Feasibility study on agricultural insurance through the Pay-at-Harvest channel

Prepared for the Shell Foundation

Pula Advisors AG

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Acronyms and abbreviations

AYII	Area Yield Index Insurance
COCOBOD	Ghana Cocoa Board
COP26	2021 United Nations Climate Change Conference
ESG	Environmental, social and governance (ESG)
EU	European Union
FCDO	Foreign, Commonwealth and Development Office
F&B	Food and beverage manufacturers
GMO	Genetic Modified Organisms
GOTS	Global Organic Textile Standard
IFOAM	International Federation of Organic Agriculture Movements
LGA	Local Government Areas
LRM	Local raw materials
Mt	Metric tonne
PAH	Pay-at-Harvest
RCP	Representative Concentration Pathway

1. Executive summary

Agriculture is a major driver of economic output in Africa, providing income and livelihoods for millions of farmers, including the most vulnerable parts of the population. However, climate-related threats, including droughts and excess rainfall as well as pests and diseases, threaten crop yields.

Agricultural insurance serves as a powerful risk mitigation tool for dealing with climate-related threats and other types of hazards. Pula's Area Yield Index Insurance (AYII) product delivers innovative agricultural insurance that helps smallholder farmers and rural clients endure climate risks, improve farming practices, and bolster their profits.

However, smallholder farmers barely break-even and purchasing insurance presents an additional financial burden. As a result, the voluntary uptake of agriculture insurance products such as AYII remains low, especially without the presence of incentives or discounted premiums. Traditionally, insurance cover is bought at the start of the season when farmers also have to buy seeds and other agricultural inputs. This puts pressure on the limited funds available to farmers at the beginning of a season, lowering their willingness and ability to pay for insurance premiums. The PAH model of insurance seeks to deal with this liquidity constraint. It is structured to allow farmers to receive insurance cover at the start of a season but pay the premium after they have harvested and sold their produce, when more disposable income is available. The results of two studies that support this insurance model are highlighted.

However, PAH insurance presents some challenges including farmers side-selling their produce or defaulting on their premium payments, as well as finding an organisation willing to pre-finance premiums.

Pula carried out a PAH insurance pilot with Olam in Nigeria that yielded some key lessons that are incorporated in subsequent sections of this report.

Opportunities for PAH insurance in various Asian and African countries are explored. Select value chains are identified as being better suited to PAH insurance because they are less susceptible to key challenges faced by this distribution model. These include **organic cotton, certified cocoa, as well as some alcoholic beverage value chains.**

Based on our findings the following value chains and markets stand out:

Research suggests that the ideal approach to implementing PAH insurance should first identify a suitable value chain, and then select the best markets to target. We use the findings in this section to assign scores (1 - worst, 5 - best) to the value chains that have been analysed, according to their potential to successfully implement PAH (figure 17).

Figure 16: Assessment and ranking of potential to implement PAH insurance

Value chain	Value of production and potential market size for premiums	Suitability for PAH	Weighted sum	Weighted sum (%)	Top 3 markets in Africa and Asia ranked by potential market size for premiums
Weight	20%	80%	100%		
Cotton as a whole	5	3	3.4	68%	1. India 2. Pakistan 3. Turkey
Cocoa as a whole	4	3	3.2	64%	1. Côte d'Ivoire 2. Indonesia 3. Ghana
Organic cotton	3	5	4.6	92%	1. India 2. Kyrgyzstan 3. Turkey
Certified cocoa	2	5	4.4	88%	1. Cote d'Ivoire 2. Ghana 3. Indonesia

Source: Pula. *Note: China was not included in this assessment*

The organic cotton value chain (India, Kyrgyzstan and Turkey) and certified cocoa value chain (Cote d'Ivoire, Ghana and Indonesia) present the greatest opportunities to successfully implement PAH insurance in Africa and Asia. However, despite the advantages that certified crops offer for PAH insurance, this model can still be effective for non-certified value chains. Targeting these farmers is important to promote insurance adoption at scale.

These value chains stand out because of the following:

Organic cotton requires farmers to adhere to strict protocols, and as a result the price of organic cotton is higher than for non-organic cotton. Farmers in the organic cotton value chain are therefore **less likely to side-sell because their produce is priced well above normal market levels,** for which there are a limited number of buyers. **This makes organic cotton particularly relevant for PAH insurance.**

High demand for cocoa grown by smallholder farmers and the presence of substantial climate risks facing the crop present a significant opportunity to provide index-insurance under the PAH model.

A set of recommendations are then laid out describing how PAH insurance can be introduced in these regions. These include identifying appropriate value chains, key stakeholder targeting,

product design and pricing, capacity building, carrying out crop cut experiment dry runs, pilot testing, and scaling with a full roll-out.

2. Project objectives

This study identifies how agricultural insurance, based on the pay-at-harvest (PAH) model, can be implemented across a number of markets in Asia and Africa. The study considers results from Pula's PAH pilot in Nigeria and includes insights from stakeholders in target value chains. We then propose a set of recommendations for PAH insurance based on lessons drawn from Pula's experience in Nigeria and research findings.

The aim of the insurance cover is to improve smallholder farmers' resilience to climate-related shocks and protect them from the risk of income losses. In doing so, the insurance cover allows farmers to maintain productivity and livelihoods too. The study looks at launching insurance products that are impactful to smallholders and commercially viable for the delivery partners in the insurance value chain.

This report is aimed at potential stakeholders in the PAH insurance value chain, including impact investors, crop aggregators, agro-processors and distributors, insurers and reinsurers, as well as development organisations.

3. Introduction to Pay-at-Harvest

3.1 Background

Agriculture is an important contributor to economic output and employment globally. It forms the basis of livelihoods for many, providing income and food security for the most vulnerable. However, farmers have to deal with climate-related threats including droughts and excess rainfall, as well as pests and diseases. Each of these can affect their productivity. Smallholder farmers are especially vulnerable because they are dependent on agriculture and have limited capacity to deal with the wide range of factors that can affect their yields.

Agricultural insurance serves as a powerful risk mitigation tool for dealing with climate-related threats and other types of agricultural hazards. However, agricultural insurance penetration remains low - particularly in Africa. In 2017, agricultural premiums in Africa amounted to roughly $200 million, less than 1% of global agricultural premiums of $25 billion, and disproportionately lower than Africa's 1.5% share of overall global insurance premiums[1]. To overcome this problem, Pula designs and delivers innovative agricultural insurance products and services that help smallholder farmers endure climate risks, improve farming practices, and boost their income. Pula's Area Yield Index Insurance (AYII) product (Box 1) provides comprehensive coverage against many of the threats to crop health and yields.

Box 1: Pula's Area Yield Index Insurance (AYII)

The AYII is a cover that insures a group of farmers against a pre-set, guaranteed benchmark yield within a predefined unit area of insurance (UAI).

The guaranteed benchmark yield is based on actual historical yields in the UAI. Pay-outs are determined via random sampling of those insured within the UAI, through a process referred to as crop cut experiments (CCE's). This involves carrying out measurements of the yields of sampled farmers.

Key Features

UAI: Sub-counties are clustered in agro-ecological zones (AEZ).

Cover against: Droughts, floods, locusts, pests and diseases affecting the yield of the crop.

Group cover: In the event of a payout, all the farmers under the AEZ will benefit.

Indemnity: CCEs are done in the selected farms located in the insured AEZs which brings transparency to the payout process and encourages trust in the farming community.

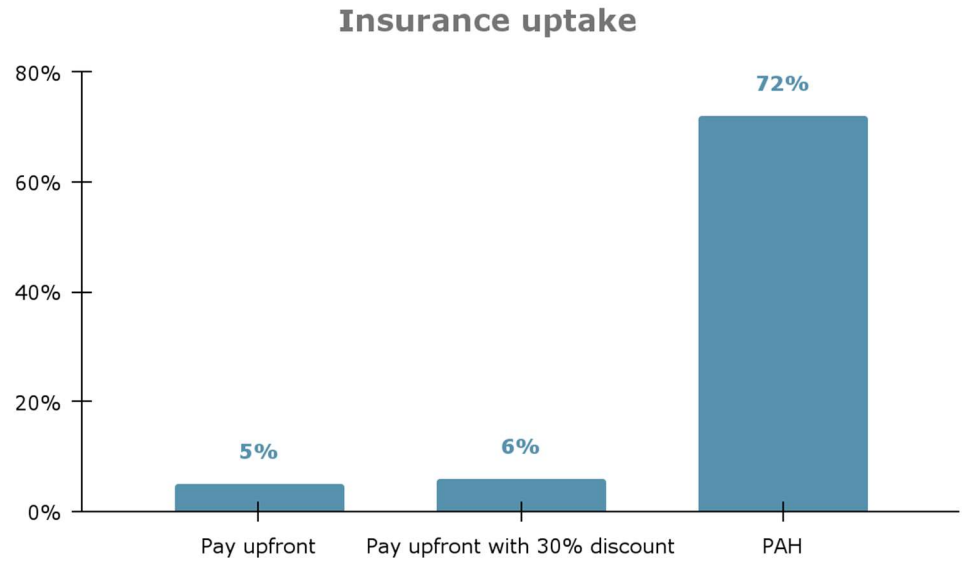
[1] Africa Re

Smallholder farmers barely break-even and purchasing insurance presents an additional financial burden. As a result, voluntary uptake of agriculture insurance products such as AYII remains low, especially without incentives or discounted premiums. Traditionally, insurance cover is bought at the start of the season when farmers have to buy seeds and other agricultural inputs. This puts pressure on the limited funds available to farmers at the beginning of a season, lowering their willingness and ability to pay for insurance premiums.

The PAH model of insurance seeks to overcome this liquidity constraint. It allows farmers to receive insurance cover at the start of a season but pay the premium after they have harvested and sold their produce. This is when more disposable income is likely to be available. PAH insurance is also likely to be more trusted by farmers, as they are required to pay for the service after having experienced it, as opposed to before.

A 2017 study used randomised controlled trials to test the PAH insurance model in partnership with a sugarcane contract farming company in Kenya[2]. It concluded that the timing of premium payment plays a key role in the level of insurance uptake. Farmers were split into three groups. One group was offered standard, pay-upfront insurance. A second group was offered the same type of insurance with a 30% discount on the premium. The last group used the PAH model. The results (figure 1) show that uptake was significantly higher for the PAH group, while adding a discount to pay-upfront insurance only improved uptake slightly.

Figure 1: Insurance uptake in 2017 Kenya study



[2] Lorenzo and Willis (2017), "Time vs. State in Insurance: Experimental Evidence from Contract Farming in Kenya".

Source: Lorenzo and Willis (2017)

The results imply that farmers have a high demand for insurance, but a low willingness to pay for it upfront. It was also found that the poorest and the most liquidity- constrained farmers increased their demand the most in response to delaying premium payments.

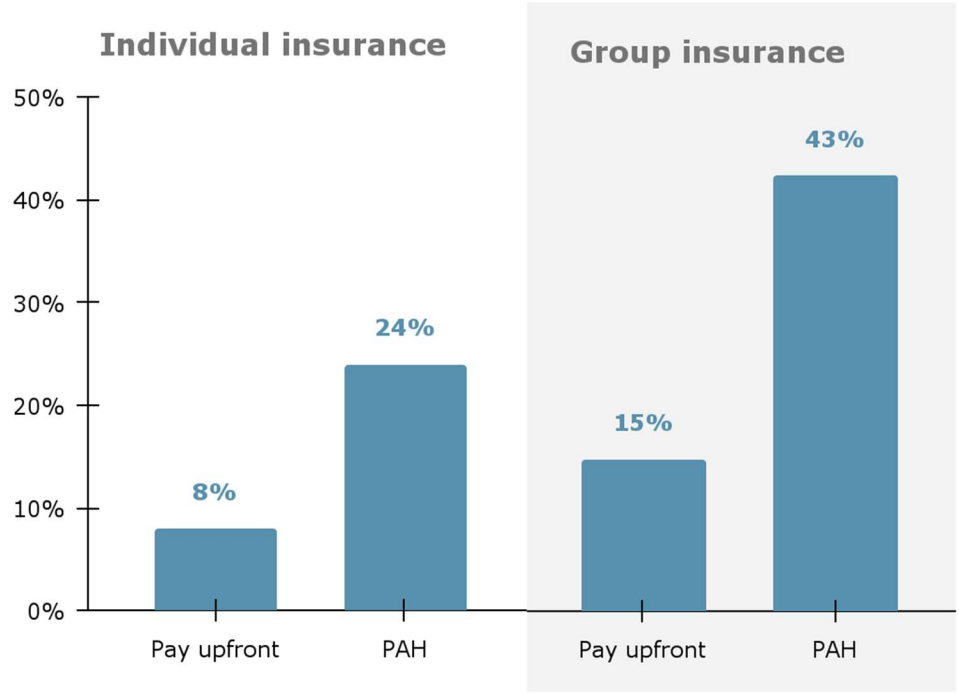
In 2019, a similar study was carried out in Ethiopia[3]. This study investigated the impact of the timing of premium payment, reflecting the PAH model, on index-insurance uptake for individuals and groups (*Iddirs*[4]). It was found that for both individuals and groups, PAH increased insurance uptake significantly (figure 2) - albeit to a smaller extent than was observed in Kenya.

The study also found that individuals adopting the PAH model had a default rate of 17%. Results suggested that default rates could be reduced by targeting groups for PAH instead of individuals. This could also be achieved by implementing PAH contracts with farmers that penalise defaults through legal channels. However, the study also noted that harsh penalties could discourage farmers from purchasing insurance. These factors are important because higher default rates can force insurance companies to charge higher premiums, making the insurance product less attractive and less affordable to farmers.

[3] Belissa, Bulte, et al. (2019). Liquidity constraints, informal institutions, and the adoption of weather insurance.

[4] Indigenous and voluntary mutual help associations made up of people united by family ties, friendship, proximity, employment, or their ethnic background.

Figure 2: Insurance uptake in 2019 Ethiopia study



Source: Belissa, Bulte, et al. (2019)

3.2 Challenges with PAH

While PAH insurance overcomes smallholder farmers' cash-flow constraints, it poses additional challenges for other parties involved.

- **Farmer loyalty:** Farmer defaults can be mitigated by deducting premiums at the point where they sell their produce to an aggregator. However, there is a risk that farmers will side-sell. This is where they sell their produce to someone other than the aggregator they have an agreement with, in order to avoid having the insurance premium deducted from their harvest proceeds. Putting in place contracts with farmers is one way to mitigate this risk.

- **Contracts with farmers:** Establishing a contract between the farmer and other relevant stakeholders, the insurer and the offtaker, can help ensure that farmers pay for their insurance premium once their harvest is sold. The offtaker can be incentivised to closely monitor farmers and enforce contracts by offering them a portion of the premiums they collect as a fee. This protects the interests of insurers and promotes the sustainability of PAH insurance in the long term. It also ensures that farmers understand the features, costs and benefits of the product. However, contracts that are too punitive in the event of default may discourage some farmers from adopting PAH insurance.

- **Pre-financing:** Because farmers only pay for insurance after harvest, one or a set of parties involved in the value chain will need to pre-finance premiums at the start of the

season. In 2021, Pula was issued $5 million from the Climate Innovation Facility announced by the UK Government's British International Investment[5] at the 2021 United Nations Climate Change Conference (COP26). The funds will be used to pre-finance insurance premiums at zero cost to farmers who adopt PAH insurance.

- **Collecting and pricing premiums:** For PAH to be effective, efficient distribution and payment mechanisms need to be in place to collect premiums from individual farmers post-harvest. Digital payment channels can help ensure that these transactions are carried out quickly. Insurance premiums need to be affordable to farmers who are price-sensitive. In addition, the higher the insurance premium is as a proportion of a farmer's harvest income, the greater the temptation to default. This needs to be taken into account when pricing PAH insurance.

- **Default rates:** The structure of the PAH scheme will inevitably see some farmers defaulting when it comes time to pay for premiums after harvest. The cost of defaults will need to be absorbed by one or more value chain partners, most likely the institution providing financing. This ensures that the product is financially feasible for insurers and that premium rates are not increased to cover default costs.

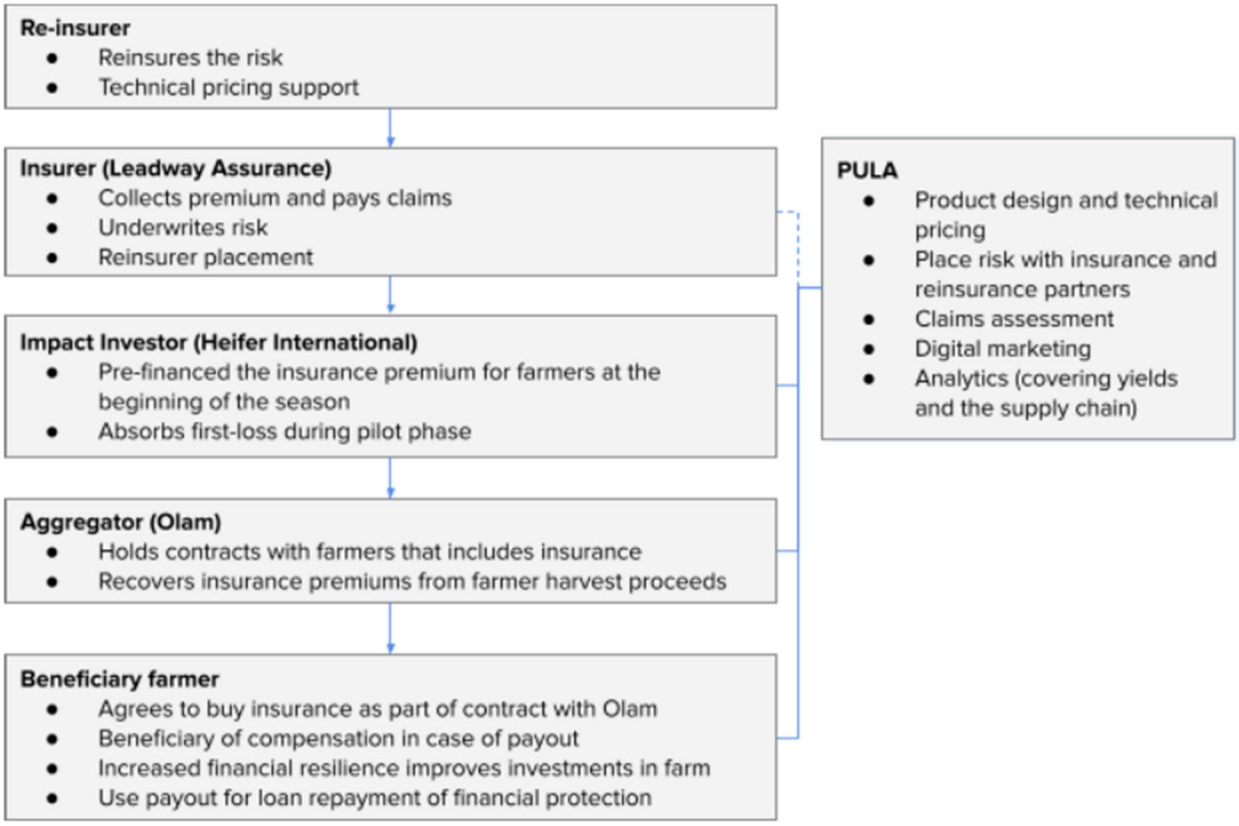
[5] Formerly the CDC Group.

4. PAH case studies from Pula

4.1 Overview

In 2021, Pula worked with a group of stakeholders in Nigeria (figure 3) to run a PAH insurance pilot targeting rice farmers. The project was financed with support from the Shell Foundation and the United Kingdom's Foreign, Commonwealth and Development Office (FCDO). The objectives of the project were to source funding to pre-finance insurance premiums, test a PAH insurance solution for smallholder farmers and increase the product's penetration. The pilot was carried out with 4,000 rice farmers in Nigeria's Benue and Nasarawa states, covering a total of 4,358 ha. Olam, a manufacturer and distributor of packaged food products to African markets, was the aggregator. The company had relationships with local farmers, encouraging them to sell their produce to Olam at the end of the season.

Figure 3: Nigeria PAH pilot value chain



Source: Pula

4.2 Implementation process

The steps taken to implement the PAH model are described below:

I. **Registration and capacity building:** Pula worked with farmer heads who manage cooperatives across 10 Local Government Areas (LGAs). Three training sessions were held with the farmer heads to sensitise them on agricultural insurance and the PAH model to be piloted with Olam. Farmer heads were then given registration forms to distribute to their farmer networks. Farmers who completed and submitted their forms were registered. A total of 4,000 farmers were enrolled for the 2021 wet planting season.

II. **Pre-financing the insurance premium:** Pula initially pre-financed the agriculture insurance component taken out on behalf of the 4,000 farmers registered under the programme. The company paid a gross insurance premium of $163,870 directly to Leadway Assurance to cover a sum insured value of $2,981,447. Pula paid for the premiums with money drawn from a revolving fund owned by Heifer International[6]. In the absence of an organisation willing to pre-finance premiums, these would be collected by the aggregator. However, this approach could burden the aggregator's working capital and could limit their willingness to adopt PAH insurance.

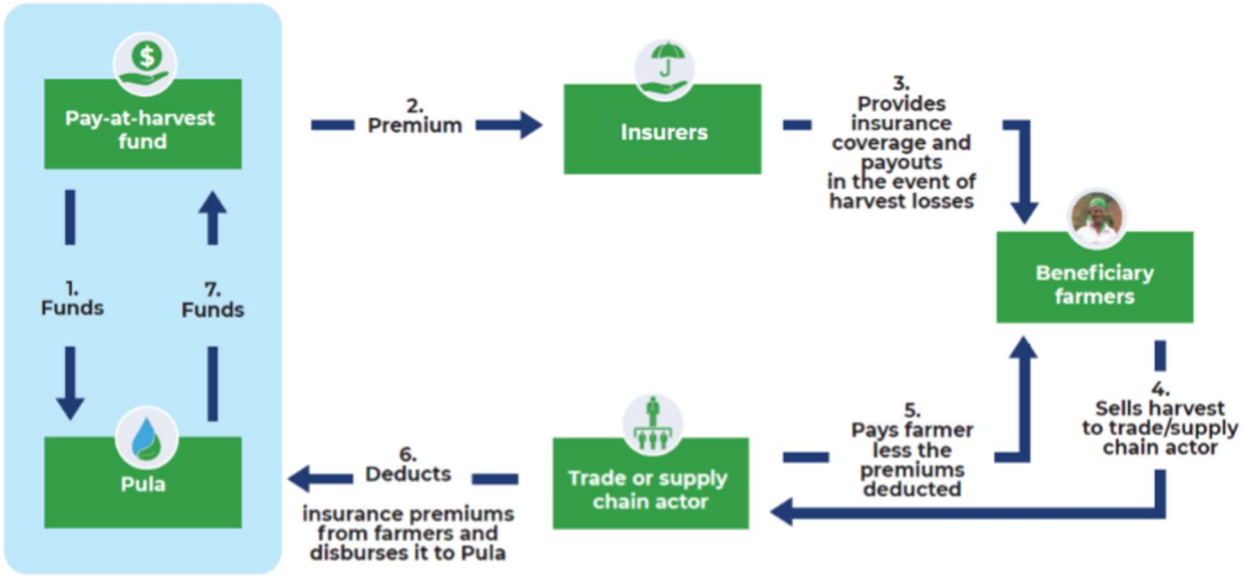
III. **Insurance premium repayment:** At harvest time, farmers were contractually bound to sell their produce to Olam. The company then withheld the premium amounts owed by individual farmers and remitted them back to the revolving fund at Heifer International.

IV. **Information sharing and claim payouts:** Pula then generated a report that listed all sales compliant farmers and their bio-data, using information provided by Olam. The report was submitted to Heifer International, and to Leadway Assurance to process claim payouts.

A visual representation of a general PAH model can be seen below (figure 4).

[6] A global non-profit organisation working to alleviate poverty through sustainable and holistic community development.

Figure 4: PAH model flow-chart



Source: Pula

4.3 Outcome

Details of the pilot are highlighted below (figure 5). Under this cover, the sum insured for a farmer was based on their crop output. As a result, a farmer received compensation based on the expected monetary value of their harvest in the event of a claim payout. The farmgate price of rice applied was $395 per metric tonne (mt). On average, farmers received a payout greater than the amount they spent on the insurance premium, and 78% of insured farmers received payouts. These are powerful motivating factors for beneficiaries to adopt insurance in the long run.

Figure 5: Nigeria PAH project summary, 2021 wet season

Item	Value
Number of AEZs covered	10
Number of CCEs	327
Number of hectares	4,358
Number of farmers insured	4,000
Total sum insured	$2,981,447
Gross premium rate	5.50%
Total gross premium	$163,870
Total payout	$271,705
Number of farmers who received payouts	3,110
Average premium per insured farmer	$41
Average payout per insured farmer	$68

Source: Pula

Note: An exchange rate of NGN/$ = 410 is applied throughout this document.

4.4 Challenges and lessons learned

While farmers were optimistic about the PAH insurance model, a few challenges emerged:

- **Limited outreach:** Awareness and sensitisation activities for the pilot targeted farm leaders who were responsible for sensitising farmers at the village-level. However, in some instances farmers in rural areas did not receive proper training. Additional and continuous training and sensitisation of farm leaders and end beneficiaries would have been beneficial.
- **Repayment mode uncertainty:** Some farmers were unsure about how premiums were meant to be paid under the PAH model. This was not properly explained to farmers, some of whom were surprised when deductions were made.
- **Payout uncertainty:** There was a lack of clarity among farmers regarding how they would receive a claim payout under the PAH model. They were unsure about whether the payout would be transferred directly to their account by Olam, or whether it would be distributed by the insurer, or another party. This was not clearly explained to farmers and as a result they were hesitant to have premiums deducted from their harvest sales.
- **Lack of payment acknowledgement:** Farmers complained about the fact that they did not receive official confirmation that they had paid for their insurance premiums. They suggested that Olam should provide a receipt for premium payment to farmers, potentially

through SMS. Ideally, the message should clearly state what total harvest proceeds were, the insurance premium amount deducted, and the final sum actually paid to the farmer.

The PAH insurance pilot that ran in Nigeria provided some key lessons that can be applied to similar initiatives:

- **Outreach to farmers should be done early and target the end beneficiary.** Dependency on farmer heads to disseminate information should be reconsidered. This is not because farmer heads lack the ability to train other farmers, but because this could be used to justify a lack of understanding by final beneficiaries.
- **The PAH insurance model would be more sustainable if farmers were more invested in it.** The aggregator could provide farmers with a small down-payment at the start of the season to support the purchase of insurance.
- **The registration of farmers should be digitised.** During the pilot, enrollment was carried out using physical forms which can be misinterpreted and increase the risk of fraud. This also created a significant administrative burden as paper forms had to be digitised. A digital solution to register farmers, such as Pula's FieldSense Advise, can overcome this problem.
- **PAH insurance works best when there is a single buyer for a crop.** If there is a monopsony[7] in the market, then farmers are not able to side-sell because there is only one buyer for that crop. For instance, the Ghana Cocoa Board (COCOBOD) is a government-controlled institution that fixes the farmgate price of cocoa beans, pays for the produce, exports it, and provides marketing services, among others. Farmers are legally required to sell their cocoa beans to the COCOBOD, or their licensed intermediaries, and face penalties for trading outside this channel. As a result, there are limited, and potentially costly, opportunities for cocoa farmers in Ghana to side-sell. In contrast, after a good season in a competitive market, farmers under a PAH insurance arrangement may be incentivised to sell to another buyer to avoid paying their premium. Therefore, the PAH model poses challenges for food crops which are generally sold in competitive markets, where there are multiple buyers.

[7] A market where there is only one buyer. In contrast, a monopoly refers to a market where there is only one seller.

5. Opportunities in Asia and Africa

In theory, the PAH insurance model can be applied to any crop that is susceptible to the risks covered by index-insurance. For Pula's AYII, CCEs are carried out at the end of a season to measure yields and determine whether these are below a predefined threshold that would trigger a payout. As a result, CCEs work best for annual crops - plants that complete their life cycle within one growing season - as opposed to perennial crops that persist for many growing seasons. This is because harvests are carried out at specific times during the year for annual crops, allowing for more reliable and cost-effective yield measurements.

This study looked at the potential for particular value chains to adopt PAH insurance in Asian and African markets. The following sections will highlight why PAH insurance is more effective for certain value chains, in particular cotton and cocoa, drawing from Pula's lessons learned in Nigeria, as well as interviews with key stakeholders.

5.1 Cotton

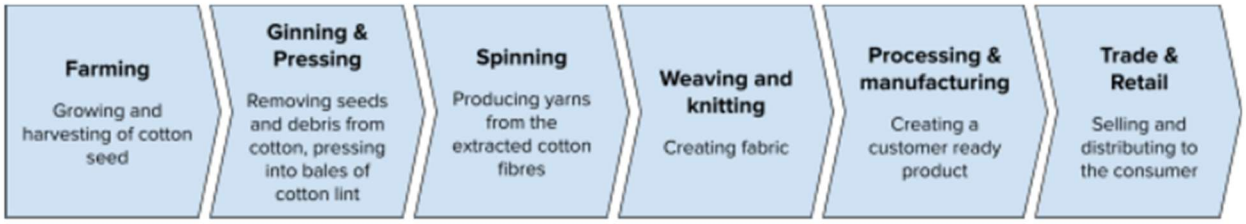
As of 2020, 25 million mt of cotton were being produced across 75 countries annually - with a market value of around $12 billion dollars[8,9]. Cotton fibre serves as a raw material for approximately 31% of the global textile market, with a yearly economic impact of at least $600 billion[9]. Cotton is also a significant source of livelihoods for many rural smallholder farmers and labourers, women in particular. The industry provides employment and income to some of the poorest rural communities in the world.

A 2021 study[9] found that all global cotton-growing regions will be exposed to increased risk from at least one climate hazard; half of these regions are expected to face high or very high risk exposure to at least one climate hazard. The same study found that 75% of the world's cotton-growing regions face greater exposure to heat stress and 40% of these areas are projected to experience a decreased growing season. In addition, the six highest cotton-producing countries – India, USA, China, Brazil, Pakistan and Turkey – are exposed to increased climate risks, particularly from wildfire, drought and extreme rainfall.

High demand for cotton grown by smallholder farmers and the presence of substantial climate risks facing the crop present a significant opportunity to provide index-insurance under the PAH model. Cotton ginners, and organisations that work with them, are key stakeholders for PAH insurance because they purchase directly from farmers. In the cotton supply chain, ginners would be responsible for deducting insurance premiums from harvest proceeds. However, processors and manufacturers with tight linkages in the cotton supply chain could also facilitate the uptake of PAH insurance (figure 6).

[8] FAO (2019)
[9] Cotton 2040 Project (2021). Physical Climate Risk for Global Cotton Production: Global Analysis

Figure 6: Cotton supply chain

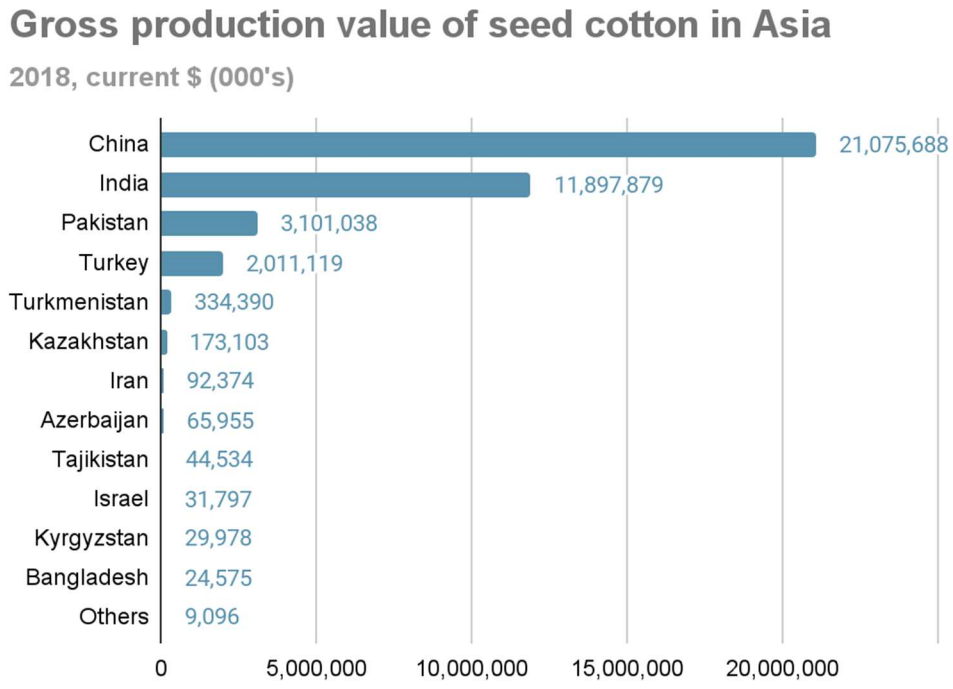


Source: Pula

5.1.1 Cotton in Asia

Assessing the total value of cotton produced at a national level (figure 7a) offers an initial indication of the potential market size for PAH insurance. While China is the leading producer of cotton in Asia by a large margin, its complex regulatory environment and issues around human rights compliance provide significant barriers to entry. India, Pakistan and Turkey would be better entry points for the Asian market, as they have large agricultural sectors and are among the top cotton producers globally.

Figure 7a: The value of seed cotton production in Asian countries



Source: FAOSTAT
Note: Others include Thailand, Laos, Philippines, Yemen, Cambodia, Indonesia and Nepal. Thailand data is from 2017.

The total value of premiums that could be collected from these Asian markets, based on the value of cotton output, is calculated using a premium rate of 6% (figure 7b). The premium rate represents an average based on Pula's experience. These figures are important because they allow insurers to assess the financial viability of these markets.

Figure 7b: Estimated premium values for seed cotton in Asia, 2018

Country	Premium Value $, (6%)
China	1,264,541,280
India	713,872,740
Pakistan	186,062,280
Turkey	120,667,140
Turkmenistan	20,063,400
Kazakhstan	10,386,180
Iran	5,542,440
Azerbaijan	3,957,300
Tajikistan	2,672,040
Israel	1,907,820
Kyrgyzstan	1,798,680
Bangladesh	1,474,500

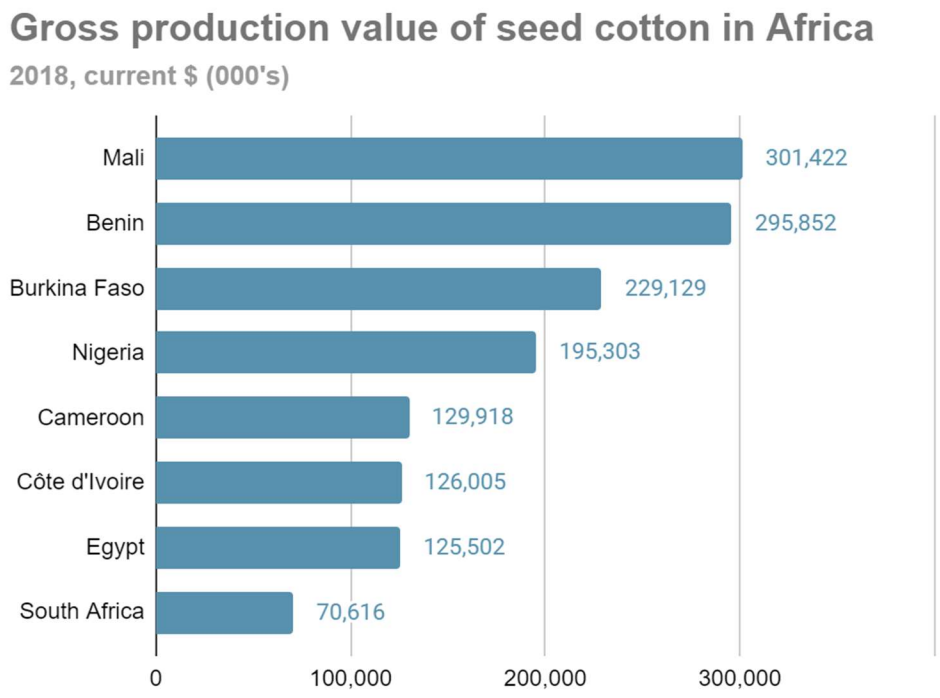
Source: FAOSTAT, Pula

Based on the ease of entry into markets, and the value of cotton production and potential premiums, India, Pakistan, and Turkey present good opportunities for PAH insurance.

5.1.2 Cotton in Africa

The top cotton producers in Africa are located in the western side of the continent (figure 8a). Unlike Asia, cotton production in Africa is significantly lower. The value of production in Africa's largest cotton market in 2018, Mali, did not surpass Turkmenistan's output for the same year. This further highlights the importance of targeting Asian markets, though African cotton markets still offer sizable insurance potential.

Figure 8a: The value of seed cotton in top-producing African countries



Source: FAOSTAT

Note: FAOSTAT does not provide data on the value of cotton production in Tanzania and Uganda however, they ranked 9th and 12th, respectively, in terms of the volume (mt) of seed cotton produced in Africa in 2018.

The potential premiums that could be collected from these African markets are shown in figure 8b.

Figure 8b: Estimated premium values for seed cotton in Africa, 2018

Country	Premium Value $, (6%)
Mali	18,085,320
Benin	17,751,120
Burkina Faso	13,747,740
Nigeria	11,718,180
Cameroon	7,795,080
Côte d'Ivoire	7,560,300
Egypt	7,530,120
South Africa	4,236,960

Source: FAOSTAT, Pula

Based on the value of cotton produced in Africa, and the average insurance premium that could be collected, Mali, Benin, and Burkina Faso present viable opportunities for PAH insurance.

5.1.3 Organic cotton

In the process of carrying out research and interviews with potential aggregators**, organic cotton value chains were identified as particularly suitable for PAH insurance. This is due to stricter controls and requirements in the value chain, as well as the higher price of the crop which reduces incentives to side-sell.** Organic fibres are defined as natural fibres grown without the use of synthetic pesticides, or herbicides and Genetic Modified Organisms (GMOs), according to the principles of organic agriculture. Organic agriculture is a production process that sustains the health of ecosystems, soils and people[10]. These restrictions generally mean that organic cotton yields are likely to be lower than non-organic cotton yields.

The IFOAM (International Federation of Organic Agriculture Movements) family of standards provide requirements for organic fibre production and certification[11]. The standards approved under the IFOAM family of standards are officially endorsed as organic and include both private and government regulations from around the world, including Africa and Asia. Farmers who grow organic cotton fibres are required to keep detailed records of their practices, as well as their yields. This data can be used to design and price an index-insurance product more accurately, potentially leading to more affordable premiums and more reliable payouts. Organic cotton farmers are also regularly inspected by external auditors to ensure that they meet the relevant standards.

Beyond fibre cultivation, organisations such as the Global Organic Textile Standard (GOTS) oversee the subsequent production processes. The GOTS is a leading textile processing standard for organic fibres, including ecological and social criteria, backed up by independent certification of the entire textile supply chain, from ginning to trading and retail.

As a result of these strict protocols, the price of organic cotton is higher than non-organic. Farmers in the organic cotton value chain are therefore **less likely to side-sell because their produce is priced well above normal market levels,** for which there are a limited number of buyers. **This makes organic cotton particularly relevant for PAH insurance.**

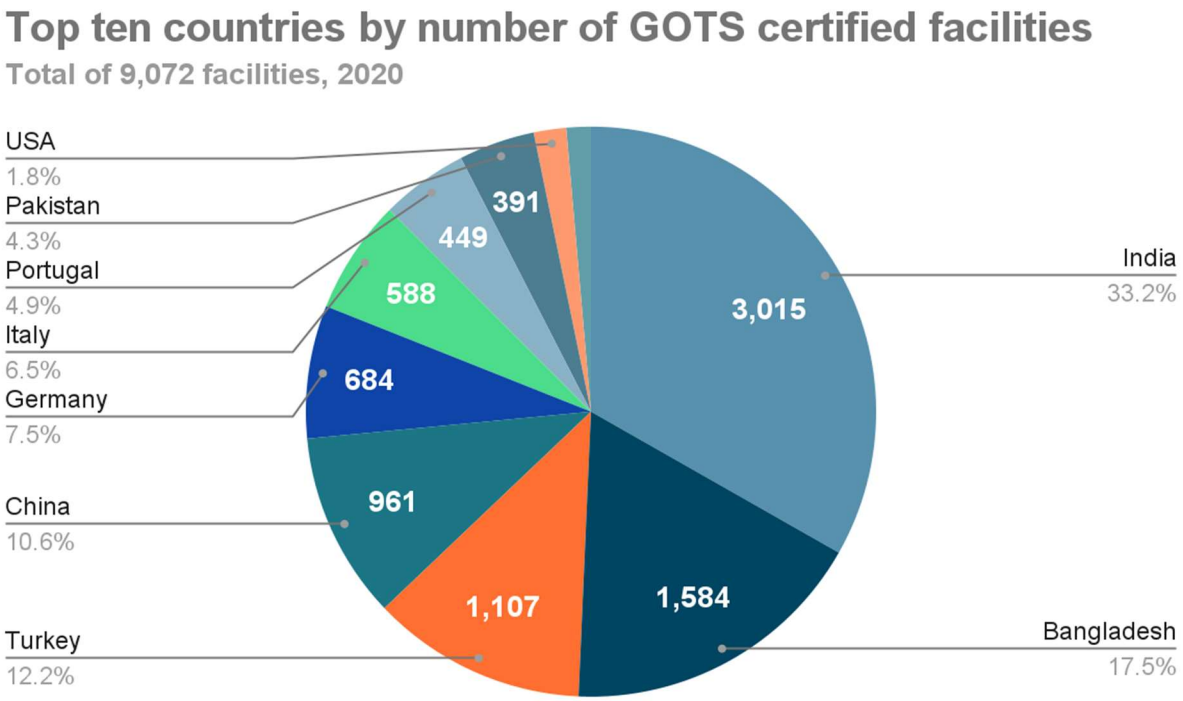
Organic cotton ginners are accustomed to providing agricultural inputs to farmers at the beginning of the season and deducting these costs from harvest proceeds. This distribution and payment structure is similar to the PAH insurance model and would allow for it to be adopted with relative ease.

India has the highest number of GOTS certified facilities, followed by Bangladesh, Turkey and China (figure 9). Given that seed cotton production in India ($12 billion) and Turkey ($2 billion) is much higher than in Bangladesh ($25 million), as of 2018, the former two present greater

[10] GOTS
[11] IFOAM Organics International

opportunities to scale PAH insurance in Asia. While there are no African countries featured, the continent experienced the fastest year-on-year growth in GOTS certifications in 2020 with 68%, followed by Europe (31%) and North America (14%)[12]. So despite lower volumes of cotton produced in Africa, there remains potential for PAH insurance in the region.

Figure 9: Distribution of GOTS certified facilities



Source: Global Organic Textile Standard (GOTS) - Annual report, 2020
Note: the 10th country not visible in the chart above is Sri Lanka, with 126 GOTS facilities

In 2019/20, 229,280 farmers grew 249,153 mt of organic cotton fibre on 588,425 hectares (ha) of certified organic land, across 21 countries[13]. India produced almost half of global organic cotton fibre over the same period, with China accounting for a much lower 12.3% in second place (figure 10). On the African continent, Tanzania and Uganda surpass Benin, Burkina Faso and Mali with regard to certified organic cotton fibre output, despite the latter group producing significantly more seed cotton. The potential premium values that could be collected from these markets reflect the value of organic cotton they produce.

[12] GOTS. Annual report 2020
[13] Textile Exchange - Organic cotton market report, 2021

Figure 10: Certified organic cotton production in Africa and Asia, 2019/20

Country	Organic cotton fibre production (mt)	Share of global production	Organic cotton fibre value* $	Premium value $ (6%)
India	124,244	49.8%	260,912,400	15,654,744
China	30,589	12.3%	64,236,900	3,854,214
Kyrgyzstan	29,415	11.8%	61,771,500	3,706,290
Turkey	24,288	9.7%	51,004,800	3,060,288
Tanzania	11,285	4.5%	23,698,500	1,421,910
Tajikistan	10,471	4.2%	21,989,100	1,319,346
Uganda	4,734	1.9%	9,941,400	596,484
Pakistan	2,026	0.8%	4,254,600	255,276
Benin	1,373	0.6%	2,883,300	172,998
Burkina Faso	574	0.2%	1,205,400	72,324
Egypt	238	0.1%	499,800	29,988
Uzbekistan	165	0.1%	346,500	20,790
Ethiopia	148	0.1%	310,800	18,648
Mali	85	0.0%	178,500	10,710
Myanmar	32	0.0%	67,200	4,032
Thailand	5	0.0%	10,500	630
Senegal	3	0.0%	6,300	378
Global	**249,153**	**100%**	**523,221,300**	**31,393,278**

Source: Textile Exchange - Organic cotton market report, 2021

**Note: the value is calculated using an average global organic cotton fibre price of $2,110 per mt*

Based on the number of GOTS certified facilities, the value of certified organic cotton produced, and the potential market for premiums, India and Turkey offer substantial opportunities for PAH insurance in Asia. In Africa, Tanzania and Uganda are the most viable options. While the list of GOTS certified facilities contains many non-African and non-Asian countries, most of these traders purchase from target markets, and therefore present a good entry point for PAH insurance.

5.2 Cocoa

Cocoa beans can be transformed into cocoa liquor which can then be used to make cocoa butter or cocoa powder. These can be further processed into chocolate, cosmetics and other foodstuffs. Exported cocoa beans in various forms - whole or broken, raw or roasted - had a combined global value of $9 billion in 2017. The global cocoa bean market is expected to grow

to $16 billion by 2025. The chocolate industry consumed 43% of all cocoa in 2017, with a retail market value of $106 billion[14]. In 2018, the top cocoa bean producers in the world, by value, were Côte d'Ivoire ($2.8 billion), Indonesia ($1.2 billion), Ghana ($611 million) and Cameroon ($558 million)[15].

The cocoa sector is an important source of livelihoods, particularly in developing countries. An estimated five million farming households depend on cocoa as a cash crop, and 70% of cocoa is produced by smallholders living on under $2 per day. These farmers rely on cocoa for between 60% to 90% of their income[14].

The European Union (EU) is critical for the cocoa sector, accounting for over half of global cocoa bean imports[16]. The EU is fully dependent on cocoa imports for its chocolate industry and would indirectly suffer the consequences of climate related disasters in cocoa growing regions. In 2017, 61% of EU cocoa imports originated from Côte d'Ivoire (40%), Ghana (12%), and Nigeria (9%)[16]. Circa 28% of cocoa imports to the European bloc of countries are predicted to be sourced from high to very highly vulnerable locations to drought in 2050 under Representative Concentration Pathway (RCP)[17] 6.0[16]. A significant escalation in drought vulnerability levels are foreseen for supplies of cocoa beans from Indonesia and from Malaysia by 2050, while supplies from Côte d'Ivoire and Ghana are slightly less vulnerable.

High demand for cocoa grown by smallholder farmers and the presence of substantial climate risks facing the crop present a significant opportunity to provide index-insurance under the PAH model.

5.2.1 Certified cocoa

The rationale behind why PAH insurance would work effectively in the organic cotton value chain also applies to certified cocoa farming. On the mainstream cocoa market, the most widespread certification scheme is the Rainforest Alliance. The Rainforest Alliance sustainable agriculture standard 2020 covers agronomic activities related to sustainable production practices, soil fertility and conservation, integrated pest management, and safe agrochemicals management. These aim to support the outcome of sustainable productivity and profitability, as well as natural resource conservation and ecosystem services.

The value of cocoa production certified by the Rainforest Alliance can be used to calculate the potential premium for the harvest value of the crop under a PAH insurance scheme (figure 11). Using the examples of Cote d'Ivoire, Ghana and Indonesia, we looked at the cost of protecting the value of each country's cocoa production. It is important to note that available market

[14] IISD (2019). Global market report: Cocoa
[15] FAOSTAT
[16] Nature Communications (2021). Cross-border climate vulnerabilities of the European Union to drought
[17] RCPs make predictions of how concentrations of greenhouse gases in the atmosphere will change in the future as a result of human activities. The four RCPs range from very high (RCP8.5) through to very low (RCP2.6) future concentrations. Source: Coastal Adapt

prices were used to calculate the premiums; however, the price of certified cocoa is likely to be higher. For Rainforest Alliance certified cocoa, West Africa offers a significant opportunity for this model of insurance.

Figure 11: Estimated premium value for PAH insurance - Rainforest Alliance certified producers in Asia and Africa, 2020

	Price per mt	Estimated production (mt)	Value	Premium (6%)
Cote d'Ivoire	$1,800[18]	191,759	$345,166,200	$20,709,972
Ghana	$1,836[18]	76,854	$141,143,908	$8,468,634
Indonesia	$1,330[19]	8,983	$11,947,390	$716,843

Source: Rainforest Alliance Annual Report 2020

Note: The cocoa price for Indonesia refers to 2019

5.3 Food and beverage manufacturers: A company-based approach to PAH insurance

Food and beverage manufacturers (F&B), especially larger and more established ones, are part of value chains that have been identified as being suitable to PAH insurance. They use agricultural crops as raw materials that are susceptible to the very risks covered by index insurance. Many of the top F&Bs tend to provide agricultural inputs to farmers on loan at the beginning of the season and deduct these costs from harvest proceeds - similar to the PAH insurance model. They maintain strict quality control measures on the crops they use as inputs, in order to guarantee the consistency of their final product. As a result, farmers within these supply chains are often carefully monitored and, in some instances, receive above-market prices for their produce, limiting their ability as well as the incentives to side-sell.

This section of the report analyses the potential for one F&B to adopt PAH insurance. Diageo is a multinational alcoholic beverage production company that owns 138 brands across 180 countries[20].

To support its new 2030 targets, Diageo is building on its existing sustainable agriculture strategy. The company is targeting farming practices and principles that deliver regenerative outcomes for soils and biodiversity, while looking to improve its carbon sequestration[21] capacity and farmer livelihoods. The company is committed to local raw material (LRM) sourcing across its African markets and other regions where smallholders form part of the supply chain.

[18] Reuters
[19] Selinawamuchii
[20] Diageo website
[21] The process of capturing and storing atmospheric carbon dioxide.

Combating climate change and managing the related issue of water stress are strategic priorities for many F&Bs, including Diageo. Many of the company's sites where water stress has been identified are in Africa and Asia (figure 12). The company accepts that physical risks resulting from climate change, such as acute weather events, have the potential to affect its business.

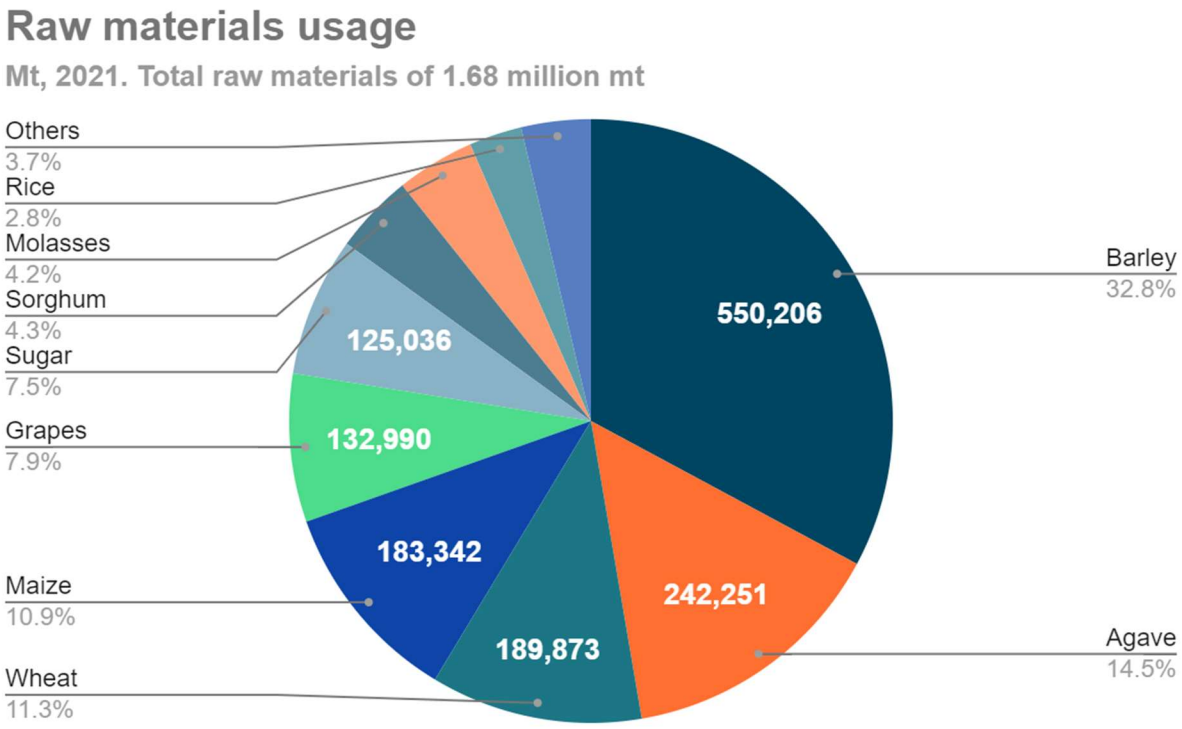
Figure 12: Map of company sites located in water-stressed areas, 2021

Source: [Diageo - Responding to climate related risks 2021]

PAH insurance would be effective for Diageo and is well-aligned with its goals. This is because of the company's focus on sustainable agriculture, their sourcing of raw materials from smallholder farmers, and their commitment to mitigate the effects of climate change as part of their environmental, social and governance (ESG) objectives.

Based on Pula's prior experience, cereal crops (including wheat, maize, sorghum and rice), root crops (e.g., cassava), and sugar crops (e.g., sugarcane and sugar beets) benefit greatly from AYII. These are all key raw materials for Diageo (figure 13).

Figure 13: Raw material inputs for 2021



Source: Diageo - ESP Reporting Index 2021
Note: Other raw materials include dairy, rye, raisins, cassava, aniseed and hops

The company sources significant amounts of raw material from crops sourced from Africa and Asia (figure 14). Each of these key crops are suitable for index-insurance.

Figure 14: Location of select raw materials, 2016

West Africa	Sorghum, Cassava, Maize
East and South Africa	Sorghum, Maize, Cassava, Sugar
India and South Asia	Sugar, Rice, Maize, Wheat, Sorghum
Turkey	Wheat

Source: Diageo - Building sustainable supply chains 2016

In 2016, Diageo spent around $390 million on agricultural produce[22]. The breakdown of agricultural inputs purchased in that year can be used to estimate the potential value of premiums under PAH insurance (figure 15). It is important to note that these figures are not necessarily limited to Africa and Asia, as they represent global purchases. These may also not strictly represent purchases from smallholder farmers but nonetheless offer valuable insights on

[22] Diageo - Building sustainable supply chains 2016

the size of these markets and the value of their investments. Based on this data, there is a substantial opportunity to provide PAH insurance to F&Bs.

Figure 15: Indicative value of potential premiums under PAH insurance, 2016

Raw materials	% of total raw materials	Purchase value	Premium (6%)
Sugar	15%	$58,500,000	$3,510,000
Maize	13%	$50,700,000	$3,042,000
Sorghum/cassava	10%	$39,000,000	$2,340,000
Wheat	3%	$11,700,000	$702,000

Source: Diageo - Building sustainable supply chains 2016

Other F&Bs working in emerging markets likely face similar challenges and could potentially be interested in agricultural insurance, structured through PAH.

5.4 Assessment and ranking of potential to implement PAH insurance using key findings

Pula's research and experience suggests that the ideal approach to implementing PAH insurance should first identify a suitable value chain, and then select the best markets to target. We use the findings in this section to assign scores (1 - worst, 5 - best) to the value chains that have been analysed, according to their potential to successfully implement PAH (figure 16). The agricultural risks facing the separate value chains have not been included in this assessment because all the crops similarly benefit from index insurance. The F&B case study has not been included here because it represents a different, company focused, approach to evaluating the potential for PAH insurance.

Figure 16: Assessment and ranking of potential to implement PAH insurance

Value chain	Value of production and potential market size for premiums	Suitability for PAH	Weighted score sum	Weighted score sum (%)	Top 3 markets in Africa and Asia ranked by potential market size for premiums
Weight	20%	80%	100%		
Cotton as a whole	5	3	3.4	68%	1. India 2. Pakistan 3. Turkey
Cocoa as a whole	4	3	3.2	64%	1. Côte d'Ivoire 2. Indonesia 3. Ghana
Organic cotton	3	5	4.6	92%	1. India 2. Kyrgyzstan 3. Turkey
Certified cocoa	2	5	4.4	88%	1. Cote d'Ivoire 2. Ghana 3. Indonesia

Source: Pula

Note: China was not included in this analysis.

The organic cotton value chain (India, Kyrgyzstan and Turkey) and certified cocoa value chain (Cote d'Ivoire, Ghana and Indonesia) present the greatest opportunities to successfully implement PAH insurance in Africa and Asia.

Despite the advantages that certified crops offer for PAH insurance, this model can still be effective for non-certified value chains. Targeting these farmers is important to promote insurance adoption at scale. In the cases where above-market prices are not an option, offtakers that have long-standing relationships with farmers are less likely to suffer from side-selling due to the trust that has been established. However, this alone is unlikely to be sufficient.

Aggregators that provide agricultural inputs on credit to their farmer networks are incentivised monitor them closely, reducing the likelihood of side-selling. Paying fees linked to the value of insurance premiums collected by offtakers can strengthen this monitoring effect and minimise side-selling.

Finally, farmers who directly experience the benefit payouts offered in the event of a harvest loss are less likely to side-sell in subsequent seasons. This implies that aggregators may have to offer PAH insurance for at least a few seasons with the expectation that some side-selling may

occur. Once farmers have directly observed or experienced the benefits of insurance payouts, the likelihood of them side-selling in the future would decrease.

The country rankings displayed above will be used in dialogue with key stakeholders and wider Pula partners to support the growth of PAH insurance in these markets.

6. Recommendations

Based on our research and experience, we suggest several recommendations to promote the adoption of PAH insurance in Africa and Asia:

1. **Value chain analysis and selection:** PAH insurance can work more effectively in specific value chains. That is, where crops benefit from index insurance, and where incentives and opportunities to side-sell are limited. These should be targeted first, since the odds of successfully implementing PAH insurance are higher. This will determine which regions or countries will be most feasible. Once PAH insurance becomes more widespread, well-known and successful, it can be more readily adopted in other supply chains.

2. **Stakeholder targeting:** Aggregators who purchase directly from farmers should be targeted first for PAH insurance, since they would be responsible for deducting premiums from harvest proceeds. They are also responsible for drawing contracts with farmers, and directly benefit from the improved yields that can result from the adoption of insurance cover. Farmers who are covered by insurance generally feel more confident about investing in their crops, which can contribute to higher yields. This is because insurance protects their investment by offering some return in the event of harvest losses. While aggregators are key, manufacturers and distributors further along the supply chain with strong linkages to farmers would also be able to help implement PAH insurance. The presence of an impact investor willing to pre-finance premiums and absorb first losses is also important. Otherwise, this role would fall to the aggregator, who could be reluctant to take on the additional risk.

3. **Product design and pricing:** Digital farmer registration should be encouraged to promote efficient and accurate data recording. Digital payment channels can help ensure that these transactions are carried out quickly. Insurance premiums should be priced affordably, taking farmers' price sensitivity into account, to minimise the temptation to default.

4. **Capacity building:** In Pula's experience, farmers and other stakeholders who have not worked with index insurance may find it challenging to understand. PAH insurance adds additional complexity to this. Workshops and training sessions targeting the end beneficiary are necessary for PAH to be adopted and for the model to ultimately succeed.

5. **CCE dry runs:** CCE dry runs are used to collect farmer yield data without actually providing insurance cover, where no premiums are paid nor payouts made. This will allow Pula to test its CCE process in the market. The data it yields can be used to illustrate to farmers and other stakeholders what level of payouts they would have received if they had adopted PAH insurance.

6. **Pilot:** Once capacity building and CCE dry runs have taken place, a pilot can be launched to deliver PAH insurance at a small-scale. The process can be used to highlight and rectify any

issues that emerge, before scaling the initiative, helping to spread product awareness, and building trust.

7. **Roll-out:** At this point, the programme would be ready for full scale implementation. Continuous monitoring and evaluation of the scheme is necessary to ensure that some of the issues highlighted in this report are mitigated.