THE UNITED REPUBLIC OF TANZANIA
MINISTRY OF AGRICULTURE
TANZANIA AGRICULTURAL RESEARCH INSTITUTE

Status and future prospects of Direct Seeded Rice in Tanzania; responding to current climate change challenges?

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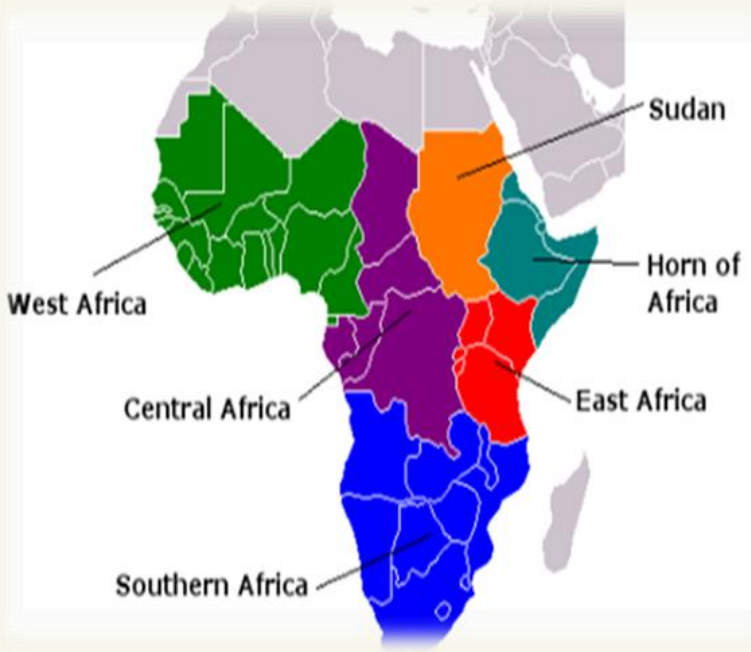
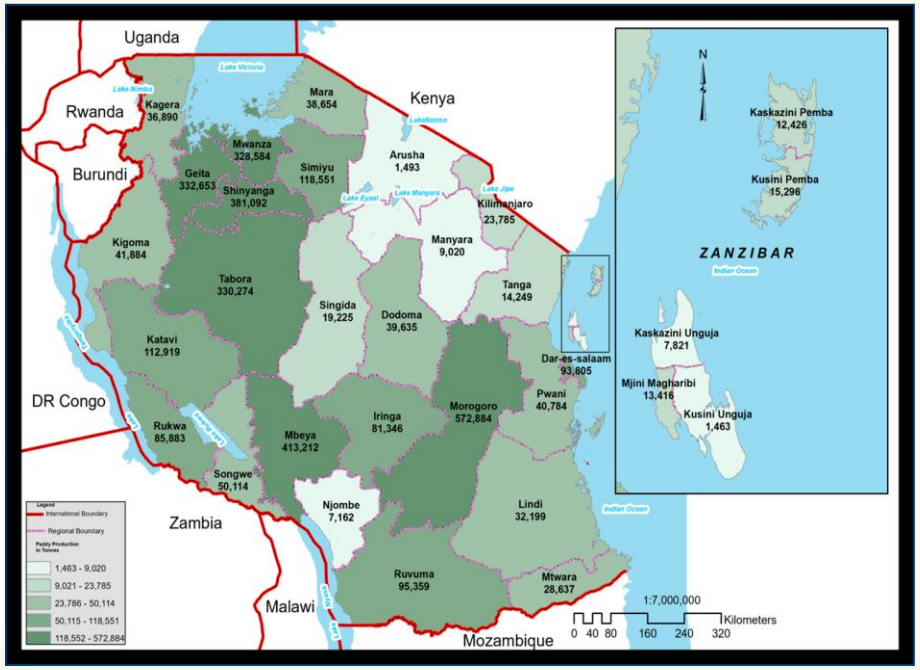
Rice production in Tanzania

- Rice is a staple food crop of increasing importance in sub-Saharan Africa (SSA) including Tanzania
- In the region, over the last three decades its consumption increased by 300%, while production increased by only 170%
- Tanzania is the 2nd leading rice producer in East and S. Africa after Madagascar
- In the country, rice is the most important food grain after maize, directly influencing the livelihoods of over 2 million people
  - *majority of rain-fed upland & lowland rice farmers are smallholders*

Rice production in Tanzania





- In Tanzania, rice is the second most cultivated cereal food crop after maize in three agro-ecosystems:
  - rain-fed lowlands (70%), rain-fed uplands (18%), irrigated lowlands (12%)

- Rainfed ~88%, Sub category; transplanted and *direct seeded*

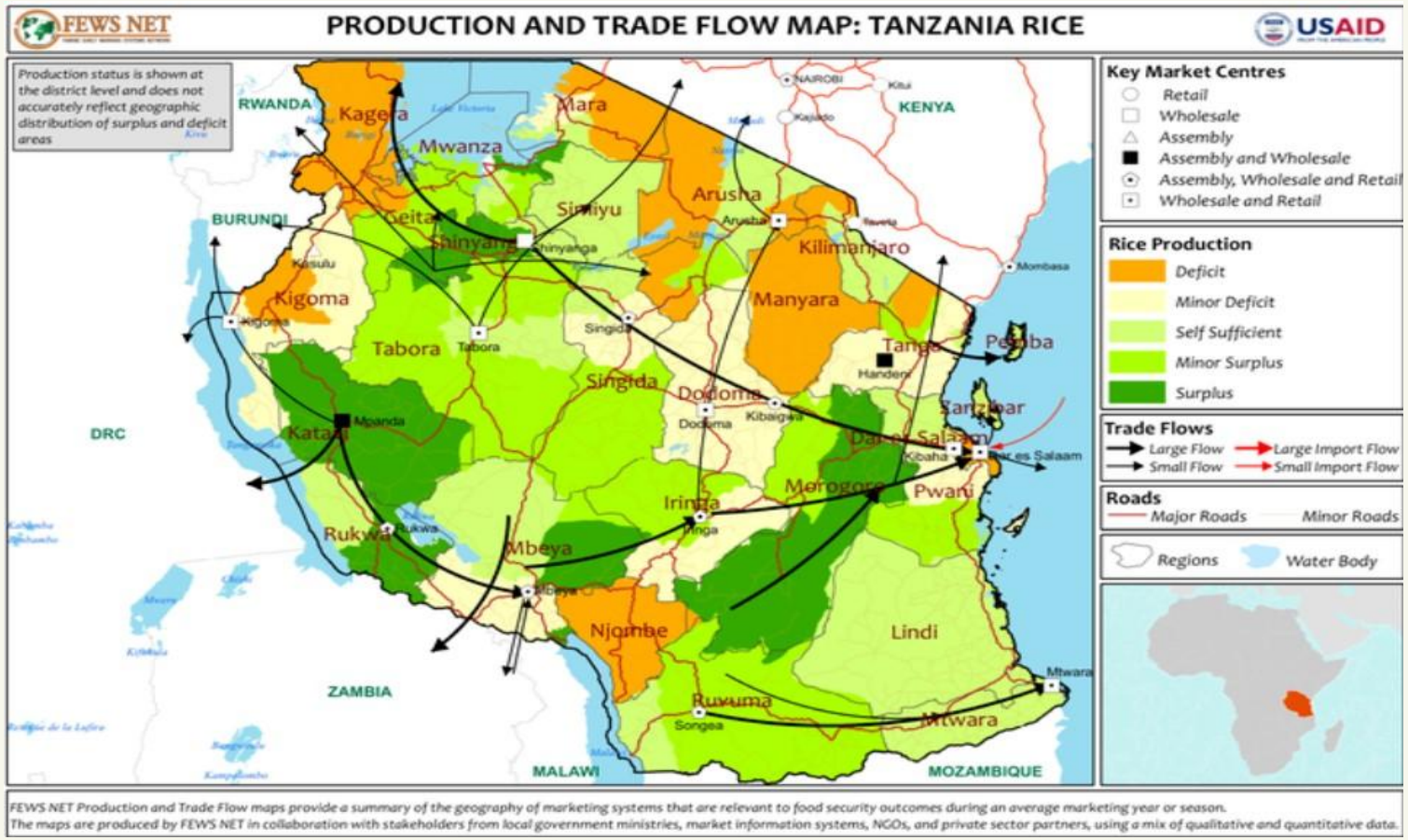
Rice production in Tanzania

- In Tanzania, rice is cultivated in an estimated area of about 1.7million hectares and the potential of 21Mha

- It is estimated that 18% of all farming households grow rice

- Rice being a food crop and cash crop, the areas under rice cultivation acreage and intensity of cultivation has been increasing

Opportunities for Rice sub-sector



❑ To a larger extent, the country serves the region: food and nutrition securities

Opportunities for Rice sub-sector

National Priority: National Rice Development Strategy

National Agenda 10/30: 10% Increase in growth of the agric sector by the year 2030

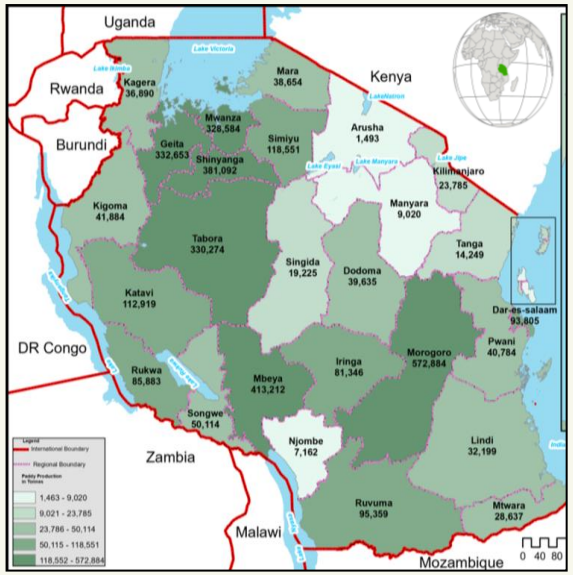
Advocacy specifically for rice-by Rice Council of Tanzania

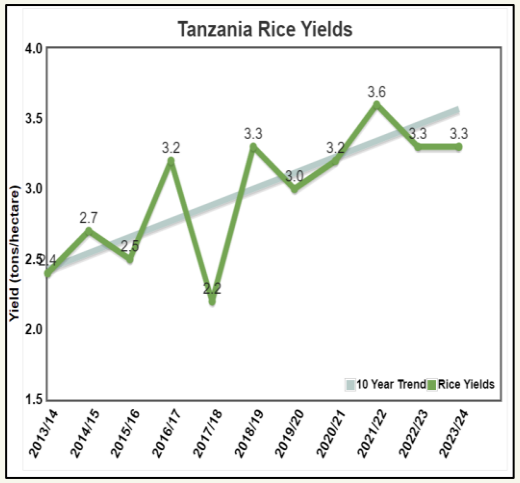
Farmers are being organized towards **commercial** entities.

Large investor farms (Kapunga, Highland estate) with combined acreages of 7000 ha

Emerging private seed companies for rice in Tanzania E.g., Sange-Mbeya.

Focus on regional markets





https://ipad.fas.usda.gov/countrysummary/Default.aspx?id=TZ&crop=Rice

Opportunities for Rice sub-sector

❑**The changing perspectives of rice research & development priorities**

Rice has evolved from being a **luxury good** eaten on special occasions to **staple** and **a commercial crop** generating income and employment

Strategic crop for national **food security and export**

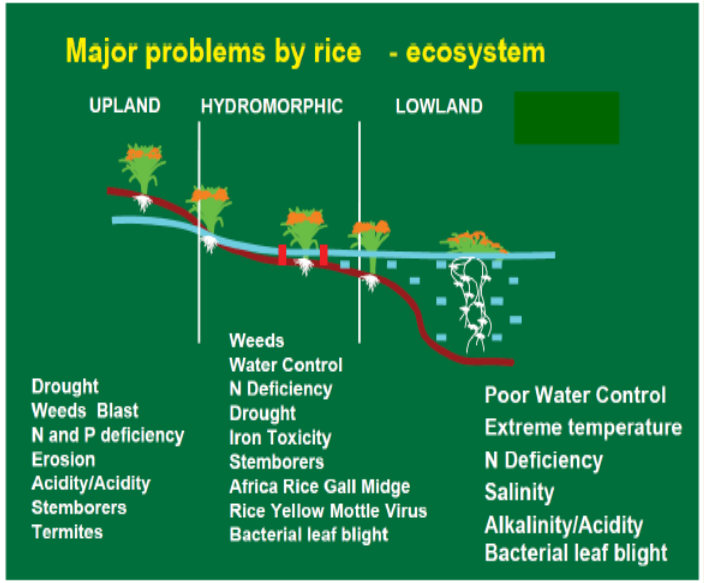
18% of farming households are engaged in rice cultivation

More people are employed in the subsector than any other food crop commodity

Research plays important role in addressing major challenges related to rice production (*varieties, crop management, seed delivery systems etc.*)

Rice production challenges

- Despite some good opportunities for the crop, in rainfed rice production ecologies the actual yield is low (1.0-2.0 t ha^{-1}) due to some production constraints:
  - abiotic (water/drought and nutrients)
  - biotic (low yielding cultivars, diseases, pests and weeds)



Source: Africa Rice Center (WARDA)

Rice production challenges

- In Tanzania, over 70% of rice is produced under rainfed ecology whereas irrigated ecology account for less than 10%

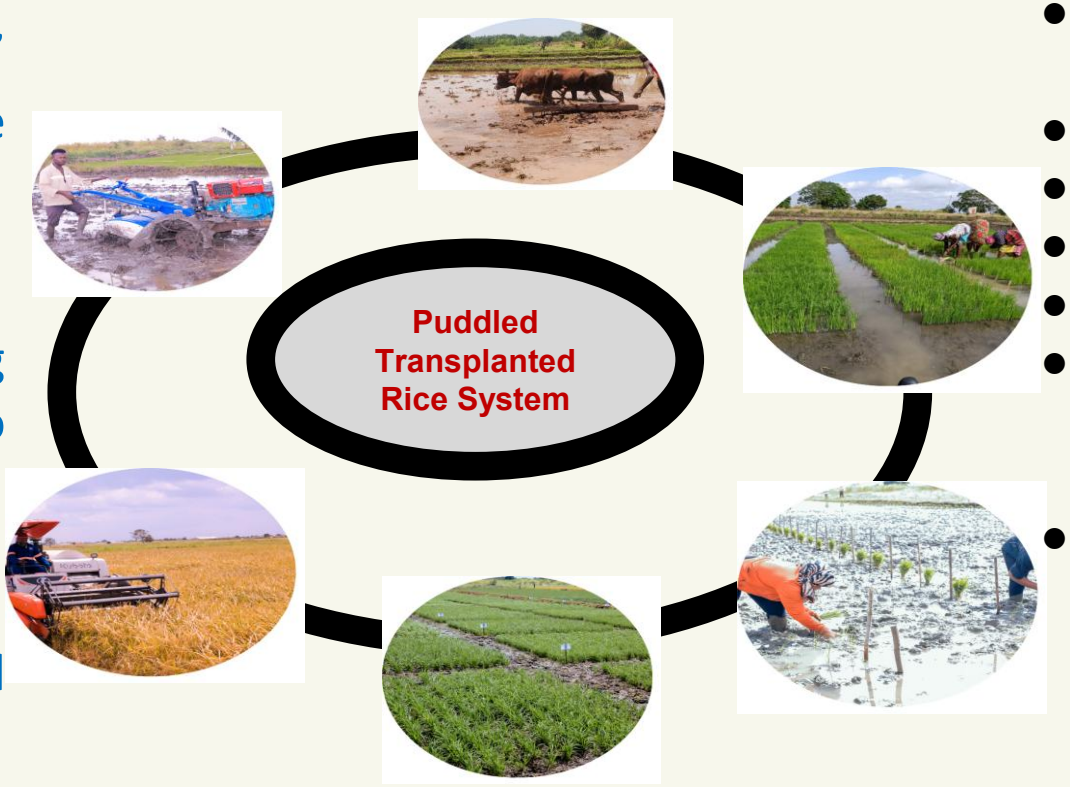
- More than 91.4% of the rice being produced in the country has potential to be cultivated under direct seeding given the challenges associated with transplanted rice in the wake of climate change

- Direct Seeding Rice (DSR) is a dominant practice and it plays a vital role in rainfed rice production ecologies

Direct Seeded Rice Technology (DSR) vs Irrigated Rice Systems

- Flooded rice cultivation is the largest source of methane emissions in global agriculture, contributing about 10% of the worldwide agriculture emissions
- The DSR technology is resource-conserving and climate-smart and has the potential to drive rice production
- DSR may increases profitability in rainfed rice production system

❑ Irrigated Rice



Key issues

- Contributor of GHG
- Labor intensive
- Water
- Energy
- Drudgery
- Soil physical and health deterioration
- Soil nutrients management

Current status of Direct Seeded Rice

Suitable varieties

- Three DSR varieties; TAI, TARI-RIC2, and Komboka)

Land preparation

- No proper leveling
- Non-uniform crop stand,
- inefficiency in distribution of irrigation,
- Reduced nutrient use efficiency

Seed treatment

- None
- Spread of seed borne diseases

Time of planting

- Nov, Dec, Jan
- Few days before start of the rains

Seed rate / spacing

- Mainly broadcasting
- Very high (80 kg / ha)

Fertilizer application

- Sub-optimal application
- Timing not coinciding with critical crop stages

Weed management

- Mainly manual

Current status of Direct Seeded Rice

❑ **Key traits for DSR**

Trait	Dry DSR
1. Anaerobic germination	√
2. Early and uniform emergence	√
3. Early vigor	√
4. Canopy coverage	√
5. Early maturity	√
6. Nematode resistance	√
7. Lodging resistance	√
8. Drought tolerance at seedling stage	√
9. Drought tolerance at reproductive stage	√

❑ Some of the DSR potential lands

	Potential area	Currently utilized irrigation	Traditional	Improved rice scheme
Mbarali,	87,734.2 ha	39,363 ha		
Kyela	Irrigated =2,750 ha Rainfed =22,500 ha		Rainfed 22,500 ha	2,750 ha
Rukwa	38,232	Rainfed 37,467.36		
Mwanza	Rainfed **96,493.35Ha**	DSR= 72,556.4		

Direct Seeded Rice Technology (DSR)

- On the ongoing efforts addressing rice production challenges, IRRI and TARI evaluated 234 entries under direct seeding in Kyela District, SW-Tanzania

- At stage 1, the top 100 entries yielded about 6.8 t ha^{-1} in average, meanwhile a range of 3.8 - 5.1 t ha^{-1} was observed for the other trialing stages

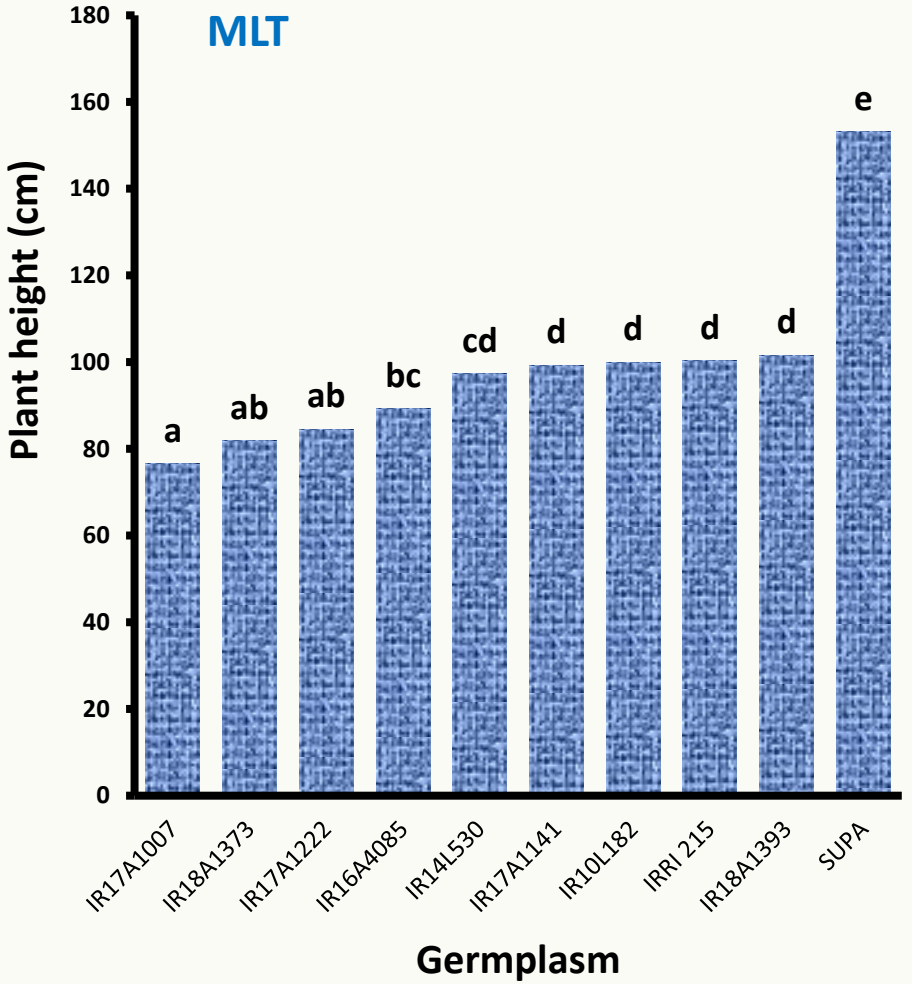
- From these materials, 14 entries were further selected based on a criteria as defined by the market segment and specific for Tanzania product profile

- **Experiments**

Trial	Location	Stage	Entries	Plots	Rep /blocks	Design	Plot size (sqm)
DSR -R	Kilasilo	Stage 1	170	200	4	Augmented	3
		stage 2	50	100	2	Alpha lattice	5
		MET	14	42	3	RCBD	5

Direct Seeded Rice Technology (DSR)

- **IRRI and TARI ongoing efforts 2022-2023-2024**



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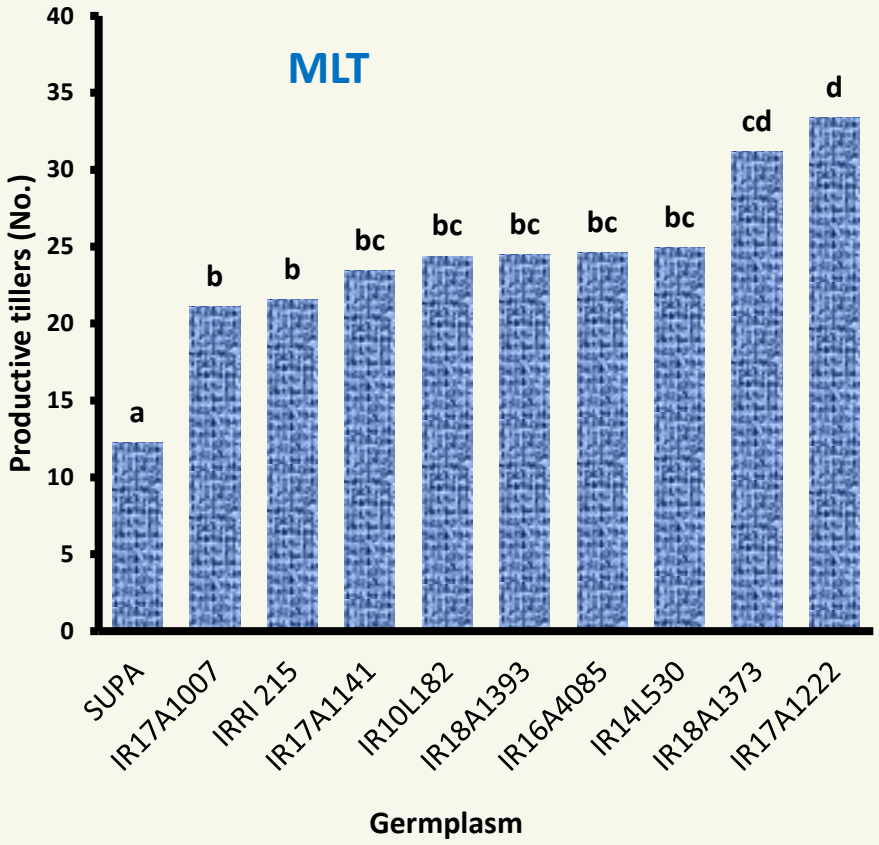

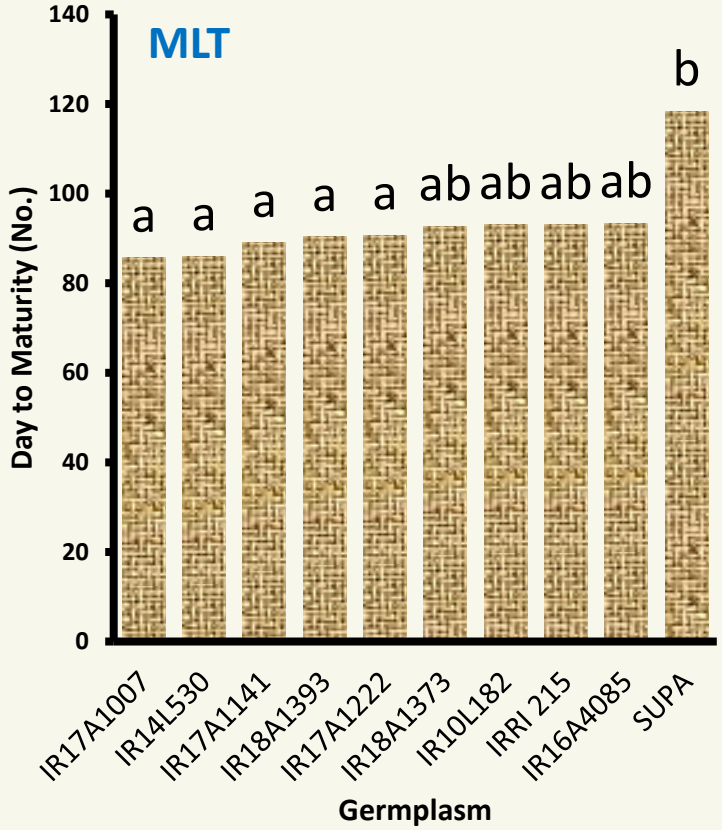

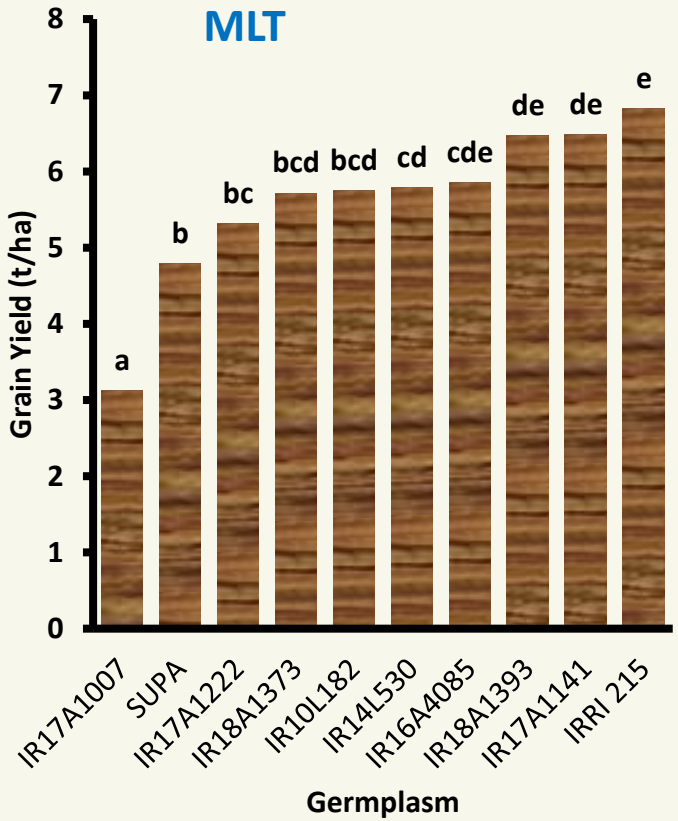

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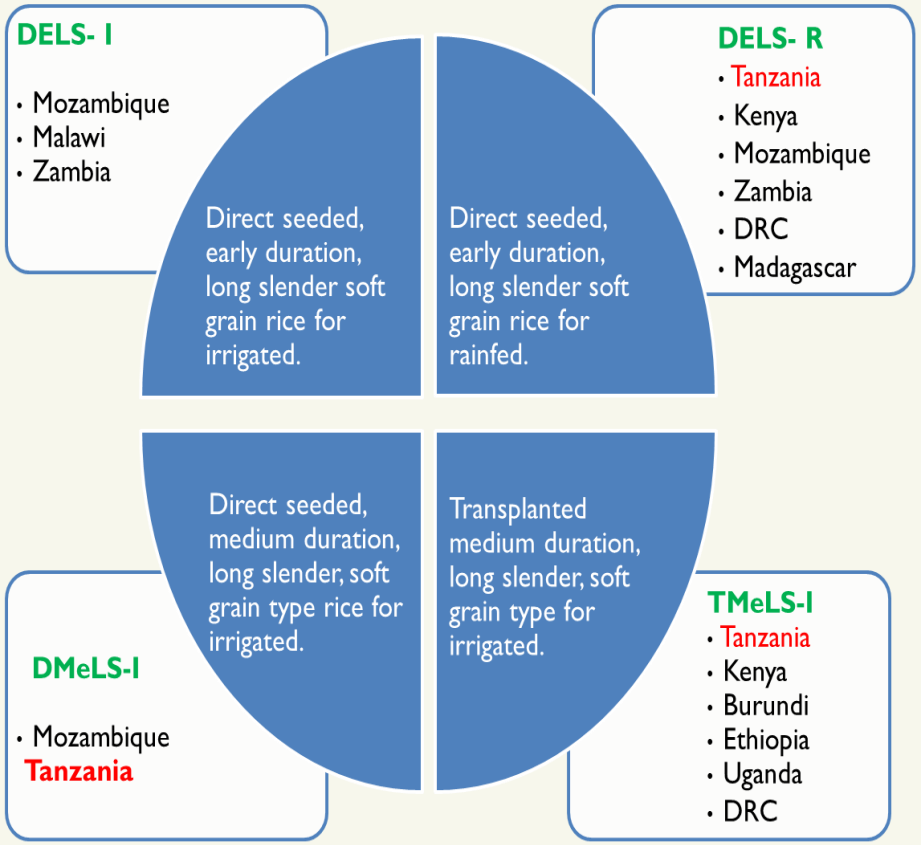


- **Participatory Varieties Selection (PVS):** The best 1st three preferred by the farmers

Entry 6; line IR10L182 (100%): Good grain color, high yield, early maturity, uniformity

Entry 5; line IR16A4085 (97%): high yield, early maturity, uniformity

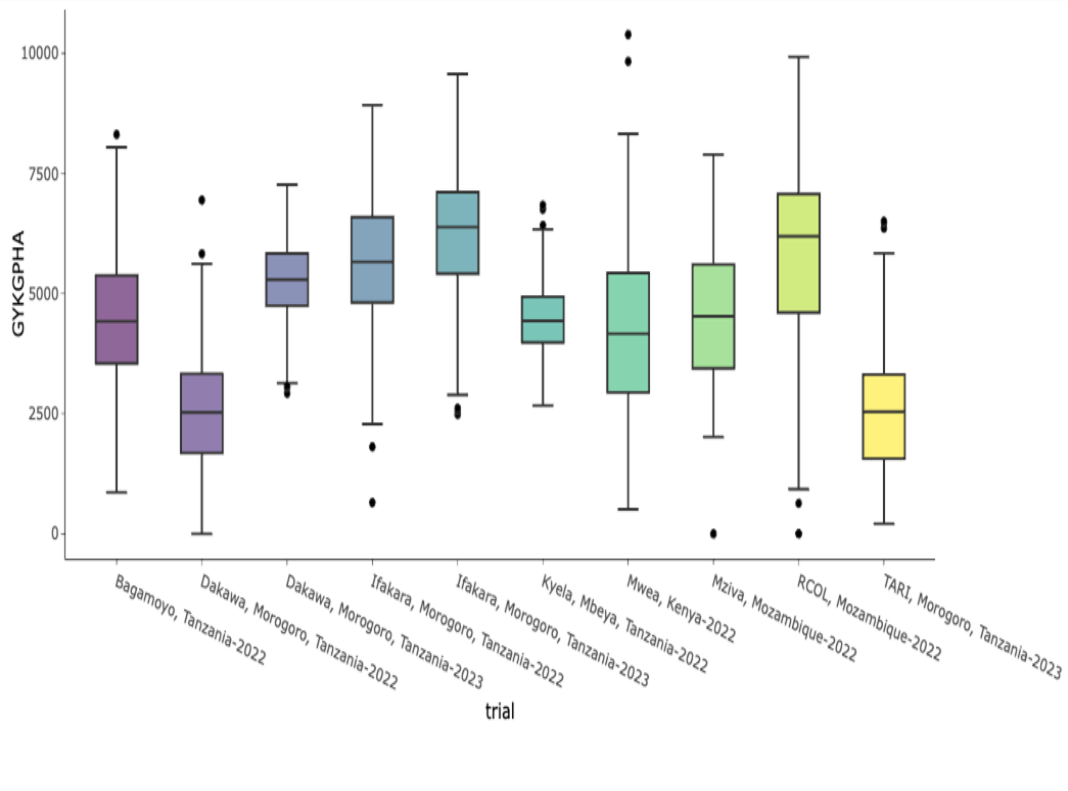
Entry 9; line IRRI 215 (95%): Good grain color, high yield, uniformity

TARI Tanzania broadly aligns with Market Segments and Breeding Pipelines defined by one

Direct Seeded Rice Technology (DSR)

The Technology; some results across the locations

Stage 1 sites: 2022/23, 2023/24

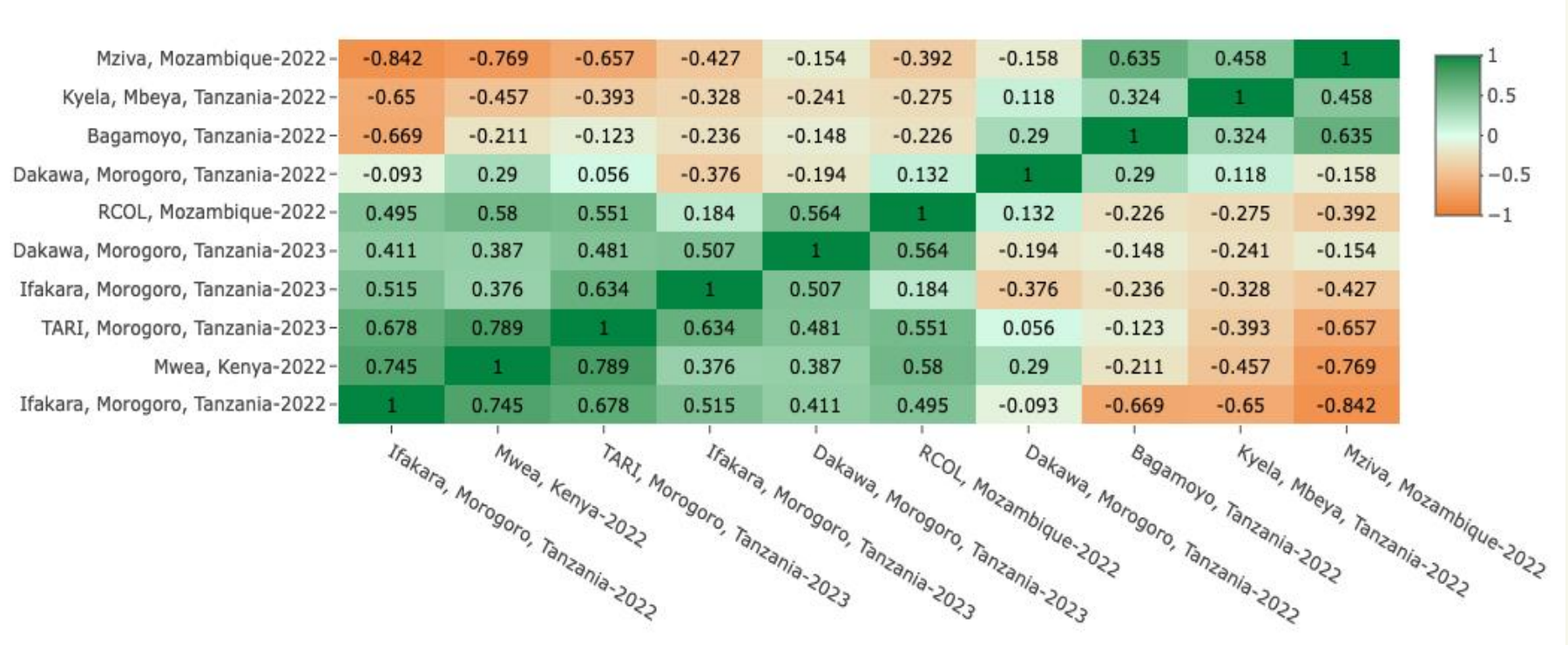


Site Name	Plot H2 (GY)
Bagamaoyo 2023	0.75
Dakawa 2022	0.73
Dakawa 2023	0.35
Ifakara 2022	0.86
Ifakara 2023	0.42
Kyela 2022	0.46
Mwea 2022	0.93
Mziva 2022	0.83
RCOL, Mozambioque 2022	0.85
TARI-Morogoro 2023	0.50

Direct Seeded Rice Technology (DSR)

The Technology; some results across the locations

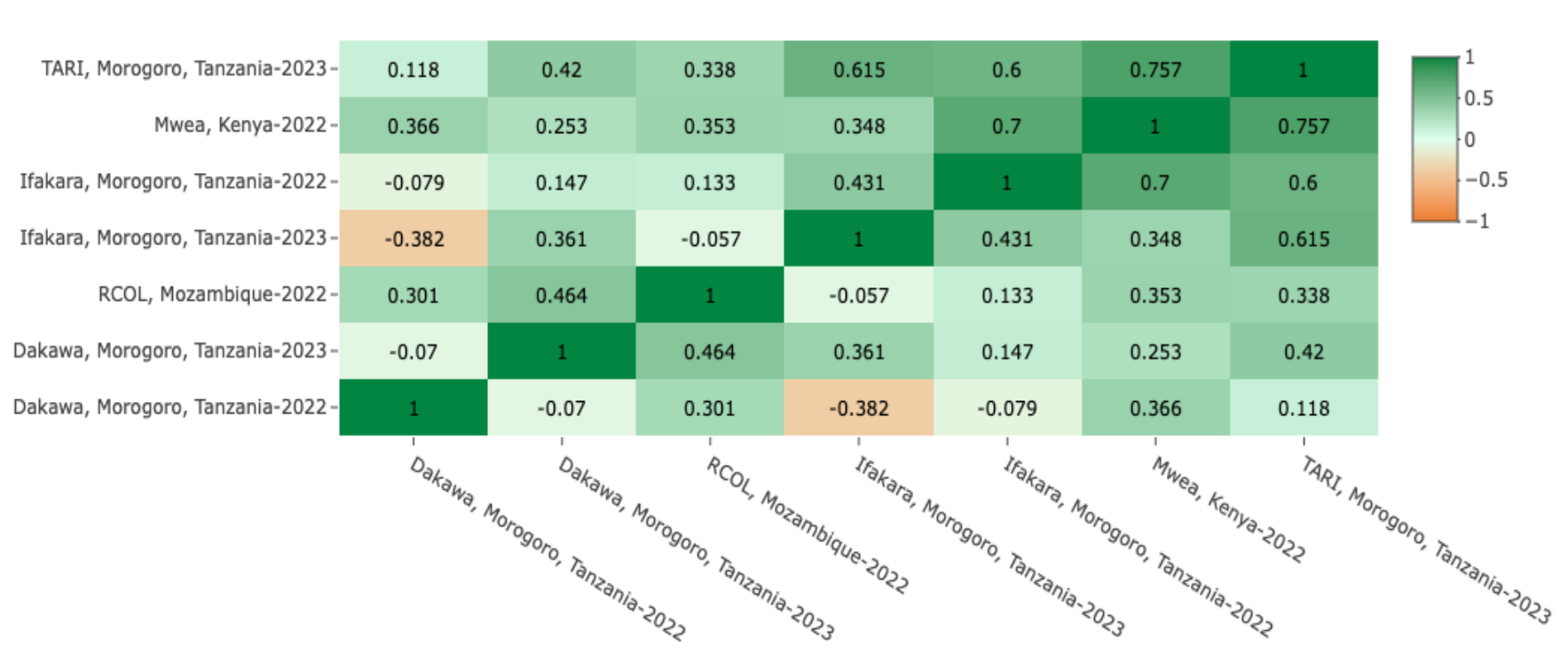
Site correlations (all sites)



- All sites reliability= 0.86

Direct Seeded Rice Technology (DSR)

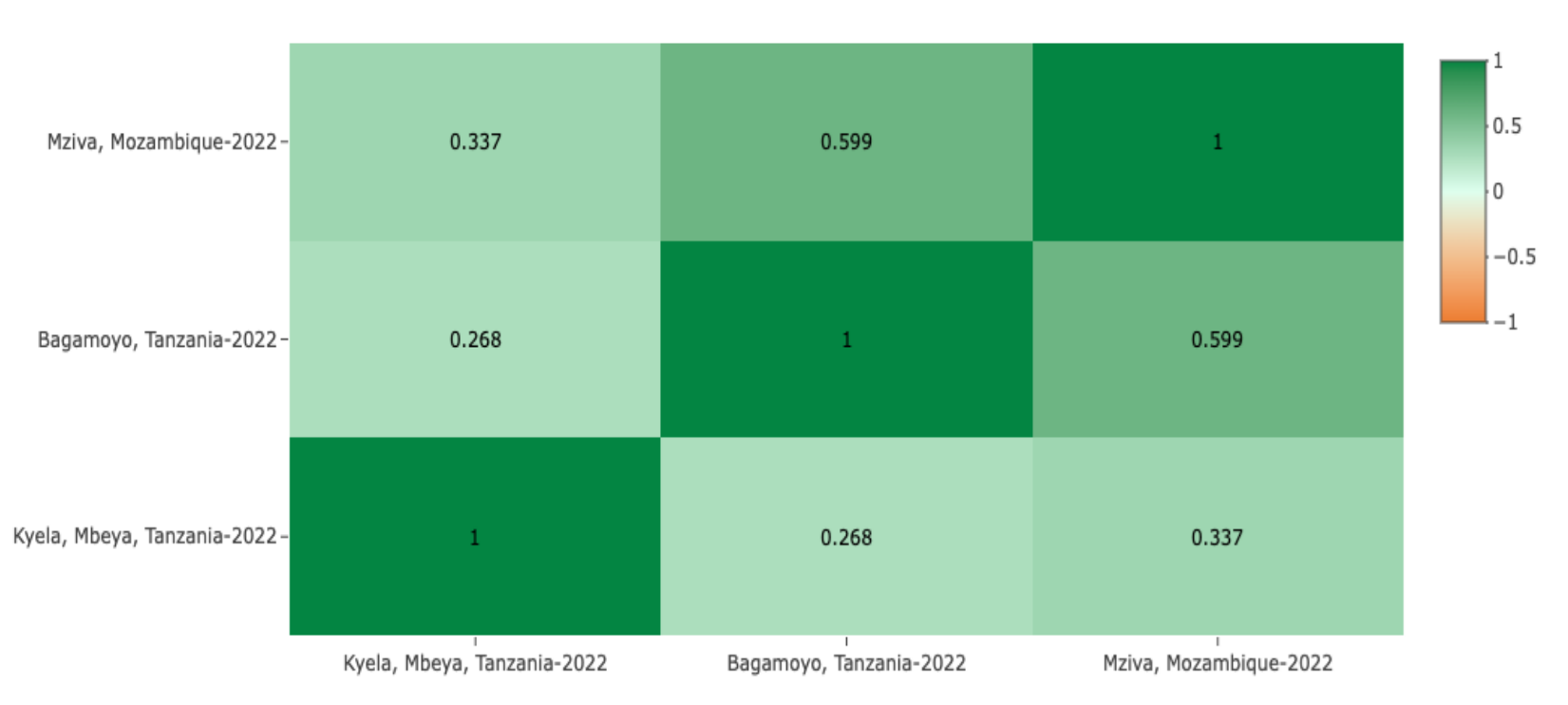
The Technology; some results across the locations



Group 1: Reliability=0.95

Direct Seeded Rice Technology (DSR)

The Technology; some results across the locations



Group 2: Reliability=0.90

Direct Seeded Rice Technology (DSR)

The Technology; some results across the locations

Selections group 1, Genomic Estimated Breeding Value (GEBVs)

LINE	GY (kg/Ha)	PH (cm)	DTF (days)	Zn (ppm)	SI	LINE	GY (kg/Ha)	PH (cm)	DTF (days)	Zn (ppm)	SI
IR18R1137	5789.29	95.56	99.87	25.25	20.45	IR18R1072	6223.19	97.27	95.55	25.03	29.07
IR19L1046	5939.86	100.93	92.77	26.62	22.78	IR18R1156	5789.29	95.56	99.87	25.25	20.45
IR18R1176	5857.30	93.52	99.26	24.98	21.91	IR18R1103	5753.92	93.58	97.76	25.03	19.86
IR18R1027	5789.29	95.56	99.87	25.25	20.45	IR18R1054	5789.29	95.56	99.87	25.25	20.45
IR18R1095	5857.30	93.52	99.26	24.98	21.91	IR18T1020	5805.48	96.51	99.20	26.62	20.14
IR18R1087	5753.92	93.58	97.76	25.03	19.86	IR18R1065	5753.92	93.58	97.76	25.03	19.86
IR18R1099	5753.92	93.58	97.76	25.03	19.86	IR18R1061	5823.36	97.62	94.11	25.03	21.22
IR18R1168	5789.29	95.56	99.87	25.25	20.45	IR16A2106	6224.62	103.35	92.51	25.30	28.97
IR18R1179	5857.30	93.52	99.26	24.98	21.91	IR13LT799	5089.88	95.38	97.03	23.53	7.52
IR18R1166	5789.29	95.56	99.87	25.25	20.45	IRRI 154	4791.51	96.05	94.92	22.65	2.07
IR18R1162	5789.29	95.56	99.87	25.25	20.45	IRRI 163	4222.11	98.90	97.99	22.65	-9.10
IR18R1113	5753.92	93.58	97.76	25.03	19.86	IRRI 176	5155.35	106.46	90.72	27.97	6.76
IR15A2407	5805.48	96.51	99.20	25.30	20.75	IRRI 201	5385.36	92.72	96.11	26.62	11.89
IR18R1068	5753.92	93.58	97.76	25.03	19.86	SAHBHAGI DHAN	4454.69	96.78	98.81	22.10	-4.29
IR18R1040	5857.30	93.52	99.26	24.98	21.91	Vandana	5005.68	99.16	98.09	21.48	6.81
IR16T1114	5735.92	96.12	97.34	25.13	19.46	Komboka	5136.08	95.31	92.14		
IR19L1044	6111.26	98.42	98.07	28.00	25.50	SUPA	4484.29	114.46	95.28		

Direct Seeded Rice Technology (DSR)

The Technology; some results across the locations

Selections group 2, Genomic Estimated Breeding Value (GEBVs)

Line	GY (kg/Ha)	DTF (days)	PH (cm)	Zn (ppm)	Line	GY (kg/Ha)	DTF (days)	PH (cm)	Zn (ppm)
IR 127155-1-4-35-1-B-B	4966.5	79.3	95.7	24.1	IR17D1096	4786.1	85.9	97.0	25.2
IR 97184-92-3-3-3	4960.4	79.1	95.0	22.8	IR14L362	4799.8	85.8	98.2	25.1
IR12C271	5237.4	81.2	97.4	23.7	IR 127152-3-22-18-1-B-B	5055.0	79.6	96.3	22.4
IR 97214-42-3-2-3	5122.9	82.0	93.8	23.1	IR19L1009	4784.9	85.7	96.6	25.4
IR15C1006	4921.3	85.8	95.0	25.3	IR19L1005	4701.3	86.0	95.2	25.9
IR 58443-6B-10-3	4785.0	85.7	96.6	24.8	IR 132084-B-1456-1-2-B-12	5007.6	79.1	97.0	22.1
IR 127152-3-22-45-1-B-B	5055.0	79.6	96.3	22.4	IR12C180	5116.6	80.8	96.9	24.4
IR16D1002	4839.4	85.7	96.7	24.8	IR13C157	5127.6	81.9	97.8	23.6
IR 132084-B-763-1-2-B-7	5007.6	79.1	97.0	22.1	IR13LT799	4461.4	79.7	94.6	23.7
IR 132084-B-763-1-1-B-19	4996.0	79.5	96.3	22.4	IRRI 154	4553.1	79.5	93.4	20.0
IR 132084-B-1202-1-3-B-17	5094.7	80.6	97.5	22.0	IRRI 163	4622.9	83.8	97.9	22.6
IR 132084-B-763-1-2-B-9	5007.6	79.1	97.0	22.1	IRRI 176	4458.4	86.0	92.1	26.6
IR19L1007	4784.9	85.7	96.6	25.4	SAHBHAGI DHAN	4711.7	80.8	94.4	21.8
IR 127152-1-6-7-1-B-B	4951.3	79.1	94.5	22.7	Vandana	4424.4	80.9	95.1	21.4
IR 97191-22-3-2-3	4951.3	79.1	94.5	22.7	Supa	4500.7	85.0	96.9	
IR 116713-B-B-23-3-B-B	5169.6	79.8	96.9	22.3	Komboka	4677.5	81.9	93.2	
IR13C164	4951.3	79.1	94.5	22.7	ZX 117	4561.3	82.2	93.9	

Conclusion

- Through DSR, the existing practices with regard to agronomic practices, availability of suitable adaptable germplasm that meet consumer demands will increase rice production in Tanzania
- Through optimization and validation of scale climate-smart agronomic practices together with adaptable varieties rice production increases
- DSR will improve rice production and contribute to reducing the environmental footprint of the current practices of rice production

Outlook

- **How can we customize these technologies??**
  - **Seed system**: More demonstration on DSR varieties and QDS – production training and registration
  - Certified seed production / partner with seed companies (ASA, TARI, other seed companies e.tc)
- Direct Seeded Rice (DSR) technology:
  - **Establish hubs**: To demonstrate DSR rice seeder machine motorized vs. broadcasting, harvesters, threshers, seed treatments e.tc
  - Mechanization of Farm Operations (MFO)
  - Seed System (Production and Utilization)
  - Agronomy (fertilizers rates, weeds management, crop pathology and physiology
    - Develop DSR Agronomy protocols; fertilizers, weed management, pathologies

Thank you

Acknowledgment