. In the end, the companies may continue to have this relationship with the customer for about 5 - 6 years.

Fig. 1 Number of PayGo products sold



Source: Gogla, *Global Off-Grid Solar Market Report Semi-Annual Sales and Impact Data, July - December 2019*

2.2. PayGo market trends & impact

PayGo sales have been increasing year-on-year and in the second half of 2019, 1.19M PayGo products were sold, the highest sales PayGo has ever had. With a market volume of USD 165M, PayGo sales made up 27% of the global solar lighting products sold between July and December 2019¹. Globally, while total sales volumes increased by 8% in 2019's second half, PayGo sales increased by 19% compared to the first half¹.

From 2018 - 2019, PayGo sales volume had a consistent growth bi-annually and increased by 31% in the last one year. Additionally, in the last one year, PayGo products' market value increased by 39%¹. To note, the market value of the PayGo products refers to the amount received once the customer has fully paid for the product.

Emergence of PayGo has helped drive financial inclusion in different countries. This model not only provides a solar product, but also enables customers to build a meaningful financial relationship through the provision of 'debt' they offer. According to an informal CGAP survey conducted in 2015, 30 - 50% of customers in three leading East African PayGo companies were new to mobile money e.g. opened mobile money accounts to access the PayGo solar products².

PayGo has also increased customer affordability of off-grid solar products enabling customers to only spend about 2 - 3 months of their saved disposable income on the products when making repayments. Additionally, not only has it increased customer affordability, but also customer ability to own more solar products and

upgrade their products; this is something the customers could not do when paying for products using cash i.e. paying for the product in full as a one-off payment.

2.3. Zambia off-grid sector trends

As of 2015, Zambia had a population of 16.2M people, expected to grow to over 25M by 2030³. With low population density, the prospects for on-grid growth have been very limited, making off-grid solar products a potentially critical energy access solution. In 2015, the average population density was 22 people per square kilometre, which is significantly low compared to other countries in Africa e.g. average of 80 people per km² in Kenya, 60 people per km² in Tanzania, 483 people per km² in Rwanda⁴. Additionally, in regard to the electrification rates in Zambia, as of 2018, 27% of the population had access to electricity, with 62% of the urban population electrified compared to 4.5% of the rural population⁵. With the low population and low density, there is a huge potential market for the solar products.

Many companies have entered this market to provide solar products and there has been a significant growth in these numbers over the years, especially over the last two to three years. Towards the end of 2018, there were 101 licensed solar companies in Zambia which are regulated by the Energy Regulation Board (ERB) compared to 31 similar solar companies in 2014⁶. Vitalite, a domestic Zambian company, is leading the country's

¹ Gogla, *Global Off-Grid Solar Market Report Semi-Annual Sales and Impact Data, July - December 2019*

² CGAP, *Digitally Financed Energy: How Off-Grid Solar Providers Leverage Digital Payment and Drive Financial, 2016*

³ United Nations, *World Population Prospects, 2015 revision*

⁴ GET.invest, *Zambia: Stand-Alone Solar Business- es Developing Guide, 2019*

⁵ *Market Map for Off-Grid Solar Energy in Zambia, 2018*

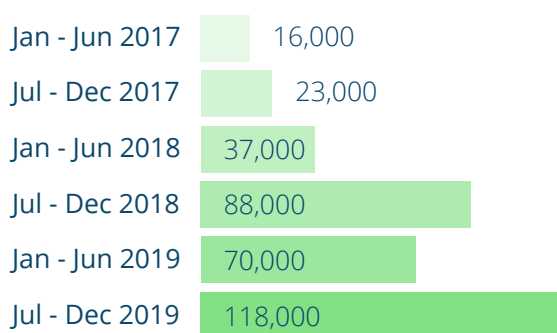
⁶ *Energy Regulation Board (ERB) website*

experience with PayGo solar products, while market leaders from East African regions e.g.

Azuri Technologies and Fenix International, have increased their presence in the market⁴. These companies have had a huge impact on the market and have led to reduction in household income spend on lighting. Before solar lighting, households were using an average of 6% of their total household income on lighting - solar has reduced this to 2%⁷.

As of the end of 2019, Zambia was the fifth largest market for solar products in East Africa. In the second half of 2019, nearly 120,000 solar products were sold, with around 70,000 of them being PayGo products; multi-light systems followed by lanterns were the most products sold. The total product sales saw a 70% increase in sales. While this increase may have been significantly influenced by USAID's Beyond the Grid Fund, cash sales increased by 160% compared to PayGo which increased by 36%⁸. To note, while cash sales significantly increased, PayGo products made up over 58% of the total products sold in Zambia in 2019's second half.

Fig. 2 Number of solar products sold in Zambia



Source: Gogla website

2.4. Default rates in Zambia

In 2018/2019, there was drought in Zambia, and this took a huge toll on farmers, which affected repayments they were making to PayGo companies. From interviews carried out with PayGo companies, we found companies also saw sales drop by about 20% and late repayments rise to about 20 to 40% compared to 10 to 20% in good repayment periods. While drought affected repayments, from the PayGo company interviews, it was also noted that some farmers were able to find alternative sources of income to make their repayments e.g. by selling their livestock. This was especially the case for farmers who generally had higher income levels and had

higher ability to purchase more expensive products e.g. solar irrigation systems. This implies that while PayGo companies targeting farmers with alternative incomes may have less challenges with repayments in seasons where farmers face natural risks e.g. floods and droughts, this may not be the case for companies targeting customers who do farming full time as repayments would be significantly affected. It therefore shows there is an opportunity to find ways to mitigate risks of PayGo companies who mostly target vulnerable populations e.g. full-time farmers.

To determine the default and write-off rates of newly registered customers, using Pula internal data, we analysed the data of two companies based in Zambia; for confidentiality purposes, the companies shall be referred to as "Company A" and "Company B" in this report.

During the repayment period, some customers may default for a significant period forcing the companies to write their loans off. The definition of default is dependent on the company, however, ideally, this occurs if there is non-payment for over 6-12 weeks, whereas write-off can be defined as non-payment for over 6 months.

⁷ Dalberg Advisors, *Lighting Global, Gogla and Esmap, Off-Grid Solar Market Trends Report 2018*

⁸ Gogla, *Global Off-Grid Solar Market Report Semi-Annual Sales and Impact Data, July - December 2019*

Fig. 3 Default and write-off rates of newly registered customers

| Season | Total new sales | Default rates | Write-off rates |
|-------------|-----------------|---------------|-----------------|
| 2015 / 2016 | 904 | 0% | 0% |
| 2016 / 2017 | 5,275 | 7% | 0% |
| 2017 / 2018 | 16,686 | 11% | 6% |
| 2018 / 2019 | 18,568 | 34% | 15% |

Based on the table above, we see the following:

In the 2015/2016 season, both companies had zero defaults possibly due to the fact the customer numbers were low

As the new customer portfolio grew, the default and write-off rates increased over the seasons. This implies there is a direct correlation between the growth of the customer portfolio and the write-off and default rates

3. The need for embedding insurance with SHS

Currently, PayGo companies face a huge challenge when it comes to customer repayments. While there are various reasons why their customers either make late repayments or default, from interviews with

PayGo companies and investors, we found the main reasons are usually because of due school fees and season harvesting. From the interviews, we found that default rates usually increase when school fees are due, when yields are low and when it is dry season. Interviewees noted that repayments in Zambia are best between May and August as this is when farmers are being paid for their harvests, but lowest between November and January as this is when farmers are paying school fees and are investing in farming inputs for their crops and thus have less funds available to make repayments for their SHS products.

To address this issue, some PayGo companies have tailored their repayment amounts in different periods to make the repayment amount due low during periods where there are issues hindering repayment and higher in periods where the customers have higher disposable income to make these repayments. For example, some PayGo companies have developed repayment schedules for their customers who are farmers whereby farmers make bulk payments during harvest season and make low payments during dry season - this is based on the fact that farmers have highest income levels during harvest season and lowest income levels during dry season. Although this has enabled them to have more guaranteed repayments, the companies still face a big problem in the market as the nature of their business model does not allow them to have fully guaranteed repayments every month, forcing them to have irregular cash flow cycles. This has had a negative impact on many companies, especially due to the fact that these companies need huge amounts of working capital to continue their operations and expand their customer reach.

To finance their working capital needs, many companies have tried approaching banks for loans, but various banks view the PayGo market as high risk and are therefore usually either reluctant to give them loans or charge them huge interest rates as high as 20% - 23%. From interviews with PayGo investors, this has led to some PayGo companies

turning to investors for soft money by selling their accounts receivables (ARs) to them and paying back the investors after about a year at a 4 - 5% mark up. However, this only works as a temporary solution and is not sustainable in the long run. From interviews with PayGo companies, companies said agricultural crop insurance would be valuable for them as it will help them mitigate the current risk they face with repayments. In particular, agricultural crop insurance would be beneficial to mitigate their current highest risk portfolio - their farmer portfolio makes up about 40% of their customer base and most farmers tend to grow maize.

While farmers make up a significant percentage of their total customer base, farmers are their highest risk as repayments from these customers are not guaranteed and are dependent on their yields. From PayGo company interviews, most of these farmers grow maize (the staple food in Zambia) on about 5 - 10 acres of land and earn USD 550 - USD 880 per annum dependent on their yields. As mentioned previously, these unguaranteed repayments have made some PayGo companies develop repayment schedules tailored to farmers to reduce the default rates from the farmers. While these tailored schedules have helped reduce the default rates, it has still not eliminated the risk PayGo companies face by working with farmers. For example, while repayments are best during harvest seasons, if a natural calamity (e.g. floods or droughts) occurs, this will adversely affect the farmer's yield and in turn have an adverse effect on the repayments, thus leading to high default rates - natural calamities that cause low farmer yields was mentioned as one of the major reasons for defaults during PayGo interviews.

Through bundling agricultural crop insurance with PayGo products, these companies can protect themselves from customer defaults and can ensure they are liquid enough to continue their operations.

The insurance will reduce the risk PayGo companies face of increased default rates from its customers due to low yields caused by catastrophic risks as even in such cases, the PayGo company will still have guaranteed repayments to offset its customers' PayGo loans.

While companies from our PayGo interviews said agricultural crop insurance would be valuable, some companies thought farmers should service the premium while others thought the PayGo companies should service it while others thought it should be a hybrid model. Those who thought PayGo companies should service it were willing to pay USD 1 - USD 3 as premiums.

For those who thought farmers should service the premium, it was observed that while they thought the insurance would be valuable, they were not convinced that the rewards of the insurance would be higher than its cost. Although farmers servicing premiums is an option, with their low income levels and current repayment challenges they face, asking farmers to pay the premium may be a challenge as many may not be able to afford it.

3.1. Embedding insurance with SHS - an investor perspective

From an investor point of view, many have raised concerns about the cost of repossession in case of a default. The main concern especially by leading impact investors in the African SHS space is that, when there are any repossessions due to default, they are unable to measure their environmental impact (CO2 Emission reduction, Health)

because the SHS has been repossessed and also their financial returns are drastically affected.

A case scenario would be during the 2016/2017 drought that ravaged Tanzania, a leading PayGo company's default rates increased by over 50%. As they were on the verge of raising their next round of investment (Series B), the act of repossession reduced their valuation greatly and they experienced a drop in their projected fundraising due to the act of repossession caused by drought.

While most PayGo companies have always allowed for **5-10% of the product price** to cover for any total default, **effectively self-insuring for the drought risk**, this sort of self-insurance does not allow for catastrophic weather events, for example droughts, such as the one experienced in Tanzania in 2016 - 2017. As a result, investors are still concerned since most solar companies have not been able to circumvent repossession caused by catastrophic events, even though, theoretically, the risk cost has been factored into the pricing. The reality is that, so far, they have not yet found a safety net solution to place the risk cost. Investors in the SHS ecosystem are therefore likely to support widespread implementation of an agricultural crop insurance product for these companies.

From interviews with PayGo investors, insurance would enable them to mitigate the risk they currently face investing in PayGo companies due to the high default rates they face making these companies more stable. More stability of the PayGo companies would mean less need for investors to price this risk into their interest rates. Additionally, it would increase PayGo companies' customer lifetime value - when a customer defaults, PayGo companies generally do not sell them products in the future. Insurance would be valuable as it would prevent default and increase subsequent renewals and lifetime value.

Also, from interviews, PayGo investors would also want to see the effect of climate risks (e.g. drought and floods) on PayGo

companies' portfolios and how insurance would solve this problem. This information would enable them to better assess and understand the value of agricultural insurance on the PayGo companies they are investing in, in turn enabling them to assess how insurance would reduce the risk they currently face when investing in PayGo companies.

4. PayGo insurance product

Based on secondary research and primary research from interviews with PayGo companies and investors, Pula developed a comprehensive insurance product to cover PayGo companies. This insurance product is typically referred to as Area Yield Index Insurance (AYII), an insurance cover that insures the PayGo companies' portfolio, thus implying that all smallholder farmers under the PayGo company received the insurance product as part of their loan. The PayGo company is expected to pay the insurance premiums upfront to receive the AYII cover on its portfolio.

This cover protects them against defaults by smallholder farmers due to perils the farmers may have faced during the season which negatively impacted their yields. The perils the insurance product covers are: **windstorm, frost, excessive rainfall, heatwave, hail, flood, drought, pest, and diseases**. At the end of the season, through crop cut experiments (CCEs), Pula collects data on the PayGo companies' insured farmers' yields and compares them against a pre-set historical yield benchmark which is usually calibrated from historical yields and is known

as the Average Production History (APH). This process usually determines if there was a loss during the season and if the company will receive a payout.

In the case of a payout, the PayGo company will receive the payout from the insurance company and use the payout to offset it against the remaining loan balances of its farmers - it is at the PayGo company's discretion to determine how it will offset the balances. Through this, the smallholder farmers under the portfolio receive a repayment holiday, while providing the PayGo company with the security that their portfolio performance will not suffer in case of such a risk materializing.

In developing the AYII insurance product, the key parameters that are used are:

Trigger: This refers to the proportion of the Average (Metric Tonnes) Per Hectare (APH) below which farmers in the Unit Area of Insurance (UAI) will start receiving compensation - UAI is a geographical area whose farmers are expected to experience similar agronomic conditions.

Exit: This refers to the proportion of the APH at which farmers in the Unit Area of Insurance (UAI) will receive maximum possible payout.

Total Sum Insured (TSI) at Exit: This refers to the proportion of the TSI that is paid to farmers in a Unit Area of Insurance (UAI) in the event of a total loss. The sum insured is based on the average instalment payment that the farmer would make to the PayGo company over 6 months.

APH: This is as a benchmark yield stated in the contract and is compared to the actual yields of that season to determine if there was a loss on the part of the farmers and if any payouts are due.

4.1. PayGo pilot with Vitalite

4.1.1. Pilot background

Pula piloted the insurance cover with Vitalite's customers who are smallholder farmers engaged in maize cultivation in the 2019/2020 season. The main objective was to de-risk Vitalite's loan portfolio, minimize costly repossessions that come with default post poor harvest season and ensure farmers can continue investing in their farms unabated.

To ensure loss assessment and payout determination, Pula was mandated to manage the insurance policy and conduct the crop cutting experiments (CCEs). The cover was limited to 8,838 maize smallholder farmers spread in twenty-four (24) districts in Eastern, Muchinga, Central, Copperbelt, Southern, Lusaka, Northern, Luapula, and North-Western provinces of Zambia. For the 2019/2020 season, Pula determined the key parameters for the area yield index insurance product as outlined in the table below:

Fig. 4 Vitalite's insurance structure

| | Total new sales |
|--|-----------------|
| Trigger | 50% |
| Exit | 30% |
| Total sum insured at exit (TSI) | 100% |
| Number of farmers | 8,838 |
| Sum insured per farmer | ZMW 300 |
| Total sum insured | ZMW 2,651,400 |
| Total gross premium | ZMW 52,372 |
| Gross premium rate | 1.98% |
| Premium per farmer | ZMW 5.93 |

Source: Pula contract structure with Vitalite for 2019/2020 season

4.1.2. Claim settlement

For the purpose of harvest measurement and loss assessment to determine claims and payout, Pula carried out CCEs. Outlined below is the procedure Pula followed to carry out the CCEs, which is the general procedure used to carry out all CCEs for all projects.

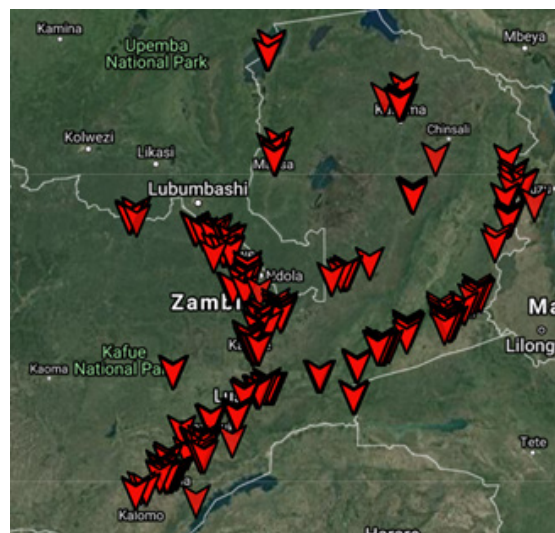
A minimum of 25 crop cut experiments (CCEs) were executed in each of the districts. The selection process for the 25 farmers whom CCEs carried out was done randomly. From these CCEs, crop yields were estimated for each district and used for loss assessment and eventual payout if any.

On the selected farm where CCEs were carried out, there are set procedures to follow in yield assessment, these are:

- On each farm, two boxes are placed using a given set of procedures
- Two boxes each measuring 8m x 5m are placed on the farm in a prescribed manner prior to harvesting
- Each farmer whose farm has been chosen for CCEs is provided with a bag to keep the produce to dry and facilitate dry harvest measurement from each box
- Enumerators use electronic scales and tablets to collect and enter data respectively for both wet and dry harvest
- To carry out the CCEs, enumerators visit selected farms 3 times, the first is to place the box in a prescribed manner, the second is to be present during the harvest and measure the wet harvest and the last is to visit the farm after the harvest has dried and take the dry harvest measurement

Once all data had been collated by all enumerators, Pula calculated the average weight in the boxes per farm and per district. The average weight in the boxes per farm and per district were used to compile the average yield. For settlement purposes, the average yield per district was computed as per terms and conditions of the policy document.

Fig. 5 GPS locations of the farmers who were sampled by the enumerators



Source: Pula internal data

4.1.3. Yield comparison

At the end of the season and after the CCEs had been carried out, Pula compared the obtained yields with the APH. This exercise was used to determine if a payout was necessary, which UAIs were to receive the payout and how much the payout should be. As seen in the figure below, the 2019/2020 yields were high, attributed to a strong performing season compared to the benchmark yield set at the product design stage.

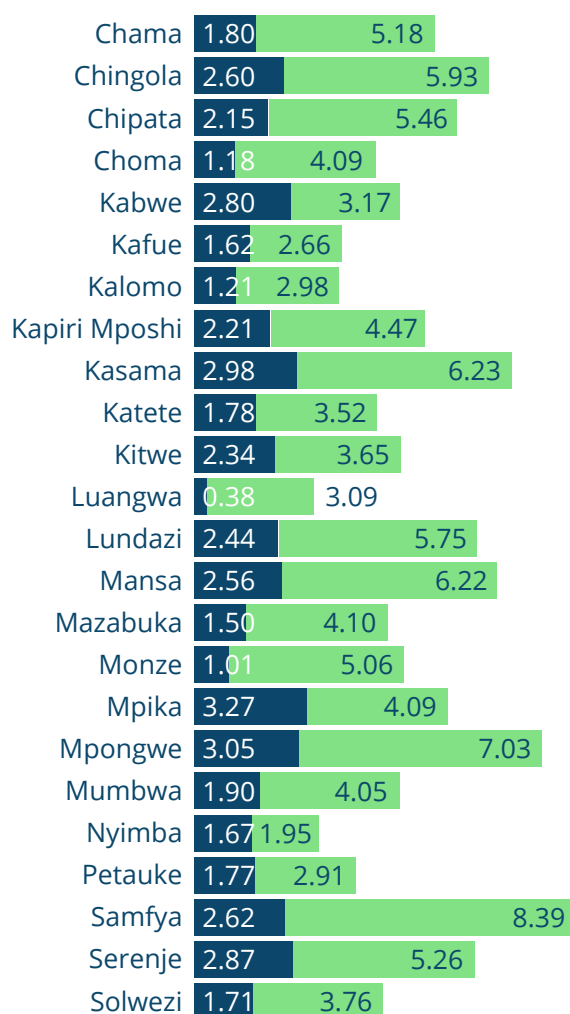


Fig. 6 Graph showing attained farmer yields compared to APH

Source: Pula internal data

■ APH (MT / Ha)
■ average realised yield (MT / Ha)

4.1.4. Payout computation

The payouts were calculated based on the following structure that had been determined during product development and it had the following parameters: **Trigger – 50%, Exit – 30%, and TSI at Exit – 100%** as can be seen in the following table.

There were no payouts for the 2019/2020 season to the farmers. This could imply that the current product structure of 50% trigger is low for the maize smallholder farmers in Zambia and thus structure revision is necessary.

Fig. 7 Payouts for the 2019/2020 season

| | Crops | Number of farmers | Total sum insured (ZMK) | APH (MT/Ha) | Trigger APH (MT/Ha) | Total number of (box 1) placed | Total number of (box 2) placed | Complete sampled farmers | Average realised yield | Realised yield as a % of APH | % Payout | Payout amount |
|---------------|-------|-------------------|-------------------------|-------------|---------------------|--------------------------------|--------------------------------|--------------------------|------------------------|------------------------------|----------|---------------|
| Chama | maize | 121 | 36,300 | 1.80 | 0.90 | 35 | 35 | 35 | 5.18 | 287.79 | 0 | - |
| Chingola | maize | 315 | 94,500 | 2.60 | 1.30 | 26 | 26 | 23 | 5.93 | 228.20 | 0 | - |
| Chipata | maize | 345 | 103,500 | 2.15 | 1.07 | 35 | 35 | 35 | 5.46 | 254.21 | 0 | - |
| Choma | maize | 239 | 71,700 | 1.18 | 0.59 | 34 | 34 | 31 | 4.09 | 346.96 | 0 | - |
| Kabwe | maize | 554 | 166,200 | 2.80 | 1.40 | 27 | 27 | 23 | 3.17 | 113.46 | 0 | - |
| Kafue | maize | 214 | 64,200 | 1.62 | 0.81 | 26 | 26 | 26 | 2.66 | 164.56 | 0 | - |
| Kalomo | maize | 244 | 73,200 | 1.21 | 0.60 | 17 | 17 | 16 | 2.98 | 246.18 | 0 | - |
| Kapiri Mposhi | maize | 249 | 74,700 | 2.21 | 1.10 | 30 | 30 | 21 | 4.47 | 202.37 | 0 | - |
| Kasama | maize | 1,066 | 319,800 | 2.98 | 1.49 | 33 | 33 | 31 | 6.23 | 208.93 | 0 | - |
| Katete | maize | 238 | 71,400 | 1.78 | 0.89 | 35 | 35 | 34 | 3.52 | 198.06 | 0 | - |
| Kitwe | maize | 1,006 | 301,800 | 2.34 | 1.17 | 23 | 23 | 23 | 3.65 | 156.07 | 0 | - |
| Luangwa | maize | 156 | 46,800 | 0.38 | 0.19 | 38 | 38 | 31 | 3.09 | 816.58 | 0 | - |
| Lundazi | maize | 398 | 119,400 | 2.44 | 1.22 | 35 | 35 | 35 | 5.75 | 235.81 | 0 | - |
| Mansa | maize | 535 | 160,500 | 2.56 | 1.28 | 39 | 39 | 34 | 6.22 | 242.45 | 0 | - |
| Mazabuka | maize | 205 | 61,500 | 1.50 | 0.75 | 31 | 31 | 28 | 4.10 | 272.57 | 0 | - |
| Monze | maize | 395 | 118,500 | 1.01 | 0.50 | 34 | 34 | 27 | 5.06 | 503.15 | 0 | - |
| Mpika | maize | 460 | 138,000 | 3.27 | 1.63 | 36 | 36 | 35 | 4.09 | 125.27 | 0 | - |
| Mpongwe | maize | 268 | 80,400 | 3.05 | 1.52 | 36 | 36 | 18 | 7.03 | 230.61 | 0 | - |
| Mumbwa | maize | 344 | 103,200 | 1.90 | 0.95 | 34 | 34 | 33 | 4.05 | 212.80 | 0 | - |
| Nyimba | maize | 78 | 23,400 | 1.67 | 0.84 | 35 | 35 | 35 | 1.95 | 116.91 | 0 | - |
| Petauke | maize | 284 | 85,200 | 1.77 | 0.89 | 33 | 33 | 32 | 2.91 | 164.06 | 0 | - |
| Samfya | maize | 282 | 84,600 | 2.62 | 1.31 | 30 | 30 | 14 | 8.39 | 320.30 | 0 | - |
| Serenje | maize | 218 | 65,400 | 2.87 | 1.43 | 27 | 27 | 24 | 5.26 | 183.27 | 0 | - |
| Solwezi | maize | 624 | 187,200 | 1.71 | 0.85 | 32 | 32 | 32 | 3.76 | 220.11 | 0 | - |
| TOTAL | | 8,838 | 2,651,400 | | | 761 | 761 | 676 | | | 0 | - |

5. PayGo product re-commendations

Based on the findings outlined above from the insurance pilot with Vitalite, Pula recommends the following for subsequent seasons. Notably, while these recommendations are based on Vitalite, they will be used to develop the product for other PayGo companies:

Instead of using districts as UAIs, it is recommended that Agro Ecological Zones (AEZs) are created based on available satellite weather data and yield data and used as the UAIs so as to reduce geographical basis risk. Geographical basis risk is a factor of the distance between the index measurement location and the production field. The bigger the Unit Area of Insurance (UAI), the greater the chance for basis risk as some households that experience loss may not receive compensation while others that experience no loss may receive payments. Pula will create an index which is homogeneous both in terms of climatic conditions and in terms of farming techniques and hence, making the UAI smaller so that basis risk is minimized.

It is recommended the trigger percentage be increased from the current 50% to 70%. This is because the current trigger of 50% was found to be very low and would only trigger if there was a catastrophic risk. However, given that Vitalite loan book is affected if there is a below average performance, they require an insurance product that is more beneficial to the smallholder farmers who are their clients and in Pula's assessment, an increased trigger from 50% to 70% would result in more appropriate coverage.

It is recommended that the exit percentage be reduced from 30% to 0%, in order to keep in line with standards set by international insurers (that the sum of TSI at exit and exit never exceed 100%) and reduce the overall cost of the policy for the client. Vitalite is looking for full sum insured being covered thus the 100% as TSI at Exit.

In order to more accurately represent production, Pula recommends the insured yields (APHs) to increase by 6% for maize. This change is driven by the farmers on average harvesting higher yields than the APH's for the 2019/2020 season.

Additionally, if farmers suffer loss and are unable to pay their debt to Vitalite, once Vitalite has been paid the amount due to them, if any amount remains based on the payout calculation, it should be distributed to the farmers.

Fig. 8 Current insurance structure vs proposed new structure

| | Current structure | Proposed new structure |
|---------------------------------|-------------------|------------------------|
| Trigger | 50% | 70% |
| Exit | 30% | 0% |
| Total sum insured at exit (TSI) | 100% | 100% |

Pula has developed a PayGo insurance product for Vitalite for the 2020/2021 season based on the recommendations above and will analyze the results of the revised product once farmers harvest and the claim settlements are assessed.