Digital Weather Advisory Service (DWAS) Survey Report

Farmers First *May 2025*

EXECUTIVE SUMMARY

Pilot Summary and Design

In LR2024, One Acre Fund ran a Digital Weather Advisory Services (DWAS) pilot in our Kenya program, known locally as **Tupande**. The pilot delivered weather forecast information to farmers via SMS and assessed its impact on their agricultural decision-making and yield outcomes. We first conducted design workshops with farmers in 2023 to develop our SMS service design, and ultimately tested three weather forecast treatments to evaluate the optimal message frequencies and costs:

(a) 5-day forecast, delivered 3x per week
(b) Weekly + 48 hour forecast
(c) Weekly + daily forecast, with AM/PM breakdown

The pilot was regionally stratified by running it in each of the 837 Tupande territories, with 6 clients randomly selected per territory to receive DWAS (2 per treatment described above).

In Q3-Q4 2024, the Monitoring, Evaluation and Learning (MEL) team surveyed farmers on their self-reported yields from LR2023 and LR2024 to evaluate the impact of LR2024 DWAS using a difference-in-difference (DiD) design. The control group were randomly selected Tupande clients, also stratified across the territories, who did not receive DWAS. We have captured the full sample size, broken out by region and treatment method, below:

DWAS Design	# farmers in pilot	# Farmers surveyed for impact evaluation					
		L. Western	U. Western	Nyanza	Rift	Mt. Kenya	Total
Control	5,022	*673*	*450*	*375*	*90*	*78*	**1,666**
5-day forecast	1,674	*222*	*159*	*126*	*37*	*30*	**574**
Weekly + 48hr	1,674	*246*	*171*	*124*	*27*	*29*	**597**
Weekly + daily	1,674	*255*	*151*	*122*	*32*	*26*	**586**

Findings

Impact:

- On average, across all treatment groups combined, farmers receiving our DWAS services saw a 6.4% yield increase (p = 0.117).
    - When we exclude farmers who were affected by drought or flood, this yield increase rises to 11%.
- **The 'Weekly + Daily' design is much more impactful than the others**, delivering a significant yield increase of **12%** (p = 0.039).

    - Excluding farmers affected by drought or floods, the yield increase is **18%.**
- The results from the 'Weekly + Daily' treatment arm drove the bulk of our DWAS pilot's impact; by comparison, the impact for both the '5-day, 3x per week' and the 'Weekly + 48 hour' service designs was far lower and not statistically significant.

Social Return on Investment (SROI):

- SROI, a metric of cost-effectiveness, measures the amount of farmer impact generated per donor dollar invested in an initiative
- The Weekly + Daily forecast SMS design costs approximately $0.56 per client to deliver, and generates an estimated impact of $44 per client, meaning it achieves an **SROI of 79:1**.
- Moreover, we expect that we can further increase the SROI of our DWAS initiatives by reducing the period over which the SMS is sent (in this trial, it was 7 months)
- Since the impact of the other treatment arms was not statistically significant, we did not evaluate SROI

Customer Satisfaction & Net Promoter Score (NPS):

- Participants shared positive feedback on the trial itself:
    - 88% of those surveyed reported that the messages they received were easy to understand
    - 88% felt that they were accurate
    - 72% would recommend Tupande's DWAS program to others
- DWAS also drove an increase in customer satisfaction with our program in Kenya
    - One Acre Fund regularly evaluates our clients' "Net Promoter Score," which measures customer loyalty and satisfaction from -100 to 100
        - Above 0 is good, above 20 is favorable, and above 50 is considered excellent
    - Clients who participated in our DWAS pilot reported a **4-percentage-point bump in NPS score**, indicating that they are more likely to recommend Tupande to others
    - NPS for the DWAS service alone was 57 (breakdown by service type TBD)

Forecast Type	**% Yield Increase** *(p value)*	**SROI**	**NPS for Tupande**
Control (no forecast)	-	-	66
5-day Forecast	7% *(0.254)*	n/a	67
Weekly + 48-hour	1% (*0.893)*	n/a	72
Weekly + Daily	**12% *(0.039)***	**79**	**70**
All DWAS Treatments	**6% (0.117)**		**70**

Recommendations

The pilot results show that the weekly and daily service type had the highest impact, resulting in an average 12% yield increase for participants. An SROI of 79 is also very strong, putting it among some of the most cost-effective of our interventions (e.g., Kenya's agroforestry program achieved an SROI of 26 in 2024). **We therefore recommend scaling the service offering to all farmers.**

While the pilot results encourage scale-up, we recognize that further research is required – for instance, into the factors contributing to lower comprehension in the Mt. Kenya and Rift Valley regions. We will only fully realize DWAS' potential if we implement it with a strong emphasis on farmers' understanding and engagement with the SMS.

FULL REPORT

Context

Weather variability poses a significant challenge for smallholder farmers in Kenya, impacting crop yields and farming decisions. **Access to timely and accurate weather information can assist farmers in optimising their agricultural practices, potentially enhancing productivity and mitigating risks.** In 2024, One Acre Fund implemented a Digital Weather Advisory Service (DWAS) pilot to assess the effectiveness of delivering weather forecasts via SMS to farmers and their impact on agricultural outcomes.

The pilot covered 258 zones across all regions where One Acre Fund operates, including the Central, Western, Nyanza, Rift Valley, and Mount Kenya regions. The intervention targeted 10,044 farmers from One Acre Fund's core program, who were randomly assigned to treatment and control groups to assess the causal impact of DWAS on yields.

Hypotheses and Trial Objective

Objectives:

- To assess the impact of DWAS on farmers' maize yields.
- To evaluate farmers' understanding and perception of the weather forecasts.
- To identify the most effective forecast service design.
- To assess the impact of DWAS on the Tupande program.
- To generate insights for improving and scaling DWAS in future seasons and other regions.

Hypotheses:

- Farmers receiving DWAS will achieve higher yields compared to those who do not receive forecasts.
- Different forecast delivery methods will have varying impacts on yield outcomes.
- DWAS will have a greater impact in regions with stable weather conditions compared to regions frequently affected by extreme weather events.

Intervention Design

The study utilized a randomized controlled trial design, with randomization conducted at the farmer level and stratified by One Acre Fund territory.

- **Control Group:** Farmers received no weather forecast messages.
- **Treatment Group:** Farmers received one of the following forecast types:
    - **5-day forecast:** Delivered three times per week (Monday, Wednesday, Friday).
    - **Weekly + daily forecast:** Weekly overview on Monday, with daily forecasts including AM/PM breakdowns
    - **Weekly + 48-hour forecast:** Weekly overview on Monday, with 48-hour updates every other day

Sample and Methodology

I. Sample

The sample size was determined using power calculations informed by One Acre Fund's MEL data and literature on weather information on yield in similar Sub-Saharan African contexts. At least 2,200 farmers per group were needed to detect a 5% yield increase with 80% power. To address potential data quality issues with self-reported yields, we oversampled, targeting 5,000 farmers. Budget constraints limited data collection to a single survey, in which farmers reported their yields.

The total sample included 10,044 farmers, divided equally between treatment (n=5,022) and control (n=5,022) groups. Table 1 below presents the distribution of farmers across regions and forecast types.

Table 1: *The number of control and DWAS farmers who participated in the pilot and those who were surveyed, split by region and DWAS service type.*

Region	Treatment	# of farmers in the pilot	# of farmers surveyed
Lower Western	Control	1,920	673
	5-day forecast	640	222
	Weekly + 48 hour forecast	640	246
	Weekly + daily forecast	640	255
Upper Western	Control	1,494	450
	5-day forecast	498	159
	Weekly + 48 hour forecast	498	171
	Weekly + daily forecast	498	151
Nyanza	Control	966	375

	5-day forecast	322	126
	Weekly + 48 hour forecast	322	124
	Weekly + daily forecast	322	122
Rift	Control	390	90
	5-day forecast	130	37
	Weekly + 48 hour forecast	130	27
	Weekly + daily forecast	130	32
Mount Kenya	Control	252	78
	5-day forecast	84	30
	Weekly + 48 hour forecast	84	29
	Weekly + daily forecast	84	26

II. Data collection and evaluation approach

Data collection occurred post-harvest, when farmers reported their yields for the long rain (LR) seasons of 2023 and 2024. The difference-in-differences (DiD) approach was employed to estimate the causal impact of DWAS on yields by comparing yield changes in the treatment and control groups across the two seasons.

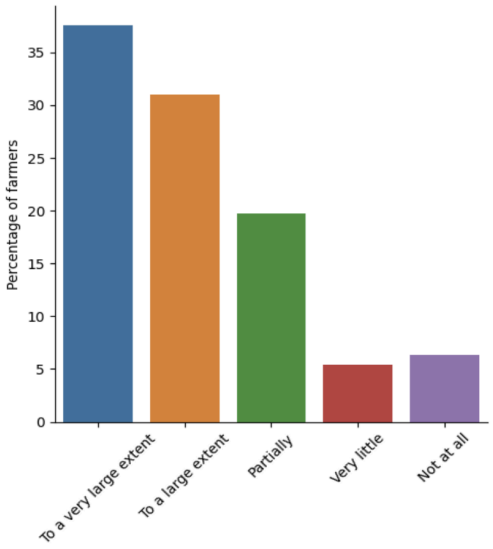
Additional analyses explored the relationship between farmers' understanding of the messages, their perception of forecast accuracy, and their influence on farming decisions. Net Promoter Scores (NPS) were calculated to assess farmers' willingness to recommend DWAS and Tupande services.

Findings

I. Farmer comprehension and perception of DWAS messages

As shown in the graph below, 98% of treatment farmers confirmed receiving DWAS messages. 88% reported understanding the messages to a large or very large extent. 12% of respondents stated that they either did not understand the messages at all or only understood very little.

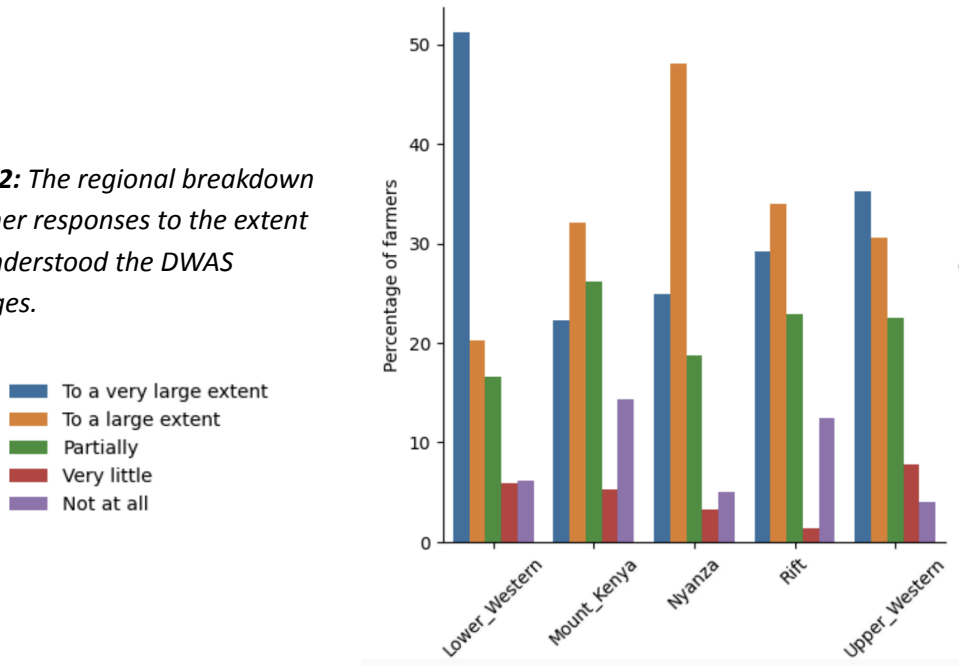
Figure 1: *The national breakdown of farmer responses to the extent they understood the DWAS messages.*



Surveys revealed significant regional variations in comprehension levels. **Figure 2** below illustrates that DWAS message comprehension was high in Lower Western, Upper Western, and Nyanza, with minimal dissatisfaction. However, both Mount Kenya and the Rift Valley had a high proportion of farmers selecting “not at all” for understanding, suggesting there may have been some communication barriers in these areas.

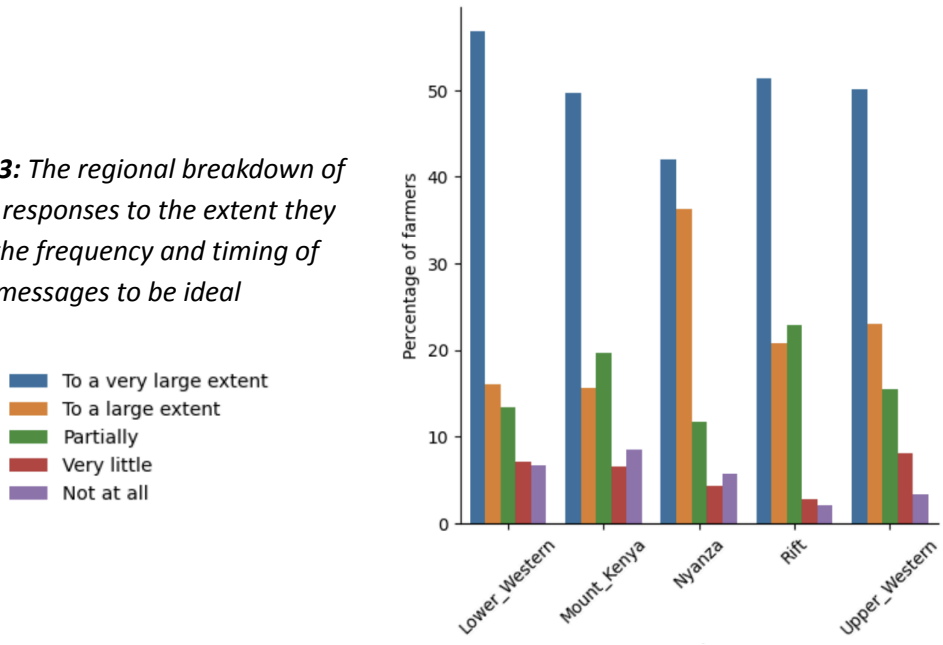
Internal MEL surveys indicate that compared to the other regions, Mt. Kenya and the Rift Valley both have a higher percentage of farmers with at least a secondary degree education. This implies that literacy was not the core driver in this result; further research is therefore required to identify how we can improve our communication in these areas.

Figure 2: *The regional breakdown of farmer responses to the extent they understood the DWAS messages.*



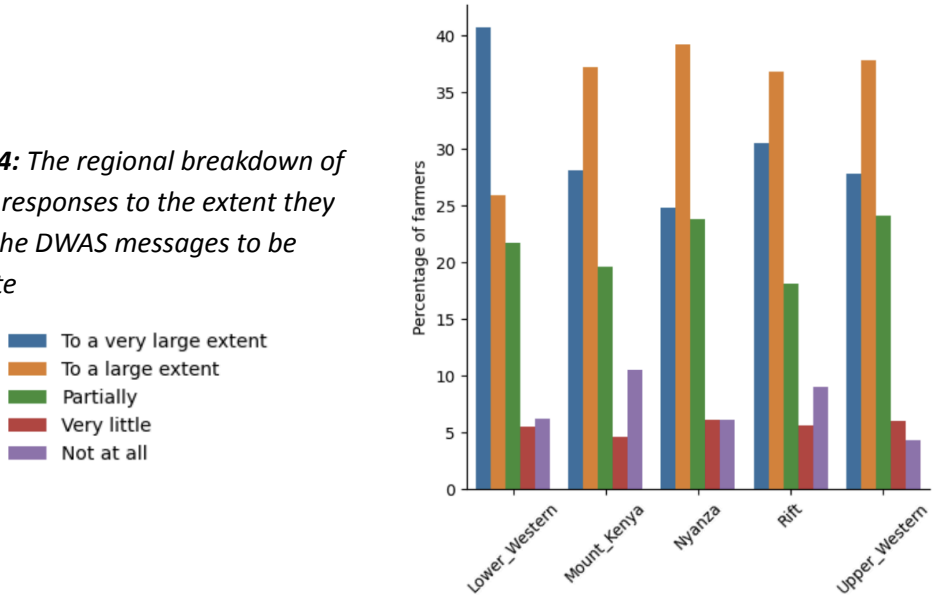
As shown in **Figure 3** below, the majority of respondents in all regions reported satisfaction with the timing and frequency of One Acre Fund's DWAS messaging. Specifically, **73.6%** of the farmers said the timing and frequency of the SMS were partially, to a large extent, or to a very large extent ideal. This indicates a generally positive perception, which was further reinforced by customer satisfaction results.

Figure 3: *The regional breakdown of farmer responses to the extent they found the frequency and timing of DWAS messages to be ideal*



As shown in **Figure 4** below, 88.2% of farmers surveyed found the messages accurate, while 11.8% reported them as very low accuracy or not at all accurate. The Mount Kenya and Rift Valley regions showed lower accuracy perceptions, correlating with the lower message comprehension rates captured in Figure 2. These findings give some confidence in how well the weather forecasts matched the farmers' actual experiences.

Figure 4: *The regional breakdown of farmer responses to the extent they found the DWAS messages to be accurate*



Key highlights from **Figure 5** below include:

- Farmers who understood the messages "to a very large extent" also overwhelmingly perceived the messages as accurate "to a very large extent" (56%). Another good proportion of these farmers believed the messages were accurate "to a large extent" (24.5%).
- Farmers with "very little" understanding of the messages were more likely to perceive the messages as "very little" accurate (24.8%) or "not at all" accurate (14.0%).
- Farmers who reported "not at all" understanding the messages overwhelmingly perceived them as "not at all" accurate (57.1%).
- Farmers reporting lower levels of perceived accuracy generally correspond to those reporting lower levels of understanding

Overall, there is a **strong positive relationship** between understanding the DWAS messages and perceiving them as accurate. Farmers who understood the messages well were more likely to consider them accurate.

Conversely, low levels of understanding of the messages correlate with low levels of perceived accuracy. This suggests that a lack of comprehension may contribute to scepticism regarding message accuracy. The effect could also occur in the opposite direction. Thus, either poor comprehension leads to scepticism about forecast accuracy, or poor forecast accuracy results in scepticism about one's own understanding of what the forecast is intended to convey.

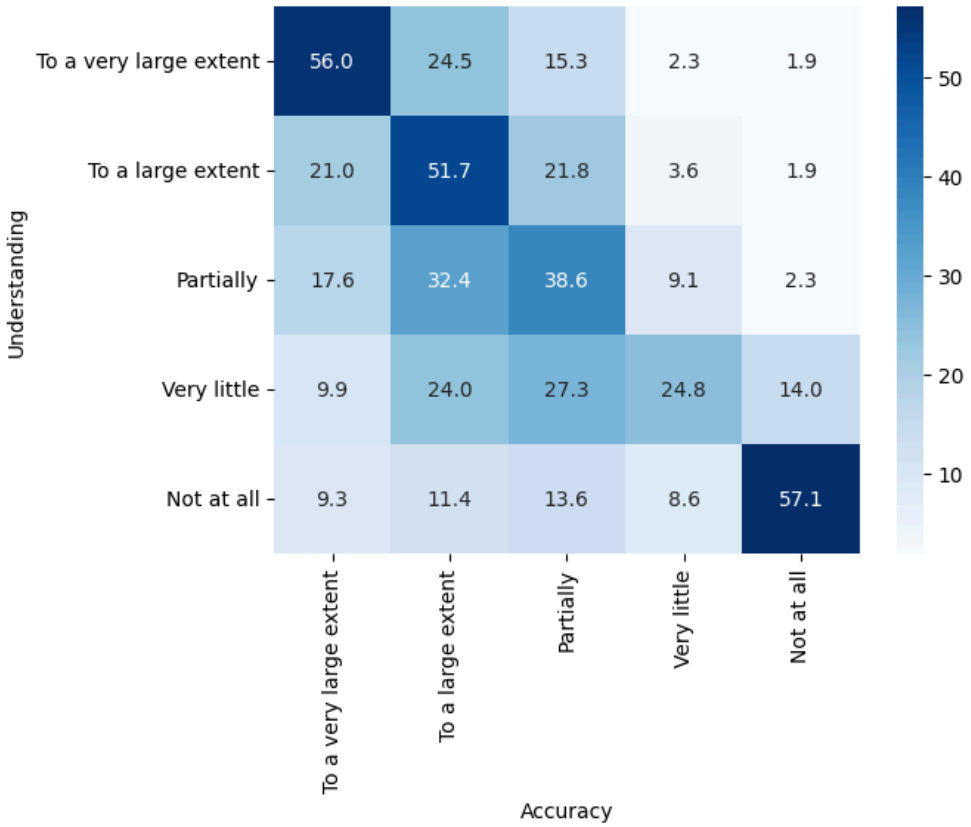


Figure 5: *Relationship between farmers' understanding of messages and their perceptions of message accuracy. The darker the blue colour, the more farmers in that box; the lighter the blue colour, the fewer the farmers in that box.*

II. Influence on farming decisions

Overall, **63.5%** of farmers reported that the DWAS messages influenced their farming decisions to a large or very large extent. However, 36.2% indicated that the messages had very little to no influence at all on their farming decisions.

Figure 6: *The national breakdown of farmer responses on the extent to which DWAS messages influenced their farming decisions*

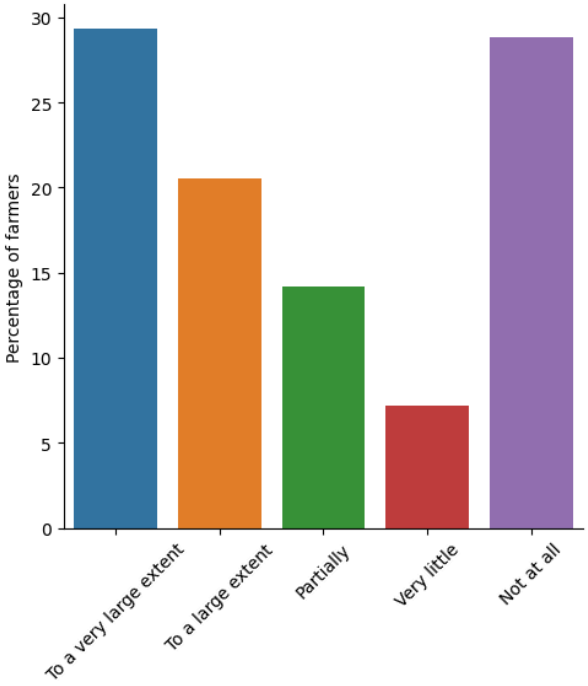
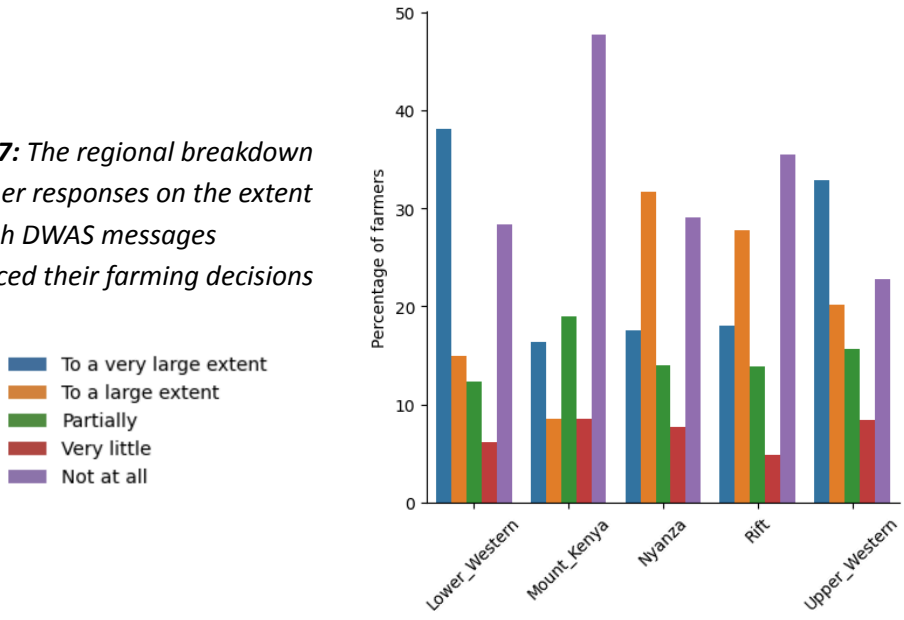


Figure 7 shows that farmers in Mount Kenya and the Rift were most likely to say that the messaging did not affect their farming decisions. This could be attributed to the fact that more farmers in those regions said they didn't understand the messages, as shown in Figure 3.

Figure 7: *The regional breakdown of farmer responses on the extent to which DWAS messages influenced their farming decisions*



Key observations from **Figure 8**, below, include:

- Farmers who understood the messages "to a very large extent" overwhelmingly reported that the SMS messages had an impact (58.3%).
- Farmers with "very little" understanding mostly perceived the SMS messages as having "no impact at all" (38.8%) or "very little" impact (27.3%).
- Farmers who reported "not at all" understanding the messages overwhelmingly felt the SMS messages affected their farm decision making "not at all" (**85%**).

Overall, there is a **clear positive correlation** between **understanding the messages** and **perceiving them as impactful**. Farmers who better understood the SMS messages were more likely to report that they significantly impacted their decision-making or outcomes.

Conversely, low understanding is strongly associated with perceptions of "no impact at all," suggesting that comprehension plays a critical role in recognizing the value of DWAS messages.

The results also highlight a gradient: As understanding decreases, perceptions of impact shift towards "no impact at all" or "very little."

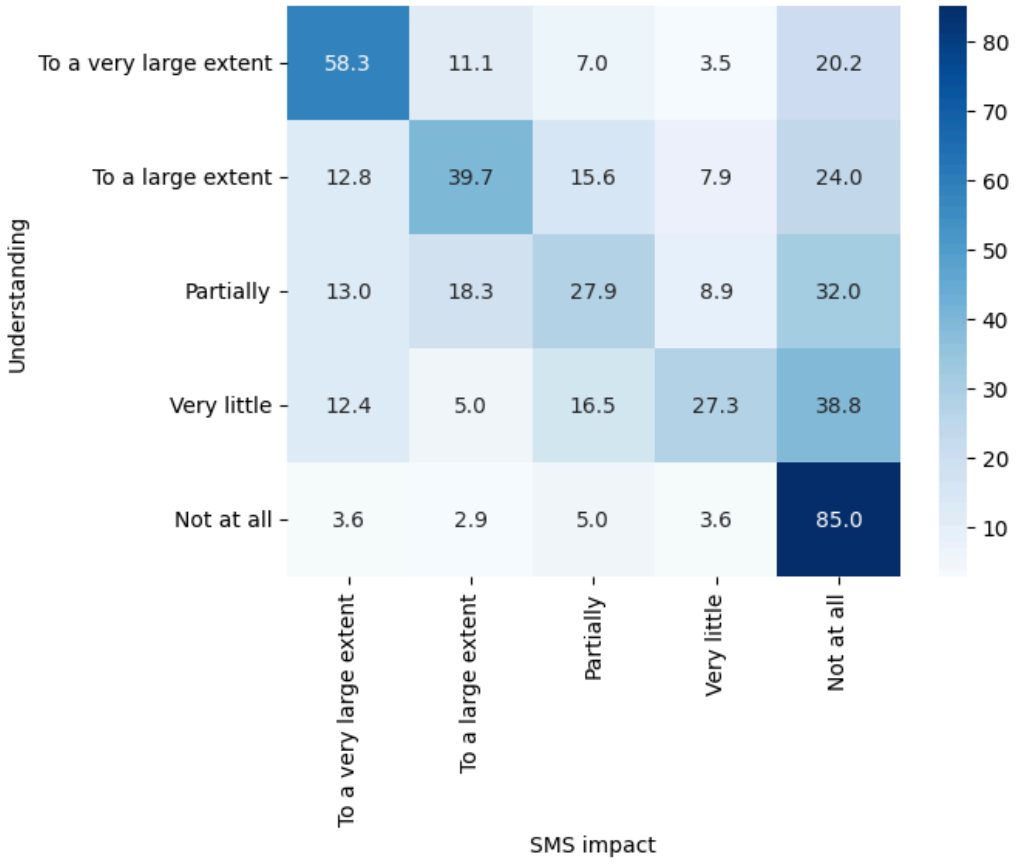


Figure 8: *Relationship between farmers' understanding of messages and the impact of the message on their decision-making. The darker the blue colour, the more farmers in that box; the lighter the blue colour, the fewer the farmers in that box.*

III. Net Promoter Scores (NPS)

As noted above, One Acre Fund regularly evaluates our clients' "Net Promoter Score," which measures customer loyalty and satisfaction from -100 to 100; above 0 is good, above 20 is favorable, and above 50 is considered excellent. It is calculated by subtracting the percentage of detractors (those who rate 0-6 on a 10-point scale) from the percentage of promoters (who rate 9-10); "passives" who rate 6-9 are not counted.

DWAS Net Promoter Score

As Figure 9 and Table 2 both illustrate, the majority of farmers (72%) would recommend DWAS to other farmers; only 15% are detractors. Given that this is the first season of piloting these recommendations, it shows a promising start that most farmers trust our service enough to recommend it to their peers.

Figure 9: *The breakdown of the percentage of farmers who received DWAS and how likely they are to recommend DWAS to another farmer, where 1 is not at all likely, and 10 is extremely likely.*

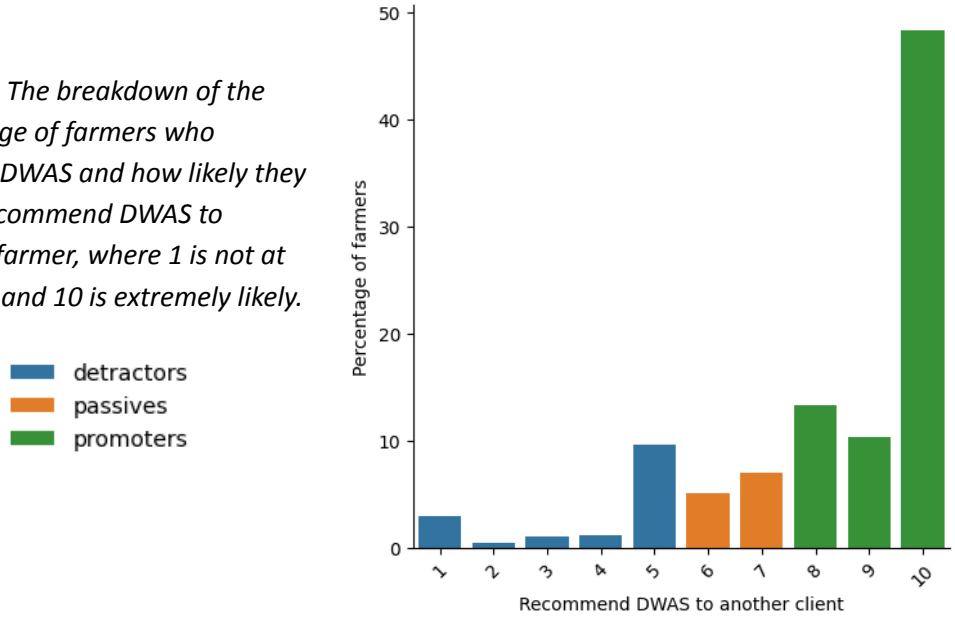


Table 2: *Percentage breakdown of participants who would recommend DWAS to another farmer*

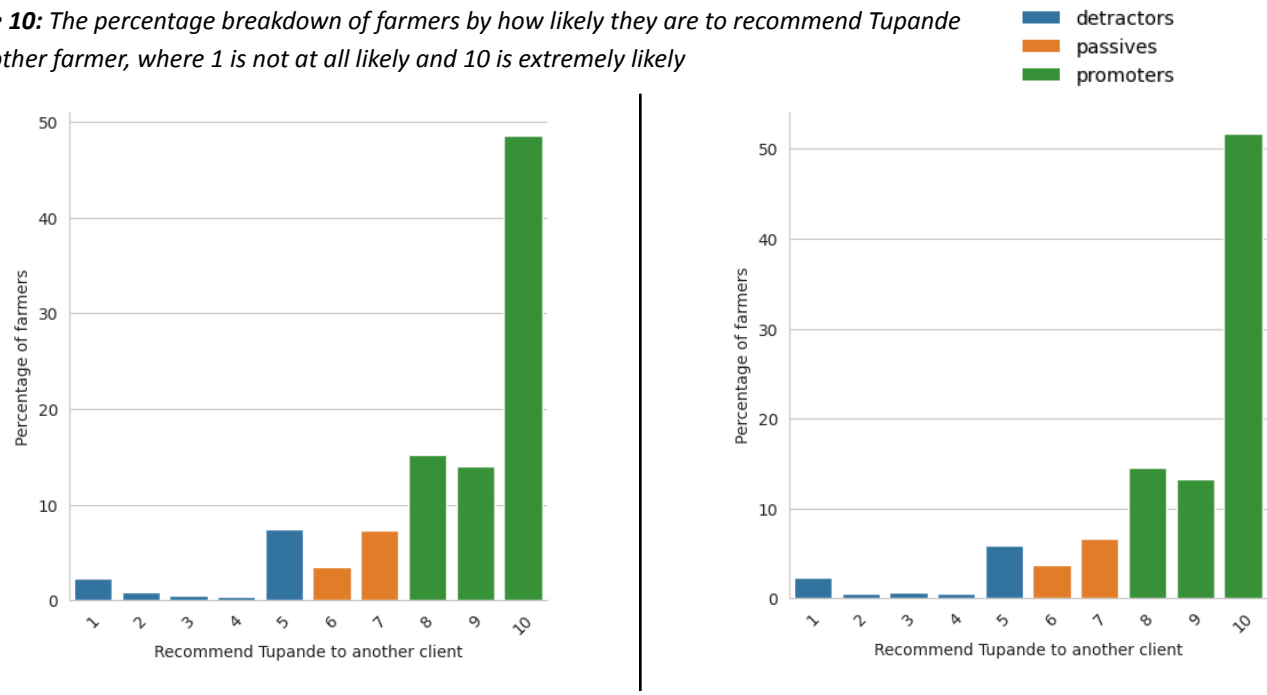
NPS Category	%
Promoters	72.14
Passives	12.30
Detractors	15.56
NPS Score	**56.58**

If we further break down the NPS by service designs, we see that the Weekly + 48-hour forecast had the best NPS score (72.46), with the Weekly + daily forecast and five-day forecast having a score of 69.68 and 66.5, respectively.

Tupande Net Promoter Score

Figure 10 and **Table 3** below both show that receiving DWAS was associated with a **higher likelihood of clients recommending Tupande to other farmers.** There were more promoters of the Tupande program in the DWAS clients compared to those who were not given the service. In addition, there was a lower number of detractors amongst farmers who received DWAS compared to control farmers, which further increased our NPS score.

Figure 10: *The percentage breakdown of farmers by how likely they are to recommend Tupande to another farmer, where 1 is not at all likely and 10 is extremely likely*



Net Promoter Score re: Tupande (Control)

Net Promoter Score re: Tupande (DWAS Clients)

Table 3: *Percentage breakdown of farmers who would recommend Tupande to another farmer, broken down by regular client and DWAS participants*

NPS Category	Standard client (%)	DWAS farmers (%)
Promoters	77.71	79.59
Passives	10.85	10.40
Detractors	11.45	10.01
NPS Score	**66.26**	**69.58**

IV. Yield impact

Overall Impact

We conducted a difference-in-difference analysis for all the farmers for whom we have harvest data to determine if there were any significant differences in yield between treated farmers and control farmers.

The results in **Table 4** below show that in the post-treatment period (LR2024), the control group's yield decreased by 250.7 kg per acre compared to LR2023. This decrease was likely due to factors reported by the farmers, such as drought, flood, pests, and diseases. However, the DWAS intervention mitigated some of this decline for the treatment group, reducing the yield to only 197.74 kg per acre.

This reflects a difference in yield between LR2023 and LR2024 for the DWAS and control groups of **52.96 kg/acre.** Although the results are not statistically significant, this corresponds to a **6.4% yield** increase attributed to the DWAS intervention (p = 0.117).

Table 4: *Year-over-year yield differences between control farmers and DWAS participants*

Forecast type	LR 23 Yield (kg/acre)	LR 24 yield (kg/acre)	Difference (kg/acre)	DiD in kg/acre (p-value)	Yield increase (%)
Control *(no forecast provided)*	1,077.80	827.10	-250.70		
DWAS clients	1,062.30	864.56	-197.74	**52.96 (0.117)**	**6.40%**

If we remove farmers who reported that they were affected by either drought or flood, we get the results as shown in **Table 5.** When we focus on farmers who reported having a more typical season, the yield difference between LR2023 and LR2024 for the DWAS and control groups was **96.35 kgs/acre** (compared to **52.96 kgs/acre** in the overall sample). This difference translates to a **10.82%** yield increase attributed to DWAS, which is **statistically significant (p = 0.053).**

Table 5: *Year-over-year yield differences, excluding those impacted by drought or flood in LR2023 and LR2024*

Forecast type	LR 23 Yield (kg/acre)	LR 24 yield (kg/acre)	Difference (kg/acre)	DiD in kg/acre (p-value)	Yield increase (%)
Control *(no forecast provided)*	1,134.19	890.59	-243.60		
DWAS clients	1,123.98	976.73	-147.25	**96.35 (0.053)**	**10.82%**

These results suggest that the intervention was more effective among farmers who were not impacted by either drought or flood; further research is required to understand how we might improve services to farmers facing these conditions.

Impact by DWAS Service Type

When we further analyse the different service types we provided and test whether the differences we observed are statistically significant, we obtain the following results:

Table 6: *Year-over-year yield differences, comparing control clients with different DWAS service models*

Forecast type	LR 23 Yield (kg/acre)	LR 24 yield (kg/acre)	Difference (kg/acre)	DiD in kg/acre (p-value)	Yield increase (%)
Control *(no forecast provided)*	1,077.80	827.10	-250.7		
Weekly + Daily	1,074.68	922.93	-151.75	98.95 (0.039)	**11.96**
Weekly + 48 hour	1,089.44	845.14	-244.3	6.4 (0.893)	0.77
Five day	1,021.43	825.19	-196.24	54.46 (0.254)	6.58

a. Weekly + daily forecast vs control

As shown in Table 6 above, farmers who received weekly + daily service in 2024 saw a positive and statistically significant **(p = 0.039**) diff-in-diff impact on their yields for the LR2023 and LR2024 seasons compared to farmers who didn't receive DWAS guidance – meaning this service type helped mitigate yield losses compared to the control group.

Farmers who received the weekly plus daily forecast had a **98.95 kg/acre** diff-in-diff yield from LR2023 to LR2024 compared to control farmers. This translates to around a **12% yield** increase attributed to our intervention.

If we focus only on farmers who were not affected by either flood or drought and once again check the impact of the weekly + daily forecast, we see a difference in yield of 156.59 kg/acre between treated farmers and the control from LR2023 to LR2024. This translates to a yield increase of **17.58% (p = 0.005)** attributed to the weekly+daily forecast.

b. Weekly + 48-hour forecast vs control

Farmers who received the weekly plus 48-hour forecast reported a 6.4 kg/acre diff-in-diff in yield from LR2023 to LR2024 compared to control farmers. However, these results are not statistically significant **(p = 0.893**).

c. Five-day forecast vs control

Farmers who received the five-day forecast had a **54.45 kg/acre** yield difference from LR2023 to LR2024 compared to control farmers. However, these results are not statistically significant **(p = 0.254).**

Conclusion and Recommendations

- In general, DWAS intervention had a positive impact on yield, as evidenced by the yield increase in the treatment group relative to the control group across the different subsets.
- Farmers who received DWAS saw a yield increase of **52.96 kgs/acre** compared to farmers who did not receive the intervention. This translates to a **6.4% yield increase (p = 0.117)**.

- The weekly+daily service type had the highest impact, with a **12% yield increase (p = 0.039),** with even higher impact for those not affected by either drought or flood, with a 17% yield increase
- Both the weekly + 48-hour forecast and the 5-day forecast had positive impacts, but not statistically significant.

Given these factors, and the program's low cost per farmer/high SROI potential, we recommend **offering DWAS guidance to farmers at scale.** We also note the following:

- Further research is required to understand the factors contributing to lower comprehension in the Mt Kenya and Rift regions, since this is a key driver of farmers' likelihood to implement and customer satisfaction
- Farmers influenced by the intervention messages could serve as community weather ambassadors, sharing their experiences during farmer training and encouraging others to make informed decisions based on these weather forecasts (thereby generating spillover impact)
- Ultimately, although the results indicate that we can successfully expand the intervention, we will only realise its full potential if we implement DWAS with a strong emphasis on farmers' comprehension and engagement with the SMS.

References

Anuga, S. W., & Gordon, C. (2016). Adoption of climate-smart agricultural practices among smallholder farmers in Ghana. Journal of Agriculture and Climate Change Studies, 45(3),123–135.

Lo, H. M., & Dieng, B. (2015). Impact of seasonal weather forecasts on groundnut and millet yields in Senegal: A comparative study. Journal of Agricultural Economics and Resilience, 12(4), 204–219.

Ouédraogo, M., Diouf, A., & Kabore, D. (2018). The role of seasonal climate forecasts in improving crop yields in Burkina Faso. Climate Change and Agriculture Review, 6(2), 89–101.

Ouédraogo, M., Traoré, S., & Zongo, Y. (2015). Access to climate information and its impact on agricultural productivity: Evidence from Burkina Faso. Journal of Applied Agricultural Sciences, 9(1), 34–47.

Traoré, S., Zongo, Y., & Ouédraogo, M. (2015). Weather and climate information services: Effects on household resilience in Senegal. African Journal of Environmental Studies, 7(3), 321–333.

Zossou, R., Agossou, V., & Tovignon, H. (2021). Impact of mobile weather advisory services on crop production in Benin. Journal of Digital Agriculture, 3(1), 56–72.