Data Article

A multivariate dataset on water–energy–food nexus: Multi-actor governance for social justice

Ngarava Saul [a],*, Vijge Marjanneke J [a], Duplessis Willemien [b], Zhou Leocadia [c], Viljoen Germarié [b], Nyambo Patrick [d], Rantlo Tiisetso J [e], Mokadem Naziha [b], Qumbu Bronwen [b], Bongoza Sibulele [f], Mugadza Alois A [g]

[a] Copernicus Institute of Sustainable Development, Utrecht University, Vening Meinesz Building, 3584 Utrecht, the Netherlands
[b] Faculty of Law, North-West University, Hoffman Street, Potchefstroom, South Africa
[c] Risk and Vulnerability Science Centre, University of Fort Hare, Alice, South Africa
[d] Agricultural Research Council, Pretoria, South Africa
[e] Faculty of Law, University of Pretoria, Lynnwood Avenue, Hatfield, South Africa
[f] Department of Geography and Environmental Science, University of Fort Hare, Alice, South Africa
[g] Groningen Centre of Energy Law and Sustainability, Faculty of Law, University of Groningen, Oude Boteringestraat 18, 9712 GH Groningen, the Netherlands

A R T I C L E   I N F O

A B S T R A C T

The article presents and validates an extensive multivariate dataset that offers insights into water–energy–food (WEF) nexus governance for social justice at the intra-household, household, and community levels. The lack of insights in the WEF nexus debate that take social justice and governance into account is what spurred the data collection. The initial process involved scoping the originally selected investigated sites and their suitability. Once the research areas were identified, the data were collected from 1184 households in the Matatiele, Magareng, and Greater Taung Local Municipalities in South Africa, using a semi-structured questionnaire and KoboCollect software. The freely available software was installed on Android Tablets which were used by the enumerators. The questionnaires

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* Corresponding author.
  E-mail address: s.ngarava@uu.nl (N. Saul).

were initially piloted in Matatiele Local Municipality, testing for internal validity and skip patterns, as well as time to complete the questionnaire. The reliability of the Likert responses from the questionnaire was evaluated using Cronbach's alpha. The questionnaire was then refined for data collection and utilized a total of twenty-two (22) locally trained enumerators who were employed at the investigated sites. These enumerators were trained in administering the questionnaire and the use of the KoboCollect software used in data collection. The enumerators also received training on how to conduct the survey ethically, including informed permission, confidentiality, and the option to withdraw from the interview. The design of the data collection process was a cross-sectional survey that was conducted between 6 June and 4 August 2022, using purposive sampling. At the end of each data collection day, the enumerators uploaded their collected data into the KoboTool cloud, which allowed the lead in the survey to assess the data and effect any correctional measures on the questionnaire if the need arose. The enumerators also used a WhatsApp chat group to communicate real time opportunities and challenges in the questionnaire, which allowed the lead in the survey to constantly update the questionnaire. The multivariate questionnaire was divided into sections of socioeconomic and demographic characteristics, community-level governance, decision-making, food, energy, and water security, social justice, legal knowledge, and rights to utilize these resources. The dataset will be of significance to multi-disciplinary researchers focusing on WEF security, governance, and social justice in Southern Africa. Furthermore, environmental and sustainability practitioners can find valuable insights from the provided data. The employed methodology is replicable and adaptable, enabling real-time monitoring of social justice and governance in the context of food, energy, and water security. The real time monitoring of governance and social justice in water, energy and food allows for the possibility of continual data collection and updating, and if a longitudinal design is adopted, it can be used for impact inquiry of any interventions or policies.

Specifications Table

Subject	Environmental Science
Specific subject area	Management, Monitoring, Policy, and Law
Data format	Raw, Analysed
Type of data	Table, Figures
Data collection	The data were collected using a semi-structured questionnaire [1] on Android Tablets with freely available software called KoboCollect. The software uploaded the data to the KoboTool cloud, allowing access by the survey lead, as well as data collation, summarization and modification of the questionnaire if required. The questionnaire design was informed by the Household Water Insecurity Experiences (HWISE), Household Multi-Dimensional Energy Poverty Index (HMEPI), and Household Food In-Access Scale (HFIAS) as prescribed by FAO, IFAD, UNICEF, WFP, and WHO [2], Stoler et al. [3], HWISE Research Coordination Network [4], Young et al. [5], Abbas et al. [6], and Sadath and Acharya [7].

Data source location	The data were collected from rural households in the Matatiele, Magareng and Greater Taung Local Municipalities in South Africa (see the GPS coordinates from the dataset; also see the map of the investigated region in the Section: Experimental Design, Materials, and Methods – Fig. 23). The data were collected through a cross-sectional survey design using multi-stage sampling. The identification of the investigated sites was informed by the municipalities' Integrated Development Plans (IDPs) [8,9], the Matatiele Spatial Development Framework Review [10], beneficiaries of land restitution [11] and the Magareng Local Municipality Spatial Development Review [12]. The selection of the households used, was informed by the traditional leadership, local Non-Governmental Organizations (NGOs) [13], and the Vaalharts Water User Association [14].
Data accessibility	Repository name: Mendeley Data Data identification number: https://doi.org/10.17632/56zskrvfwf.1 Direct URL to data: https://data.mendeley.com/datasets/56zskrvfwf/1 Instructions for accessing these data: The data is freely available using the URL above
Related research article	S. Ngarava, Impact of land restitution benefits on Water, Energy and Food (WEF) misgovernance and social injustice. Environmental and Sustainability Indicators, 22 (2024) 100386. https://doi.org/10.1016/j.indic.2024.100386

1. Value of the Data

- The data provide information on water, energy, and food (WEF)-related issues at the individual and household level, as well as local community decision-making from a socio-ecological-development perspective. It can be used to explain the governance of WEF resources at the intra-household, household, and community levels to achieve distributive, allocative, restitutive, and procedural justice.

- The data may also generate broader insights into WEF interlinkages and decision-making at the household level. The data can contribute insights into the WEF nexus and the ill-understood relations between local-level realities and governance and decision-making at higher levels. The data is useful for stakeholders in the WEF sectors as well as those tasked with cross-sectoral coordination, assisting them in aligning governance and social justice as proposed in the Sustainable Development Goals (SDGs) and national development plans.

- The presented research methodology can also be used as a conceptual and/or methodological framework to investigate water, energy, and food-related issues at household levels, particularly (but not exclusively) focusing on the WEF nexus. The methodology is also simplified and replicable, and combined with the user-friendly data, it allows for further methodological inquiry to empirically account for social constructs such as governance, the community's knowledge of their rights and the law, as well as social justice. The data is also significant as it accounts for these social science constructs of governance and social justice at the basic unit of analysis of the individual instead of the household. This enhances the spectrum of possible theoretical insights and outcomes from the experiences of rural communities.

- The broad-spectrum re-usability of the data allows its use beyond WEF nexus studies. The data is simplified enough to use for other context specific inquiries such as SDG indicators that can be used by researchers and policy makers to ascertain developmental outcomes. The ease of use and the re-usability of the data can build into a time series data framework that can account for temporal changes and impacts. The same survey instrument can thus be adopted and/or adapted to other spatial locations as well as other temporal periods.

- Using this data, academics, researchers, and practitioners in the field of governance and social justice can find practical examples of indicator-based governance and social justice modelling and how this affects inter and intra-household as well as community level decision making to achieve WEF securities and social justice. Academics, researchers, and practitioners can use the dataset to validate deductively constructed agency, governance and social justice models at the individual, household, and community levels.
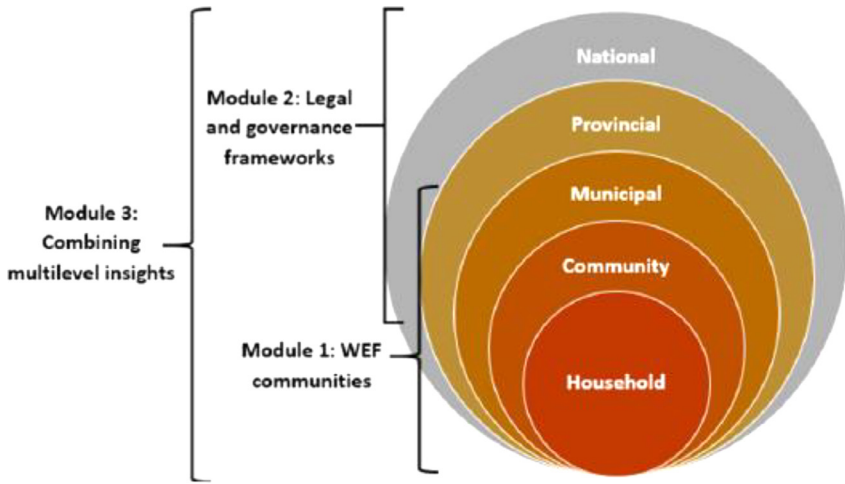
Fig. 1. The context under which the data was compiled.

2. Background

As far as is known, some nations' governance frameworks have not yet completely included information regarding how the Sustainable Development Goals (SDGs) relate to whole-of-government or whole-of-society approaches, as mandated by the SDGs [15]. A growing body of research has shown how and why WEF nexus approaches are effective, although the majority of this research has only examined analyses at one level of governance—primarily at the national level in industrialized (OECD or EU) nations [16,17]. Furthermore, even though the nexus method is portrayed as one of SDG Agenda 2030's holy grails, it is unclear what applying the strategy will actually entail in terms of social justice. It begs the question, How and under what circumstances can WEF nexus governance contribute to the achievement of Leaving No One Behind, and the central goal of Agenda 2030? The data used was premised on 3 Modules (Fig. 1). The dataset described is related to Module 1 which focused on livelihood assessments of water, energy, and food resource use, production, availability, allocation, and access, and decision-making on synergies and trade-offs between these. This involves social capital assessments to improve knowledge of social justice levels in WEF interlinkage decision-making, as well as relationships between homes, communities, people, and (higher-level) decision-makers.

3. Data Description

The raw data, which can be found at (https://data.mendeley.com/datasets/56zskrvfwf/1) [1] and was later analyzed, pertained to socio-economic and demographic characteristics, water, energy, and food security indicators through the Household Water Insecurity Experience (HMEPI), Household Food In-Access Scale (HFIAS), and Household Multi-Dimensional Energy Poverty Index (HMEPI). The data further represents household and community-level decision-making on water, energy, and food as well as social justice considerations in this decision-making. The accompanying files for the raw data include a questionnaire that can be used to code the data for further analysis. In this current data description, reference will only be made to the major highlights and indicators. All Likert scaled questions were reliable, with a Cronbach's alpha between 0.61 and 0.96.

Most of the households were located in the Greater Taung (46.96 %) and Matatiele (46.37 %) Local Municipalities (Table 1). In the Magareng Local Municipality, the focus was on Ward 5 and

Table 1
Nominal sample characteristics (N = 1184).

		%		
Municipality	Matatiele	46.37		
	Greater Taung	46.96		
	Magareng	6.67		
Household head[a] (primary decision-maker) gender	Male	46.03		
	Female	53.72		
	Other	0.25		
Household head (primary decision-maker) marital status	Single	36.49		
	Married (monogamous)	30.91		
	Married (polygamous)	4.05		
	Widow	12.58		
	Widower	5.41		
	Divorced	1.44		
	Separated	2.36		
	Living with partner	6.76		
Household head (primary decision-maker) highest educational level	None	8.70		
	Pre-school	3.89		
	Primary	40.79		
	Secondary	41.64		
	Tertiary	4.98		
Household tenure	Own	84.12		
	Rent	1.35		
	Family trust	14.53		
Household head (primary decision-maker) employment status	Unemployed	74.41		
	Formal employment in non-agricultural related activities	8.28		
	Formal employment in agricultural related activities	4.05		
	Informal/self-employment in non-agricultural related activities	6.50		
	Informal/self-employment in agricultural related activities	6.76		
Main source of income	Formal employment in non-agricultural related activities	9.71		
	Formal employment in agricultural related activities	4.65		
	Informa/self-employment in non-agricultural related activities	6.17		
	Informal/self-employment in agricultural related activities	3.80		
	Social grant/Pensioner	69.00		
	Remittances	1.35		
	Other	5.32		

		Food	Water	Energy
Water, energy and food expenditure decision-maker	Head/acting head	33.02	24.83	33.70
	Husband/partner	2.70	1.77	2.79
	Wife/partner	17.31	9.88	13.85
	Son	1.69	1.44	1.52
	Daughter	6.33	3.29	5.24
	Brother	1.10	0.84	1.01
	Sister	2.20	1.60	1.77
	Mother	22.38	17.57	19.68
	Father	3.13	2.36	3.46
	Parent-in-law	0.59	0.34	0.42
	Grandson	0.17	0.25	0.17
	Granddaughter	0.93	0.76	0.93
	Grandmother	1.52	1.01	1.18
	Grandfather	0.34	0.17	0.34
	Other relative	0.34	0.08	0.17
	Caretaker	0.08	0.08	0.08
	Non-related person	0.08	0.08	0.08
	Family as a group	5.74	3.46	7.18
	N/A	0.34	30.15	6.42

[a] Household head refers to the primary decision-maker within the households. This however has a presupposition that households are hierarchical even if there are divisions in decision making. In the current data, this presupposition is addressed by disaggregating the household into its component members.

Table 2
Scale sample characteristics ($N = 1184$).

	Minimum	Maximum	Mean	Skewness	Kurtosis
Household head (primary decision-maker) age (years)	18	103	55,91	−0,12	−0,54
Duration of stay in the area (years)	1	200	40,27	1,88	6,73
Household size	1	19	4,68	1,04	1,86
Total monthly household income (Rand)	0	36,000	3066,62	4,38	29,53
Water expenditure (Rand)	0	4500	44,18	13,77	240,53
Energy expenditure (Rand)	0	5000	241,94	5,99	77,79
Food expenditure (Rand)	0	5000	1286,83	1,09	1,67
Estimated crop production land size (m^2)	0	10,000	512,41	4,19	17,76
Estimated vegetable production land size (m^2)	0	10,000	216,02	7,00	52,45
Number of cattle owned by household	0	250	3,61	11,24	183,88
Number of sheep owned by household	0	450	4,33	13,41	245,85
Number of goats owned by household	0	72	2,86	4,38	25,44
Number of chicken owned by household	0	100	7,20	2,61	12,17
Number of pigs owned by household	0	24	0,49	6,95	67,25
Radius to grazing land (m^2)	0	900,000	2623,08	27,26	821,17
Time spent fetching water for household (min/day)	0	660	28,13	5,39	48,11
Time spent collecting fuelwood (min/day)	0	720	108,86	22,96	664,59

specifically the Majeng Communal Property Association, which lives on restituted land (referred to hereinafter as Magareng). Over half of the household heads (i.e., primary decision-makers) were female (53.72 %), single (36. 49 %) and in monogamous marriages (30.91 %). The household heads had secondary (41.64 %) education and were predominantly unemployed (74.41 %), relying on social grants (69.00 %) as their main source of income. Most of the household food (33.02 %), water (24.83 %) and energy (33.70 %) expenditure decisions have been undertaken by household heads (mostly females), followed by 22.38 %, 17.57 % and 19.68 % undertaken by mothers, respectively.

The average age of the household head was 56, having stayed in the community for 40.27 years (Table 2). The households ranged in size from 1 to 19 and the average household income was R3 066.62. Households spend R44.18, R241.94 and R1 286.83 on water, energy, and food, respectively. Land sizes range from 512.41 m^2 for crop production to 216.02 m^2 for vegetable production. Households own an average of 4 cattle, 4 sheep, 3 goats and 7 chickens, with a radius of 2 623.08 m for animal grazing. Households spend on average 28.13 min fetching water and 108.86 min collecting fuelwood. Appendix 1 shows that there were outliers in the age of the household head, duration of stay, total monthly household income, expenditures on water and energy, radius of grazing land and time spent fetching water and collecting wood.

There was income inequality in the data set, mostly found in Greater Taung Local Municipality (Fig. 2).

Magareng Local Municipality had the highest level of water security (60.76 %), while Greater Taung had the highest level of food security (54.87 %), and Matatiele had the highest food security levels (32.42 %) (Fig. 3). Greater Taung had the highest levels of water and food insecurity at 11.33 % and 16.01 % respectively, while Magareng had the highest level of energy insecurity at 51.76 %.

Fig. 4 shows the reasons why households do not engage in agriculture to ensure their food security. Lack of money was a reason for not engaging in agriculture for 58.23 % of the households in the Magareng Local Municipality, compared to 27.85 % who indicated poor soil quality. In the Greater Taung Local Municipality, 50.54 % of the households had no access to water while 27.52 % indicated they had no money or that the soil's quality was poor. Lack of access to water and land was also a hinderance to engaging in agricultural production for 31.15 % and 27.32 % of households in the Matatiele Local Municipality.

To improve food security, 65.82 % and 58.47 % of the households in Magareng and Matatiele indicated that it would require them to grow their own crops, while 56.47 % and 58.23 % in Greater Taung and Magareng indicated that they would require a small vegetable garden (Fig. 5).
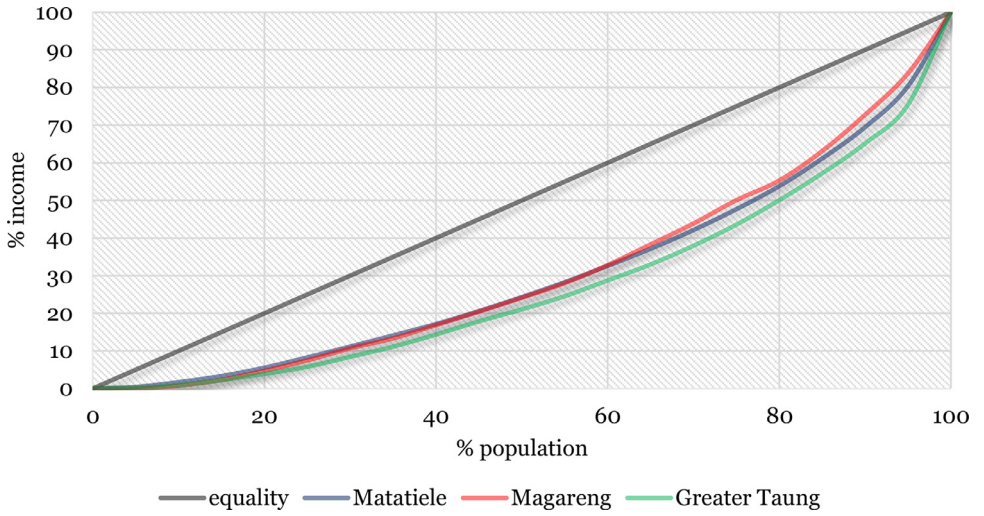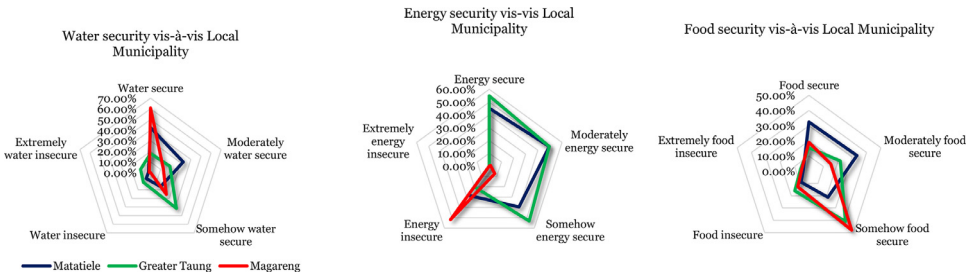
Fig. 2. Lorenz curve of inequality.

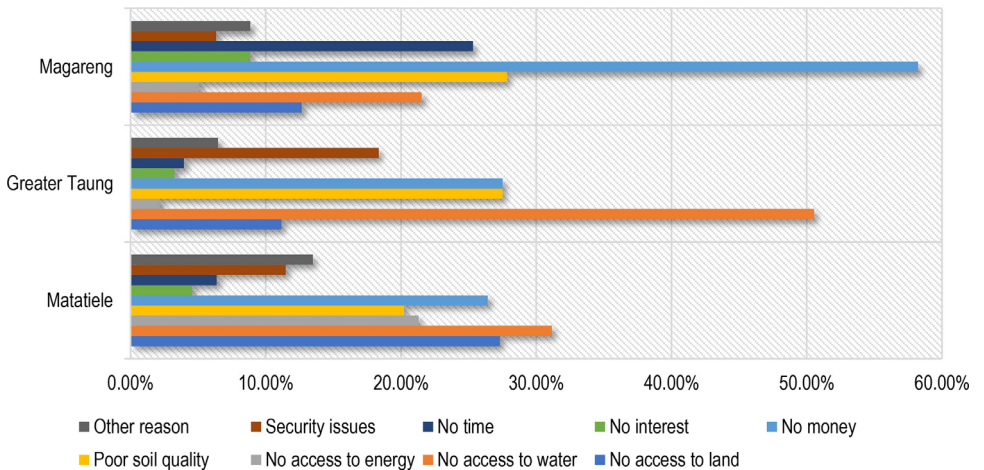**Fig. 3.** Water, energy and food security.

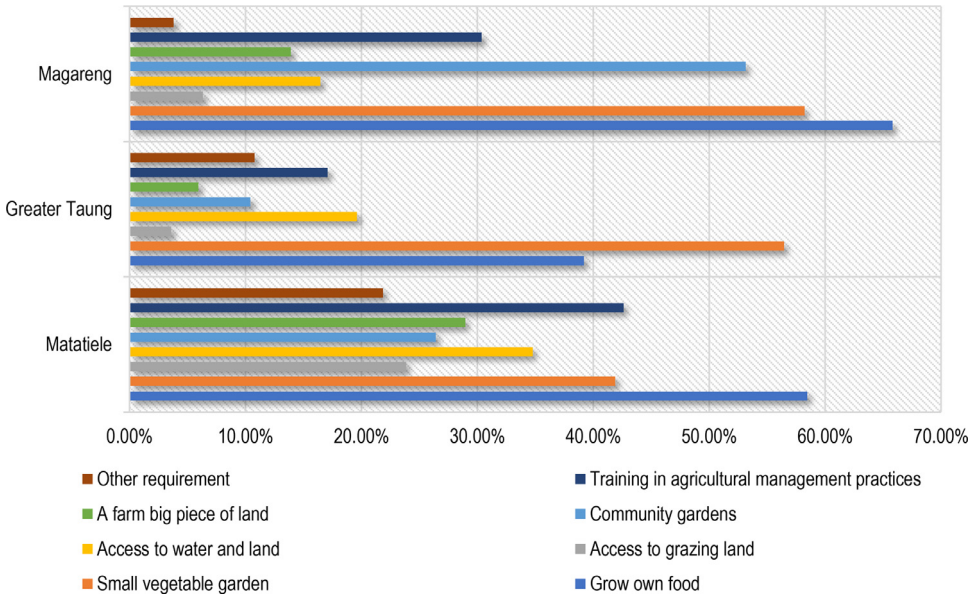**Fig. 4.** Reasons for not engaging in agricultural production/reduced productivity.

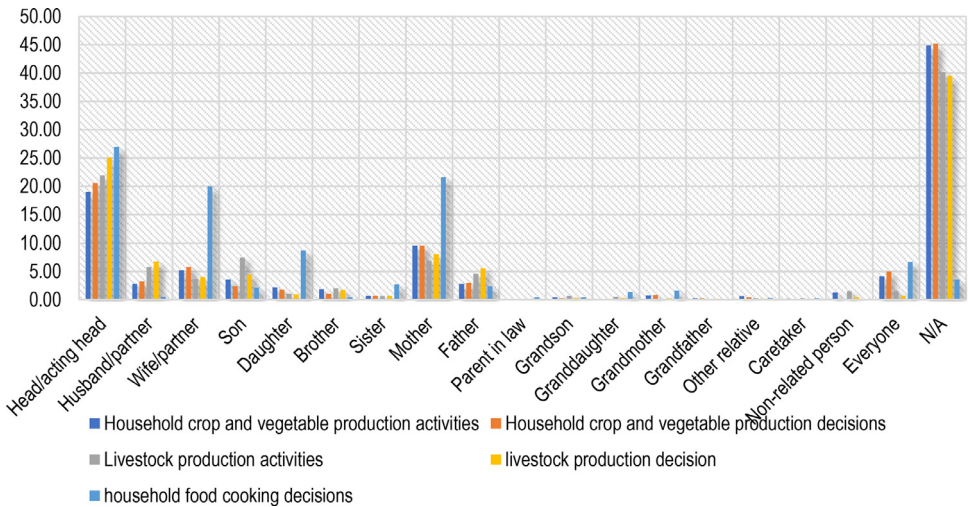**Fig. 5.** Requirements to improve food security.

Fig. 6. Agency in household food production and cooking decisions.

The household head is responsible for making household cooking decisions (26.94 %), livestock production decisions and activities (25.08 % and 21.96 %), and vegetable production decisions and activities (20.61 % and 19 %) (Fig. 6). In 20.02 % of households, the wife or female partner makes decisions on household cooking, compared to 21.62 % where the mother makes the cooking decisions.

The households indicated that poor water quality in the Magareng Local Municipality is mainly caused by a lack of energy (39.24 %) and poor government service delivery (15.19 %) (Fig. 7). In Greater Taung Local Municipality, poor water quality is mainly regarded as a result of poor government service delivery (62.59 %) and ground-water depletion (23.02 %). Flooding
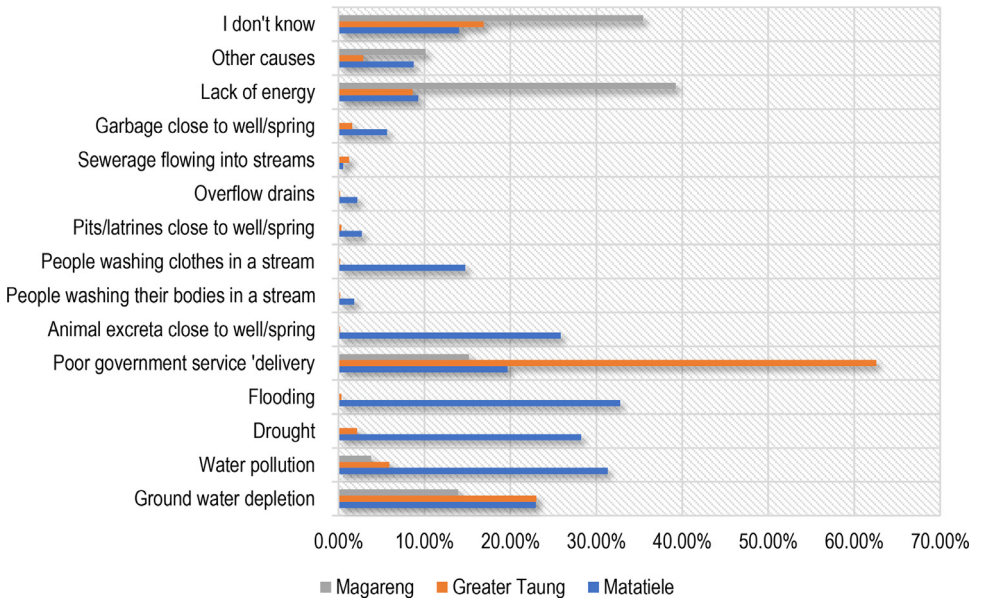
Fig. 7. Opinion on causes of poor water quality.
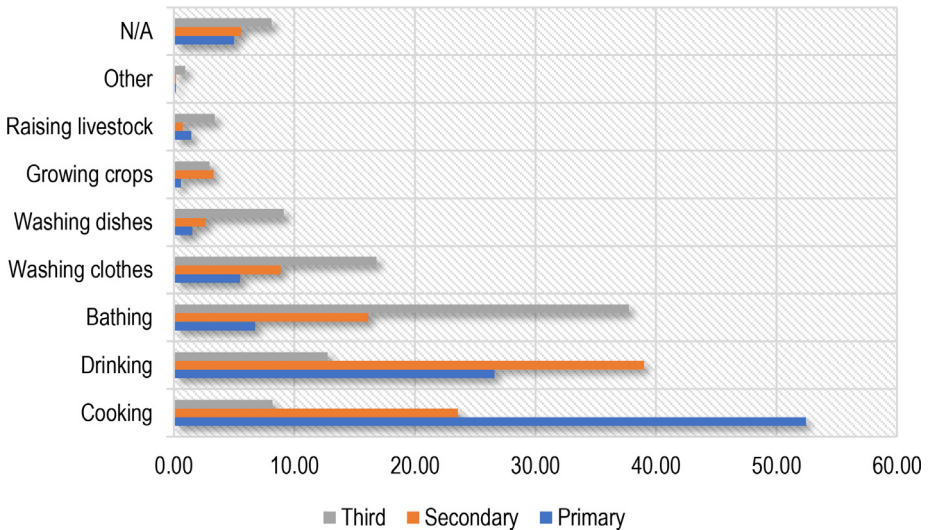
Fig. 8. Problems associated with not having access to clean water.

(32.79 %) and water pollution (31.33 %) were indicated as the major causes of poor water quality in the Matatiele Local Municipality.

Cooking was a major problem associated with lack of access to clean water for 52.45 % of the households, while drinking (39.02 %) and bathing (37.75 %) were the second and third problems indicated (Fig. 8).

The types of toilet facilities available in the Magareng Local Municipality are mainly pit latrine (91.14) and bush (8.86 %) (Fig. 9). In Greater Taung, households mainly use pit la-
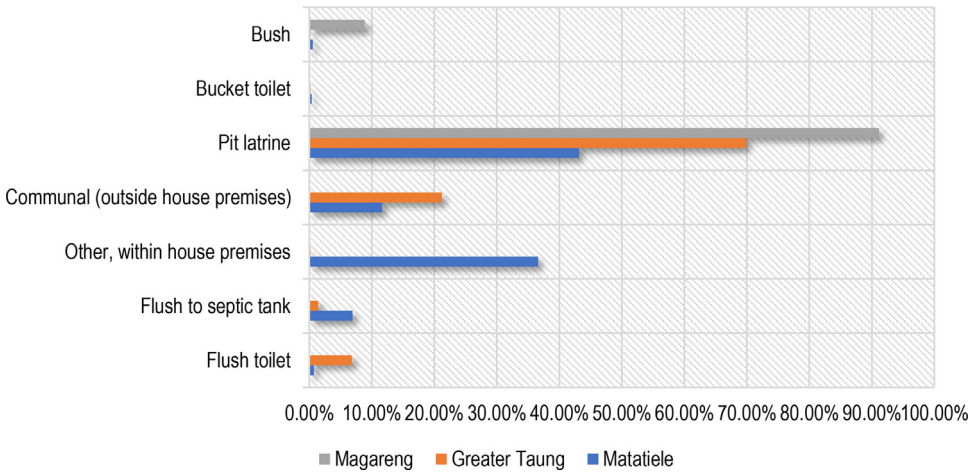
Fig. 9. Type of toilet facilities available.
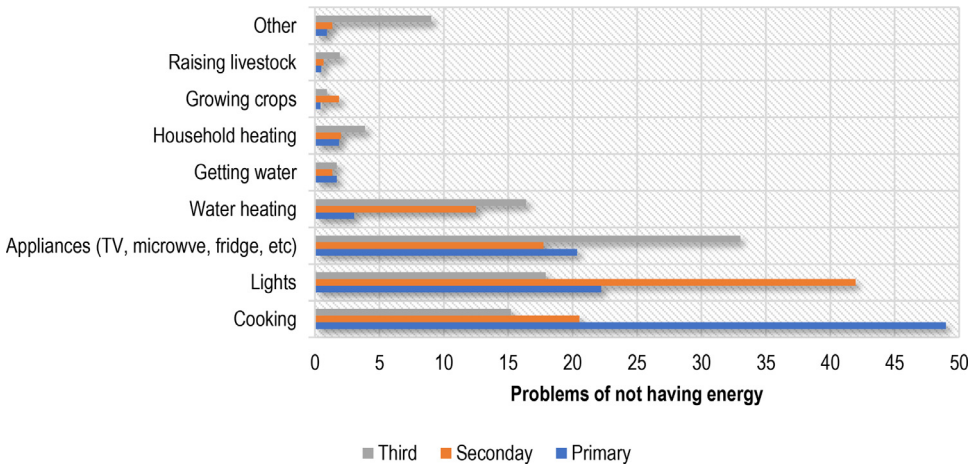
Fig. 10. Problems associated with not having access to energy.

trine (69.96 %) and communal toilets (21.22 %), while in Matatiele, they mainly use pit latrine (43.17 %) and other types of sanitation facilities (36.61 %).

Cooking was a primary problem for 49.0 % of the households when there was a lack of energy (Fig. 10). Lighting and use of appliances were the second and third problem for 41.98 % and 33.02 % of the households, respectively.

The major problems associated with energy in Magareng Local Municipality were unreliable service provision (37.97 %) and infrastructure disruption (16.46 %) (Fig 11). In Greater Taung Local Municipality, the frequent energy problems were caused by unreliable service (60.61 %) and the cost of electricity (38.85 %). The cost of electricity (28.96 %) and unreliable service (24.23%) were the frequent energy problems in Matatiele Local Municipality.

The existence of ward committees was identified by 67.45–90.20 % of households in the Greater Taung, Matatiele and Magareng Local Municipalities (Fig. 12). IDP forums presence was identified by between 7.59 % and 27.32 % of the households.
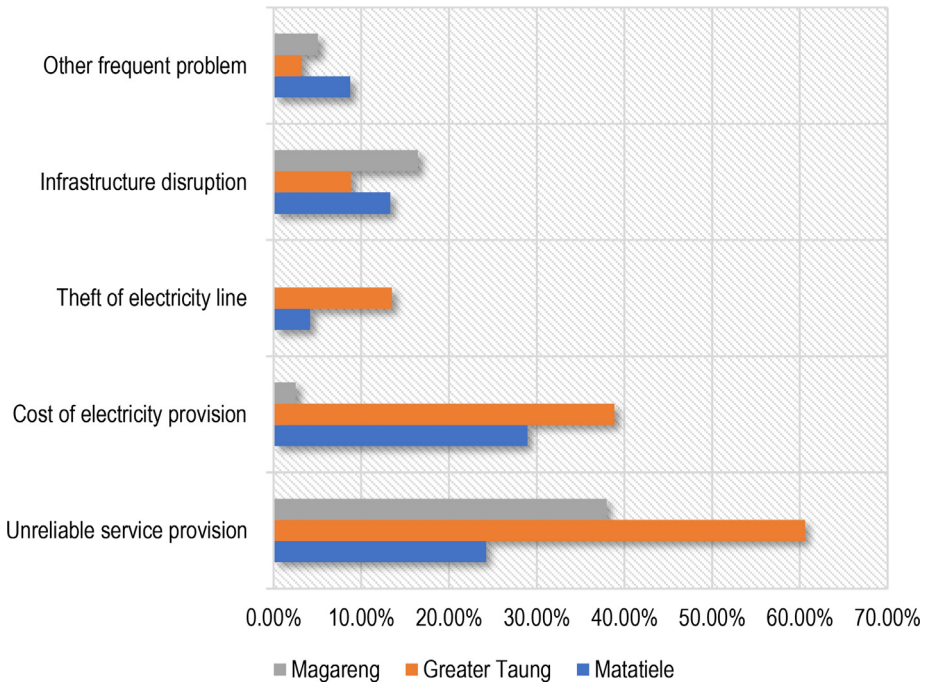
Fig. 11. Causes of frequent energy problems.

Ward committees were identified by 36.71 % and 27.69 % of households in the Magareng and Matatiele Local Municipalities as being effective in community water, energy, and food development (Fig. 13). Agricultural, energy and water producer groups were also identified by 43.04 % of the households in Magareng as being effective in community water, energy, and food development while 18.35 % and 15.66 % in Greater Taung and Matatiele were identified as ineffective. In the Magareng and Matatiele Local Municipalities, 12.66 % and 10.20 % of the households indicated that IDP forums were effective while 3.80 % and 14.39 % indicated that they were ineffective in community water, energy, and food governance.

Agricultural, energy, and water user groups were mainly identified by 24.05 % of households in Magareng to consider different stakeholders in community water, energy, and food development (Fig. 14). In the Greater Taung Local Municipality, 13.49 % of the households indicated that agricultural, energy, and water user groups consider gender, while 9.47 % in Matatiele Local Municipality highlighted the inclusion of different stakeholders.

Households in the Magareng Local Municipality identified that different stakeholders based on their age (44.30 %), gender (40.51 %) and disability (27.85 %) were considered by ward committees in community water, energy, and food development (Fig. 15). In the Greater Taung and Matatiele Local Municipalities, 17.45 % and 18.76 % of households indicated that ward committees considered gender and age in community water, energy, and food development.

In IDP forums, 7.37 %, 5.40 % and 5.04 % of households in Greater Taung Local Municipality indicated that there was consideration of gender, different stakeholders and age in community water, energy, and food development (Fig. 16). Gender, age disability and a variety of stakeholder groups were identified as being considered in the IDP forum's consideration of community water, energy, and food development, by 5.46 %, 3.38 % and 3.64 %, respectively.

In the Magareng Local Municipality, 39.24 % and 37.97 % of the households indicated that ward committees or IDP forums and agricultural, water, and energy user groups never took their recommendations on board for community water, energy, and food governance (Fig. 17). In the
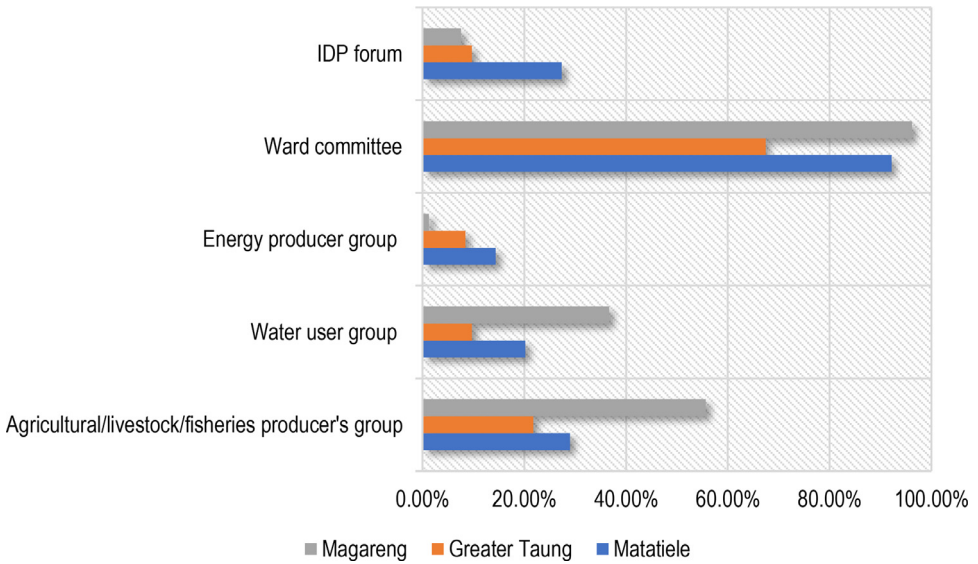
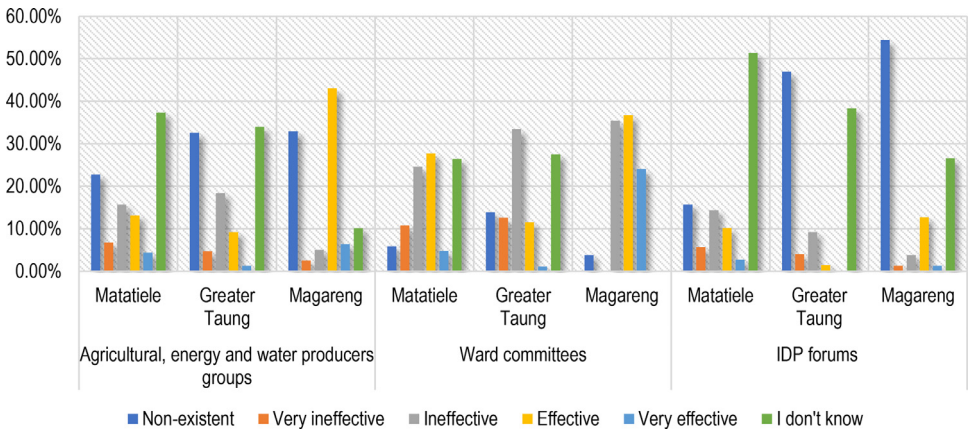**Fig. 12.** Existence of community-based forums and groups.

Fig. 13. Effectiveness of community-based forums and groups in water, energy and food development.

Matatiele Local Municipality, 12.02 % and 8.93 % of the households have their recommendations on community water, energy, and food development regularly taken on board by the ward committees or IDP forums and agricultural, water, and energy user groups. Ward committees or IDP forums and agricultural, water, and energy user groups were identified as rarely taking recommendations on board community water, energy, and food development, as indicated by 7.01 % and 5.94 % of households in the Greater Taung Local Municipality.

In Magareng, Greater Taung and Matatiele Local Municipalities, 45.57 %, 39.39 %, and 28.42 % of the households indicated that no action had been taken based on their water, energy, and food-based recommendations in the different forums and groups (Fig. 18).

Households in the Magareng (44.30 %), Matatiele (33.15 %) and Greater Taung (31.47 %) Local Municipalities were willing to work with each other on water, energy, and food issues (Fig. 19). However, 39.03 %, 20.77 % and 15.19 % of the households in the Greater Taung, Matatiele and
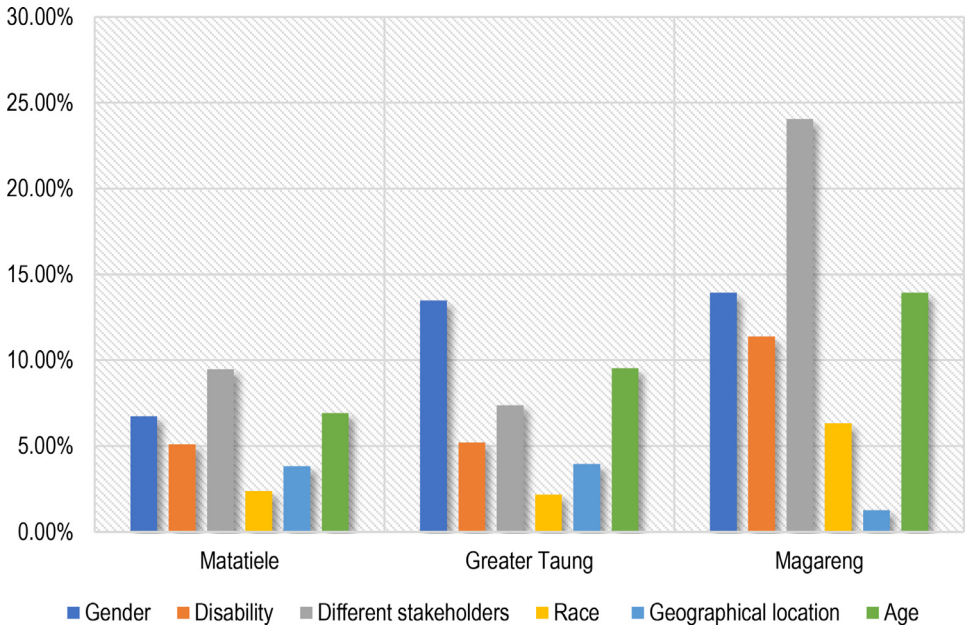
Fig. 14. Social group consideration by agricultural, energy and water user groups in water, energy and food development.
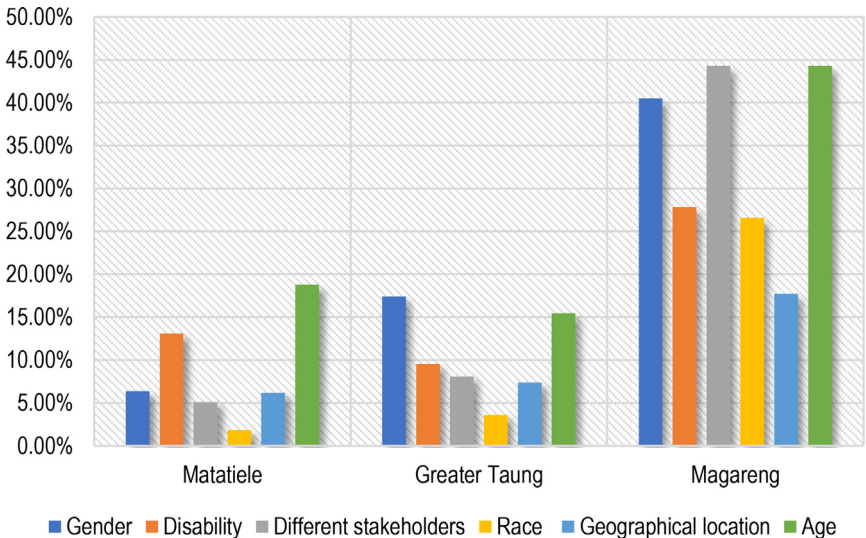

Fig. 15. Social group consideration by ward committees in water, energy and food development.

Magareng Local Municipalities were not willing to work with others on water, energy, and food issues. There was a great deal of ability to speak in public about water, energy, and food issues as indicated by 48.10 %, 31.12 % and 29.33 % of households in the Magareng, Greater Taung and Matatiele Local Municipalities, respectively. However, 36.87 %, 25.58 % and 21.52 % of the households in the Greater Taung, Matatiele and Magareng Local Municipalities were not able or comfortable to doing so.
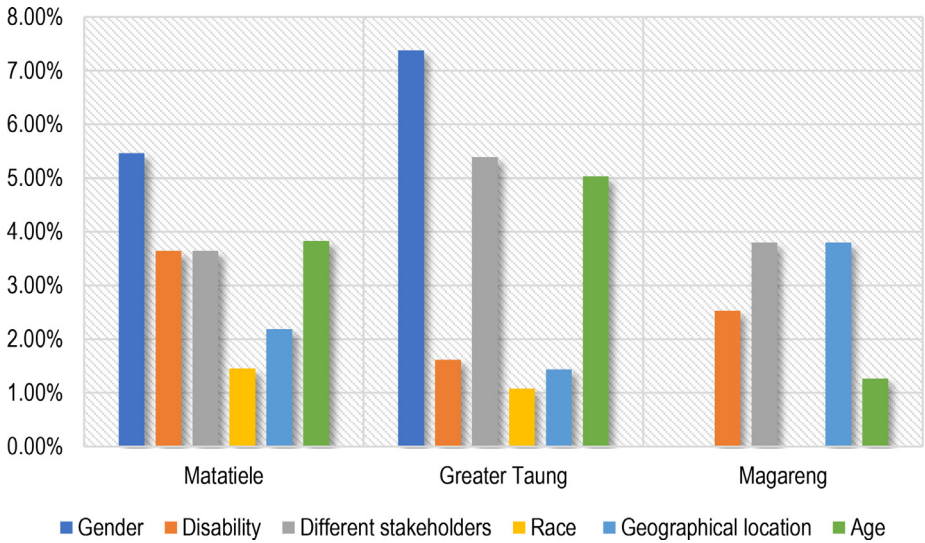
Fig. 16. Social group consideration by IDP forums in water, energy and food development.
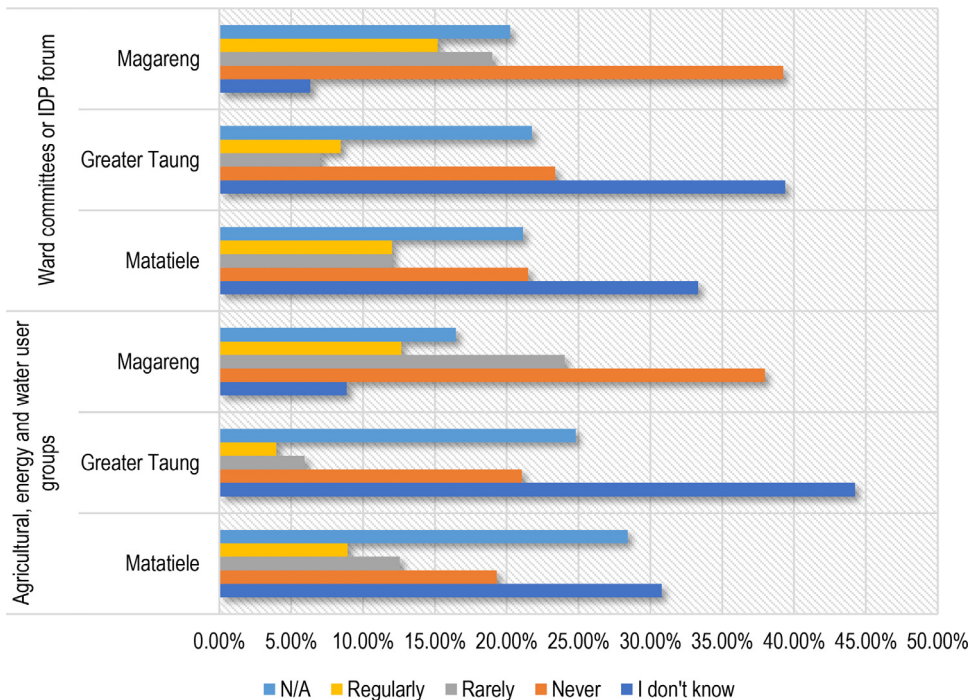

Fig. 17. Water, energy and food development recommendations through different forums and groups.

In the Greater Taung Local Municipality, 65.47 % of the households are not aware of their rights, relevant legislation concerning water, energy, and food decisions at the community level (Fig. 20). This was also similar for 47.36 % and 18.99 % of households in the Matatiele and Magareng Local Municipalities, respectively. Thirty-one percent of the households in the Matatiele
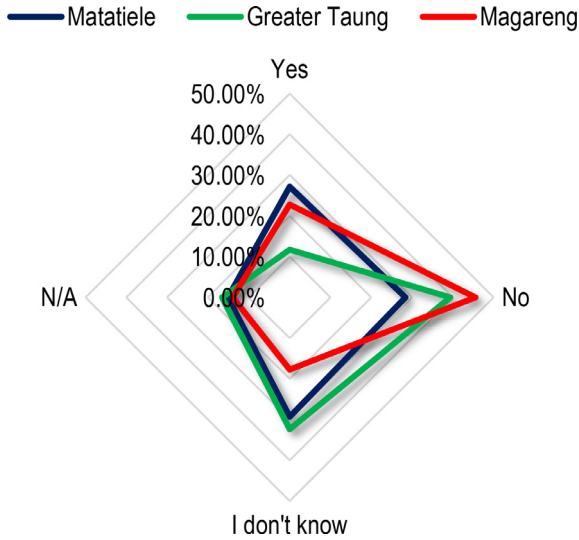
Fig. 18. Action-taken based on water, energy and food based recommendations in the different forums and groups.
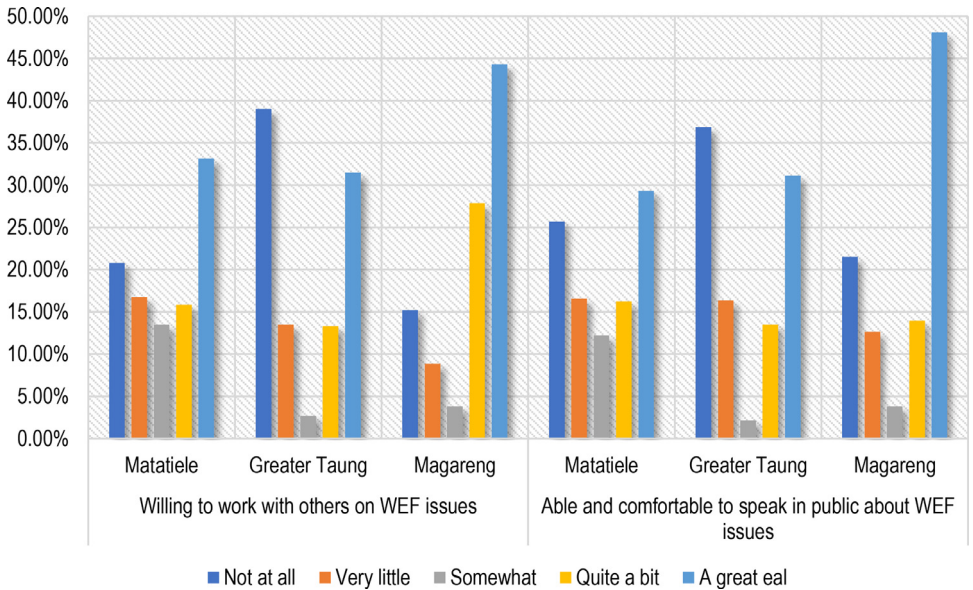

Fig. 19. Public speaking and working together with community members on water, energy and food issues.

Local Municipality reported having very little knowledge of their rights and the applicable laws pertaining to decisions about water, energy, and food at the community level, whereas 22.78 % of the households in Magareng reported having a fair amount of knowledge of these laws.

Improving community water, energy and food was identified as the responsibility of local municipalities by 63.29 %, 53.60 %, and 42.44 % of households in the Magareng, Greater Taung and Matatiele Local Municipalities, respectively (Fig. 21). Ward committees were identified as responsible for improving community water, energy, and food security by 42.26 % of households in the Matatiele, 22.78 % Magareng, and 21.40 % in the Greater Taung Local Municipalities.
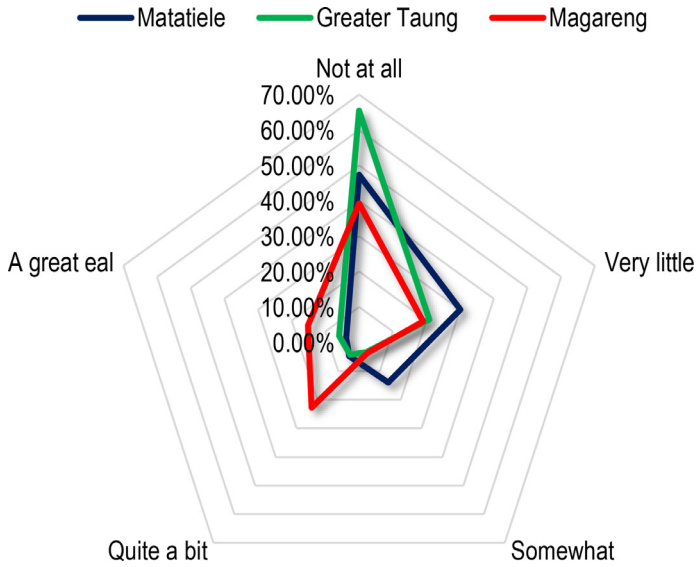
Fig. 20. Awareness of the relevant laws, legislation and regulations concerning water, energy and food decisions at the community level.
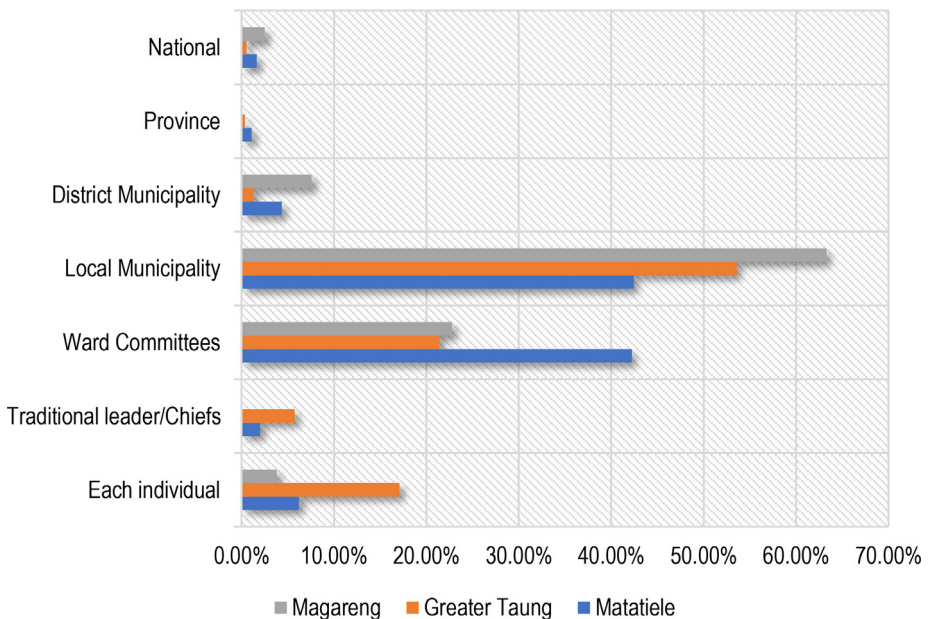

Fig. 21. Responsibility for improving water, energy and food security in the community.

60.25 %, 59.89 %, and 53.96 % of the families in the Greater Taung Local Municipality indicated that decisions made at the community level regarding food, water, and energy were not sufficient, correct, or timely; nor were they accommodating, objective, independent, and unaffected by people or organizations (Fig. 22). This was also highlighted by 44.30 %. 44.30 % and 34.18 % of households in the Magareng Local Municipality, as well as 28.23 %, 27.32 %, and
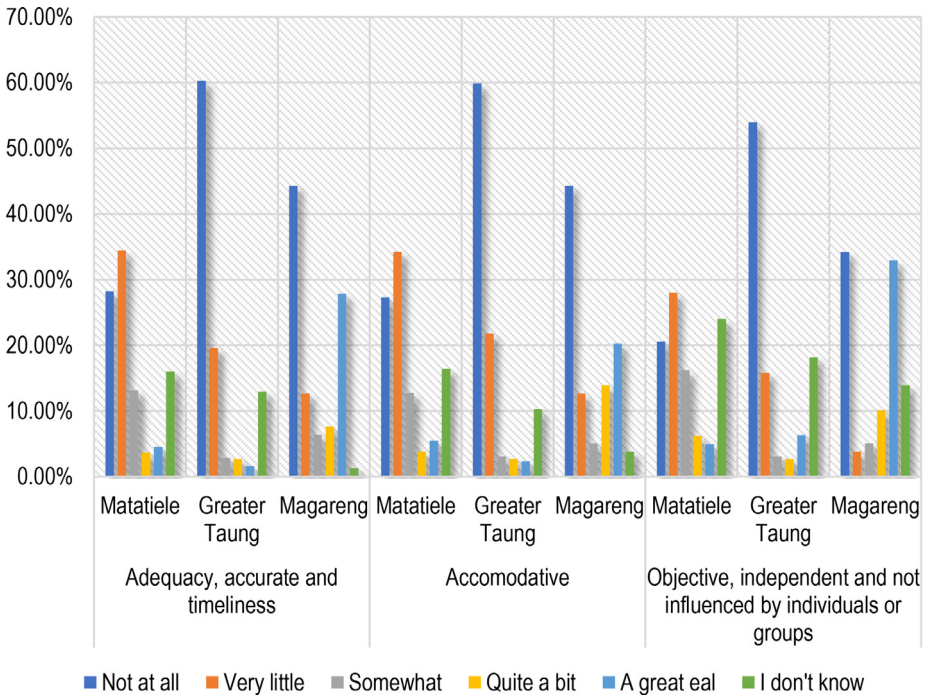
Fig. 22. Adequacy, timeliness, accuracy, accommodation, objectivity and independence of community level water, energy and food decisions.

20.58 % in the Matatiele Local Municipality. However, 32.91 %, 27.85 % and 20.25 % of the households in the Magareng Local Municipality, highlighted that community level water, food, and energy decisions were objective, independent, and not influenced by individuals or groups; were adequate, accurate, or timely; and were accommodative.

4. Experimental Design, Materials and Methods

The data were collected in the Matatiele, Magareng, and Greater Taung Local Municipalities of South Africa through a cross-sectional survey design. The selection of the sites was informed by the IDPs [8,9], the Matatiele Local Municipality Spatial Development Framework Review [10], the Magareng Local Municipality Spatial Development Review [12], and the beneficiaries of land restitution [11]. The selection of the households used was informed by traditional leadership, local NGOs [13], and the Vaalharts Water User Association [14]. It is worth mentioning that the sites were part of a project entitled "Water–energy–food nexus: multi-actor governance for social justice" which targeted rural households that exhibited water, energy, and food insecurity in rural areas of South Africa. Furthermore, the selection was also biased towards the confluence of some of the partners involved in the project. The areas were therefore purposively selected using convenience sampling. Purposive sampling was also used to select the wards, villages, and households that were targeted.

The initial phase of the purposive sampling involved selecting the wards and villages with the aid of traditional leadership, local NGOs [13], and the Vaalharts Water User Association[14]. Once the wards and villages were selected, the household populations in the wards and villages were obtained from Wazimap [18]. There were 16 purposively selected wards, which had a total population of 35 580. The Yamane [19] sample size calculation method was used to come up

Table 3
Sample size.

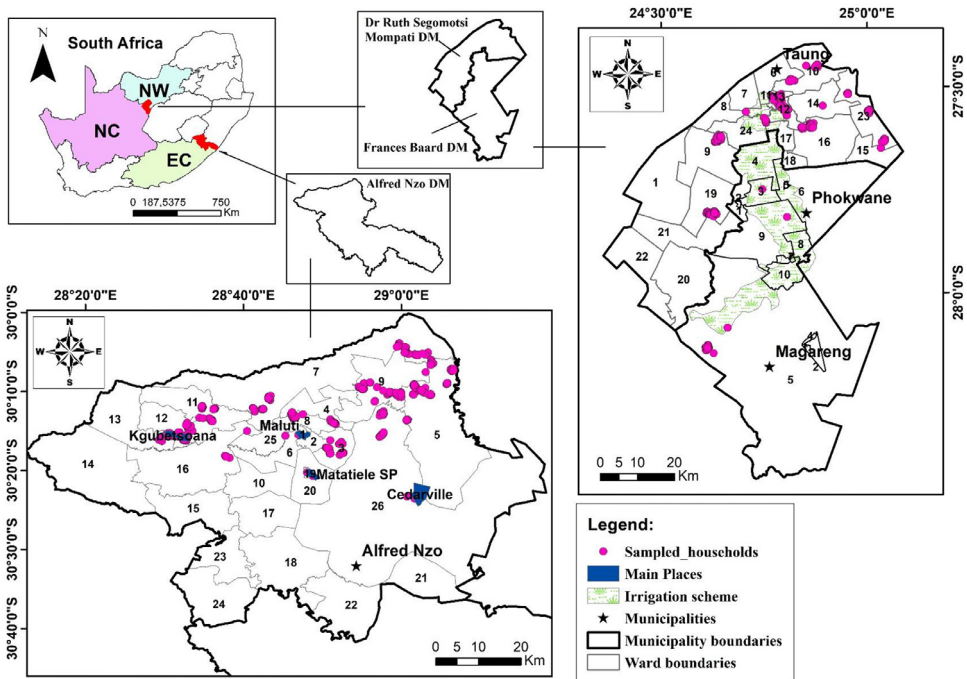| Municipality	1	2	3	4	5	7	8	9	11	12	13	14	16	18	19	21	23	25	26	28	20	Total
Matatiele			38	50	71	77	43	78	80	55					2				55			549
Greater Taung	65							80	52	72	75	1	59		73	1	78					556
Magareng					79																	79
Total	65		38	50	150	77	43	158	132	127	75	1	59		75	1	78		55			1184

Fig. 23. Study area.

with a sample size of 396 based on 95 % accuracy. Due to the availability of resources, and proportional sampling, a sample of 1 184 households was obtained (Table 3). The distribution of the sampled households is shown in Fig. 23.

There was initial contact with the municipalities, traditional leadership, local NGOs, and the Vaalharts Water User Association before embarking on data collection and obtaining permission from the gatekeepers. This included a number of pre-visits to the mayors, municipal managers and senior traditional leaders in the Greater Taung Local Municipality and Magareng Local Municipal Areas. The local NGO secured the required authorization in the Matatiele Local Municipality. The NGO and Vaalharts Water User Association not only helped to identify the locations for the data collection, but they also helped to notify the gatekeepers—mayors, municipal managers, ward council members, senior and local traditional leaders—about the research project team's presence and objectives. Once the permission was obtained as well as our consent letters and ethical approval letters verified, the data collection commenced.

The data collection exercise was initiated by identifying the type of data that was required to answer questions pertaining to intrahousehold, households, and community level water, energy,

and food insecurity as well as questions on decision-making, the law and social justice. Once the indicators of these constructs were identified from the literature, a questionnaire was constructed using KoboTool software, which is freely available. KoboTool software allows installation of KoboCollect on Android devices, which were used in the data collection exercise. The Android devices allowed off-line data collection which was then uploaded to the KoboTool cloud once the device had access to the internet. This proved significant as some of the areas were remote and did not have internet coverage. The KoboTool software was also convenient as it allowed real time modifications of the questionnaire which were visible on all devices that had the software.

Once the questionnaire and the selection of sites to be investigated were finalized, the data collection was scheduled for 6 June to 4 August 2022. A local NGO, Environmental Rural Solution (ERS) in Matatiele Local Municipality and a water user association, Vaalharts Water User Association covering the Magareng and Greater Taung Local Municipalities, were tasked (with the help of the traditional leaders) with recruiting local enumerators who were conversant in the local languages of Sesotho, isiZulu, isiXhosa, Afrikaans, and Setswana. Some of the household questionnaires were conducted in English only. The enumerators and the research project participants (academics, post-doctoral fellows, and postgraduate students) were trained on the use of the questionnaire and likely ethical issues to be encountered before commencing the data collection exercise. There was an initial piloting of the questionnaire in the Matatiele Local Municipality on 6 June 2022. The Likert scaled questions were then tested for reliability. Thereafter, the data collection commenced with the aid of twenty-two (22) enumerators in total from the investigated areas.

During the data collection exercise, the survey lead had access to the KoboTool cloud, had real time access to the data that was collected and monitored the patterns in the data including skip patterns. The data collection team also had a WhatsApp group chat where challenges and opportunities in data collection were discussed in real time. This allowed real time modifications to the questionnaire without compromising internal validity and reliability.

Limitations

The sample size calculation that was used relied on Wazimap [17] which contains data from the 2011 census. At the time of drafting this article, a new census had been conducted in 2022 and reported in 2023. The population will thus be different. However, due to the fact that the research ended up using a larger sample than what was required from the calculations, integrity, validity, and reliability were not compromised. Sample selection was also not devoid of bias, informed by operational areas of the research team, as well as traditional leadership who may be characterized by their own tentative biases. The external validity of the data is also limited as the data is only representative of the research area, which are rural areas in the provinces of the Eastern Cape, Northern Cape, and North-West in South Africa. Exigent conditions during the time of data collection might also have influenced the responses gathered during the exercise. For instance, some of the questions, pertaining to energy, may be biased due to the ongoing loadshedding and power cuts at the time when the questionnaire was undertaken. The question on the ownership of land, did not take into account the specific content of the land use rights, for example, whether it is communal land use rights or private ownership. The data is also cross-sectional and cannot be used for longitudinal inquires unless similar research is carried out at other time periods. Internal validity is also limited especially in the constructs of governance and social justice used in the questionnaire which are vast, difficult to measure and context specific.

Ethics Statement

Data were collected through 1 184 questionnaires and face-to-face interviews observing ethical issues such as anonymity, confidentiality, and integrity (Ethical Clearance No: NWU-01,216-21-S3 Law) after obtaining informed consent [1] in accordance with the Declaration of Helsinki.

CRediT Author Statement

Saul Ngarava-Conceptualization, Formal analysis; Original writing, Investigation; Marjanneke J Vijge-Conceptualization, Funding acquisition; Willemien Duplessis-Funding acquisition, Investigation; Leocadia Zhou-Supervision; Germarié Viljoen-Supervision, Investigation; Patrick Nyambo-Project administration, Visualisation, Investigation; Tiisetso J Rantlo-Project administration, Investigation; Bronwen Qumbu-Investigation; Naziha Mokadem-Investigation; Sibulele Bongoza-Investigation; Alois A Mugadza-Original writing, Visualisation.

Data Availability

Water–Energy–Food Nexus: Multi-Actor Governance for Social Justice (Household survey) (Original data) (Mendeley Data).

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Supplementary Materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.dib.2024.110805.

References

[1] S. Ngarava, M. Vijge, W. DuPlessis, L. Zhou, G. Viljoen, P. Nyambo, A. Mugadza, J. Rantlo, N. Mokadem, M.D. Fontana, Water–energy–food nexus: multi-actor governance for social justice (household survey), Mendeley Data (2024), doi:10.17632/56zskrvfwf.1.

[2] Y. Xing, H. Peng, L. Gao, A. Luo, X. Yang, A compound containing substituted Indole ligand from a hyperaccumulator *Sedum Alfredii* hance under Zn exposure, Int. J. Phytoremediation 15 (10) (2013) 952–964, doi:10.1080/15226514.2012.751351.

[3] J. Stoler, J.D. Miller, E.A. Adams, F. Ahmed, M. Alexander, G. Asiki, M. Balogun, M.J. Boivin, A. Brewis, G. Carrillo, K. Chapman, S. Cole, S.M. Collins, J. Escobar-Vargas, H. Eini-Zinab, M.C. Freeman, M. Ghorbani, A. Hagaman, N. Hawley, Z. Jamaluddine, W.E. Jepson, D. Krishnakumar, K. Maes, J. Mathad, J. Maupin, P.M. Owuor, M.M. Morales, J. Morán-Martínez, N. Omidvar, A.L. Pearson, S. Rasheed, A.Y. Rosinger, L. Samayoa-Figueroa, E.C. Sánchez-Rodríguez, M.V. Santoso, R.C. Schuster, M. Sheikhi, S. Srivastava, C. Staddon, A. Sullivan, Y. Tesfaye, A. Trowell, D. Tshala-Katumbay, R. Tutu, C.L. Workman, A. Wutich, S.L. Young, The household water insecurity experiences (Hwise) scale: comparison scores from 27 sites in 22 countries, J. Water Sanit. Hyg. Dev. 11 (2021) 1102–1110, doi:10.2166/washdev.2021.108.

[4] S.L. Young, G.O. Boateng, Z. Jamaluddine, J.D. Miller, E.A. Frongillo, T.B. Neilands, S.M. Collins, A. Wutich, W.E. Jepson, J. Stoler, The Household Water InSecurity Experiences (HWISE) Scale: development and validation of a household water insecurity measure for low-income and middle-income countries, BMJ Glob. Health 4 (5) (2019) e001750, doi:10.1136/bmjgh-2019-001750.

[5] S.L. Young, S.M. Collins, G.O. Boateng, T.B. Neilands, Z. Jamaluddine, J.D. Miller, A.A. Brewis, E.A. Frongillo, W.E. Jepson, H. Melgar-quiñonez, R.C. Schuster, Development and validation protocol for an instrument to measure household water insecurity across cultures and ecologies : the Household Water InSecurity Experiences (HWISE) Scale, BMJ Glob. Heal. 9 (2019) 14, doi:10.1136/bmjopen-2018-023558.

[6] K. Abbas, S. Li, D. Xu, K. Baz, A. Rakhmetova, S. Asia, Do socioeconomic factors determine household multidimensional energy poverty ? Empirical evidence from South Asia, Energy Policy. 146 (2020) 111754. https://doi.org/10.1016/j.enpol.2020.111754.

[7] A.C. Sadath, R.H. Acharya, Assessing the extent and intensity of energy poverty using multidimensional energy poverty index: empirical evidence from households in India, Energy Policy 102 (2017) 540–550, doi:10.1016/j.enpol.2016.12.056.

[8] Greater taung local municipality, Greater Taung LM fourth generation integrated development plan, Taung, 2017. https://gtlm.gov.za/wp-content/uploads/2018/06/0-GTLM-Final-Fourth-Generation-IDP-2.pdf.

[9] Dr S Mompati District Municipality, Integrated development planning fourth generation 2017/2022 draft 2021/2022 review, Vryburg, 2017.

[10] Matatiele Local Municipality, Matatiele local municipality spatial development framework review, matatiele, 2020. https://www.cogta.gov.za/cgta_2016/wp-content/uploads/2021/02/MATATIELE-ADOPTED-2020-21-IDP-document-1.pdf.

[11] Magareng Local Municipality, Integrated development plan review, Warrenton, 2012. https://ia802908.us.archive.org/15/items/ted_development_plans_2011-12_02_local_municipalities_nc093_magareng_nc093_magareng_-_idp_-_1112_pdf/Documents/01. Integrated Development Plans/2011-12/02. Local Municipalities/NC093 Magareng/NC093 Magareng - IDP -.

[12] Magareng Local Municipality, Magareng local municipality spatial development framework 2014–2019, Warrenton, 2014. https://francesbaard.gov.za/wp-content/uploads/2015/06/Magareng-SDF-2014-19-reduced-size.pdf.

[13] ERS, Environmental Rural Solutions, (2024). https://enviros.co.za/ (accessed 12 January 2024).

[14] VWUA, Vaalharts water user association, Jan Kempdorp, South Africa, 2008.

[15] OECDGovernance as an SDG Accelerator: Country experiences and Tools, OECD Publishing, Paris, France, 2019, doi:10.1787/0666b085-en.

[16] OECD, Policy coherence for sustainable development 2018. Toward sustainable and resilient societies, Paris, France, 2018.

[17] A. Jordan, A. Lenschow, Policy paper: environmental policy Integration: a state of the art review, Environ. Policy Gov. 20 (2010) 145–158, doi:10.1002/eet.539.

[18] Wazimap, South Africa, (2023). https://wazimap.co.za/profiles/country-ZA-south-africa/ (accessed 6 June 2023).

[19] T. Yamane, Statistics: an Introductory Analysis, 2nd Edition, Harper and Row, New York, USA, 1967.