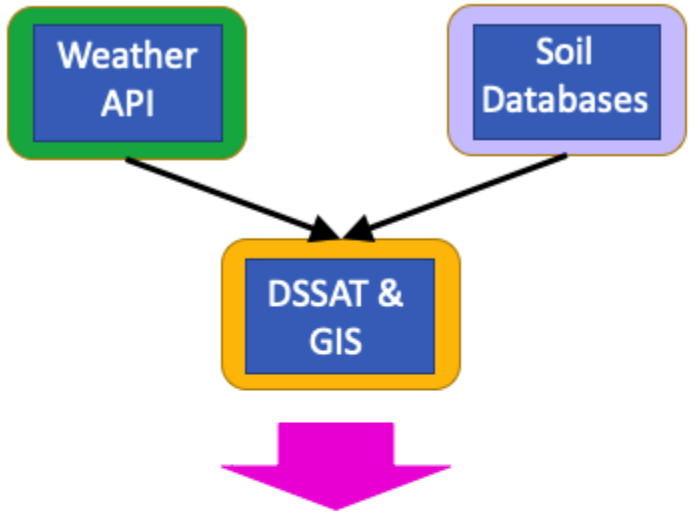
Predicting alfalfa yield and quality using FARMs

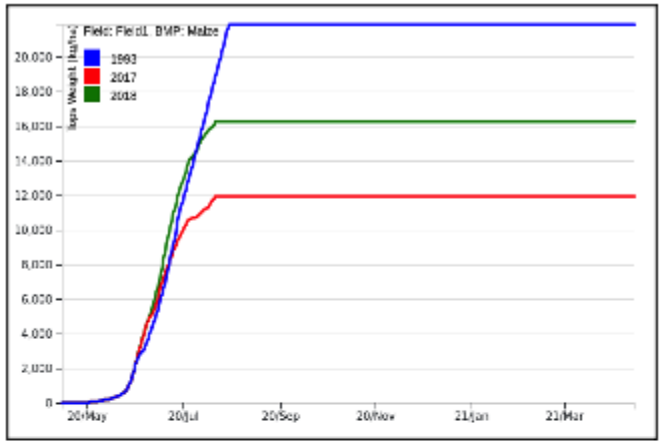
Isaya Kisekka
UC Davis
World Alfalfa Congress
Nov. 14 – 17 San Diego California

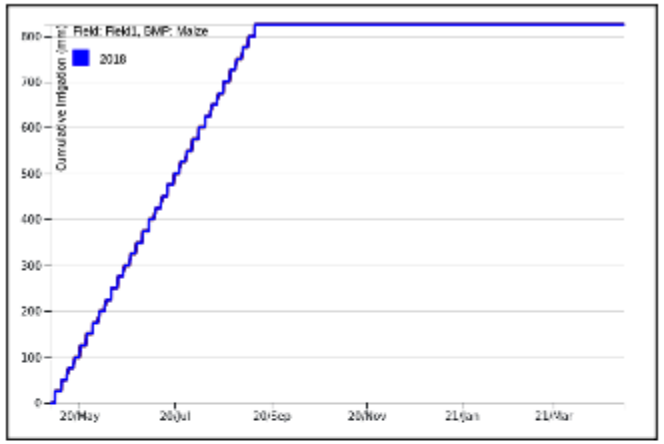
FARMs Beta Disclaimer https://ciswma.lawr.ucdavis.edu/ Log In Register

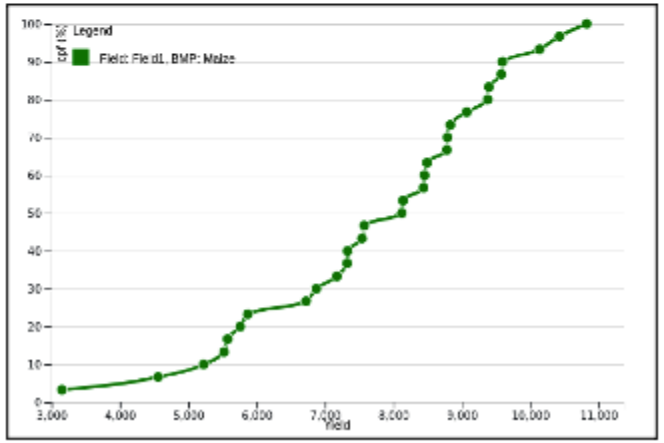

SCAN ME!

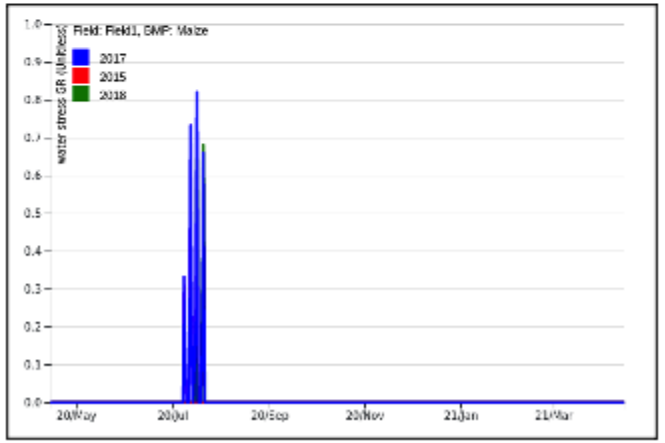
What is FARMs (Food, Agriculture, and Resource Management system)? Is a web app for crop yield prediction











FARMs Beta Disclaimer

https://ciswma.lawr.ucdavis.edu/

Log In Register

Justification

- Alfalfa production is threatened by constrained water supplies and climate change e.g., multiyear droughts

- There is an urgent need to develop simple web and mobile-friendly apps that simulate crop response to the complex interactions between the soil (S), environment (E), genetics (G), and management (M)

- These web and mobile apps can be used for strategic (land-water allocation) and tactical decision-making (irrigation scheduling)

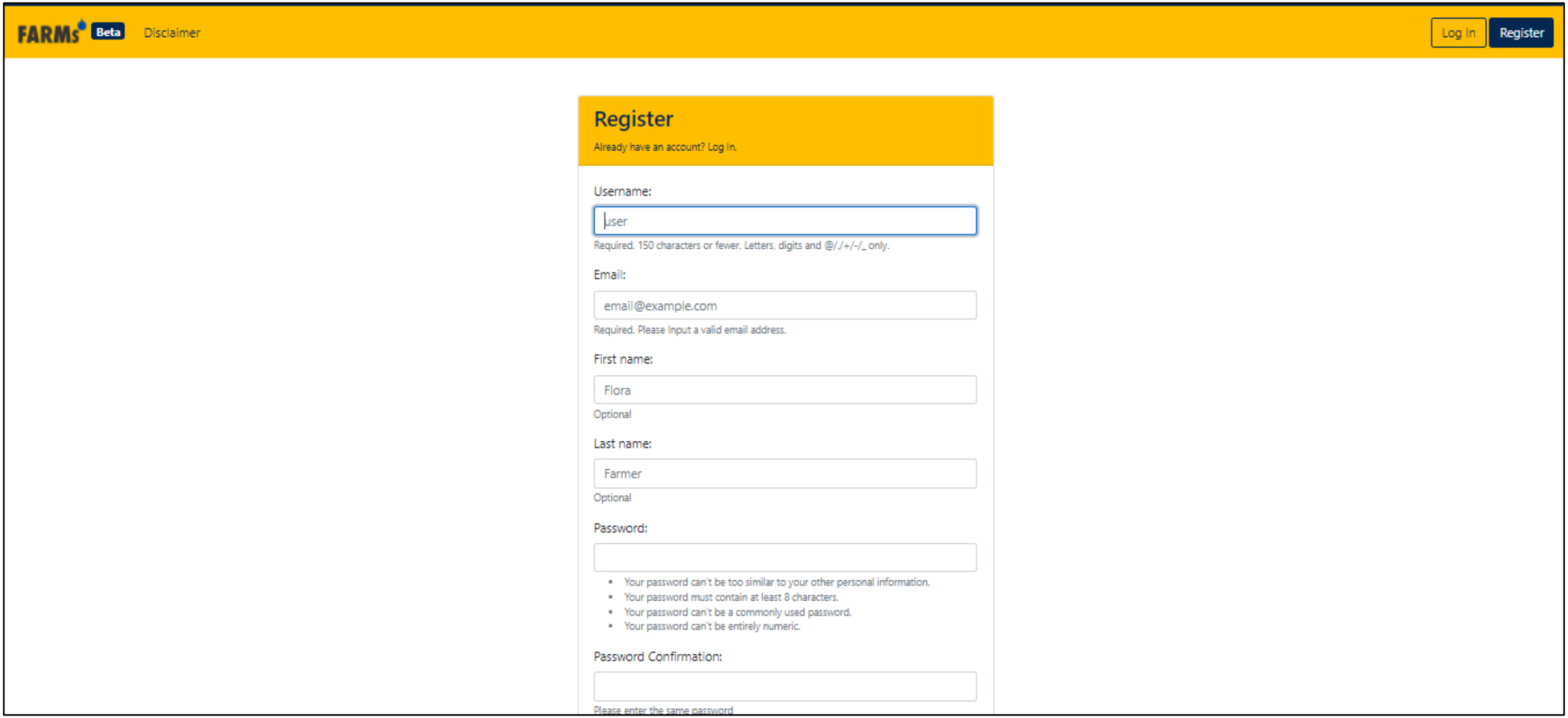
Questions you can ask using FARMs

- Given a water allocation limit, should I spread my water over many acres (i.e., deficit irrigate) or concentrate it on fewer acres (i.e., maximize productivity on fewer acres)?
- How do various alfalfa varieties perform in different locations?
- How does irrigation management affect forage quality?

FARMs Beta Disclaimer https://ciswma.lawr.ucdavis.edu/ Log In Register

Kim and Kisekka (2021). https://www.mdpi.com/2220-9964/10/8/553

FARMs Beta Disclaimer https://ciswma.lawr.ucdavis.edu/ Log In Register

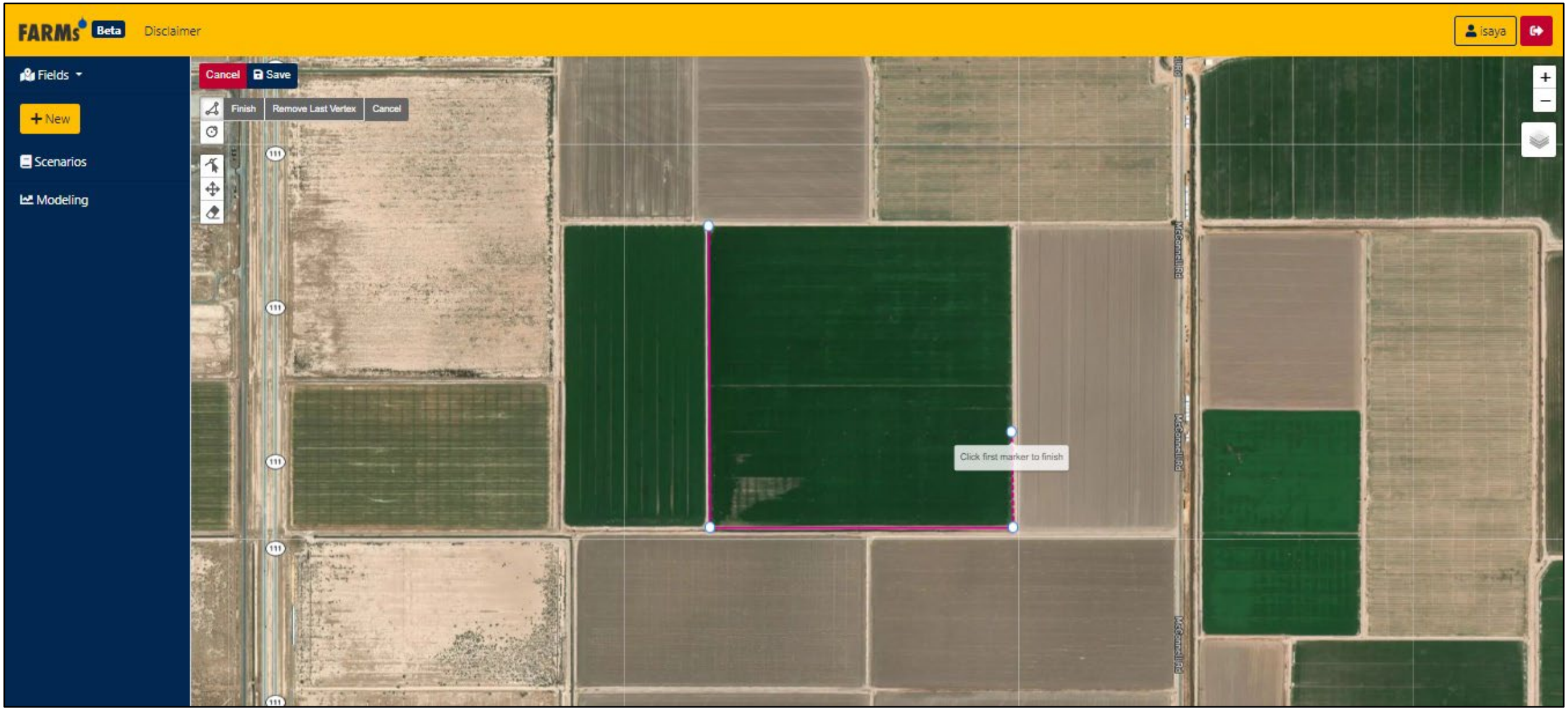


Registering login|

Zoom out to see the map of the world | FARMs can be used anywhere in the world

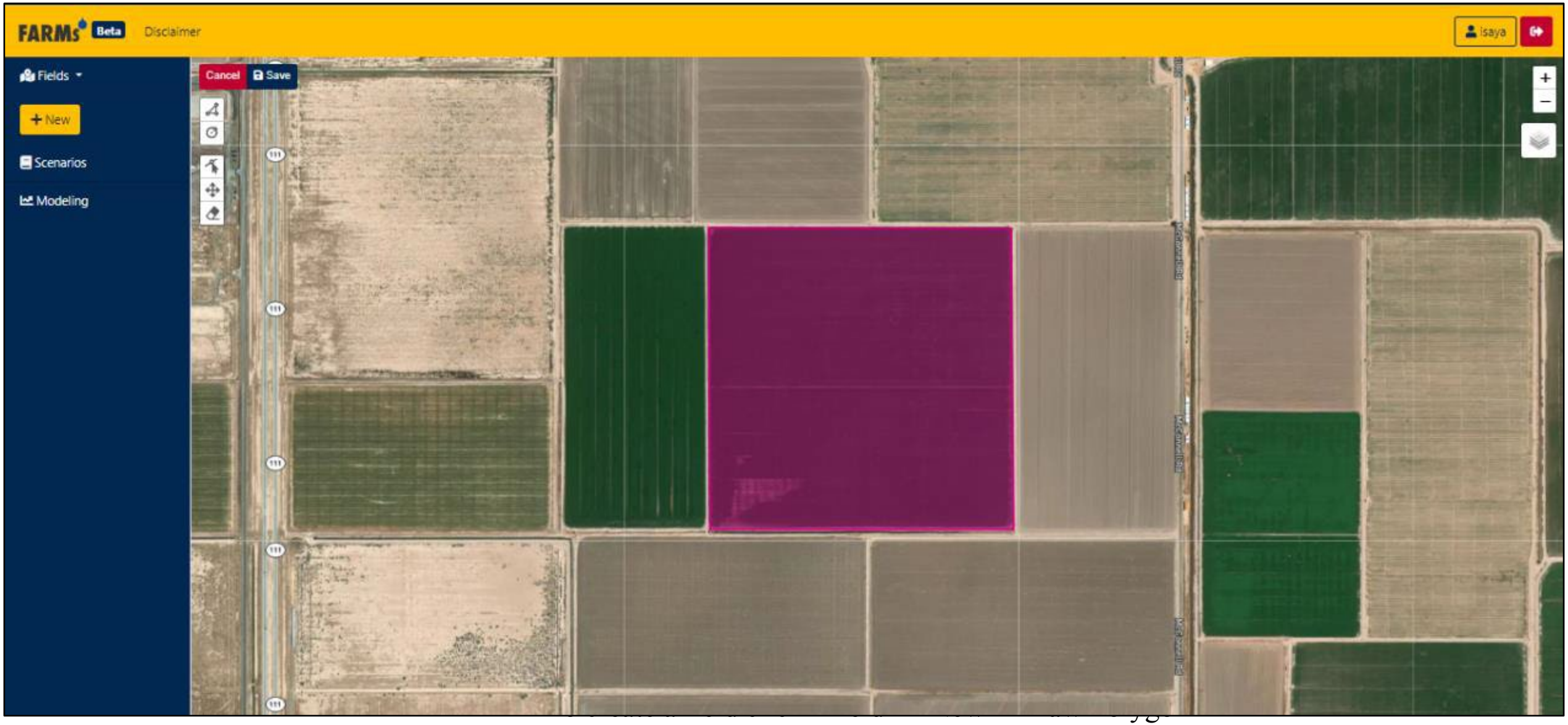
FARMs Beta Disclaimer https://ciswma.lawr.ucdavis.edu/ Log In Register

Zoom in to Imperial Valley California (West of San Diego)

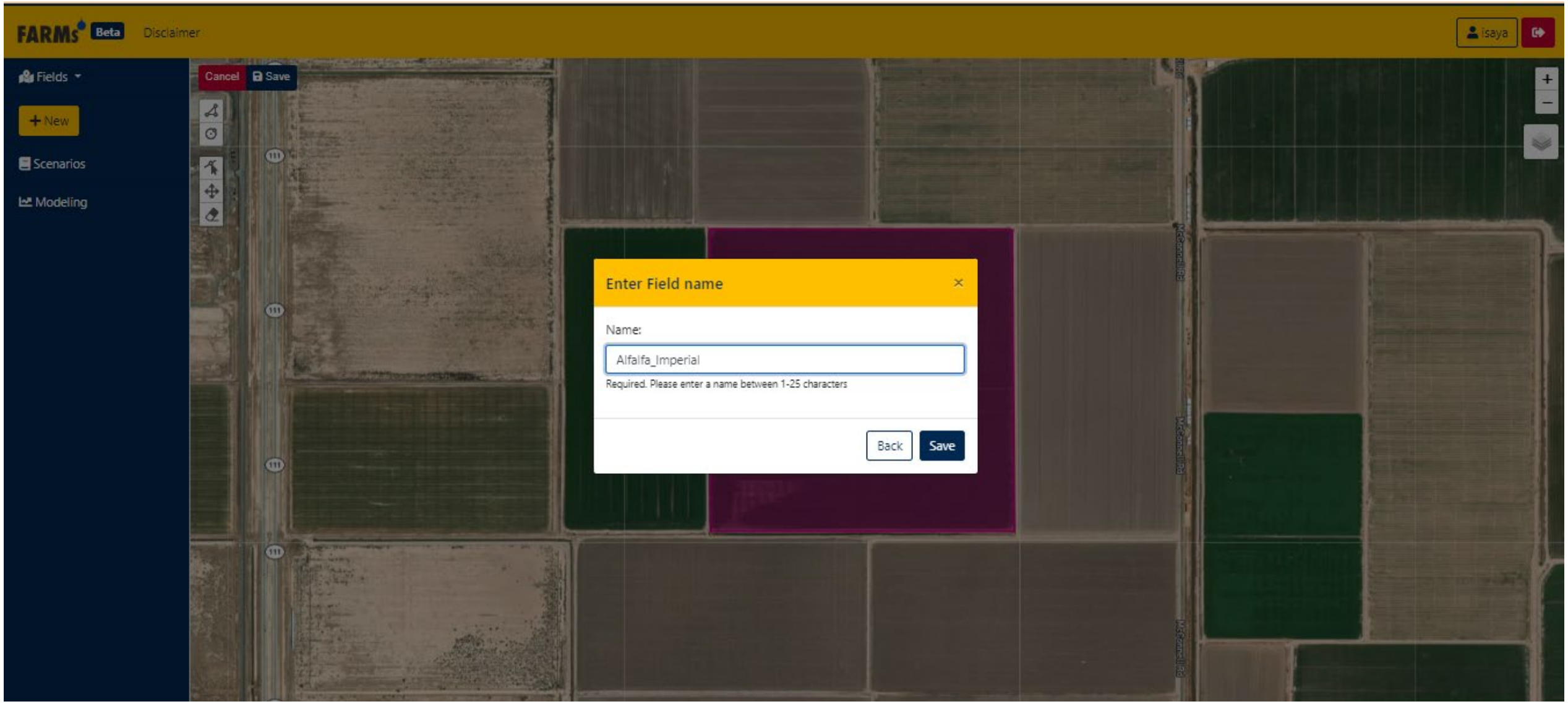


To create a field click “Field” > New > Draw Polygon

FARMs Beta Disclaimer https://ciswma.lawr.ucdavis.edu/ Log In Register

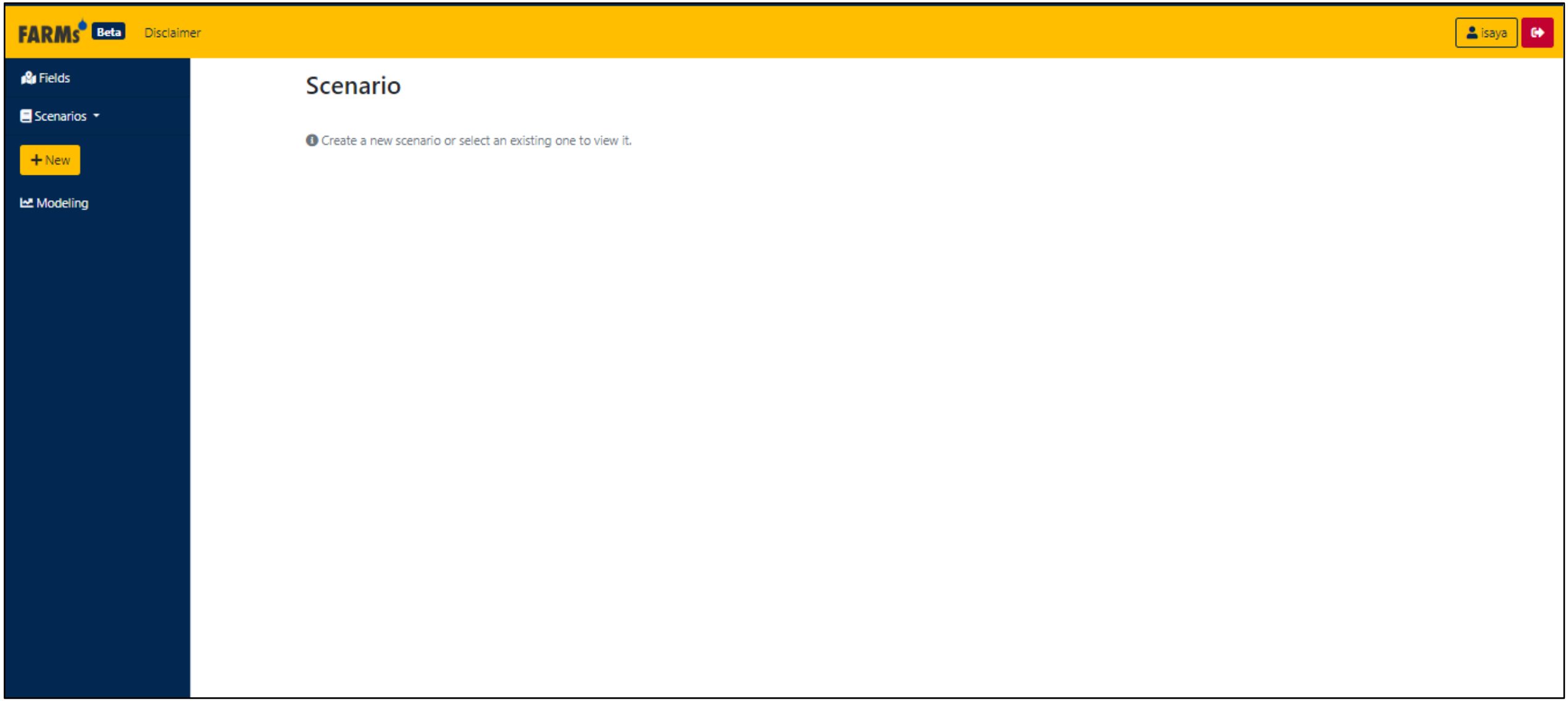


FARMs Beta Disclaimer https://ciswma.lawr.ucdavis.edu/ Log In Register



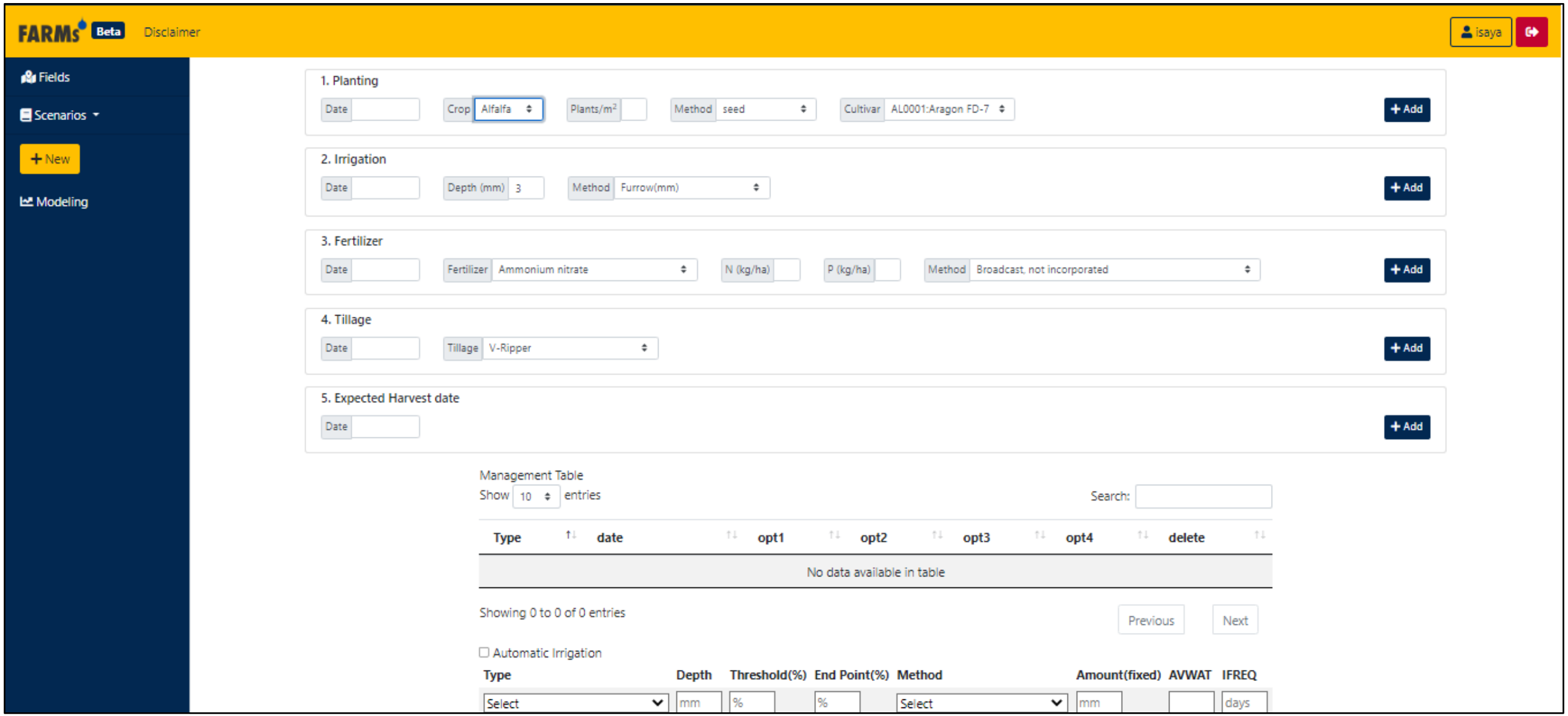
Click Save and give the field a name (you might need to refresh to see the field you created)

Defining Management Practices (Scenarios)

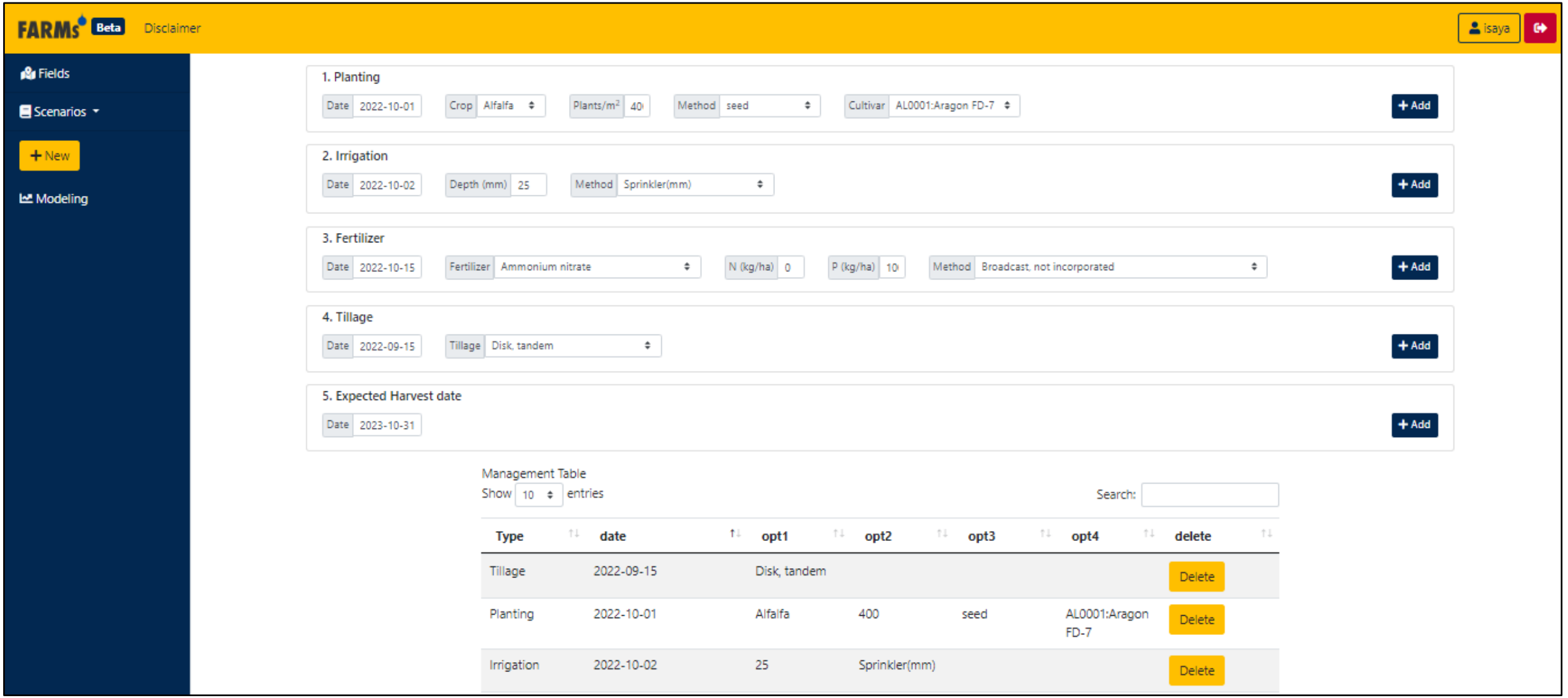


Click on “Scenarios

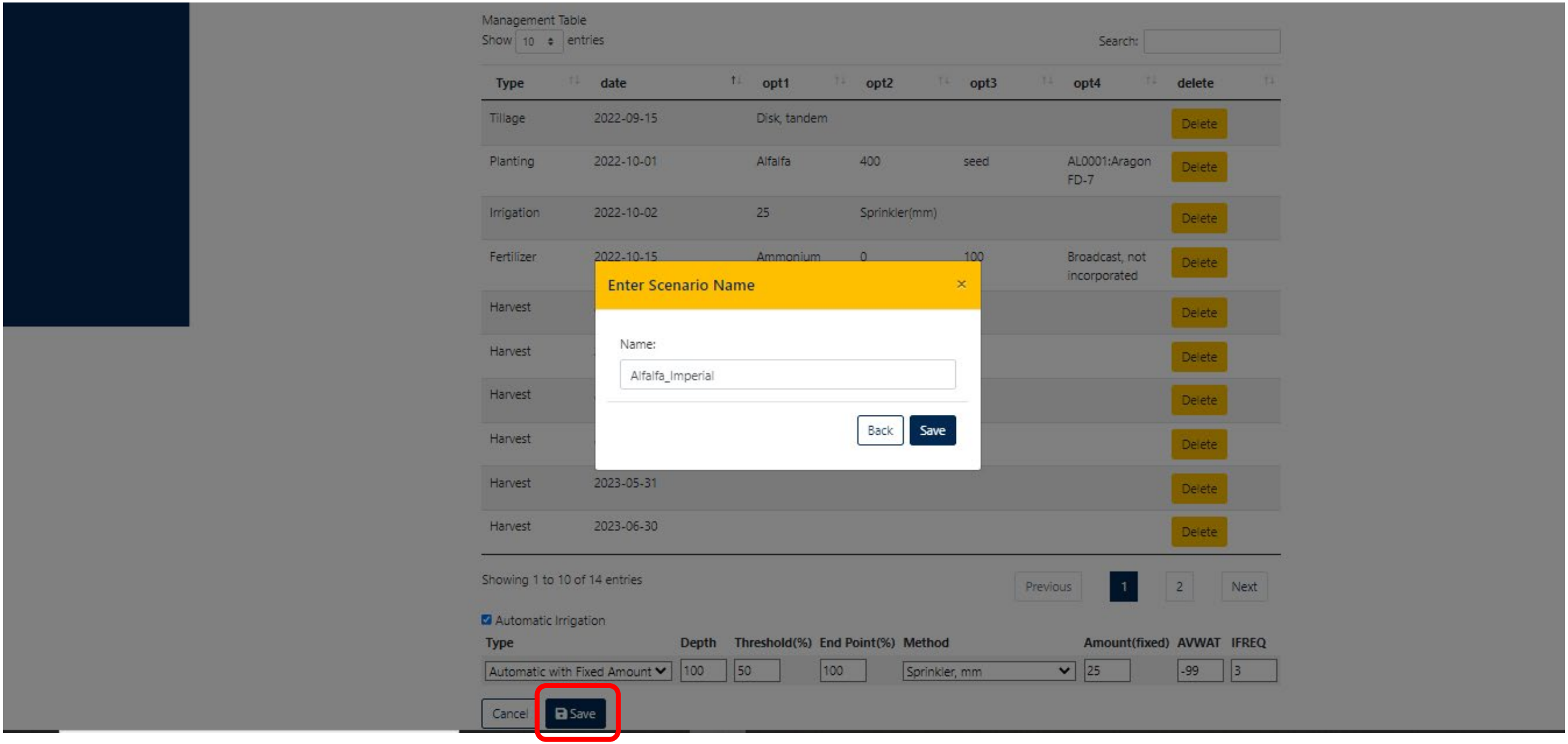
FARMs Beta Disclaimer https://ciswma.lawr.ucdavis.edu/ Log In Register



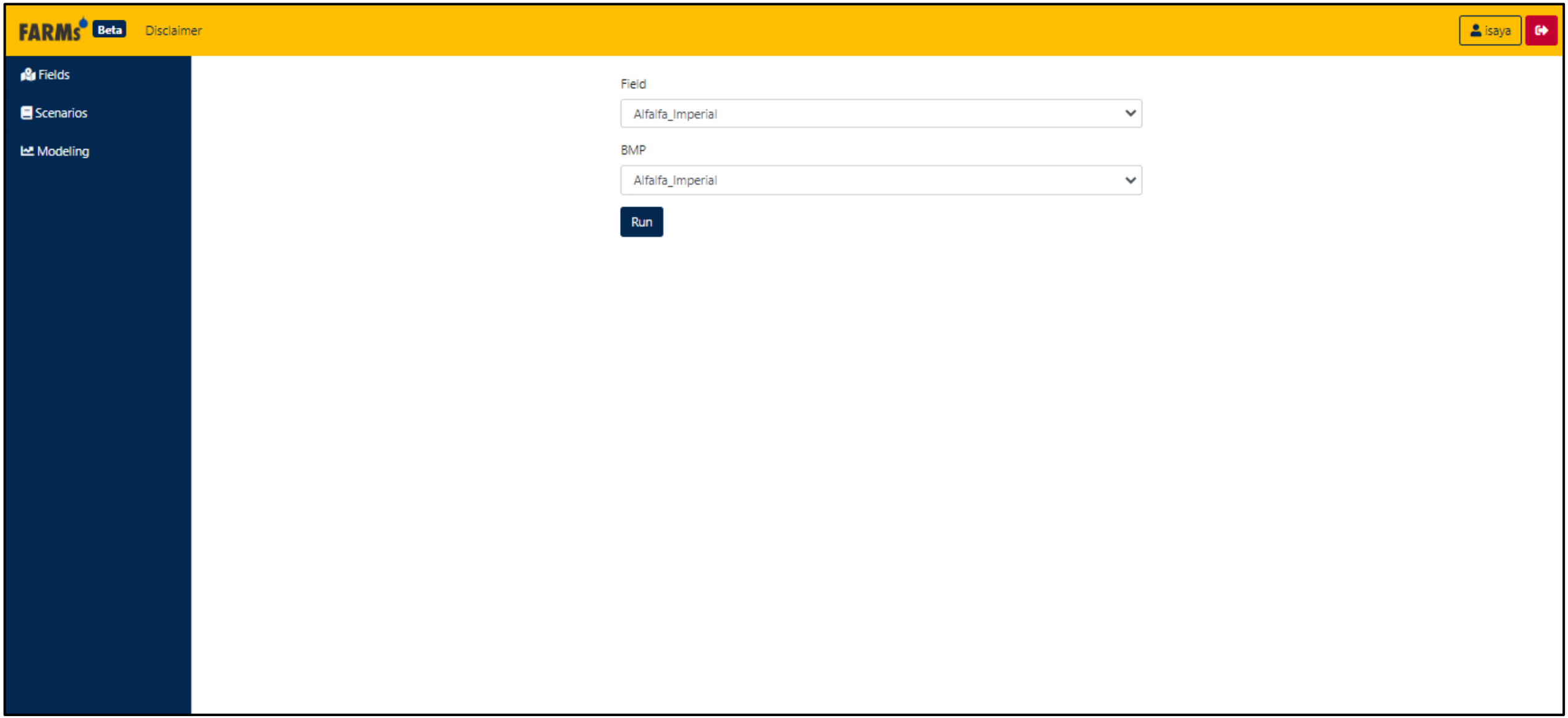
Click on New and enter values on the next slide



Click “Add” after entering inputs in each category (You will see the management practice added below) then click Save and give the scenario a name e.g., Alfalfa_Imperial

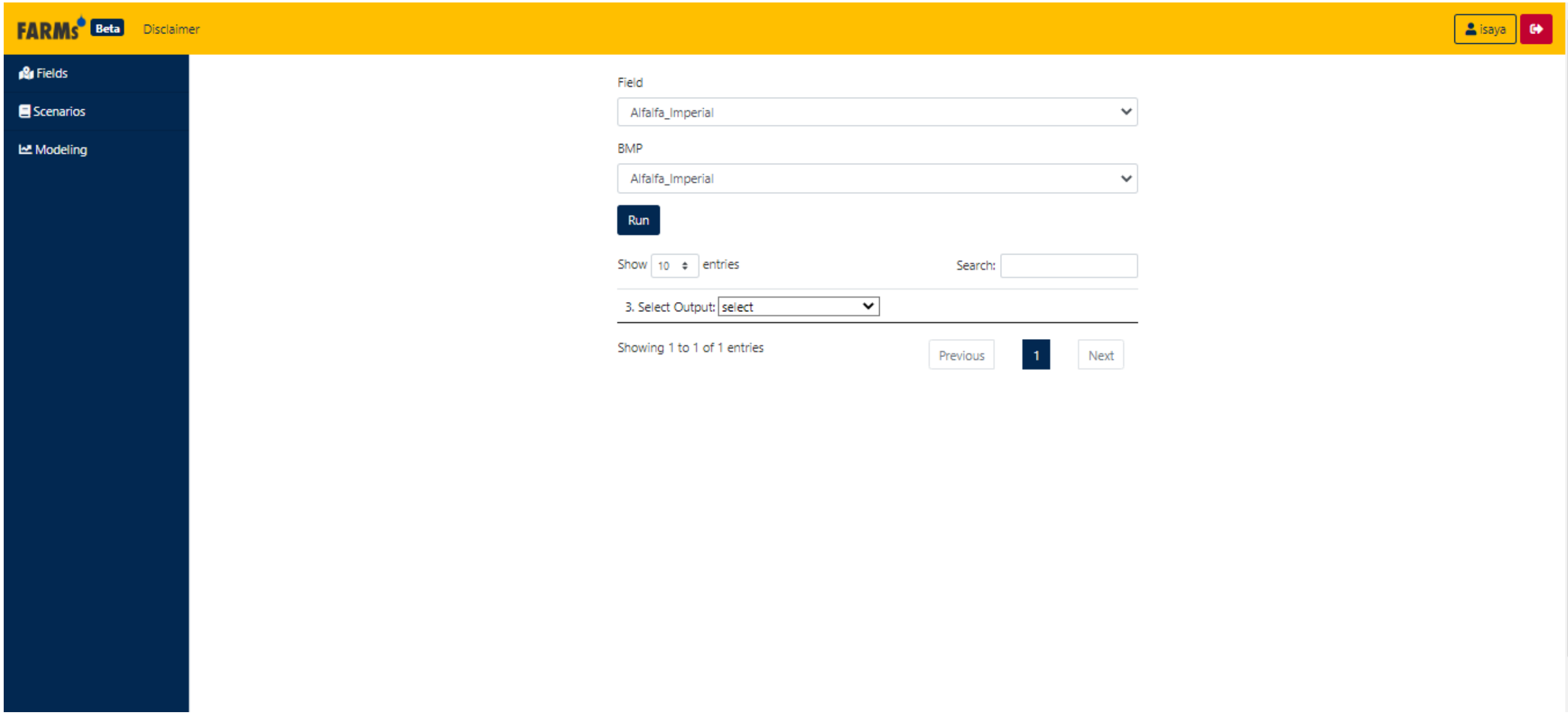


Remember to save scenario

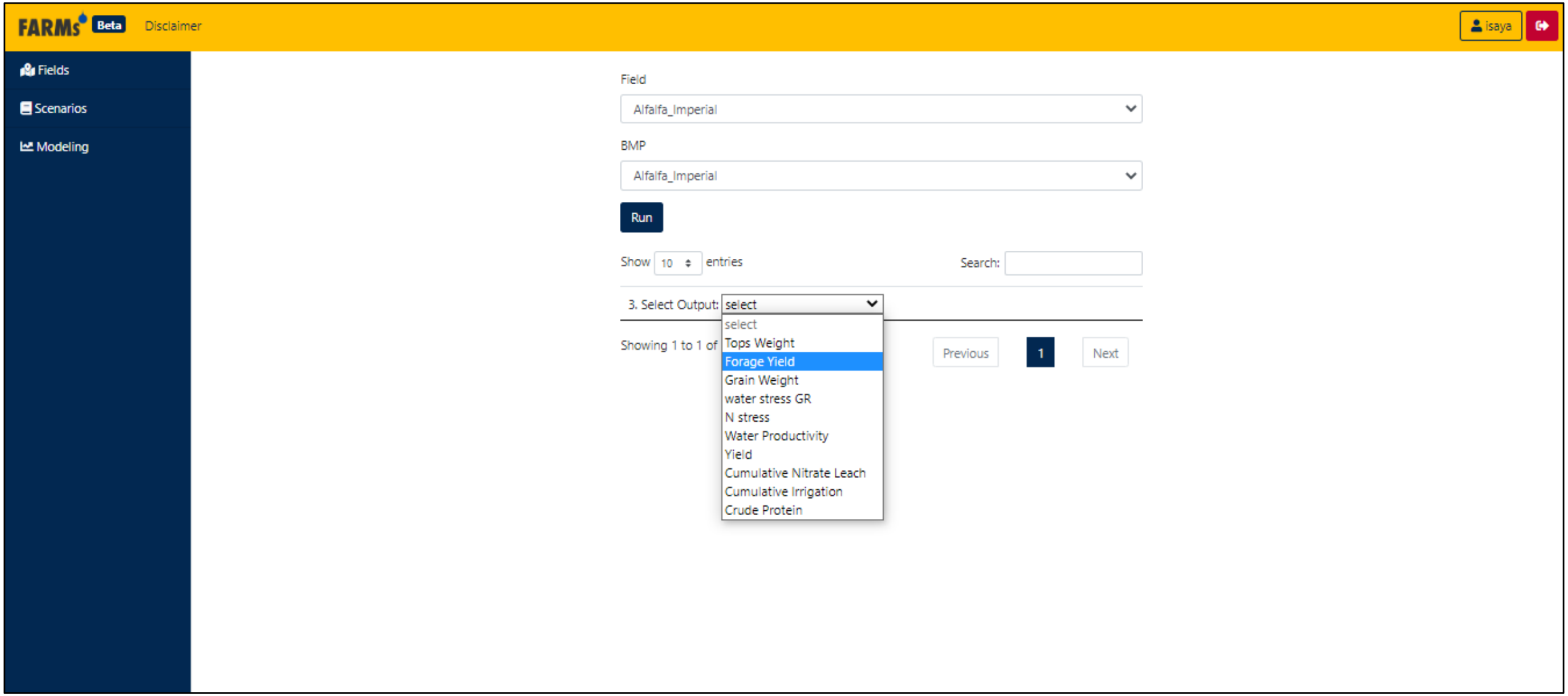


To run the model select your field and scenario and click run

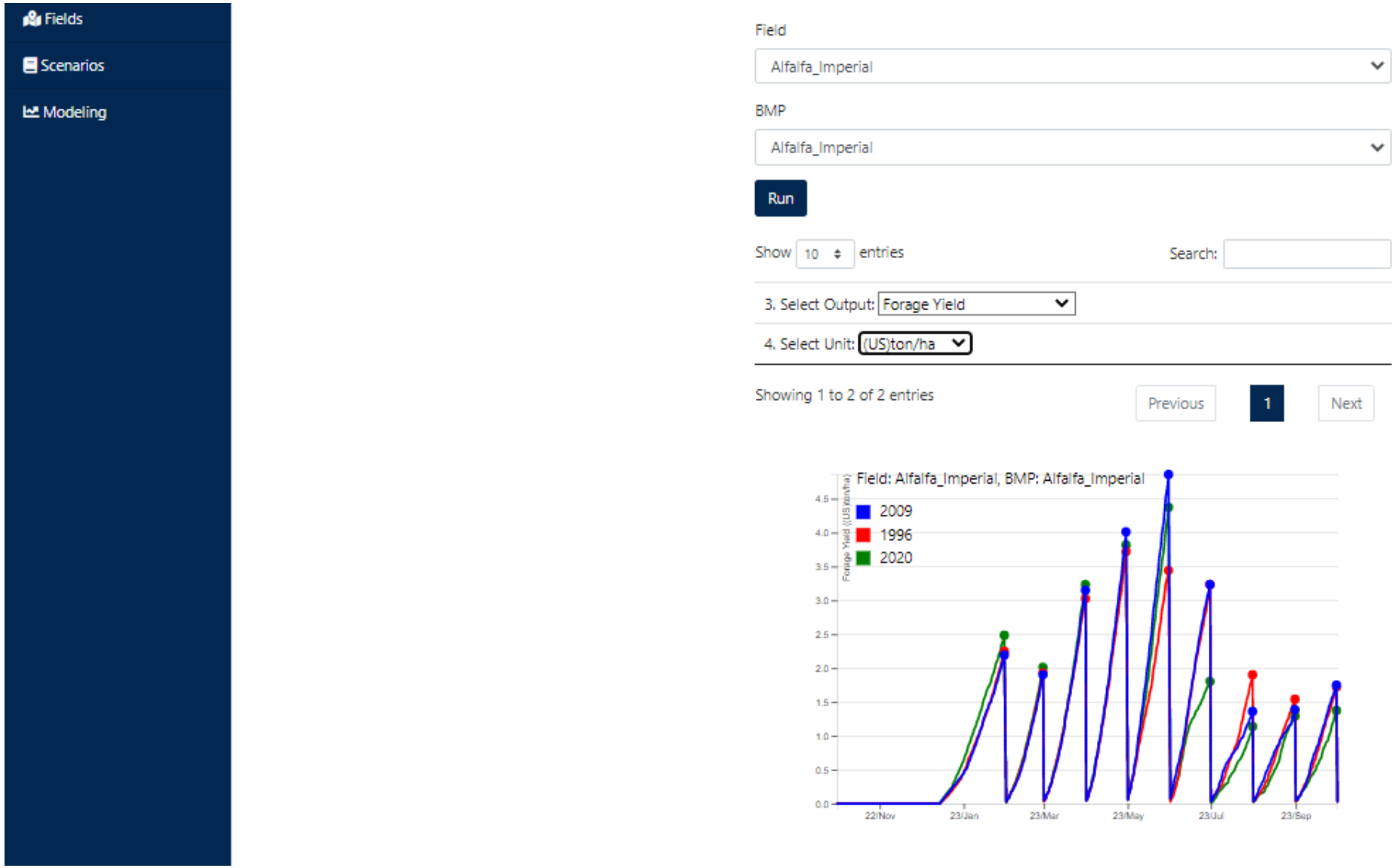
FARMs Beta Disclaimer https://ciswma.lawr.ucdavis.edu/ Log In Register



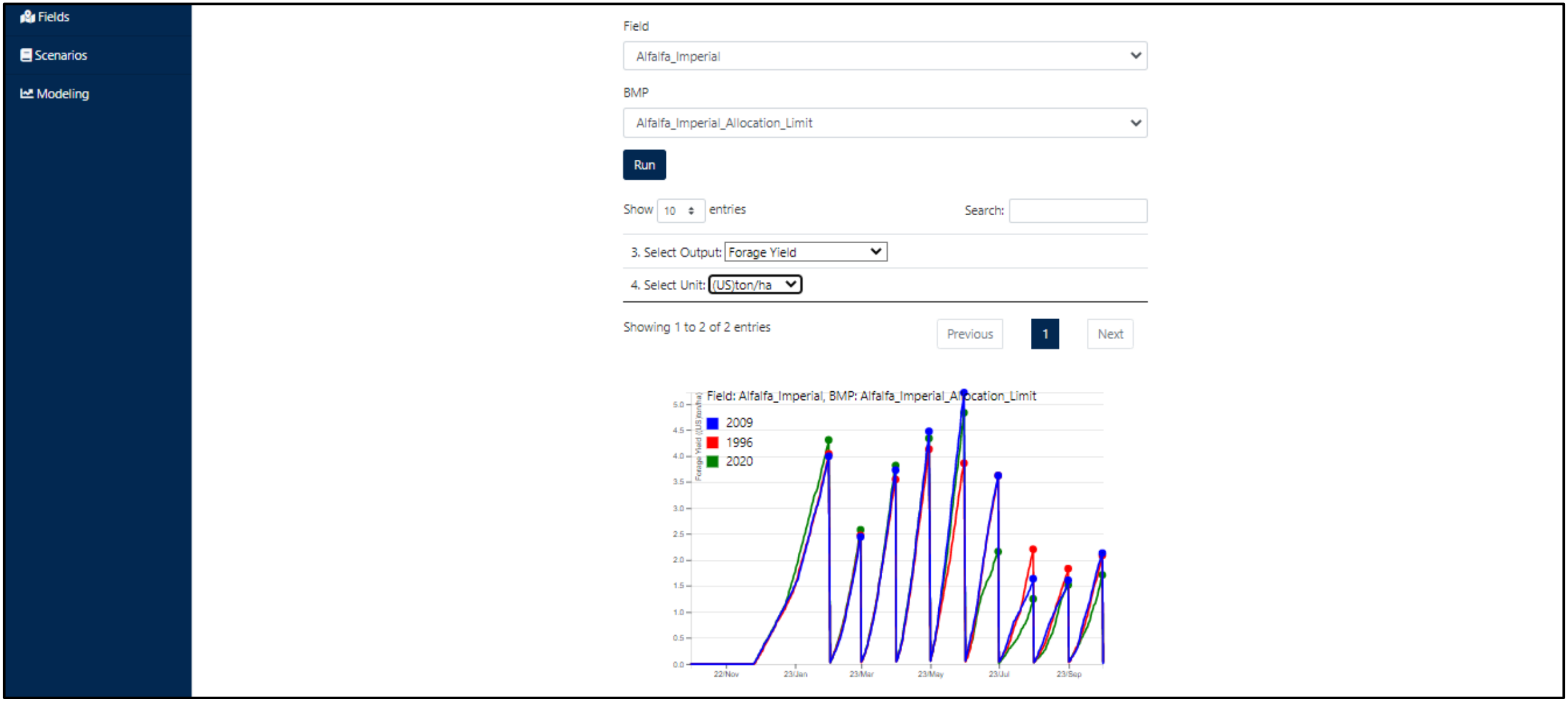
Select > Forage Yield



View graphs for model predicted alfalfa yield

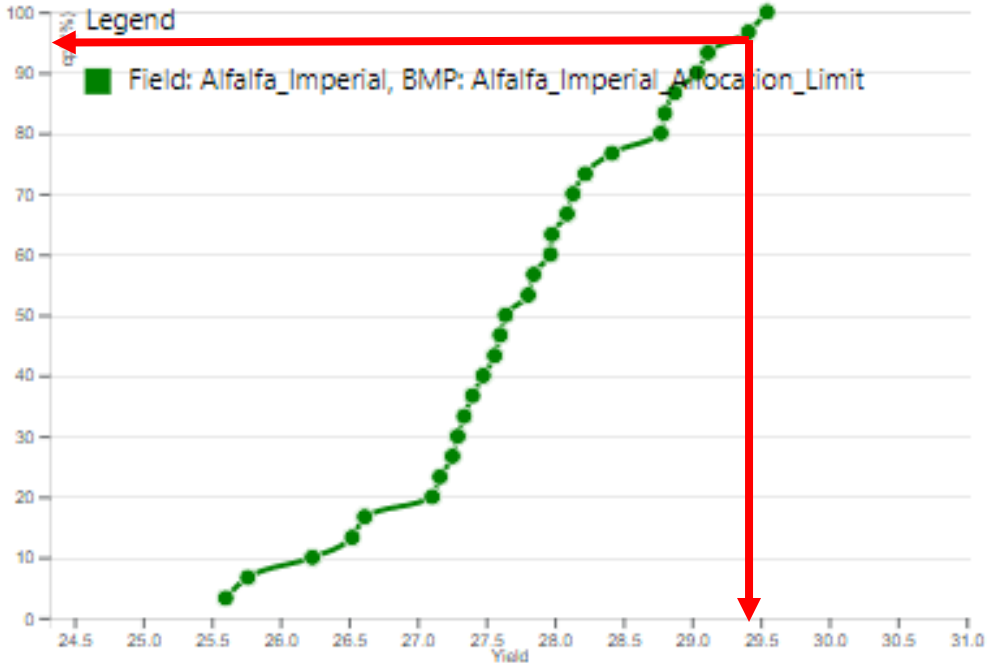


Alfalfa yield for example alfalfa field in Imperial Valley 9 cuts (tons/ha): **Variety FD 7**

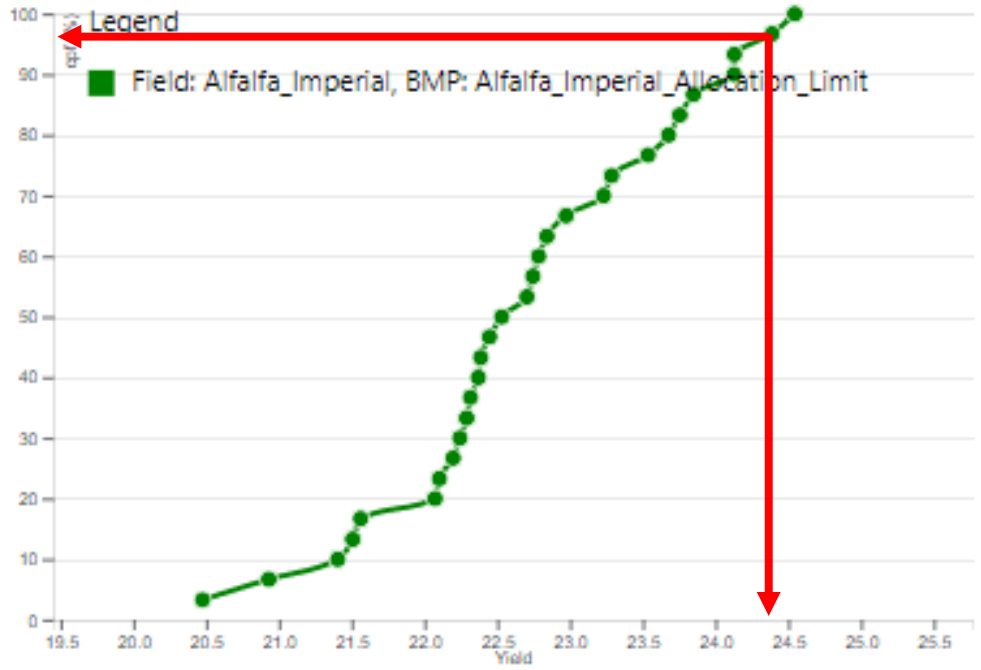


Alfalfa yield for an example alfalfa field in Imperial Valley 9 cuts (tons/ha): **Variety FD 9**

Assessing the effect of alfalfa variety on yield potential



Formal Dormancy Rating (FD): 9



Formal Dormancy Rating (FD): 7

Comparing FARMs predictions to UC Davis alfalfa variety trial yields for Imperial (El Centro)

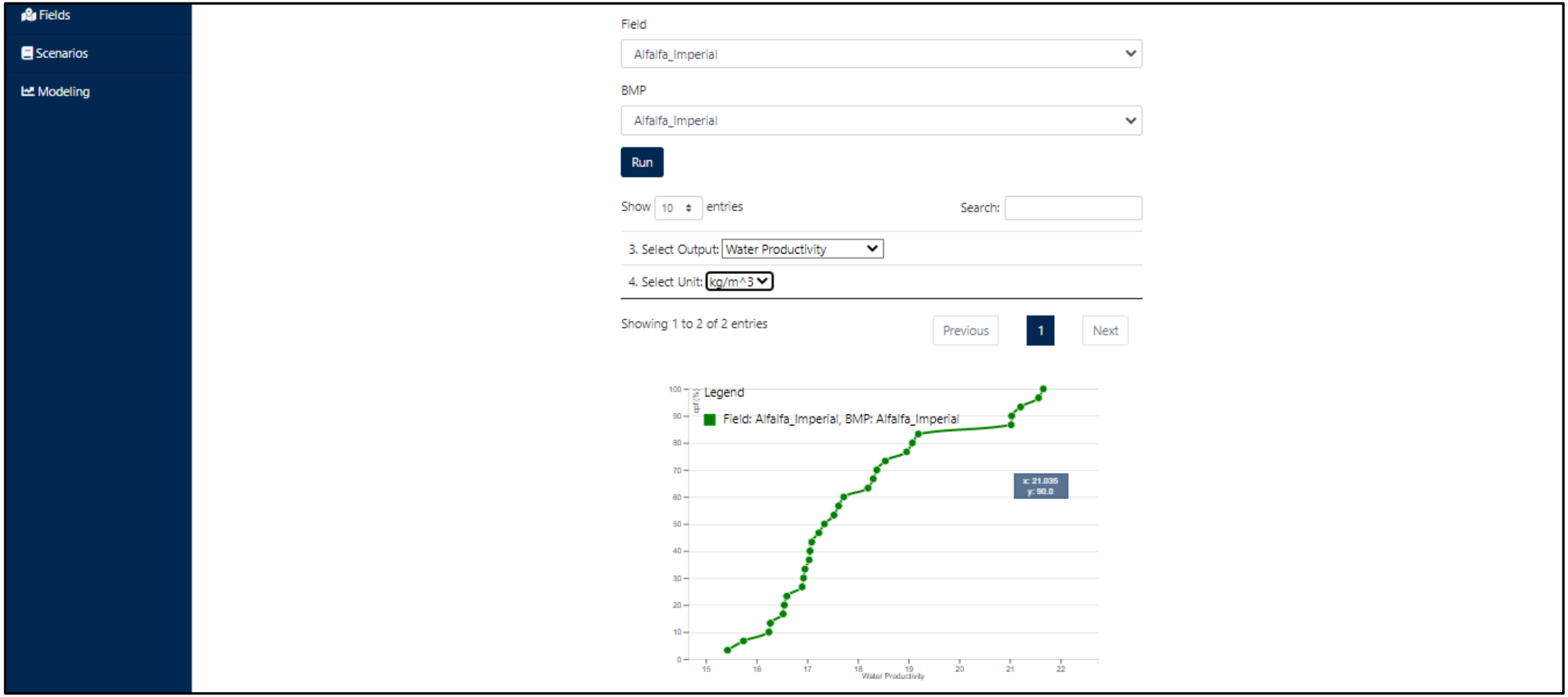
Table 3. 2019 Yields. El Centro Alfalfa Cultivar Trial (Trial planted 10/19/16)

Note: Single year data should not be used to evaluate alfalfa varieties or choose alfalfa cultivars

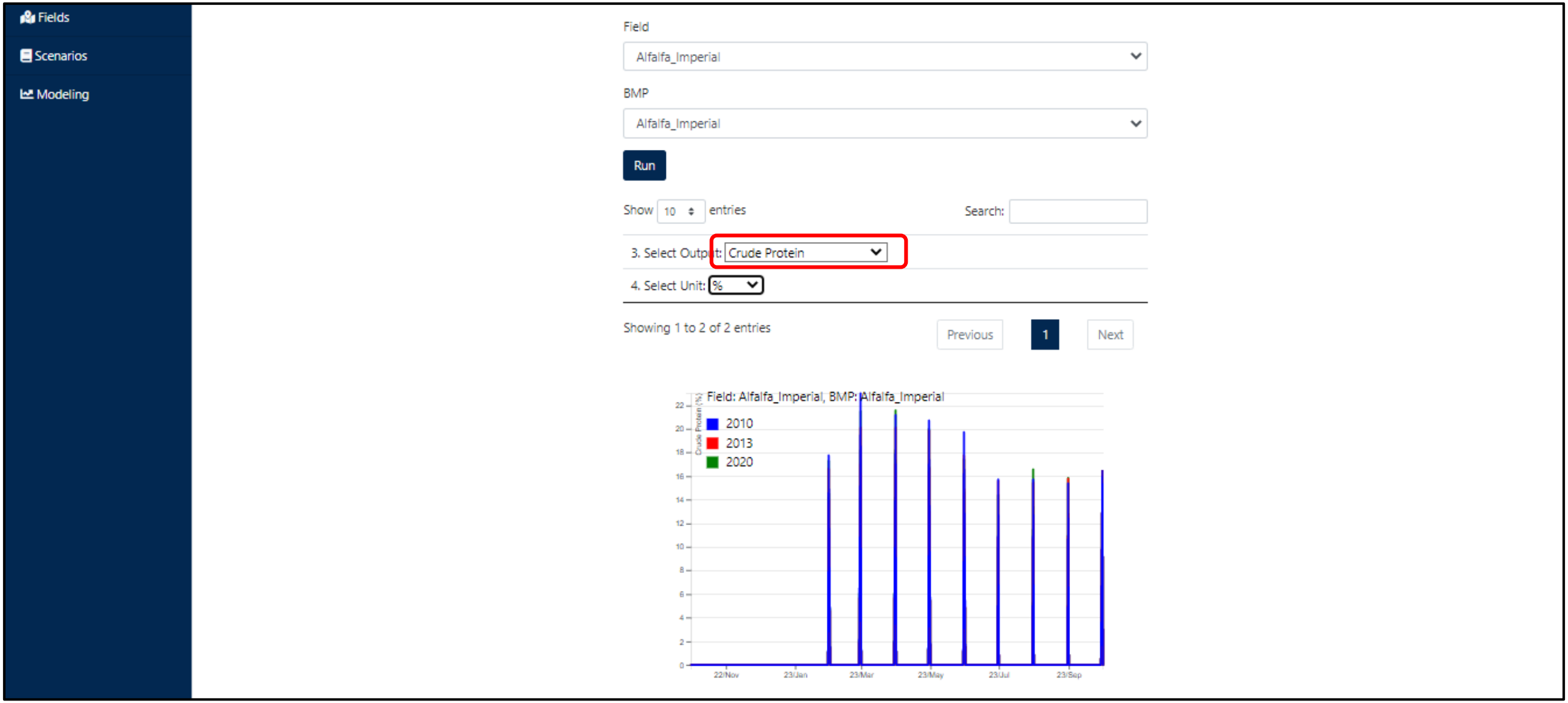
		Cut 1	Cut 2	Cut 3	Cut 4	Cut 5	Cut 6	Cut 7	Cut 8	Cut 9	YEAR		% of
		29-Jan	19-Mar	24-Apr	31-May	27-Jun	23-Jul	27-Aug	9-Oct	18-Nov	TOTAL		CUF101
	FD						Dry t/a						
Released Varieties													
106T701	10	0.98 (18)	1.49 (7)	2.10 (19)	2.37 (8)	3.12 (2)	2.00 (2)	1.51 (3)	1.06 (11)	1.14 (5)	15.76 (4)	A B C D	127.8
6906N	10	0.96 (20)	1.38 (18)	2.16 (9)	2.39 (6)	3.02 (11)	1.73 (17)	1.39 (14)	0.94 (23)	0.95 (22)	14.93 (16)	C D E F G	121.0
UC-Impalo	9	1.07 (8)	1.39 (15)	2.15 (12)	2.14 (26)	2.95 (16)	1.69 (21)	1.35 (18)	1.04 (13)	1.07 (11)	14.86 (18)	D E F G	120.5
Fertilac 11	11	0.95 (22)	1.42 (14)	2.13 (15)	2.25 (17)	2.96 (14)	1.71 (19)	1.32 (22)	0.95 (22)	1.03 (16)	14.71 (19)	D E F G	119.3
UC-Highline	9	1.01 (15)	1.45 (11)	2.12 (17)	2.29 (12)	2.83 (23)	1.64 (23)	1.32 (21)	0.87 (26)	0.97 (20)	14.50 (21)	E F G H	117.6
AFX 1060	10	0.85 (28)	1.19 (29)	2.03 (22)	2.22 (21)	2.94 (18)	1.80 (10)	1.40 (13)	0.97 (20)	0.83 (28)	14.24 (22)	F G H I	115.4
Fertilac 10	10	0.97 (19)	1.35 (22)	2.13 (16)	2.28 (13)	2.86 (22)	1.53 (24)	1.25 (25)	0.87 (25)	0.88 (25)	14.12 (24)	F G H I J	114.5
59N49	9	1.00 (16)	1.26 (26)	1.94 (27)	2.22 (23)	2.56 (28)	1.36 (28)	1.19 (27)	0.77 (30)	0.74 (30)	13.03 (28)	J K L	105.7
UC-Cibola	9	0.79 (30)	1.13 (30)	1.88 (29)	2.16 (25)	2.67 (26)	1.43 (27)	1.18 (29)	0.82 (27)	0.83 (27)	12.89 (29)	K L	104.5
CUF101	9	0.81 (29)	1.26 (28)	1.84 (30)	2.00 (30)	2.40 (30)	1.35 (30)	1.11 (30)	0.80 (28)	0.77 (29)	12.33 (30)	L	100.0
Experimental Varieties													
118T816	11	1.11 (3)	1.55 (2)	2.24 (3)	2.37 (9)	3.18 (1)	2.01 (1)	1.59 (1)	1.17 (2)	1.17 (4)	16.37 (1)	A	132.7
1014T552	10	1.23 (1)	1.58 (1)	2.15 (11)	2.47 (1)	2.97 (12)	1.84 (7)	1.45 (9)	1.17 (3)	1.27 (2)	16.12 (2)	A B	130.7
1014T549	10	1.12 (2)	1.52 (4)	2.11 (18)	2.26 (15)	2.96 (15)	1.88 (5)	1.57 (2)	1.32 (1)	1.28 (1)	16.03 (3)	A B C	129.9
108T813	10	1.10 (6)	1.51 (5)	2.20 (5)	2.41 (3)	3.03 (8)	1.79 (12)	1.49 (4)	1.09 (6)	1.10 (8)	15.73 (5)	A B C D	127.5
1011T105	10	1.10 (5)	1.48 (8)	2.14 (13)	2.25 (16)	3.04 (7)	1.87 (6)	1.46 (7)	1.16 (4)	1.13 (7)	15.63 (6)	A B C D E	126.7
1012T408	10	1.01 (14)	1.53 (3)	2.25 (2)	2.42 (2)	3.05 (6)	1.74 (15)	1.44 (11)	1.07 (9)	1.03 (13)	15.54 (7)	A B C D E	126.0
105T286	10	1.11 (4)	1.47 (10)	2.21 (4)	2.39 (7)	2.97 (13)	1.78 (14)	1.48 (5)	1.03 (14)	1.08 (10)	15.51 (8)	A B C D E	125.8
1012T402	10	0.94 (23)	1.36 (20)	2.19 (7)	2.40 (5)	3.12 (3)	1.91 (3)	1.39 (14)	1.07 (10)	1.06 (12)	15.45 (9)	A B C D E	125.2
1014T013	10	0.96 (21)	1.44 (12)	2.29 (1)	2.41 (4)	3.06 (5)	1.82 (9)	1.44 (10)	0.97 (19)	1.03 (15)	15.42 (10)	A B C D E	125.0
1111T108	11	1.04 (9)	1.48 (9)	2.20 (6)	2.32 (10)	3.08 (4)	1.80 (11)	1.38 (17)	0.97 (20)	0.98 (19)	15.24 (11)	A B C D E F	123.5
1013M185	10	0.98 (17)	1.34 (23)	2.17 (8)	2.29 (11)	3.02 (9)	1.88 (4)	1.47 (6)	1.05 (12)	1.01 (18)	15.22 (12)	A B C D E F	123.4
UCExp-HD	9	1.02 (12)	1.43 (13)	2.14 (14)	2.24 (18)	2.88 (21)	1.83 (8)	1.40 (12)	1.14 (5)	1.10 (9)	15.17 (13)	B C D E F	123.0
109T901	10	1.07 (7)	1.50 (6)	2.00 (24)	2.12 (28)	2.91 (19)	1.72 (18)	1.45 (8)	1.09 (7)	1.20 (3)	15.06 (14)	B C D E F	122.1
UC-2705	9	1.02 (11)	1.39 (17)	2.06 (21)	2.23 (19)	2.94 (17)	1.78 (13)	1.35 (19)	1.08 (8)	1.13 (6)	14.97 (15)	B C D E F G	121.4
1013T184	10	1.03 (10)	1.39 (16)	2.07 (20)	2.22 (22)	3.02 (9)	1.73 (16)	1.39 (16)	1.02 (15)	1.02 (17)	14.90 (17)	C D E F G	120.8
1114T010	11	0.90 (27)	1.37 (19)	2.16 (10)	2.26 (14)	2.90 (20)	1.71 (20)	1.28 (23)	1.00 (18)	0.93 (23)	14.51 (20)	E F G H	117.7
1113T186	11	1.01 (13)	1.29 (24)	2.00 (23)	2.13 (27)	2.79 (24)	1.65 (22)	1.32 (20)	1.02 (16)	0.97 (21)	14.19 (23)	F G H I J	115.0
UC-2693	9	0.93 (24)	1.35 (21)	1.95 (26)	2.23 (19)	2.68 (25)	1.46 (26)	1.23 (26)	1.00 (17)	1.03 (14)	13.87 (25)	G H I J K	112.5
1114T012	11	0.92 (25)	1.26 (27)	1.94 (28)	2.10 (29)	2.56 (29)	1.49 (25)	1.27 (24)	0.93 (24)	0.90 (24)	13.37 (26)	H I J K L	108.4
UC-2671	9	0.91 (26)	1.27 (25)	1.99 (25)	2.17 (24)	2.65 (27)	1.35 (29)	1.18 (28)	0.78 (29)	0.85 (26)	13.14 (27)	I J K L	106.6
MEAN		1.00	1.39	2.10	2.27	2.90	1.71	1.37	1.01	1.02	14.76		
CV		14.33	9.12	10.68	9.71	10.36	13.77	12.91	11.67	9.36	8.02		
LSD (0.1)		0.14	0.12	0.22	0.22	0.30	0.23	0.17	0.12	0.09	1.16		

https://alfalfa.ucdavis.edu/+producing/variety/apr/APR-2019.pdf

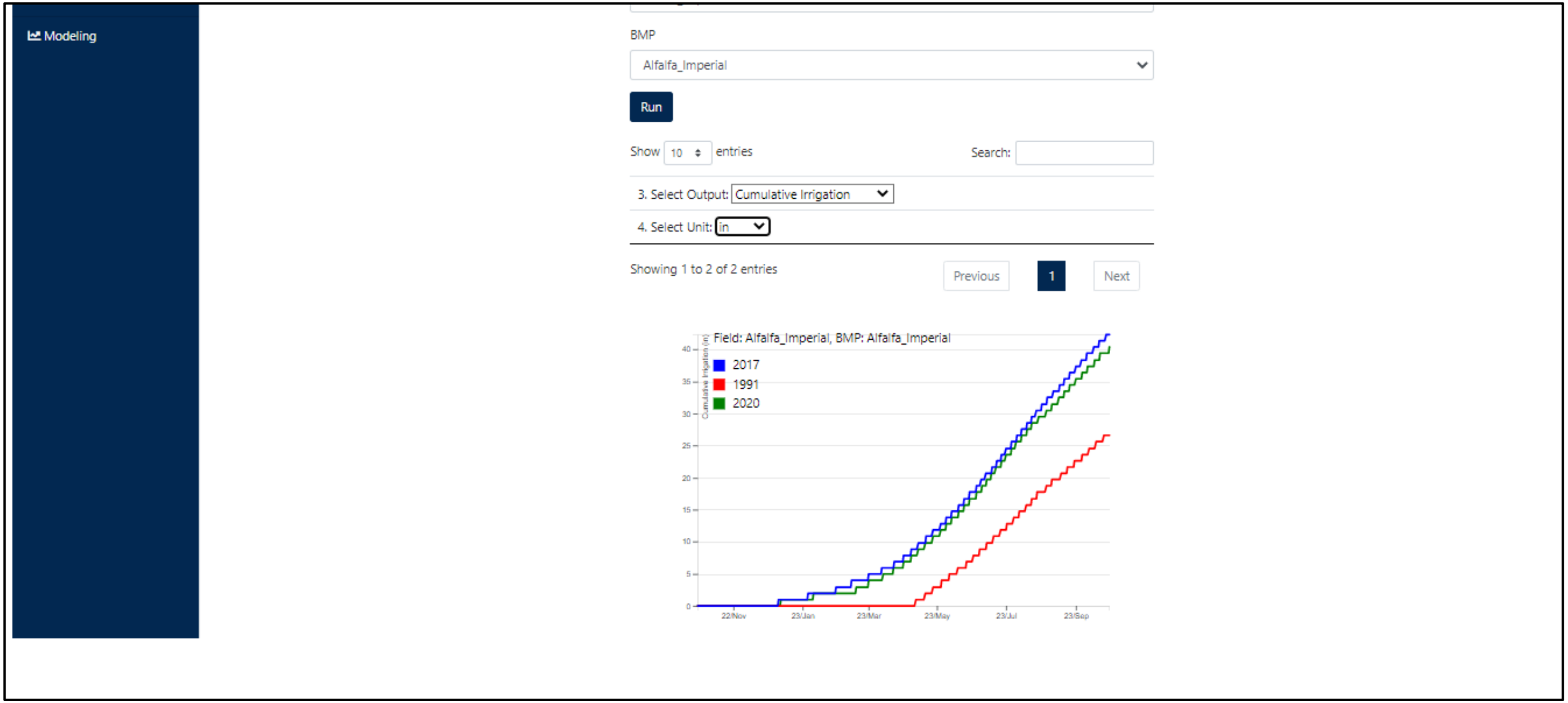
FARMs Beta Disclaimer https://ciswma.lawr.ucdavis.edu/ Log In Register



Crop per drop: Water productivity of alfalfa under full irrigation



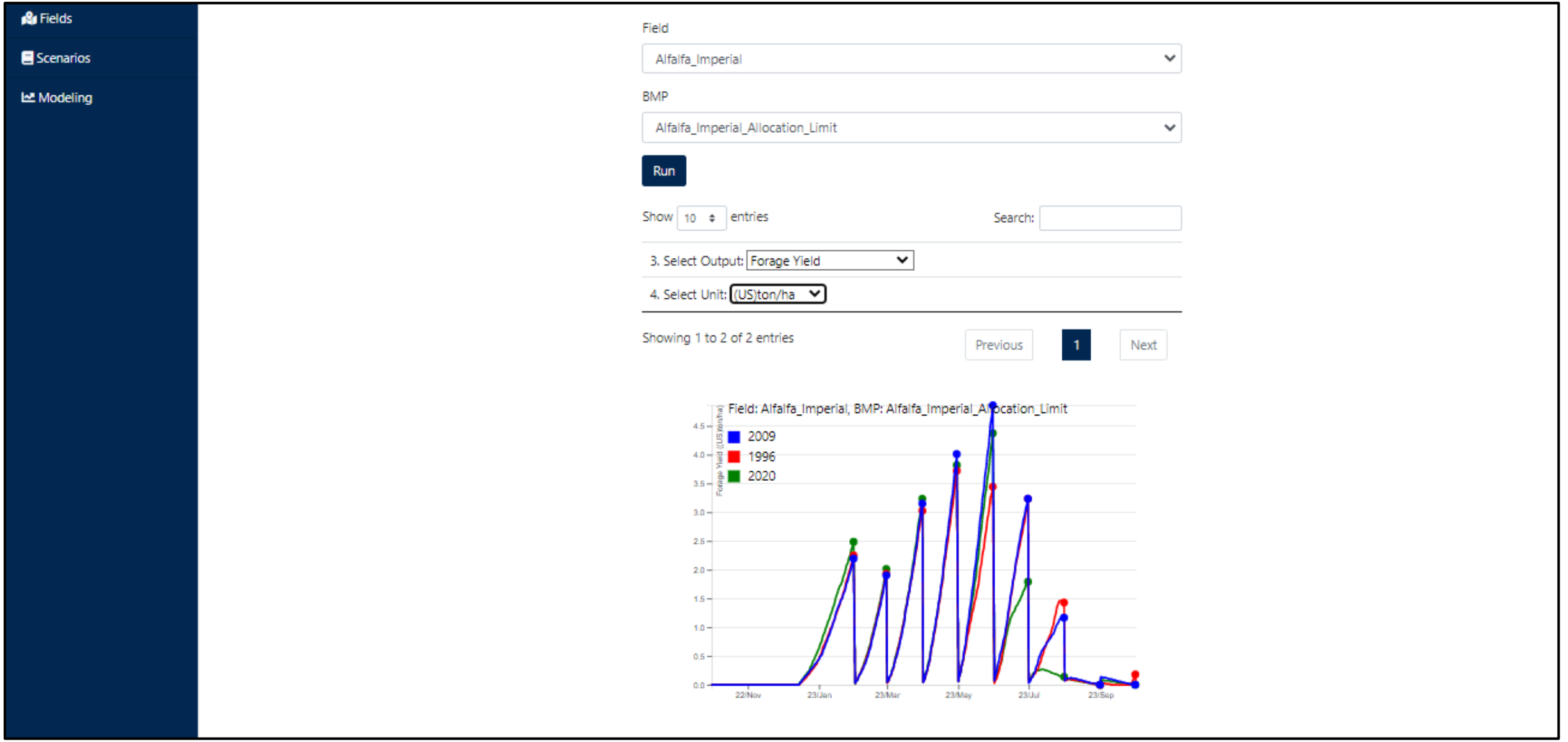
Alfalfa quality expressed as crude protein.



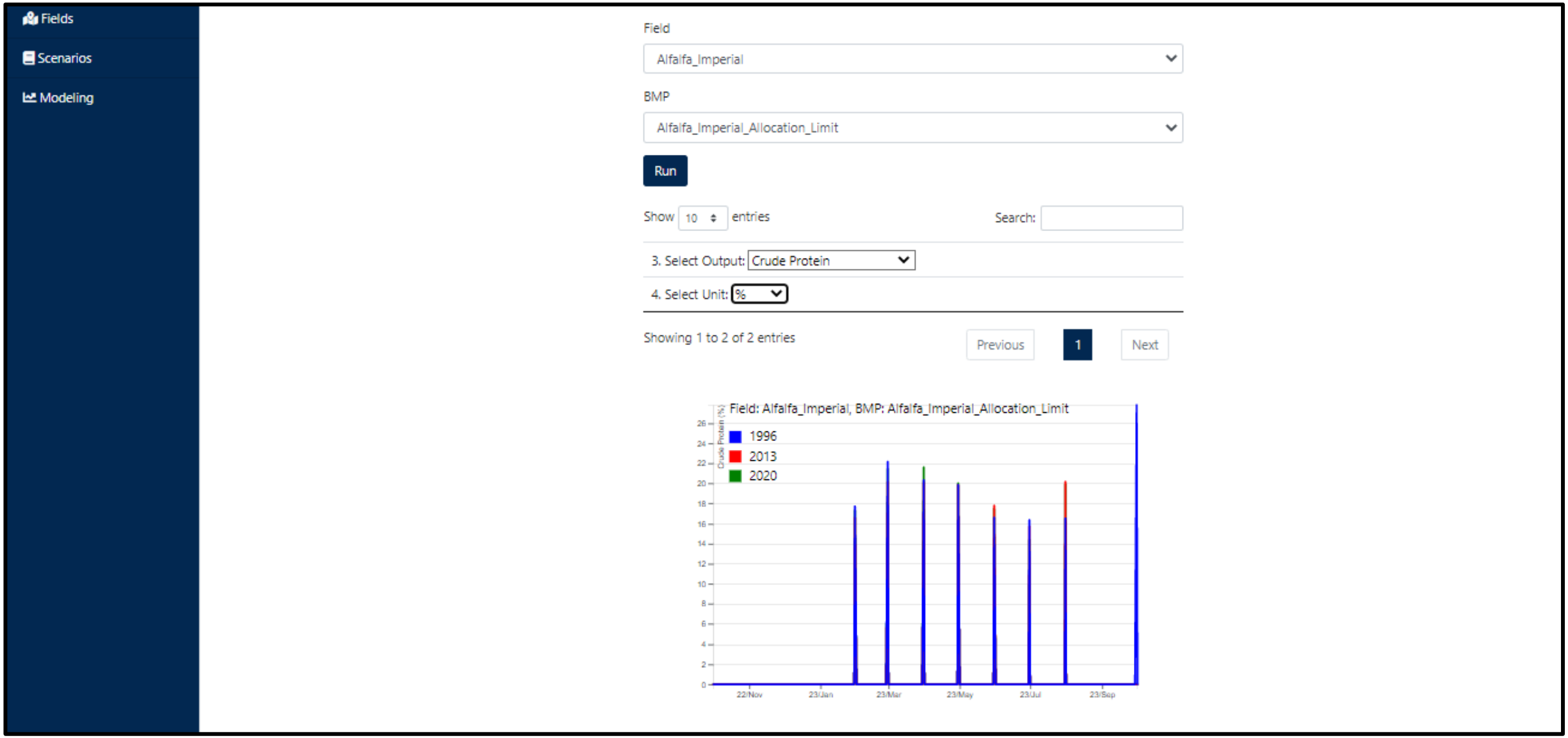
Predicted alfalfa net irrigation requirement

Predicting the impact of water allocation limits on alfalfa yield

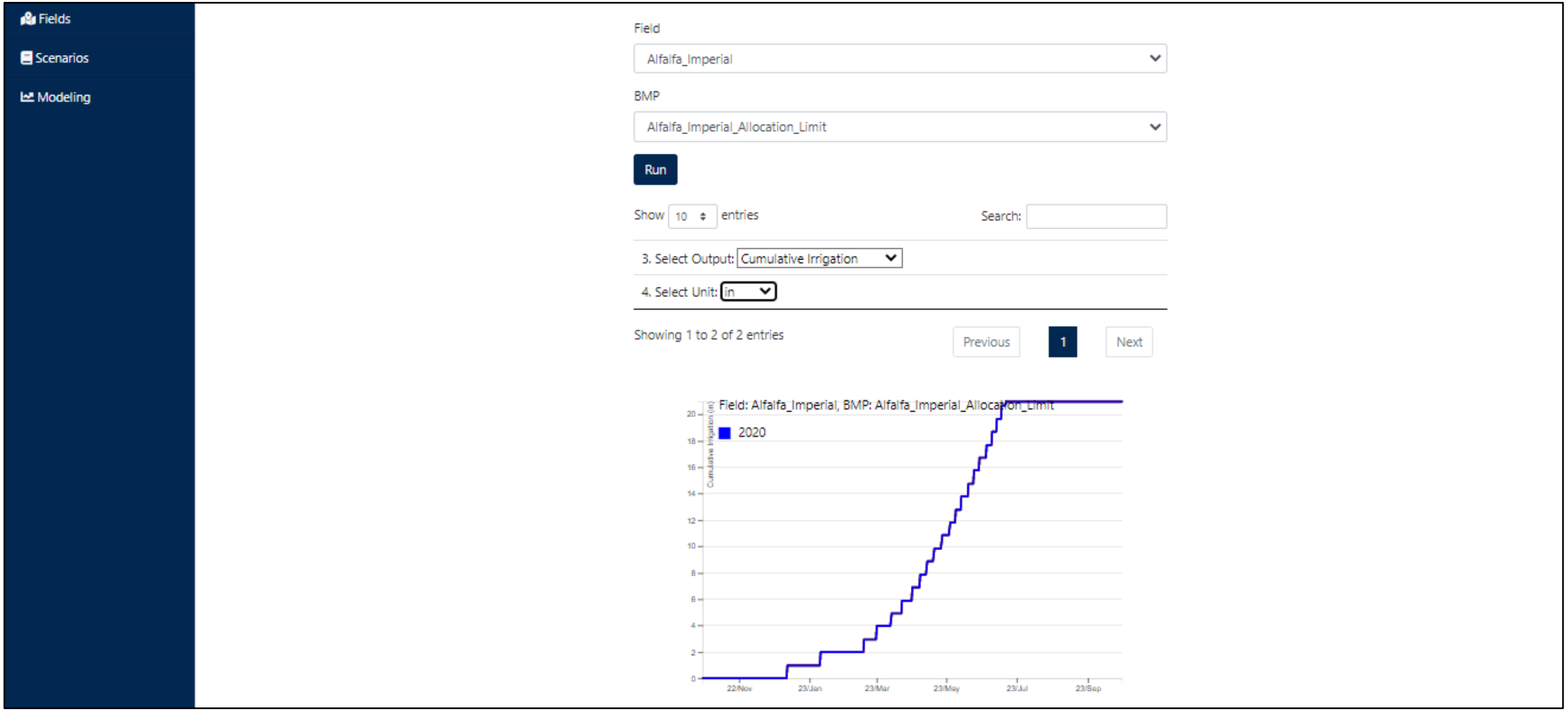
FARMs Beta Disclaimer https://ciswma.lawr.ucdavis.edu/ Log In Register



Reducing irrigation by 50% significantly reduces yield of later cuttings ~0 tons/ac of the last two cuts

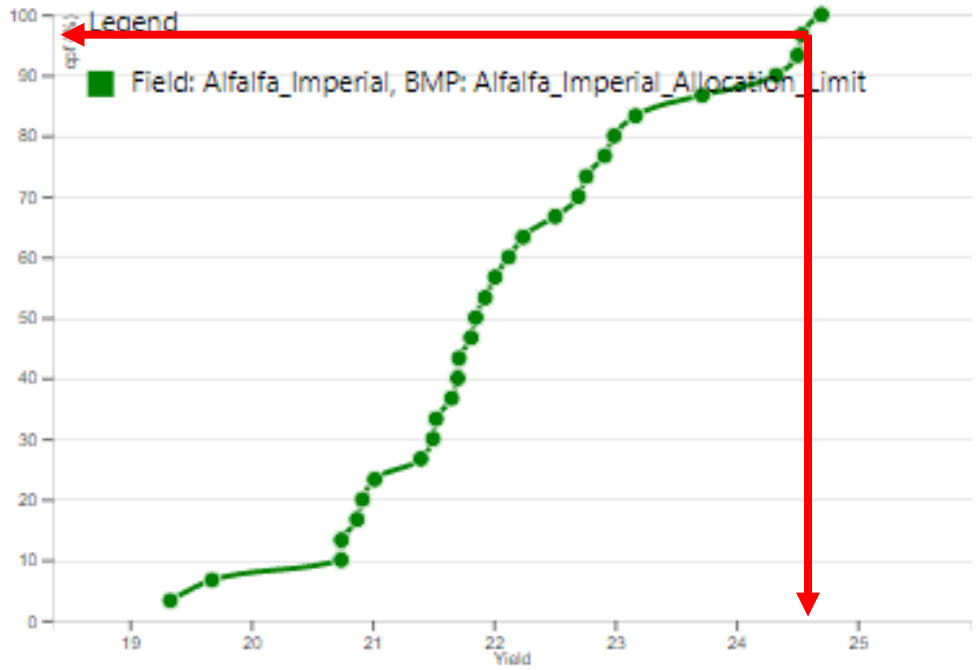


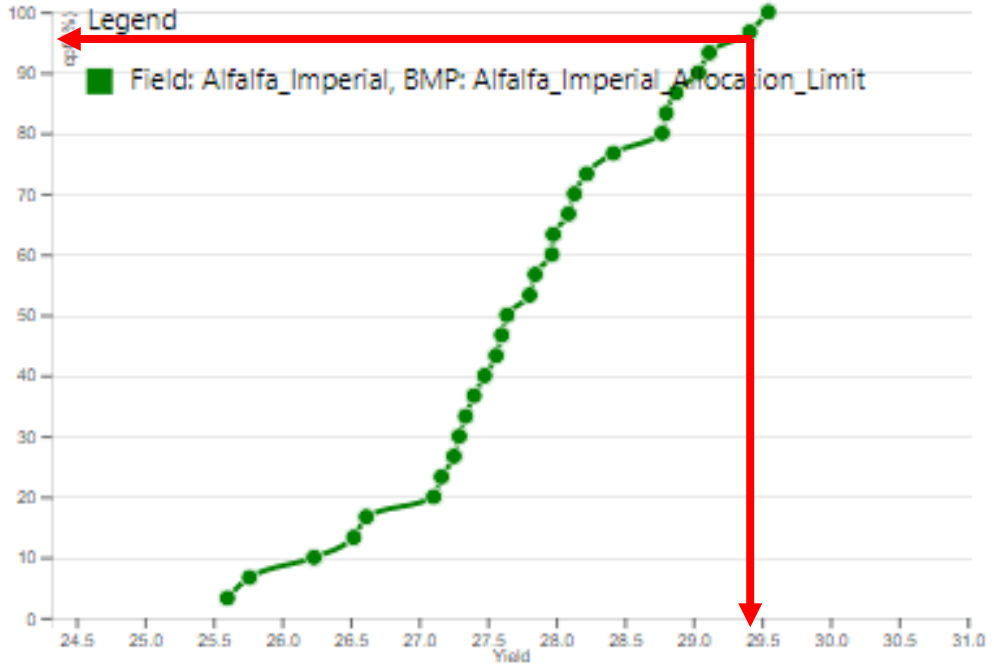
Notice increase in crude protein as yield decrease for the later cuttings.



FARMs cuts of irrigation when total cumulative irrigation reaches water allocation some time in July in 2020.

Effect of deficit irrigation on yield





Deficit irrigation: Irrigation frequency limited to 7 days

Full irrigation

Other resources

- Weather and Climate Data: NASA Power: https://power.larc.nasa.gov/
- Soil data: Gridded Global Soil Info: https://www.isric.org/explore/soilgrids
- A video tutorial on how to use the FARMs web app is available at the following url: http://kisekka.ucdavis.edu/software/farms/.
-

Thank you!

Isaya Kisekka
Associate Professor
Agrohydrology and Irrigation
Director: Agricultural Water Center
University of California Davis
Phone: 530-379-9549
E-mail: ikisekka@ucdavis.edu

Web: http://kisekka.ucdavis.edu/

Acknowledgements

USDA NIFA SAS Award
number 2021-68012-35914