

# Household-level perceptions of governance in smallholder irrigation schemes in KwaZulu-Natal Province\*

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## ABSTRACT

Good governance is a prerequisite for better management of common-use resources. Awareness of institutions, inclusion of members in decision-making processes, stakeholder engagement and transparency are needed for good governance, which enhances the sustainable use of communal water resources. This paper therefore considers perceptions of farmers on irrigation scheme governance in its various dimensions. The study uses household data of 341 farmers drawn from four irrigation schemes in KwaZulu-Natal. The results show that farmers who are satisfied with the informal institutions, being the rules and norms set locally to govern the scheme farmers, value the involvement of the tribal authorities in scheme management, including their contribution to rule enforcement. Age, agricultural training, water adequacy, participation in scheme activities, psychological capital and land tenure have a positive effect on perceptions of governance constructs. Farmers are satisfied with the informal institutions governing the schemes and therefore the study recommends the inclusion of informal institutions in policy formulation. Farmers should be empowered through training and be made aware of formal institutions applicable to their irrigation scheme, and stakeholder engagement in the schemes should be strengthened.

**KEYWORDS:** KwaZulu-Natal, perceptions of governance, principal components analysis, smallholder irrigation schemes

## **1 INTRODUCTION**

The increasing frequency of droughts has negatively affected agriculture in South Africa and resulted in an increased demand for irrigation (Sinyolo et al., 2014). Smallholder irrigation schemes (SISs) have become an important water source for agriculture among smallholder farmers, and thus play a key role in poverty reduction (Muchara et al., 2014). In the South African context, an SIS is defined as a multi-farmer irrigation project larger than 5 ha in size, used mainly for agricultural production (Perret & Geysler, 2007; Van Averbek, 2012). SISs have the potential to alleviate poverty and improve household food security in rural areas in South Africa (Sinyolo et al., 2014). However, many of them continue to face technical challenges such as inadequate water supply and dilapidated infrastructure (Dirwai et al., 2019). To address these issues, the government introduced a process to rehabilitate the schemes, which is an engineering-centred concept, involving the restructuring of infrastructure to ensure adequate water supply and the redesigning of systems (Department Agriculture, Fisheries and Forestry [DAFF], 2012).

Despite the rehabilitation process, SISs have continued to underperform (Gomo et al., 2014). As such, social dynamics were included in the development of SIS, which resulted in a process called revitalization, a philosophy that includes both the redesign of existing infrastructure and engagement with the organizational and social dynamics of water distribution and allocation (Gomo et al., 2014). It was through this revitalization process that irrigation management transfer (IMT) was introduced in South Africa in 1996. IMT sought to decentralize management of the schemes. Two years later, participatory irrigation management (PIM) was introduced under the National Water Act of 1998. PIM is a philosophy that is centred on involving farmers or water users in the operation, management and maintenance of irrigation systems at tertiary and secondary levels (Kulkarni & Tyagi, 2012). In essence, this involves transforming the farmer into a 'water manager' (Gomo et al., 2014) and involving them in governance of the scheme.

## **2 WATER GOVERNANCE AND INSTITUTIONAL ARRANGEMENTS IN SMALLHOLDER IRRIGATION SCHEMES**

Water governance refers to 'all those interactive arrangements in which public as well as private actors participate, aimed at solving problems or creating opportunities, attending to the institutions within which these governing activities take place' (Hassenforder & Barone, 2019). Institutions provide a basis for human cooperation and enhance stable interactions (Nielsen et al., 2013), while also shaping water-related decision making, including behaviour, and drive behaviour associated with activities such as water sharing and use (Hassenforder & Barone, 2019). Institutions can either be formal or informal, with formal institutions representing the policies, strategies and organizations formed by government, while informal institutions refer to the rules and norms that are usually set locally (Muchara et al., 2014). In the context of irrigation systems, 'institutions generally include the rules applied to operation and maintenance of the systems, designing cropping patterns, allocation and scheduling of water, conflict resolution, and to maintain a coordinated flow of action and transactions in the society' (McKay & Keremane, 2006: 206).

Several studies have evaluated the success of IMT and PIM in irrigation schemes across the world and have shown that farmers' involvement in scheme management contributes to improved scheme performance (Meinzen-Dick et al., 2002; McKay & Keremane, 2006; Khalkheili & Zamani, 2009; Muchara et al., 2014). Given that farmers are actively involved in

scheme management, it then becomes imperative that they are aware of the institutional arrangements in irrigation management. Awareness and understanding of institutions and inclusion of members in decision-making processes and transparency of governance are needed for improved scheme management (Hassenforder & Barone, 2019; McKay & Keremane, 2006).

Meinzen-Dick et al. (2002) found that the involvement of traditional leaders reduced the transaction costs of organizing people and makes users more willing to take part in scheme governance. Khalkheili and Zamani (2009) found that good relationships between farmers and other involved stakeholders are important for farmer participation. The overarching finding of these studies is that the success of management transfer ultimately depends on a set of institutional arrangements and the understanding of, and or farmers' satisfaction with, these institutional arrangements. Normally, institutional analysis of the water sector focuses on the formal aspects of law, policy and administration (McKay & Keremane, 2006) and hardly on the informal institutions governing the schemes.

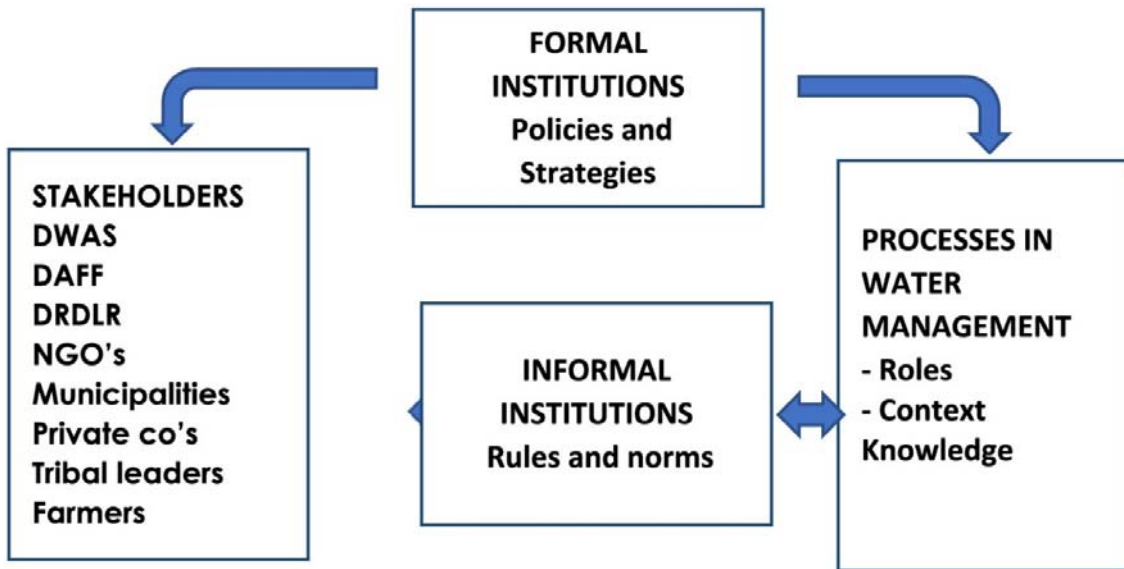
Most studies have considered the impact of IMT and PIM on the performance of SISs, and have also focused on how institutional arrangements can be adapted to improve scheme management; however, Shah (2005) and McKay and Keremane (2006) note that these types of analysis are not complete if they do not include the understanding of the institutional arrangements and the 'working rules/rules in use' which are deemed the informal institutions in scheme governance. Governance and management of schemes are in the hands of the local farmers and assessing their perceptions is important as they possess knowledge that is holistic and critical in evaluating local scheme governance (Cookey et al., 2016). For this reason, this study aims to add to the literature by evaluating the perceptions of governance at household level in SISs. It also assesses determinants of the governance perceptions of farmers in SISs. To the knowledge of the authors, this is the first study to investigate perceptions of both formal and informal institutions at household level in KwaZulu-Natal irrigation schemes, and the first also to introduce household-level SIS governance using indices. This paper has five sections: the second part presents the conceptual framework, followed by the third section of the paper explaining the methods adopted for the study; the fourth part disseminates the results on the perceptions of governance by farmers in SISs, and the determinants of the computed governance indices; the fifth section puts forward the conclusions and recommendations of the study.

## **2.1 Conceptual framework**

Water governance in South Africa is a multifaceted, interdisciplinary concept involving various institutional arrangements and stakeholders. This study considers the management transition framework (MTF), which is an interdisciplinary conceptual and methodological framework used for evaluating water systems, management processes and multi-level governance regimes (Pahl-Worstl & Knieper, 2014). MTF provides an interdisciplinary approach across social and natural science by integrating a range of concepts to enable understanding of water management regimes (Paul-Worstl & Knieper, 2014). It also provides a comprehensive analysis of resource management. It is an operational tool that can be used for structural and comparative analysis of water resource management (Knieper et al., 2010) and gives practical guidance on the implementation of processes towards more adaptive resource systems.

The framework considers various facets of water resources, but for this study the framework is adapted to focus on the social and regulative systems in water management as shown in

Figure 1. The social system consists of formal institutions such as national water policies and strategies, which stipulate the use and management of water resources.



**FIGURE 1.** Linkages in the social facets of smallholder irrigation scheme management. Source: adapted from Charbit (2011); Pahl-Worstl and Knieper (2014)

The relevant stakeholders, who each have roles to play in water management, carry out the stipulated guidelines. The stakeholders include the Department of Water and Sanitation (DWAS), the Department of Agriculture, Fisheries and Forestry (DAFF), the Department of Rural Development and Land Reform (DRDLR), NGOs, tribal authorities and farmers. The processes in water management, guided by the formal institutions, include roles of stakeholders and context knowledge of the dynamics of water resources. The roles of stakeholders are aligned to their respective goals and responsibilities, as governmental ministries, tribal authorities and farmers. The processes in water management also include context knowledge of the dynamics of water resource management, such as conflict management, irrigation scheduling and election of committee members. The stakeholders, particularly farmers and tribal authorities, often devise rules and mechanisms to govern irrigation schemes, which form the informal institutions. These rules are also guided by the different roles and knowledge of the dynamics in scheme management. The informal institutions set basic conditions about the water management processes and guide the involvement of local stakeholders. The components of the social aspects of MTF are used in the study to gather information about farmers' perceptions of SIS governance, incorporating formal and informal institutions, processes in management and stakeholder engagement.

## 2.2 Methodology

### 2.2.1 Data collection and study area

The study focused on four irrigation schemes in two local municipalities in KwaZulu-Natal Province in South Africa, namely, Jozini Local Municipality (JLM) in Umkhanyakude and the Msinga Local Municipality (MLM) in Umzinyathi District. The four schemes selected for the study are representative of the characteristics of other irrigation schemes in South Africa.

Systematic random sampling was used to select 341 farmers across the schemes. The total number was fixed to capture a representative sample according to the number of farmers operational within the schemes. Due to the different sizes of the schemes, 120 farmers were selected in both the Mooi River Irrigation Scheme (MRIS) and Tugela Ferry Irrigation Scheme (TFIS) located in the MLM. The same sampling procedure was used in the JLM, where 60 farmers from the MFIS and 41 from the NIS were selected. A questionnaire including information on irrigation activities, institutional arrangements, demographic, agricultural production and related information was administered to farmers who source water from the schemes. Additionally, focus group discussions (FGDs) with farmers and committee members of the schemes were held in the schemes, where issues regarding scheme governance, the role of farmers and institutional arrangements in the schemes were discussed. Information was kept using audio-recording and scripts.

### ***2.2.2 Scheme characteristics***

The Makhathini Flats Irrigation Scheme (MFIS) comprises individual (mostly males) and cooperative irrigators (mostly women). The individual farmers produce sugar cane, while the cooperatives mostly produce vegetables. The individual irrigators operate on land provided by land trusts (under tribal authorities) and the cooperative irrigators operate on state-supplied land. The NIS is a 500 ha scheme operated by 50 farmers. They produce a variety of commodities commercially. The irrigators belong to two cooperatives, representing the older and newer block (Dlangalala & Mudhara, 2020). The MRIS comprises about 842 irrigators, drawing water from a 25 km scheme. It is undergoing rehabilitation and water access is extremely variable (Dirwai et al., 2019). The TFIS comprises about 1500 farmers on 800 ha of land. The TFIS irrigators use various water transmission mechanisms (canal via gravity, diesel and electric pumps) and farmer production is more for subsistence. The farmers operate on an average of 0.4 ha of land allocated by the local tribal authority.

## **2.3 Empirical methods**

### ***2.3.1 Principal components analysis (PCA)***

Principal components analysis (PCA) was used to evaluate farmers' perceptions of governance within the schemes, including satisfaction with formal and informal institutions and stakeholder engagement. PCA is a multivariate data analysis method used to reduce the dimensionality of many interrelated variables, while retaining as much as variation in the data as possible (Joliffe, 2002; Muchara et al., 2014). Dimension reduction is attained by the creation of new variables (principal components) that are uncorrelated. The new retained variables explain the variation present in all the variables and can explain certain phenomena within the data (Joliffe, 2002).

Study participants ranked their understanding and perceptions of governance. A total of 18 governance items were included. Their perceptions and understanding were ranked using a 5-point Likert scale from zero (0) if a farmer strongly disagrees, to five (5) if he/she strongly agrees. Farmers were asked to rank their perceptions of formal institutions, satisfaction with stakeholder engagement and informal institutions. Ranking perceptions is important as water users may not have the same level of satisfaction for every item. For instance, a farmer might be satisfied with involvement of the tribal authorities in rule enforcement, but not be satisfied with the election process of committee members. PCA was also used to generate household governance indices (HGIs) based on farmers' awareness and perceptions governance in the

**TABLE 1** Description of explanatory variables

| <b>Variable name</b>              | <b>Description</b>                                                                                                                                                               | <b>Exp. sign</b> |
|-----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| Age                               | Age of a water user (years)                                                                                                                                                      | +/-              |
| Gender                            | The gender of the water user (1 = male; 0 = female)                                                                                                                              | +/-              |
| Total farming income              | Continuous variable which is the amount of income received from irrigated agriculture (rands)                                                                                    | +                |
| Cooperative member                | Binary variable representing whether a water user is part of an agricultural cooperative (1 = yes; 0 = no)                                                                       | +                |
| Credit access                     | Binary variable which represents whether or not a farmer has access to credit (1 = yes; 0 = no)                                                                                  | +                |
| Land tenure security              | Binary variable, representing whether or not a farmer is satisfied with the existing land tenure (1 = satisfied; 0 = not satisfied)                                              | +/-              |
| Agricultural training             | Binary variable indicating whether a farmer has received agricultural training (1 = trained; 0 = not trained)                                                                    | +                |
| Irrigation training               | Binary variable that captures whether a water user has undergone irrigation and water training (1 = trained; 0 = not trained)                                                    | +                |
| Psychological capital             | PCA-derived composite score which represents the self-efficacy, hope and resilience of a water user                                                                              | +                |
| Water adequacy                    | Binary variable which indicates whether a water user considers irrigation water they have access to is adequate for their cropping requirements (1 = adequate; 0 = not adequate) | +                |
| Participation in management index | PCA-derived composite score which represents participation in management activities in the schemes                                                                               | +                |

schemes. The indices were then used as dependent variables in multiple regressions to evaluate their determinants.

### 2.3.2 Multiple regression model

The PCA-derived composite indices of perceptions of governance at household level were used as the dependent variable ( $Y$ ) in a regression specified in Equation 1 as

$$Y^*_i = \beta_1 + \beta_2 X_i + \dots + \beta_j X_i + u_i \quad (1)$$

$$E(u_i | X_i) = 0 \quad (2)$$

where  $Y^*_i$  is a latent variable representing the HGI index,  $X$  the vector of explanatory variables,  $\beta$  a vector of estimated parameter coefficients and  $u_i$  the vector of independently and normally distributed residuals with a common variance (Greene, 2003).

The variables included as explanatory variables in the multiple regression model are described in Table 1; also included is their expected coefficient estimate sign, showing their relationship with the HGI.

## 3 RESULTS AND DISCUSSION

### 3.1 Descriptive statistics

Table 2 presents descriptive statistics of farmer characteristics across the schemes. As is the case with many rural settings, there are more female water users, accounting for about 77% of the sample. This is expected, as smallholder crop farming in the rural areas of KZN is dominated by females (Muchara et al., 2014; Sinyolo et al., 2014). The average age of the farmers is 54, showing that relatively older people are part of the schemes, which is consistent with Dlangalala and Mudhara (2020) who found an average age of 55 among farmers in SISs in KwaZulu-Natal. Most of the water users consider themselves secure in terms of land tenure, with about 54% having received agricultural training.

About 63% feel that irrigation water is inadequate for their cropping requirements and only 29.5% of the farmers noted that they had received irrigation training. Only about 36% of the farmers are members of agricultural cooperatives, while 60% have access to credit.

### 3.2 Principal components analysis of farmers' understanding and perceptions of governance of SISs in KZN

Farmers' perceptions and understanding of governance in the schemes were evaluated using PCA. Table 3 presents the PCA results which show that the Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy yielded a value of 0.75, implying that PCA can be performed on the data. The Bartlett test of sphericity, which is used to check whether the observed correlation matrix diverges significantly from the identity matrix, was statistically significant, showing that the included variables are not perfectly correlated. Using the Kaiser criterion, five principal components that had eigenvalues greater than 1 were retained. The results showed that the first principal component (PC1), informal institutions, has the highest explanatory power, accounting for 24.8% of the variation in farmers' perceptions of governance in the schemes. PC1 together with principal components (PC2)-stakeholder engagement, (PC3)-

**TABLE 2** Descriptive statistics of explanatory variables

| <b>Variables</b>                   |            | <b>Percentage % (N = 341)</b>                                                          |
|------------------------------------|------------|----------------------------------------------------------------------------------------|
| Gender:                            | Male = 1   | 1 = 22.6                                                                               |
|                                    | Female = 0 | 0 = 77.4                                                                               |
| Agricultural training:             | Yes = 10   | 1 = 54.4                                                                               |
|                                    | No = 0     | 0 = 45.6                                                                               |
| Irrigation training:               | Yes = 1    | 1 = 29.5                                                                               |
|                                    | No = 0     | 0 = 70.5                                                                               |
| Land tenure security:              | Yes = 1    | 1 = 74.6                                                                               |
|                                    | No = 0     | 0 = 25.4                                                                               |
| Credit access:                     | Yes = 1    | 1 = 60.2                                                                               |
|                                    | No = 0     | 0 = 39.8                                                                               |
| Cooperative membership:            | Yes = 1    | 1 = 36.4                                                                               |
|                                    | No = 0     | 0 = 63.6                                                                               |
| Irrigation water adequacy:         | Yes = 1    | 1 = 37.2                                                                               |
|                                    | No = 0     | 0 = 62.8                                                                               |
| <b>Continuous variables</b>        |            |                                                                                        |
| Age:                               |            | Mean = 54<br>Standard deviation = 14.0<br>Min. = 20<br>Max. = 88                       |
| Total farming income (ZAR):        |            | Mean = 18 800<br>Standard deviation = 50 070<br>Min. = 600<br>Max. = 503 000           |
| Participation in management index: |            | Mean 5.12 e <sup>-09</sup><br>Standard deviation = 2.01<br>Min. = -5.24<br>Max. = 3.02 |
| Psychological capital index:       |            | Mean 2.15 e <sup>-09</sup><br>Standard deviation = 2.2<br>Min. = -6.93<br>Max. = 4.85  |

Source: Survey data (2018).



formal institutions, (PC4)-scheme management and (PC5)-youth involvement cumulatively account for 68.5% of the variation in the data.

PC1, 'informal institutions', is dominated by variables which represent informal institutions, which are the norms and rules set locally to govern the schemes. The results show that farmers who are satisfied with the involvement of tribal authorities are satisfied with the informal institutions, and are also satisfied with how farmers work together with the local tribal councils. Farmers who are satisfied with the election process of the current committee members also feel that penalties within the schemes are fair and are satisfied with conflict management in the schemes. PC2, 'stakeholder involvement', is dominated by variables which rank farmers' perceptions of governmental stakeholders' involvement in the scheme. The results show that farmers who are satisfied with the involvement of the Department of Agriculture, Forestry and Fisheries (DAFF) are also satisfied with the involvement of other stakeholders such as the Department of Rural Development Land Reform (DRDLR), the Department of Water and Sanitation (DWAS) as well as non-governmental organizations such as Lima and Technoserve.

PC3, 'formal institutions', is dominated by farmers' awareness of the National Water Act of 1998 (NWA), the Natural Water Resource Strategy and government's aims in SISs, which form part of the formal institutions in place in governing schemes in the country. Farmers who are aware of the NWA, are also aware of the NWRS. PC4, 'scheme management', is dominated by variables ranking farmers' perceptions of local scheme management such as their involvement in formulating scheme rules, the process of electing scheme committee members and satisfaction with the current committee, consistent with the findings of Dlangalala and Mudhara, 2020). PC5, 'youth involvement', shows that farmers who are satisfied with youth involvement in scheme management are also satisfied with the youth's understanding of scheme rules.

The five retained PC representing the aggregate farmers' perception of governance in the scheme were used to compute indices which are proxies of perceptions of the different governance constructs or facets.

### **3.3 Results of the determinants of farmers' perceptions of governance**

Table 4 presents the multiple regression results of determinants of the PCA-derived composite indices of perceptions of governance at household level. The five retained PCs gave rise to indices which are proxy perceptions of informal institutions, stakeholder engagement, formal institutions, local scheme management and youth involvement. The mean variance inflation factor of 1.25 indicates that multicollinearity is not a problem in the data. The results are mostly in line with a priori expectations and are discussed below.

The results show that factors that determine perceptions of the governance indices in SISs are age, gender, cooperative membership, credit access, agricultural training, land tenure, irrigation water adequacy, participation index, income and psychological capital.

The results indicate that older farmers are satisfied with the informal institutions and local scheme management. The informal institutions PC includes satisfaction with local rules and traditional authority engagement; it is plausible that older farmers would therefore have better perceptions of scheme governance. This is also because the schemes are based in rural settings, where traditional authorities play a key role in the management of resources (Muchara et al., 2014) and because older farmers are more inclined to respect and uphold tradition, they are

TABLE 3 Principal components analysis of farmers' perspectives of SIS governance

| Variables                                                                      | Principal components      |                            |                         |                       |                       |
|--------------------------------------------------------------------------------|---------------------------|----------------------------|-------------------------|-----------------------|-----------------------|
|                                                                                | PC1-informal institutions | PC2-stakeholder engagement | PC3-formal institutions | PC4-scheme management | PC5-youth involvement |
| Awareness of National Water Act                                                | 0.04                      | 0.001                      | <b>0.585</b>            | 0.159                 | 0.218                 |
| Awareness of Natural Water Resource Strategy                                   | 0.048                     | -0.023                     | <b>0.568</b>            | 0.185                 | 0.234                 |
| Knowledge of government's aims in SISs                                         | 0.024                     | 0.118                      | <b>0.421</b>            | -0.085                | -0.015                |
| Satisfaction with fairness of penalties in SISs                                | <b>0.224</b>              | -0.014                     | 0.036                   | 0.128                 | 0.043                 |
| Satisfaction with conflict management in SISs                                  | <b>0.215</b>              | 0.052                      | 0.042                   | <b>0.337</b>          | -0.075                |
| Satisfaction with the involvement of tribal authorities                        | <b>0.326</b>              | -0.124                     | 0.069                   | -0.226                | -0.063                |
| Satisfaction with involvement of DAFF                                          | 0.163                     | <b>0.464</b>               | 0.079                   | -0.185                | -0.134                |
| Satisfaction with involvement of DRDLR                                         | 0.181                     | <b>0.422</b>               | 0.072                   | -0.282                | -0.095                |
| Satisfaction with involvement of DWAS                                          | 0.116                     | <b>0.346</b>               | 0.044                   | 0.001                 | -0.204                |
| Satisfaction with involvement of NGOs                                          | 0.029                     | <b>0.346</b>               | 0.034                   | -0.305                | -0.081                |
| Satisfaction with the involvement of farmers in making rules                   | 0.198                     | 0.131                      | -0.067                  | <b>0.382</b>          | -0.012                |
| Satisfied with the current executive committee                                 | <b>0.228</b>              | 0.142                      | -0.0902                 | <b>0.4202</b>         | -0.214                |
| Satisfied with the process of electing the executive committee                 | <b>0.206</b>              | 0.134                      | -0.134                  | <b>0.398</b>          | -0.2003               |
| Satisfied with the contribution of the tribal council in irrigation management | <b>0.374</b>              | -0.198                     | 0.0102                  | -0.141                | -0.072                |
| Satisfied with the tribal council's understanding of scheme rules              | <b>0.366</b>              | -0.238                     | 0.019                   | -0.112                | -0.021                |
| Satisfied with how farmers and traditional councils work together              | <b>0.367</b>              | -0.239                     | 0.019                   | -0.112                | -0.021                |
| Satisfaction with youth involvement in SIS management                          | 0.141                     | 0.219                      | -0.243                  | 0.011                 | <b>0.586</b>          |
| Satisfied with youth understanding of scheme dynamics                          | 0.146                     | 0.202                      | -0.204                  | 0.0202                | <b>0.606</b>          |
| Eigenvalue                                                                     | 4.7                       | 2.68                       | 2.1                     | 1.87                  | 1.66                  |
| Variance explained (%)                                                         | 24.8                      | 14.1                       | 11.1                    | 9.87                  | 8.75                  |

(Continues)

TABLE 3 (Continued)

| Variables                         | Principal components      |                            |                         |                       |                       |
|-----------------------------------|---------------------------|----------------------------|-------------------------|-----------------------|-----------------------|
|                                   | PC1-informal institutions | PC2-stakeholder engagement | PC3-formal institutions | PC4-scheme management | PC5-youth involvement |
| Cumulative variance explained (%) | 24.8                      | 38.9                       | 49.9                    | 59.8                  | 68.5                  |
| Keiser–Meyer–Olkin (KMO)          | 0.75                      |                            |                         |                       |                       |

Bartlett test of sphericity

Chi-square = 3080

Degrees of freedom = 171

 $p$ -value = 0.00001

Source: Survey data (2018).

Notes: Dominant variables are highlighted in bold.

TABLE 4 Multiple regression model of the determinants of HGI

| Variables                 | PC1 informal institutions                      | PC2 stakeholder engagement                      | PC3 formal institutions                        | PC4 local scheme management                        | PC5 youth involvement                          |
|---------------------------|------------------------------------------------|-------------------------------------------------|------------------------------------------------|----------------------------------------------------|------------------------------------------------|
| Age                       | <b>0.015* (0.01)</b>                           | <b>-0.01** (0.01)</b>                           | <b>-0.01* (0.01)</b>                           | -0.01 (0.01)                                       | -0.05 (0.01)                                   |
| Gender                    | <b>-0.57* (0.3)</b>                            | 0.2 (0.22)                                      | <b>1.22*** (0.22)</b>                          | 0.26 (0.19)                                        | 0.05 (0.19)                                    |
| Cooperative membership    | <b>-0.63** (0.26)</b>                          | <b>1.11*** (1.98)</b>                           | 0.02 (0.19)                                    | <b>-0.28* (0.16)</b>                               | 0.22 (0.17)                                    |
| Access to credit          | 0.17 (0.22)                                    | -0.21 (1.64)                                    | -0.03 (0.16)                                   | <b>-0.58*** (0.14)</b>                             | <b>-0.29** (0.14)</b>                          |
| Agricultural training     | <b>0.51** (0.25)</b>                           | 0.27 (0.19)                                     | 0.08 (0.18)                                    | 0.17 (0.16)                                        | -0.24 (0.16)                                   |
| Irrigation training       | -0.19 (0.27)                                   | 0.12 (0.21)                                     | <b>0.37* (0.2)</b>                             | 0.12 (0.17)                                        | -0.54 (0.18)                                   |
| Land tenure               | <b>0.60** (0.27)</b>                           | <b>-0.47** (0.2)</b>                            | 0.07 (0.19)                                    | <b>0.78*** (0.17)</b>                              | 0.23 (0.17)                                    |
| Irrigation water adequacy | <b>0.61** (0.25)</b>                           | <b>0.92*** (0.18)</b>                           | -0.18 (0.17)                                   | 0.07 (0.15)                                        | 0.21 (0.16)                                    |
| Participation index       | <b>0.11* (0.06)</b>                            | -0.01 (0.04)                                    | -0.01 (0.04)                                   | <b>0.2*** (0.04)</b>                               | <b>-0.16*** (0.04)</b>                         |
| Psychological capital     | <b>0.104* (0.06)</b>                           | -0.01 (0.04)                                    | -0.05 (0.04)                                   | 0.02 (0.04)                                        | <b>0.09** (0.04)</b>                           |
| Total income              | 2.31 e <sup>-06</sup> (2.95 e <sup>-06</sup> ) | -1.08 e <sup>-06</sup> (2.22 e <sup>-06</sup> ) | 1.81 e <sup>-06</sup> (2.16 e <sup>-06</sup> ) | -4.16 e <sup>-06</sup> ** (1.89 e <sup>-06</sup> ) | 1.27 e <sup>-06</sup> (1.92 e <sup>-06</sup> ) |

Mean VIF = 1.25

Obs = 341

Notes: \*\*\*, \*\* = Statistical significance at 1 and 5% levels, respectively. Robust standard errors in parentheses. Obs = observation.

Source: Survey data (2018).

likely to be satisfied with local institutions which are largely enforced by traditional authorities. Older farmers, however, are shown to not be satisfied with stakeholder engagement in the schemes and are not aware of the formal institutions governing the schemes. This finding is consistent with Duhan and Singh (2017) who found that younger farmers accumulate information from different sources and are willing to adopt and adhere to formal policies; therefore younger farmers are more likely to be aware of current policies and strategies in water resource management.

The negative gender coefficient estimate shows that female farmers have better perceptions of informal institutions. Most of the farmers in the schemes are female and would likely be satisfied with government of the schemes, as they would be part of the rule setting, decision making and engaging with other stakeholders such as the tribal authorities and governmental ministries. The results suggest that male farmers are more aware of formal institutions, consistent with the findings of Dlangalala and Mudhara (2020). This could be attributed to male farmers being active in executive management of the schemes, and therefore engaging more with governmental entities and other stakeholders.

Findings also indicate that farmers who are not part of cooperatives have better perceptions of informal institutions and scheme management. During FGDs farmers highlighted that cooperative membership does not mean that farmers operate as cooperatives, and because of this, may not fully benefit from the rules set within the schemes. Farmers who are part of cooperatives were shown to have better perceptions of stakeholder engagement, not consistent with the findings of Tshishonga and Bandyambona (2016) who found that cooperatives lack the support of institutions such as government. Cooperatives are usually registered entities and benefit from the support of government through extension services and NGOs, and as such would have good perceptions in terms of stakeholder engagement. Farmers who have received agricultural and irrigation training perceive informal institutions and formal institutions schemes in a good light; this could be due to the fact that most training and support is provided by entities such as government and NGOs, and through the training, could be made aware of policies and strategies relating to water resource management.

Farmers who are secure in terms of their land tenure have good perceptions of informal institutions and local scheme management. This is plausible as the tribal authorities are usually responsible for land allocation and are also involved in scheme management (Muchara et al., 2016). However, farmers with secure land tenure are less satisfied with stakeholder engagement. During FGDs farmers highlighted that they hardly interact with other stakeholders, but often interact with tribal authorities or elected committee members in the schemes.

Farmers who feel that irrigation water is adequate for their cropping needs have better perceptions of governance. Irrigation water adequacy is dependent on the rules in terms of water access and irrigation infrastructure supply, which involve the support of stakeholders. Therefore, farmers who have adequate water would most likely have good perceptions about governance of the scheme, particularly the engagement of stakeholders and the informal institutions governing the scheme.

The participation index is a PCA-derived composite score which represents participation in the management activities in the schemes. These include decision making, financial contribution, information dissemination and regulation and control. Consistent with a priori expectations, farmers who therefore have a higher participation index are most likely to have a better

perception of governance because in order to participate in the schemes, they would have to be satisfied with the informal institutions and local scheme management. Similarly, psychological capital index, a higher-order construct which captures the self-efficacy, hope and resilience of a farmer, positively affects the HGI, showing that farmers with a higher psychological index are more likely to have positive perceptions of governance; that is, being satisfied with the rules in use and aware of formal institutions, as farmers with higher psychological capital they have a mindset and attitude that enable them to take initiatives and would most likely be involved and satisfied with scheme governance.

#### **4 CONCLUSIONS AND RECOMMENDATIONS**

Although it is important to evaluate the formal institutions, i.e. the law, policy and administration in water management, it is equally important to analyse governance issues taking into consideration the informal institutions governing the schemes. This study evaluated farmers' perceptions of governance and their determinants at household level in four SISs in KwaZulu-Natal Province. This included a holistic view of governance including both formal and informal institutions in the schemes. The study found that farmers are generally satisfied with the informal institutions, being the 'rules in use' they have set for themselves in the schemes. Furthermore, they are satisfied with the involvement of traditional authorities in scheme governance, including conflict resolution and rule enforcement.

As such, informal institutions should be at the forefront in policy formulation, since farmers are comfortable and satisfied with the rules they devise to govern the schemes. Furthermore, the involvement of traditional authorities in formulating policies should be considered. Failure here could lead to unsuccessful decentralization of the management of schemes and lack of compliance with formal arrangements formed outside the schemes. The study found that several factors such as gender, cooperative membership, and agricultural and irrigation training determine farmers' perceptions of governance. Male farmers should be encouraged to participate in the schemes, to get involved in the formulation of rules, while female farmers should be made aware of the formal institutions of scheme governance.

The training of farmers results in their having good perceptions of informal institutions and being aware of formal institutions. Better land agreements and water supply arrangements should be promoted, since farmers who are secure in terms of land tenure and feel that they have adequate irrigation water supply have better perceptions of scheme governance. The inclusion of informal institutions in policy formulation and improved stakeholder engagement is encouraged to ensure successful governance of the schemes. This will also strengthen participation of farmers in the management of schemes, thus making irrigation management transfer and other policy imperatives a reality at local level.

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