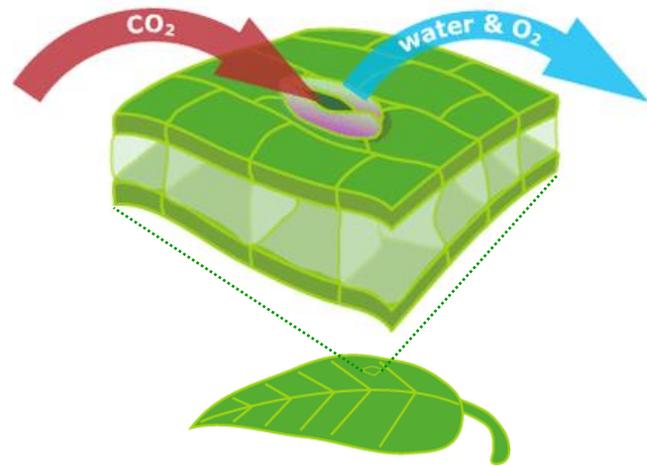


Satellite-based drought index insurance

Drought conditions which adversely impact crop yields can be monitored from space using the EARS Relative Evapotranspiration (RE) Index. The strong relationship between the RE index and crop yields exists because biomass and yield (produced using CO_2 entering the plant) are proportional to evapotranspiration (water exiting the plant). The opening and closing of the plant stomata as a result of drought affects these both equally (see image right), therefore making the RE index highly suitable for estimating drought related crop yield losses.



Biomass and crop yield (produced using CO_2 entering the plant) are proportional to evapotranspiration (water exiting the plant).

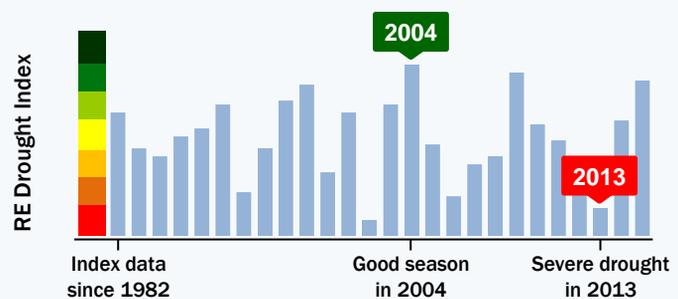
The RE index is used in product design to understand historical drought risk (frequency and severity). Daily index monitoring by satellite then detects when a drought occurs, what the impact on the crop yield is, and how much the farmer should be paid at the end of the season.

How drought index insurance works

Drought index insurance is an innovative type of insurance which pays out based on the level of a pre-determined drought index. The EARS RE drought index is continuously monitored by satellite and represents drought and growing conditions anywhere in Africa. It is an excellent indicator of declining water availability and resulting crop yield losses, both for current conditions as well as historic events.

The RE drought index (right) shows drought severity from year to year in a sample location. If the index drops below a certain point then a payout occurs.

- Long term (since 1982) reliable index data
- No need for on site assessment
- Fast payout and claim handling
- No fraud or moral hazard



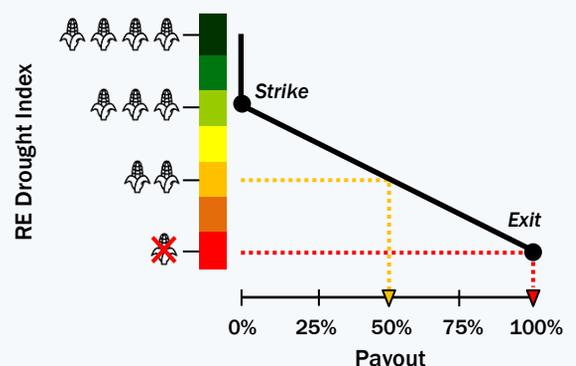
How a payout is triggered

During growing season the RE index tracks drought severity throughout the insured areas. If the index level during the growing season is above average, then no payout is triggered. If the index drops below average, then it indicates the onset of a drought. When the RE index reaches the *strike* level then yield losses are imminent and a payout for that location is triggered. The *exit* marks the maximum payout of 100% of the sum insured in case of a total loss.

Additional product design features are:

- Designs for various crops and drought sensitivities.
- Coverage during different growing seasons.
- Customized rates available per zone, such as a group of farms, subcounty, or district.

The payout (bottom) in each location depends on yield losses indicated by the RE drought index (left)

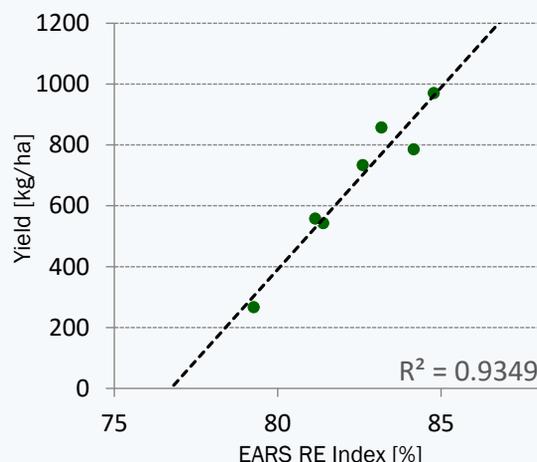


Crop yield and the RE drought index

Plants growing in optimal conditions need significant amounts of water. Water enters the plant through the soil and the roots, and it exits the plant through small pores (*stomata*) in the leaves. The same pores are also used to take in CO₂ from the air, which the plant turns into biomass and crop yield. The water which escapes to the atmosphere from the plant and the soil is called *evapotranspiration*.

When drought stress occurs, plants will close their pores to reduce water loss. The closing of the pores also means less CO₂ is taken up, thereby reducing the amount of yield that the plant produces. Evapotranspiration is also reduced as a result of closing the pores, and because gas exchange for biomass production from CO₂ and evapotranspiration happen through the same pathways they are proportional to each other. This means that a reduction in evapotranspiration results in a proportional reduction in crop yield.

This relationship has long been documented in the field by the FAO⁽¹⁾ but it is also clearly observed in the EARS RE Index produced using satellites (see right).



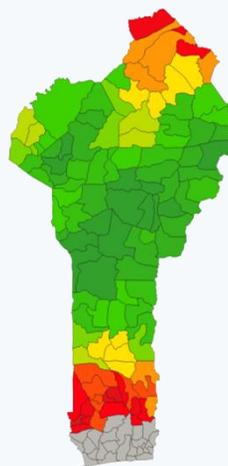
Relationship between the EARS RE Index and annual yields on Kaweri coffee farm in Uganda.

(1) Doorenbos and Kassam (1979) Yield Response to Water, FAO Drainage and Irrigation Paper 33. FAO, Rome.

Product design

During the product design the *strike* and *exit* thresholds are determined depending on the crop, growing seasons, and zoning requested by the insurance company.

Insurance products powered by the EARS RE index have been developed in over 13 African countries for maize, beans, coffee, sesame, sorghum, pasture, and various other crops. Generic products are also available to cover smallholder farmers that grow a combination of crops through an intercropping system.



Premium rates per zone for a cotton product in Benin.

All designs include:

- Maps and databases of risk and premium rates
- Monthly monitoring reports
- Historical payout simulation

How payouts are calculated per zone

Rates and premiums in the RE drought index designs are calculated on 3km by 3km pixels and then aggregated to zones. Zones can be a group of farms, a subcounty, or a district. Everyone in the same zone has the same premium and payout rate for the same sum insured.

