Exploring farmers' perception, knowledge, and management techniques of salt-affected soils to enhance rice production on small land holdings in Tanzania

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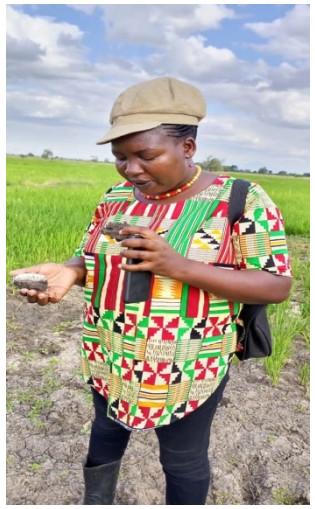
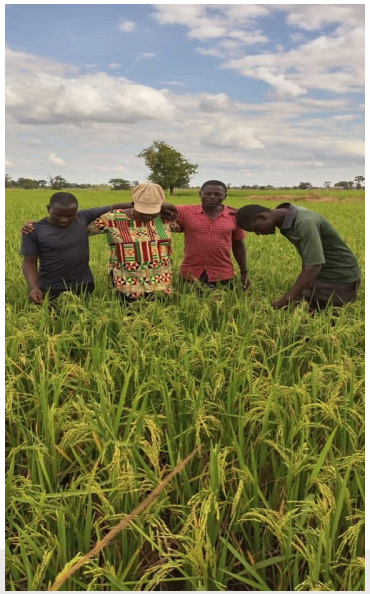
Presentation Outline

- Background
- Methodology
- Results
- Discussion
- Conclusion
- Recommendation





Background Information

- Soil is a vital resource critical to human life that contributes to food and feed and ecosystem services

- Provision of these services is limited by the availability of healthy soil

- And thus, can limit its key functions.

- Among the challenges including salinization, erosion, pollution and nutrients decline.
- Soil salinity on agricultural land is a global concern due to its direct impact on food production and sustainability.

Background Information

- In Tanzania, this challenge has been reported to exist in some irrigation schemes and rainfed lowlands.
- And, it has also reported as one of the limiting factors for rice production and sustainability (Kashenge-Killenga *et al.,* 2012).

- Available literature shows that 3.6 million ha of land had salt problems, with 83% saline and 16% sodic (Mnkeni, 1996).

- According to FAO (2000), soils in 1.7 million ha were saline, and 300,000 ha were sodic.
- But the current information on extent and severity is still inadequate.

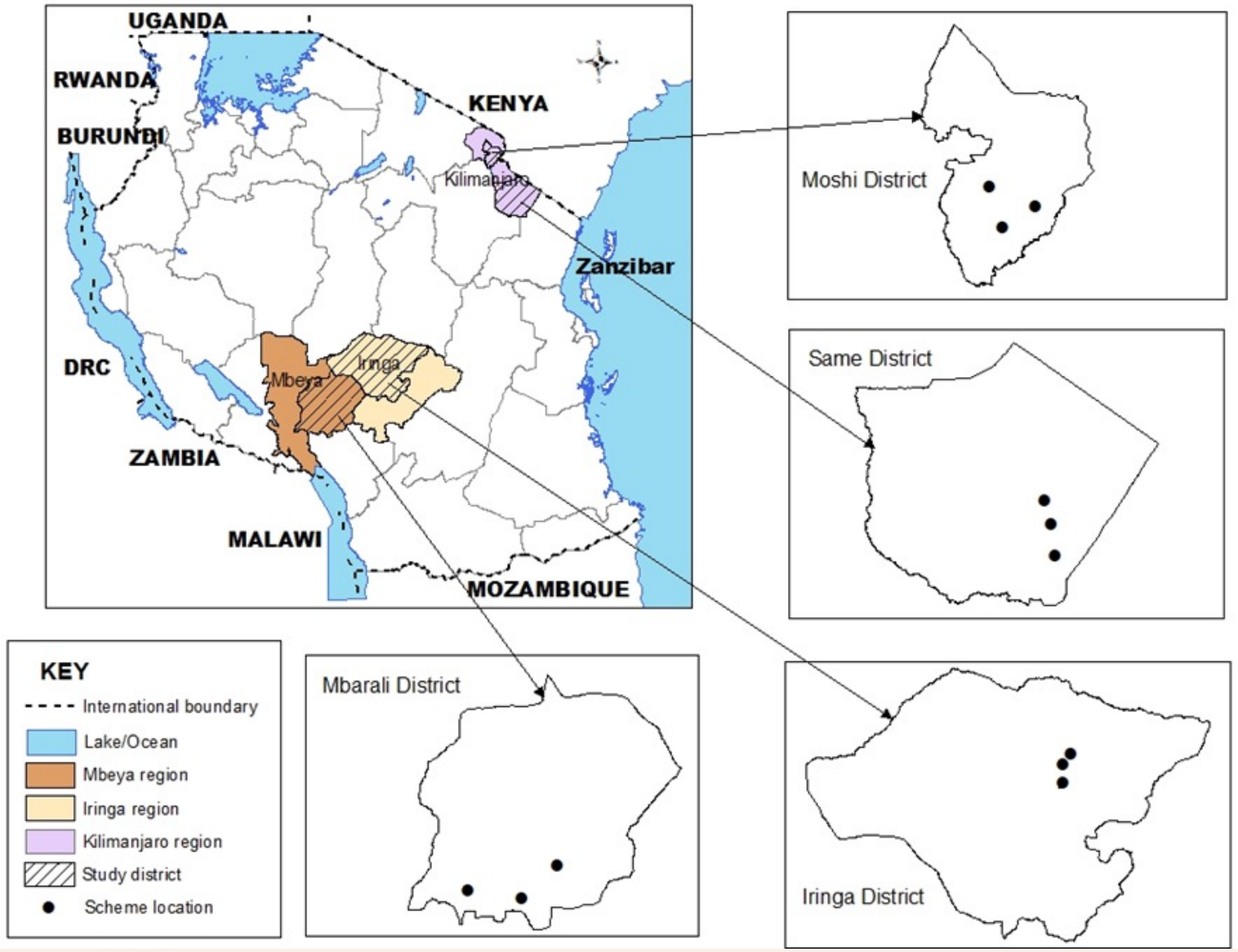
Background Information

- Rice is the second-largest produced and consumed cereal crop in Tanzania, with annual grain yields of about 3.3 million tons matching 1.7 million ha of the cultivated land area (NBS,2021).

- More than 1.3 million households are engaged in rice production (NBS,2021), of which productivity ranges from grain yields of 1.8 to 4.3 t ha^{-1} which is lower than the potential grain yield of more than 9 t ha^{-1} (Kwesiga et al.,2020).

Materials and Methods

- Description of study areas



Methodology

- Participatory Rural Appraisal (PRA) approach is a useful tool for assessing farmers' perceptions of crop output limits induced by abiotic and biotic stresses (Mogga *et al.,* 2019; Mrema *et al.,* 2017; Srijna *et al.,* 2020).

- The Approach encourages the community to share opinions, ideas, and experiences about the local problems that often face the community (Abdullah *et al.,* 2012; Campbell, 2001; Jha & Gupta, 2021).

- So, it is a key source for generating primary information and identifying research gaps for a particular problem to further research.

Methodology

Sampling design and procedures

- The study adopted a purposive sampling protocol for identification of districts, rice irrigation schemes, and farmers involved in the survey
- The selection of the district was based on its potentiality to rice production and prior reported information on salt-affected soil issues.
- Random sampling technique was used in the selection of representative farmers
- A total of 323 rice farmers were generated
- Cochran (1977) formula, $n_0 = \frac{z^2 pq}{e^2}$

Methodology cont....

- These form 81 respondents from each district except Same district were (80 farmers)

- Farmers selection criteria were based on gender equity and rice farming experience (of not less than 5 years)

Methodology cont….

- Questionnaires were administered to individual farmers

Methodology cont....

- The study also involved interviewing 2 key informants from each irrigation scheme
- Transect walk along the irrigation schemes was conducted for observations of direct indicators of salt-affected soils.
- Also for validation of some of the information and/or concerns raised during the interviews and group discussions.
- But prior to the interview, the questioners were tested on selected farmers for workability.

Some of salt affected rice farms

Methodology cont....

- Both primary and secondary data was collected

Triangulation of data

- The follow-up discussion was conducted with key informants and extension officers as a backup for validating the collected information and missing data

- The key questions used during the personal farmer's interview and FGDs were used to clarify incomplete information

- The aim was to increase research findings' credibility and validity

Questionnaire content

- Demographic and socio-economic characteristics
- Knowledge of salt-affected soils and activities influences the occurrence
- Management practices (Copping mechanism) by the farmers
- Training conducted for salt-affected soil management

Data analysis

- Statistical Package for Social Sciences software (SPSS) version 20 was used for data analysis

- Frequency means and percentages for various variables were computed
- Cross-tabulation tables were constructed using chi-square tests at probability p = 0.05 to analyse relationships between variables

- The responses based on queries (yes/no type) were analysed through Cochran's Q test

- Farmers' coping mechanisms were prioritized through the Kruskal Wallis H Test

Soil sampling and laboratory analysis

- Prior conducted the interview a composite soil samples were collected randomly at depths of 0 - 30 cm from some of the surveyed irrigation schemes.

- For laboratory analysis to examine salt status.

- The most important parameters determined were soil pH electrical conductivity ($EC_{1:2.5}$) and eexchangeable bases (Ca^{2+}, Mg^{2+}, Na^{+} and $K^{+)}$

- ECe was calculated using an equation developed by Isdory et al. (2021)

- ESP and SAR were also determined

Results

Farm sizes characteristics

- Farmers in the studied irrigation schemes produce rice in a land area ranging from 0.4 to 12 ha (Table 4).

- Majority of farmers (55.2 %) cultivate less than 1 hectare of rice.
- Very few respondents (3.7%) cultivate a large portion of land (> 4 ha)

Land ownership

- 61.6% of the farms were owned by individual farmers, family land (22.6%), rent (15.2%) and borrow (0.6%)

Rice Variety Grown

- The majority (69.1%) of the farmers cultivate improved rice cultivars, of which SARO5 (TXD 306) is widely cultivated.

Results……..

Table 6: Major constraints to rice production in surveyed irrigation schemes

Constraint	Rank
Diseases	5
Insect pest	7
High cost of fertilizer	2
Poor quality seeds	9
Poor soil fertility	4
Salt-affected soils	1
Poor irrigation infrastructure	3
Drought	8
Flood	6

Results cont……

Table 7: Farmers' awareness and knowledge of salt-affected soils

Cochran's Q test			
Sample size	323	d.f.	2
Q	401.485	p-value	<0.001
Statistics:			
Variables	Sum	Proportional 1 (yes) %	Proportional 2 (no) %
Knowledge about salt-affected soil	323	98.8	1.2
Experience of salt-affected soil on their farms	323	78.3	21.7
Differentiate types of salt-affected soils	323	19.5	80.5

Results cont.....

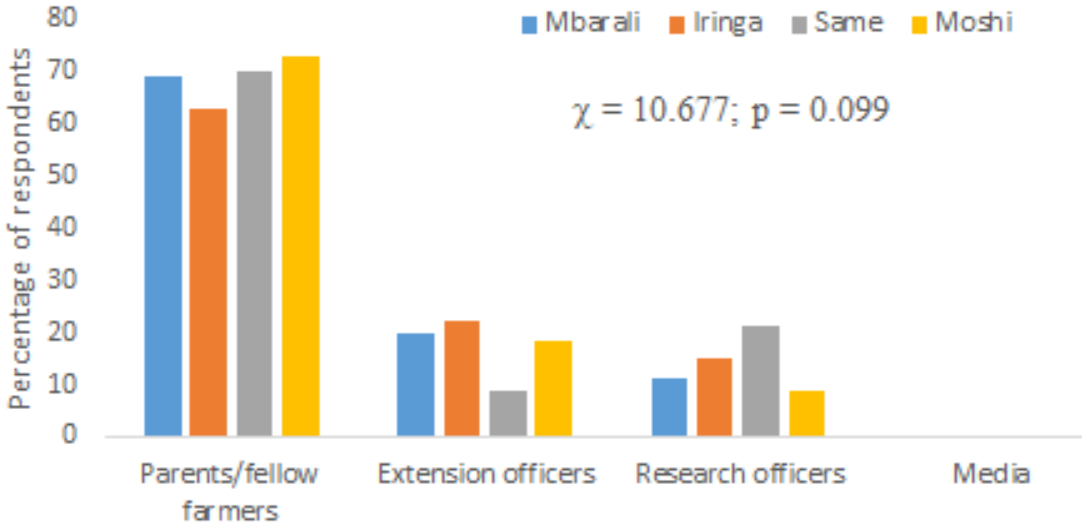


Figure 6: Source of knowledge about salt-affected soils

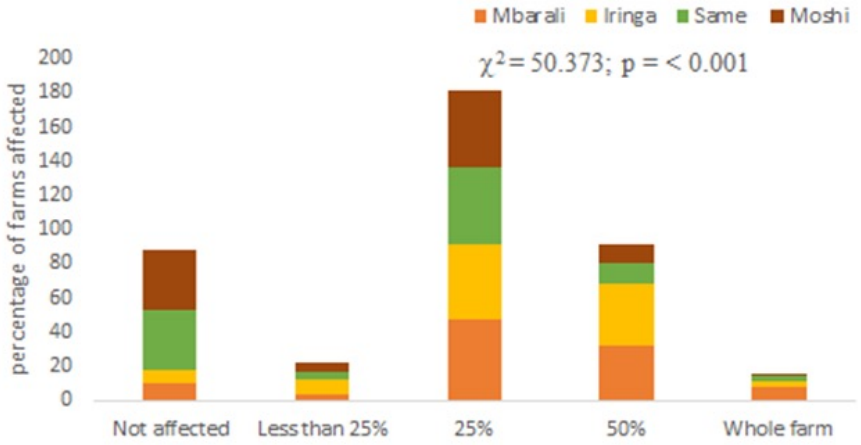


Figure 9: Farmers' perception of the extent of salt-affected soils in their rice farms

Results cont…….

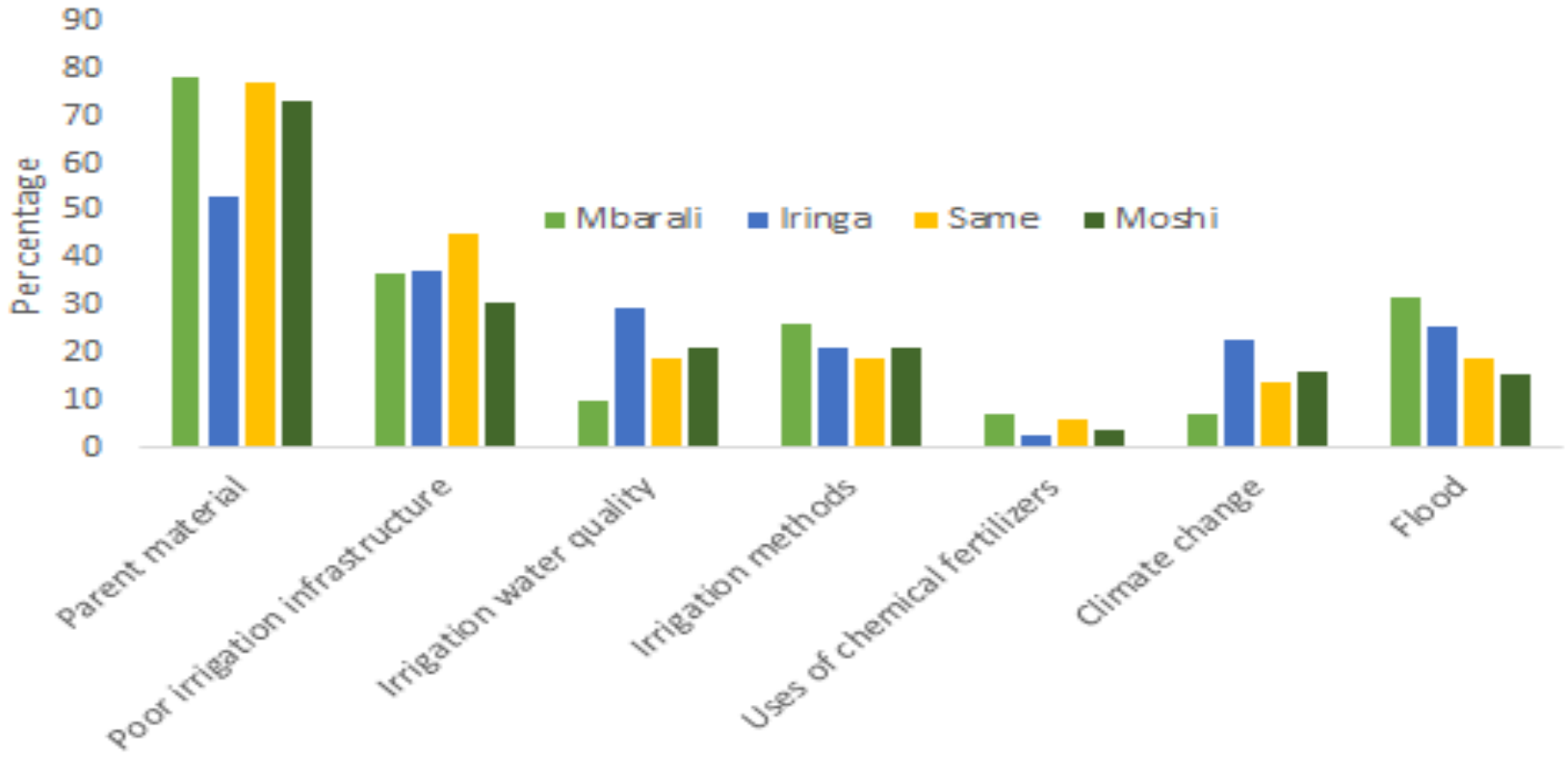


Figure 7: Farmers' perception of the major sources of salt-affected soils in rice

Results cont….

Table 9: Farmers' perception on coping mechanisms of salt-affected soils

Practices Methods	Type of practices Application of:	N	Mean of Ranking	Chi-Square	[a]d.f.	p-value
Indigenous	Manure	95	134.54	19.836	4	0.001
	Unburned rice husk	22	143.57			
	Burned rice husk	16	130.44			
	Burned rice straw	30	161.30			
	Not using	90	102.94			
Scientific						
	Gypsum	12	190.58	23.941	2	< 0.001
	Chemical fertilizers	21	69.24			
	Not using	220	129.05			

Results cont.....

Table 10: Soil laboratory results

Irrigation scheme	Sample Size	Salt classes			
		Saline	Saline-sodic	Sodic soil	Free from salt
Ndungu	12	9	0	0	3
Magozi	10	0	3	0	7
Lower Moshi	6	1	0	3	0

Discussion

- The findings of the present study showed that the majority of respondents knew about salt-affected soils.
- And perceived it exists and its extent and severity are increasing.
- This is supported by evidence of abandoning some land and declining yield or total loss under extreme conditions
- Soil results substantiated with farmer's perception that indicated the presence of a salinity problem
- And used indicators like soil colour, fragmented rice growth, and salts deposited on the soil surface as indicators of salinity or sodicity

Discussion cont....

- Under normal conditions farmers' reported harvest to ranges from 3.2 t/ha to 3.8 t/ha

- While, under salt-affected soils, farmers' harvest ranges from 0.4 t/ha – 0.95 depending on salinity or sodicity levels

- Apart from salt-affected soils other constraints to rice production in the surveyed irrigation schemes based on farmers' perceptions were;
  - cost of fertilizers;
  - poor irrigation infrastructure such as inadequate outlet canals;
  - outbreaks of diseases; poor soil fertility;
  - harsh weather conditions (floods; drought);
  - invasions from insect pests
  - poor-quality seeds

Discussion cont.....

- Majority of farmers believe that the nature of the underlying parent materials is the major source of soil salinity and sodicity on their farms
- Though it is accelerated by poor irrigation infrastructures due to limited outlet canals that force farmers to share irrigation water with nearby farms
- Farm yard manure (FYM), unburnt rice husk, burned rice husk, burned rice straw were reported as an indigenous coping mechanisms practiced by farmers
- However, it is not efficient at alleviating the problem.

Discussion cont.....

- Flushing also is a common and well-known practice, but the major challenge is inadequate water availability and outlet canals

- Though gypsum is widely reported (Bello et al. 2021; and Lastiri-Hernández et al. 2019) common and effective amendment for reclaiming saline-sodic and sodic soils

- But the study revealed that only a few farmers used gypsum and in lower quantities than the recommended rate due to transportation costs.

Conclusion and recommendation

- The present study explored farmers' perceptions and awareness of salt-affected soils and assessed the coping mechanisms in rice irrigation schemes in the selected irrigation schemes of Tanzania.

- The study concluded that salt-affected soils are among the major constraints limiting rice production in the studied irrigation schemes.

- Farmers' coping mechanisms for salt-affected soils were based on locally available and affordable materials

- Farmers are largely unaware of modern salt reclamation options, like salt-tolerant cultivars and gypsum

Recommendation

- Critical soil characterization to identify the types of salt-affected soils and their extent and severity.

- Developing appropriate management options based on identified type of salt affected
  - breeding of salt-tolerant rice cultivars
  - management options

- Strengthening farmers' management options to enhance rice production.

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THANK YOU

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