Sovereign Disaster Risk Solutions
A Specialized Agency of the African Union

Technical Analysis of the *Africa RiskView* 2017 Customization for Mauritania

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Content

1. Background

During the joint meet of the ARC Agency Governing Board and representatives of the ARC Ltd Board (collectively, the Meeting Attendees), held on 3-4 November in Washington DC, ARC Agency staff presented to the Meeting Attendees a report about the drought in Mauritania. The report was the result of findings from the ARC team following a field mission to Mauritania from 30 October 2017 to 2 November 2017.

Initial indications suggested that the drought situation is worse than in 2014, when ARC Ltd Drought Policy triggered a 6.3 million USD payment to Mauritania. For the 2017 agricultural season, *Africa RiskView* model shows that Mauritania would not receive a payout with its current customization parameters. This is because the maximum number of people affected estimated by the model stands at 259 043 people, below the attachment point of 400 000 people.

After extensive discussions, the Meeting Attendees concluded that the *Africa RiskView* customization should be reconsidered. The ARC staff's approach consisted of an interrogation of the cause for the discrepancies, and a proposed recommendation to the Board regarding a way forward. The initial indications are that the discrepancies are basis risk issues rather than data input errors made during the customisation process.

2. What Happened?

The results from the *Africa RiskView* model are less severe than the 'on the ground' situation. Based on the analysis performed so far, the following factors have been identified:

2.1. Rainfall overestimation

Africa RiskView uses the FAO Water Requirement Satisfaction Index (WRSI) to detect drought in countries. The WRSI estimates the behavior of the crop or the grassland based on satellite rainfall data. We have noted significant discrepancies between the RFE2 satellite data and meteorological station data especially in the two most populated regions. It is clear that there are some significant differences between satellite-based estimates and measurements on the ground. The differences vary during the season and between stations, but on average satellites have overestimated the amount of rain received on the ground.

2.2. Sowing dates and practices

The information on the ground indicated several failed plantings (roughly in June, July and August, depending on the regions) and only a few moderately successful plantings. After a failed planting, farmers will generally not replant in the same way at the next opportunity (for instance: the area planted might be smaller or the crop variety might be different), or they may abandon the land. The 2017 agriculture season suffered from an alternation of favourable rains and dry spells leading to multiple failed plantings, and eventually the inability to plant and/or discouragement of farmers in many parts of the country. However, *Africa RiskView* is not designed to put a limit to how many times farmers are able to replant and doesn't adjust for reduced planting area after a previous failed sowing. This situation highlights the model's inability to accurately replicate the farmers' behaviour. If we manually adjust (see Annex 2 for the methodology of adjustments) the successful planting dates based on field reports (See Annex 1, option 2, for the source of data), the model shows a significant impact of drought leading to a payout.

2.3. The Water Satisfaction Requirement Index (WRSI) suitability for pasture

There is also doubt about the ability of the WRSI to replicate adequately the severity of a drought on a pastoral season. The discrepancies relate to the complexity of pastures' development, which are not fully captured by the model.

2.4. Potential Evapotranspiration

There were reports in the field about hot and dry winds having a significant impact on Potential Evapo-Transpiration (PET) during extensive periods of time, but the real-time PET data (reflecting actual values instead of long term averages) was not available in *Africa RiskView* at the time of the customization. The reliability and usability of the real-time PET dataset is currently being assessed. Dependent on the results, real-time PET may become a feature of ARV available during the course of 2018.

2.5. Reference crop

Finally, it also appeared during the mission that farmers grow both long and short cycle varieties of sorghum, which is not taken into account in the customisation. However, the chosen reference of 100-day sorghum appears to be robust as changing it to 60 days does not have a significant impact on the estimates of the model.

In conclusion, the main causes of discrepancy are related to model's limitations (satellite data overestimation, farmers' behavior, PET, and rangeland development complexity). We can therefore conclude that what occurred in this case is a basis risk event associated with the model's limitations.

3. Considerations

In order to address this situation, which points to basis risk, we have taken into consideration several facts.

- <u>Lessons learned from the Caribbean Catastrophe Risk Insurance Facility (CCRIF) practices</u>: the CCRIF has a mechanism for dealing with basis risk. The CCRIF offers an aggregate deductible cover (ADC) component as part of their parametric policies. This feature enables CCRIF to make small payouts (that do not put the financial viability of CCRIF's capital at substantial risk) to affected countries on the occurrence of a basis risk event which does not trigger the policy.

- <u>Previous experience</u>: On 21st January 2015, ARC Ltd paid out 6.3 million USD to Mauritania to account for a rainfall deficit in 2014. According to the mission's findings, the situation on the ground in 2014 was less severe than this year. However, we also noted that the customisation and the Risk Transfer Parameters selected by Mauritania were different at the time. If the current customisation and Risk Transfer Processes (RTPs) were used, Mauritania would instead have received a payout of $3.16m in 2014.

- <u>Timeliness</u>: as opposed to a Malawi case where a resolution was reached 5 months after both ARC entity Boards were first informed, the solution we recommend should be timely so that ARC remains the first-responder to a drought situation because our biggest value added for our Member States is timely response. In the case of Mauritania, a response is needed by January 2018, as the lean season[1] starts in February 2018.

[1] A period of time that farmers have less of something such as food, money.

4. Recommendations

Based on our inferences made from the findings, this is a basis risk event resulting from the limitations of the ARC model, and ARC recommends the following approach for determining the payout amount:

- Approach: We are proposing to adjust[2] *Africa RiskView* outside of the parameters of Mauritania's current contract. It could be positioned as a basis risk payment (subject to ARC Ltd Members approval) using *Africa RiskView* and a spreadsheet model as tools to help determine a basis risk response amount based on the actual situation on the ground. We are not operating within the scope of parametric insurance, but rather calculating a basis risk payment in recognition of *Africa RiskView*'s limitations. The use of *Africa RiskView* and a spreadsheet model to calculate a basis risk payment may also serve as a key principle which could inform how a formalized basis risk fund would work in future.

- "Tailoring" *Africa RiskView* for 2017: We propose manually adjusting the assumptions made by the *Africa RiskView* after the fact to determine the amount of a basis risk payment to correct for factors that were not modelled in *Africa RiskView* for 2017. Based on the analysis of currently available ground data, a basis risk payout amount would be 2.4 million USD. Please refer to annex 4 for a detailed description of the methodology used.

- If, in addition, we manually use zero rainfall as observed on the ground, using a simplified method in *Africa RiskView* to substitute the satellite rainfall data as the rainfall estimated was zero in the areas we know didn't receive rain in certain periods, the payout amount would be higher than the 2.4 million USD by approximately 0.5 million USD. However, the ARC Technical Team does not recommend this sort of correction of rainfall overestimation, due to the fact that there are not enough rainfall ground meteorological stations to infer the discrepancy at regional level and use the vulnerability data at regional level to actually quantify the impact of this factor in terms of people affected.

[2] Please see annex 3 for considerations on the source of data for the correction of *Africa RiskView*

5. Other Important Elements

Beyond the financial resolution of the discrepancies between *Africa RiskView* and the actual drought situation in Mauritania, ARC is also looking at improving the model and the customization process. One of the most important components in this regard is the creation of a Technical Advisory Committee and a Customization Review Committee. Both Committees, composed of international, regional, and national experts, will examine in detail the model properties and its input. The first meetings will take place in the first quarter of 2018.

Finally, a signal has also been raised by the Government of Mali, where a dry spell in September seems to have destroyed a significant number of crops, and where *Africa RiskView's* estimates point to a potential underestimation of people affected. As per the Standard Operating Procedure developed to deal with potential discrepancies between the model and a situation on the ground, the ARC will be in Mali to assess the situation from 29 November to 1st December.

In order to give the Ad-Hoc Committee a comprehensive view of the potential situation, the ARC Technical Team has compared the situation on the ground with that of *Africa RiskView* in all the insured countries in the Sahel. It appears that only Mali will require further assessment. In Mali, the situation seems to be in no way as severe as in Mauritania, and ARC has not yet determined what the causes for discrepancies are. As such, ARC staff recommend that the ARC entity Boards expand the mandate given to the Ad-Hoc Committee (relating to Mauritania) to also provide guidance to ARC staff and recommendations to the Boards regarding Mali as required.

Annex 1: Considerations on data used to adjust Africa RiskView

In order to adjust Africa RiskView, ARC Technical Team explored the possibility of using the real sowing dates practiced by the farmers, and inserting them into *Africa RiskView* to reproduce the farmers' behaviour in the 2017 season. The team looked at four options for sourcing the data, each with varying levels of reliability, timeliness, and practicality:

Option 1: The team contacted the Technical Director in charge of value chains at the Ministry of Agriculture and sent him a questionnaire. His task was to conduct telephone interviews with each focal point in the regions to obtain the sowing dates used by farmers. Unfortunately, the quality and accuracy of the data obtained were not satisfactory enough so the team resolved not to use the information received.

Option 2: The team explored the possibility of using the mission reports from the GTS or Specialized Technical Group on food security, composed of the Government and the Partners. Between September and October, the GTS went to the field in each wilaya (region) to assess the season. The list below shows the composition of the team per wilaya visited, and the date of the visit:

Hodh El Chargui: the World Food Program, Action Contre la Faim, and Ministry of Agriculture (mission conducted from 28/09 to 06/10).
Hodh el Gharbi: the World Food Program, Action Contre la Faim, and Ministry of Agriculture (mission conducted from 28/09 to 06/10).
Tiris Zemmour: The Ministry of Agriculture and the Food Commission (October 2017)
Adrar: The Ministry of Agriculture and the Food Commission (October 2017)
Inchiri: The Ministry of Agriculture and the Food Commission (October 2017)
Tagant: Ministry of Agriculture and FAO (25/09 to 04/10)
Assaba: Ministry of Agriculture and FAO (25/09 to 04/10)
Guidimakah: Ministry of Agriculture and FAO (25/09 to 04/10)
Brakna: Ministry of Agriculture and Food Commission (October 2017)
Gorgol: Ministry of Agriculture and Food Commission (October 2017)
Trarza: Ministry of Agriculture and Food Commission (October 2017)

Option 3: An additional option would be to commission a field survey as it was done in the case of Malawi to collect the information directly from the farmers. The team did not yet explore this option because timeliness was an important factor in the Boards's recommendation at the November's board meeting. In 2014, the payout to Mauritania was released on 26 January, and the objective, if a payout is released to Mauritania, is to respect this deadline, especially because of the indications of the lean period starting as early as February. However, if this option is adopted, ARC could commission an independent field study, which would take up to 30 to 45 days to complete excluding the procurement processes. It is important to consider that this option would not be completed before the 2018 Conference of the Parties, which is to take place the week of 8 March in Nouakchott.

Annex 2: Methodology used for *Africa RiskView* adjustment

The outcome of the drought methodology used in Africa RiskView as per the terms of the contracts with Mauritania are as follows:

Sorghum component:

Wilaya	2017 WRSI value	Benchmark	2017 Drought Ratio	# people affected
Assaba	62.0	74.7	83%	32,629
Brakna	37.4	46.8	80%	45,479
Gorgol	68.1	74.5	91%	0
Guidimaka	99.5	96.2	103%	0
Hodh Ech Chargui	76.6	79.8	96%	0
Hodh El Gharbi	59.3	75.5	79%	62,391
Tagant	27.6	45,2	61%	7,779
Trarza	23.6	43.2	55%	31,565
TOTAL				**179,843**

Rangeland component:

Wilaya	2017 WRSI value	Benchmark	2017 Drought Ratio	# people affected
Assaba	64.3	76.2	84%	18,884
Brakna	52.7	64.9	81%	20,655
Gorgol	82.9	81.5	102%	0
Guidimaka	91.9	85.7	107%	0
Hodh Ech Chargui	39.9	38.2	105%	0
Hodh El Gharbi	67.8	78.7	86%	16,530
Tagant	20.9	34.1	61%	9,219
Trarza	19.8	43.2	46%	14,255
TOTAL				**79,543**

Total (Sorghum + Rangeland) = 259,386

As explained in this report, several potential sources of discrepancy between the modelled estimate and the situation on the ground have been identified (see section 2 of this document):

1. Satellite data overestimation
2. Potential Evapo-Transpiration
3. Sowing dates and practices
4. WRSI suitability for pastures
5. Reference crop

Most of these potential causes can unfortunately not be addressed in the short term in ARV:

1. The satellite data (RFE2 in the case of the Mauritania customisation) is produced by NOAA[3]. Only 6 synoptic weather stations are located within the sorghum calculation mask of the Mauritania customisation of ARV. An analysis by ARC Technical team has shown that, on average, for these 6 stations and since 2001, there has been a gradual shift from underestimation to slight overestimation. It is unclear whether there is indeed a systematic overestimation by RFE2, or what the reason for that might be. Nevertheless, while RFE2 has been selected by the TWG for better historical performance, ARC2 is also available in ARV.

[3] National Oceanic and Atmospheric Administration (www.noaa.gov)

Switching to ARC2 increases the estimates slightly (from approx. 260 to 310 thousand), but not enough to explain the extent of the discrepancy observed on the ground. Other satellite rainfall datasets are currently being reviewed and will be made available in ARV for future pools.

2. The Potential Evapo-Transpiration (PET) used in ARV is based on long-term averages produced by FAO[4]. As such, it doesn't allow ARV to take into account unusual circumstances like higher-than-average temperatures, drying wind conditions etc. A new real-time dataset is currently being reviewed by IRI[5] and will be made available in ARV for future pools.
3. Planting dates are estimated by ARV on the basis of rainfall timing and "modelled" farmer behaviour. It has become clear after the field missions and extensive discussion with various partners that ARV has not appropriately captured the actual planting dates. This is partly due to ARV assigning some failed plantings as successful plantings (which itself may be due to the overestimation of rainfall by satellites and/or the underestimated PET which can both result in dry spells not being correctly identified) and partly because of the complexity of actual farmer behaviour which can only be partially captured in ARV (which must be locked for insurance purposes at the start of the growing season). Indeed, it was reported by the Mauritania Technical Working Group that a major contributor to the severity of the situation on the ground in 2017 is due to an aspect of farmer behaviour that had not been discussed before (partly because it is not modelled in ARV): many farmers in Mauritania are unable – or consider it too risky – to replant the same amount or the same quality of seeds after one or several failed plantings. This year the extensiveness of early plantings failure at the beginning of the season has made that behaviour more prominent and, thus, a point of discussion.
4. While there are some concerns about the suitability of WRSI as an indicator for pasture development, there is currently no alternative in ARV. However, ARC is actively looking at other indices (in particular NDVI-based indices) to be added to the drought modelling options. These should become available in 2018.
5. The reference crop chosen by Mauritania is long-cycle sorghum. While it was indicated to the ARC team that short-cycle sorghum also plays an important role in food security in Mauritania, the long-cycle sorghum is normally what represents the bulk of the production. In future pools it might be relevant to represent both long-cycle and short-cycle sorghum in the customisation, but in terms of results of the 2017 agricultural season, this parameter doesn't explain ARV underestimation of the situation on the ground. In fact, switching to a short-cycle sorghum results in a smaller modelled impact (approx. 83,000 vs 180,000), indicating that the drought this year mostly affected long-cycle sorghum.

Therefore, it appears that the only identified potential source of discrepancy that can be addressed is the sowing dates and the area planted. While the correction of WRSI to account for a reduction in area planted is not currently part of the drought model in ARV, this particular situation has pointed to the relevance of such a component in the model, and some steps have already been taken by the ARC development team to address that. However, until this work is finalised, this can only be manually adjusted.

Indeed, these two factors can be confirmed by looking at external data, and ARV's estimates in that regard can be corrected so that the WRSI values are calculated on a more appropriate basis.

Unfortunately, at the time of this review, few sources of information were available to implement this correction.

- The Government has scheduled a survey on crops planted, yields, production etc. to start at the beginning of December, but results would not be available until late-January or February.

[4] Food and Agriculture Organisation of the United Nations (www.fao.org)

[5] International Research Institute for Climate and Society (iri.columbia.edu)

- Mid-season field visits by the *Groupe Technique Specialisé* (GTS) have results in a series of narrative reports which describe the situation in the field between approx. 25 Sep and 5 Oct.
- ARC attempted to liaise with the Ministry of Agriculture to conduct a series of telephone interviews with key informants in the wilayas, but this proved unsuccessful (with the information obtained turning out to be incomplete, inconsistent and/or irrelevant).

Therefore, at this stage, only the GTS reports can be used to address ARV inability to correctly estimate the sowing dates. However, the reports do not provide clear information about sowing dates and instead focus on the current stage of development of crops at the time of the mission. Therefore, in order to estimate the corresponding sowing dates and the percentage of area planted, it is necessary to make a series of assumptions, in particular about the duration of the various development stages, about the sorghum varieties being observed, and about the percentage of area having reached that stage.

For example, for Gorgol, where the report says that "traditional cereals are at the tillering stage for late-maturing varieties", it is assumed that:
- "late-maturing varieties" refers to 125-day varieties,
- tillering stage corresponds to days 10-20 for a 125-day variety,
- and therefore planting occurred 10-20 days before the time of the mission (which took place approx. 1 Oct), i.e. 11-21 September = dekads 26 and 27.

Even though the customisation is based on 100-day varieties, it is further assumed that 100-day sorghum would have been planted at the same time as the varieties mentioned in the report.

Furthermore, in order to accommodate various development stages or development stages that last more than 10 days (corresponding to a variety of possible planting dates), the aggregation method in ARV has been switched to 'average', meaning that equal weight will be given to the various possible planting dates.

These revised sowing windows were then used in *Africa RiskView* and the WRSI values for 2017 per wilaya have been recalculated accordingly.

Wilaya	**Sowing dekads interpreted from the GTS reports**	**Corresponding WRSI value for 2017 as per ARV**
Assaba*	n/a	62.0*
Brakna	D23-D26	33.3
Gorgol	D26-D27	11.9
Guidimaka	D23-D24	55.4
Hodh Ech Chargui	D24-D26	31.6
Hodh El Gharbi	D24-D27	28.4
Tagant	No successful sowing	0
Trarza*	n/a	23.6*

* Since no information for rain-fed agriculture was available for Assaba and Trarza, the WRSI used is the one produced by the original customisation.

In relation with the reduction of area planted as a result of farmers' inability to replant after one or several failed plantings, the GTS reports also provide useful, but qualitative, information. It appears that for those late planting opportunities, many farmers didn't grow anything, or planted on only part of their land, so that even in areas where the conditions turned out to be good, the reduced area planted or the lower quality of seeds used resulted in a lower production as compared to what they would have harvested under identical conditions had planting occurred earlier in the season. From a modelling perspective, this means that the WRSI, which is by definition a proxy for yield, should be adjusted to also be used as a proxy for production and, in turn, for income (which is what the model uses to estimate impact of drought on vulnerable populations).

Until a corresponding functionality can be developed for ARV, the best way to take that into account is by looking at ground data on reduced area planted. For example, the GTS report for Hodh El Chargui says that “in comparison with last year, the area planted has declined sharply due to replantings and abandonments”, in which case it is assumed that 25% of fields were left unexploited. The situation is similar in Brakna, Gorgol and Hodh El GharbiIn. In one extreme case (Tagant), the report says that “rain-fed agriculture is inexistent”, and therefore it is assumed that 100% of fields are empty and therefore the Water Requirement Satisfaction Index is assumed to be 0. Guidimakha is the only wilaya where the season was reported to be going well. No information was available for rain-fed agriculture in Trarza and therefore it was assumed that 100% of fields were grown.

Since a failed harvest (or an empty field) corresponds to a WRSI value of 0, the average WRSI value at wilaya level is calculated by multiplying the WRSI calculated previously by the percentage of fields that is estimated to be planted. The table below shows the initial WRSI values per wilaya, as well as the area planted reduction factors, and the adjusted WRSI values.

Wilaya	**Intermediate 2017 WRSI value (based on actual planting dates)**	**Estimated area planted in late plantings**	**Adjusted 2017 WRSI value (based on actual planting dates and area planted)**
Assaba	62.0	25%	15.5
Brakna	33.3	75%	25.0
Gorgol	11.9	75%	8.9
Guidimaka	55.4	100%	55.4
Hodh Ech Chargui	31.6	75%	23.7
Hodh El Gharbi	28.4	75%	21.3
Tagant	0	0%	0
Trarza	23.6	100%	23.6

These adjusted WRSI values have then been compared to the Benchmark values as per the original customisation to obtain the adjusted Drought Ratio. (Obviously, the Benchmark values are left unchanged since the customisation is still considered to be valid, and the unusual circumstances having resulted in the discrepancy between the model and the reality only apply to 2017.) Finally, these Drought Ratios have then been compared with the vulnerability profiles to calculate the number of drought-affected people in each wilaya.

Wilaya	**Adjusted 2017 WRSI value**	**Benchmark**	**Adjusted 2017 Drought Ratio**	**Adjusted number people affected**
Assaba	15.5	74.7	21%	35,024
Brakna	25.0	46.8	53%	46,570
Gorgol	8.9	74.5	12%	99,029
Guidimaka	55.4	96.2	58%	70,022
Hodh Ech Chargui	23.7	79.8	30%	44,856
Hodh El Gharbi	21.3	75.5	28%	64,261
Tagant	0	45,2	0%	7,779
Trarza	23.6	43.2	55%	31,565
TOTAL				**399,106**

This number corresponds to the number of farmers that is estimated to have been affected by drought as per ARV methodology, following the corrections on sowing dates and area planted as described above. Compared with the numbers provided by the original (unadjusted) customisation, the differences mostly concern Gorgol (+99,029 people), Guidimaka (+70,022 people) and Hodh El Chargui (+44,856 people).

Adding to that the number of herders that is estimated to be affected as per the original rangeland customisation (79,543 people), we get a total of **478,649 drought-affected people**, for a total estimated response cost of $28,718,937. This is $4,718,937 more that the attachment point of $24,000,000 and therefore the corresponding payout would be $4,718,937 * 51.2% = **$2,416,096**