

## REPORT on 3<sup>rd</sup> Multi-Stakeholder Workshop

### Enhancing Sustainable Groundwater Use in South Africa – ESGUSA



22<sup>nd</sup> November 2019

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## **Acknowledgement**

The author would like to thank the participants of the 3<sup>rd</sup> Stakeholder Workshop on the Establishment of Citizen Science at Bolivia Lodge, Polokwane, South Africa for their contribution and discussions before, during and post workshop.

## Acronyms and Abbreviations

App	Application
CS	Citizen Science
DWS	Department of Water Affairs and Sanitation
ESGUSA	Enhancing Sustainable Groundwater Use in South Africa
GEUS	Geological Survey of Denmark and Greenland
IWMI	International Water Management Institute
RSA	Republic of South Africa
UWC	University of the Western Cape
WP	Work Package

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Figure 1: Map of Hout River Catchment in the larger Sand River Basin

This report documents the 3<sup>rd</sup> ESGUSA stakeholder workshop between stakeholders from the Department of Water and Sanitation (DWS), the private sector and commercial farmers within and around Dendron, Limpopo area. The international Water Management Institute – Southern Africa (IWMI-SA) together with the University of the Western Cape (UWC) convened this workshop which was held at Bolivia Lodge, Polokwane, South Africa on the 22<sup>nd</sup> of November 2019. The workshop also included some basic groundwater monitoring instrumental demonstration for farmers who were not familiar with these particular monitoring instruments.

## 1.1 Workshop Objectives and Participants

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The objective of the 3<sup>rd</sup> Stakeholder workshop was to present the Enhancing Sustainable Groundwater Use in South Africa (ESGUSA) project and introduce the concept of Citizen Science (CS) and its application in the Hout catchment to the participants as well as to gain an understanding of the current water resource monitoring processes undertaken by commercial farmers in the Dendron area.

A total of 19 participants attended the ESGUSA stakeholder workshop. A complete list of the participants can be found in ANNEX 1. The stakeholder participants included representatives from the Department of Water and Sanitation (DWS), University of the Western Cape (UWC), International Water Management Institute (IWMI), WSM Leshika consulting and commercial farmers in Dendron area.

The meeting highlighted the importance of collaboration and joint water resource monitoring for enhanced groundwater management in the area.

## 1.2 Target audience

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The target audience of the first and second stakeholder workshops were farmers and volunteers from the Hout Catchment (see ANNEX 1), Department of Water Affairs and Sanitation officials and the private sector. The target audience for the third workshop are commercial farmers in the Dendron area as well as officials from DWS and the private sector. The Project team thanked Mr Stefan Jacobs from the Commercial Farmers' Agricultural Union and representatives from the DWS for their efforts in identifying and helping the team to gather all the participants that were present at the workshop.

### 1.3 Workshop schedule

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The agenda for the workshop can be found in ANNEX 2. The workshop began with welcome remarks from the Department of Water Sanitation and a representative of the commercial farmers, followed by a self-introduction session by all participants of the workshop. The workshop then proceeded to introduce the ESGUSA project. The introduction covered the project objectives, partners, approaches and activities that have been on-going since the initial project kick-off in March 2019. The second presentation focused on the introduction to Citizen Science (CS), its implementation and the progress to date in the Hout catchment. The third presentation introduced the monitoring tools and volunteer tasks relevant to the CS component. This was then followed by an open panel discussion which encouraged the stakeholders to present their experiences, concerns and challenges around groundwater use, monitoring and management. The final presentation focused on the roles and engagement of CS volunteers in the Hout. The workshop concluded by identifying volunteers interested in participating in CS activities and a group discussion of the preferred/proposed monitoring sites, followed by concluding remarks from the ESGUSA research team.

### 1.4 Programme approach

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The programme ensured sufficient time and facilitation so as to allow for input from farmers and other stakeholders (government and private sector) residing in Section Two of the Hout Catchment.

### 1.5 Outputs

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- Workshop report
- Workshop evaluation sheet
- Mapping and identification of known and 'unknown' boreholes in Section 2
- Mapping of location of commercial farmers

All presentations, exercises and photos from the workshop are available at the project website [https://cgjar-my.sharepoint.com/:f:/g/personal/iwmisa-helpdesk\\_cgjar\\_org/EtWi-80JanNDitKEJgha8jkBY1YhleNEv-f0LRZBmcTYMg?e=3i4Fo3](https://cgjar-my.sharepoint.com/:f:/g/personal/iwmisa-helpdesk_cgjar_org/EtWi-80JanNDitKEJgha8jkBY1YhleNEv-f0LRZBmcTYMg?e=3i4Fo3). The workshop report will be emailed to all participants.

## 2. Friday 22nd November presentations and discussion

2.1 Welcome by Mr. Shonisani Mutheiwana from the Department of Water Affairs and Sanitation and Mr Stefan Jacobs – Chairperson of the Polokwane Agricultural Union

Mr Shonisani Mutheiwana welcomed the participants and expressed the willingness of the Department to participate in ESGUSA as the project focus on borehole water in the Hout Catchment is essential because groundwater is a key area of concern for the Department. It is critical for the Department to obtain reliable data on groundwater for their policy and planning.

2.2 ESGUSA Project: vision, objectives and timeframe (Prof Karsten Jensen, University of Copenhagen)

### 2.2.1 Project background

The ESGUSA project is funded by DANIDA to the value of DKK 5 million. It is administered by the DANIDA Fellowship Center. There are close relationships with the Strategic Sector Cooperation (SSC) programme between South Africa and Denmark. The life cycle of the project is 1<sup>st</sup> April 2018 to 30<sup>th</sup> September 2020. As this is a pilot project there is also, potentially, an opportunity for an extension and eligibility for future funding. Phase two eligibility for proposal submission is January 31<sup>st</sup> 2020. Close relationships are being forged between the Strategic Sector Co-operation (SSC) and South Africa and Denmark

### 2.2.2 Project motivation

The fact that groundwater is increasing in use in the RSA is significant. Groundwater is generally better protected than surface water and normally has year-round availability. It is a

resource that is vulnerable to exploitation, depletion and degradation. Sustainable use of groundwater requires knowledge of aquifer settings, recharge, interaction with river systems, impacts of human interactions and options for mitigation of adverse effects. Groundwater recharge varies in space and time and it is replenished on an irregular basis subject to large uncertainty.

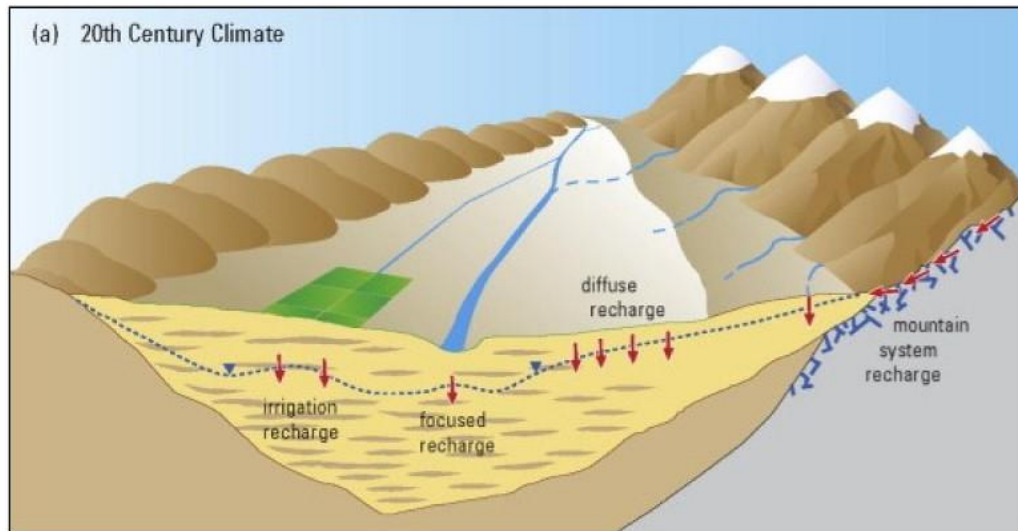


Figure 1: Map showing the different types of groundwater recharge within the Hout Catchment (Source: Meixner et al. 2016)

### 2.2.3 Study Area

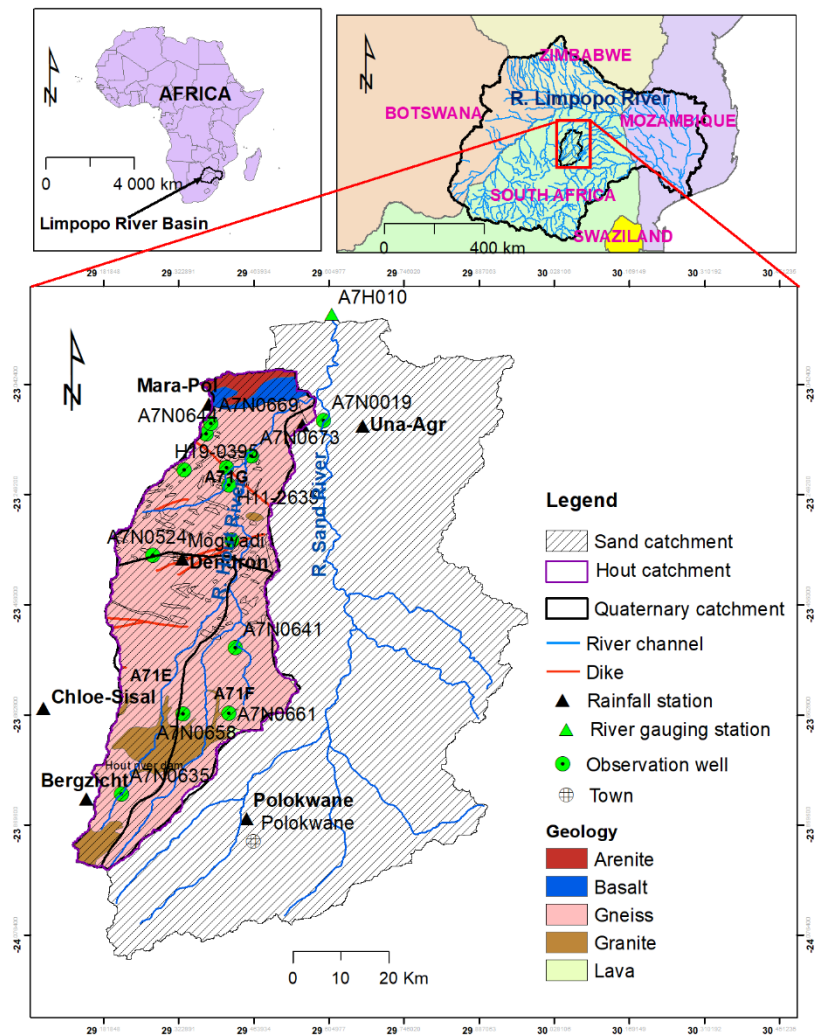


Figure 2: Map showing Hout catchment study area.(Source: Ebrahim et al 2018)

## 2.2.4 Borehole Map

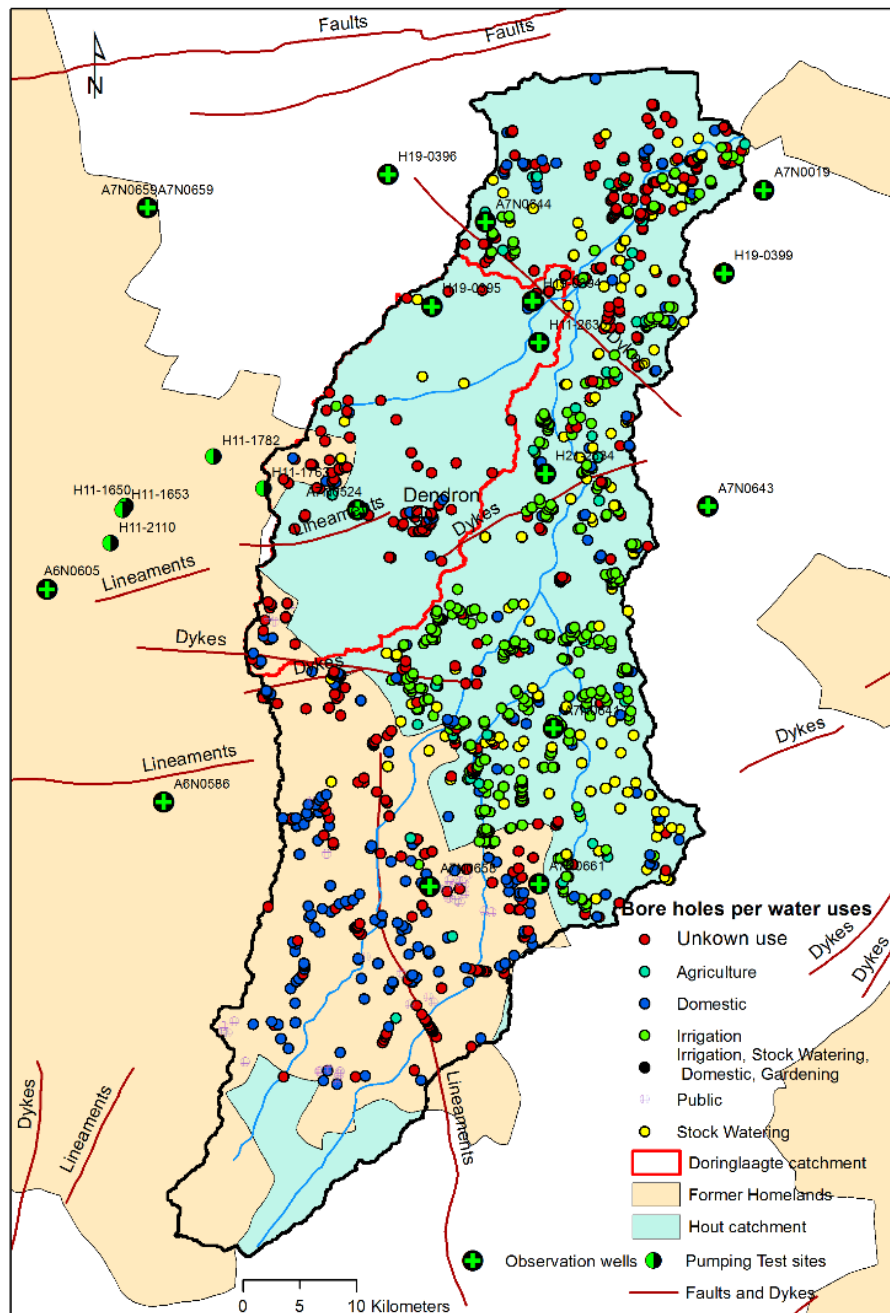


Figure 3: Map showing pumping boreholes and Dyke structures within the Hout catchment. (Source: Ebrahim et al 2018)

#### 2.2.5 Project objectives

- Establish research partnerships between RSA and Denmark
- Improve the understanding of hydrogeological conditions in typical geological settings and farming communities in RSA, exemplified by the Hout/Sand river catchment in Limpopo Province
- Develop modelling and resource indicator tools for integrated groundwater management
- Promote stakeholder involvement in development and promotion of sustainable groundwater management options (Citizen Science)
- Increase the research capacity in RSA within integrated groundwater resource assessment and management

#### 2.2.6 Project Partners

- University of Copenhagen
- Geological Survey of Denmark and Greenland (GEUS)
- University of the Western Cape
- EkoSource
- International Water Management Institute (IWMI)
- Department of Water and Sanitation (DWS)

The Catchment is part of the Limpopo River Basin and the main landmarks are the Hout River Dam, Dendron and Mogwadi. The Hout River is a tributary to the Sand. The river flow is ephemeral or from discharges – when rivers are flowing in the dry season its being fed by discharge (e.g. waste water). When the general groundwater levels are known it is possible to infer the approximate drilling depth of a borehole in a given area

## 2.3 ESGUSA WORKPACKAGES

The project is divided into a number of work packages and these are presented below:

### 2.3.1 WP1: Data collection and hydrological field investigations

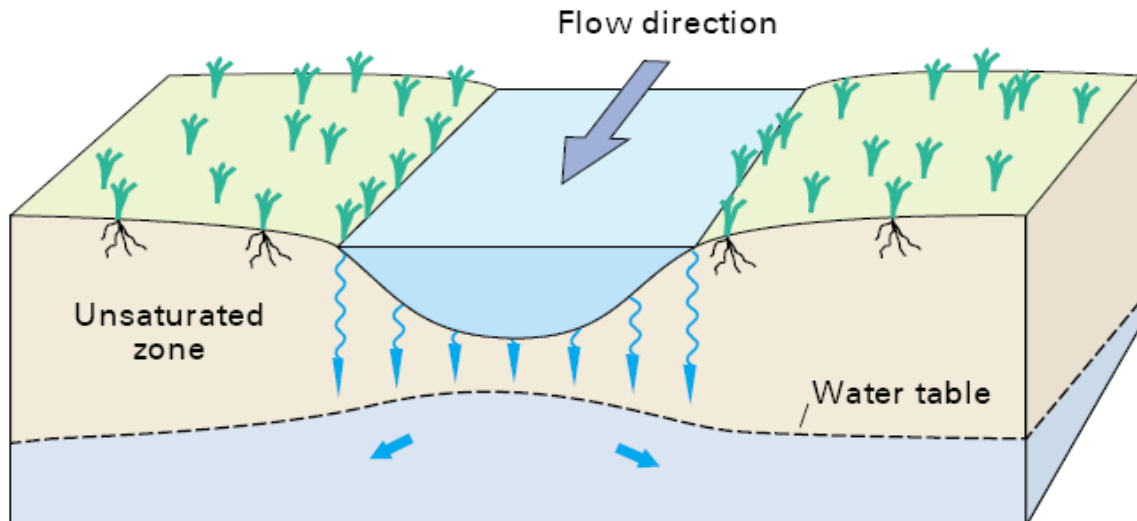


Figure 4: Diagram shows how the river stream contributes to the groundwater recharge in the Hout catchment (Source: Winter et al. 1998)

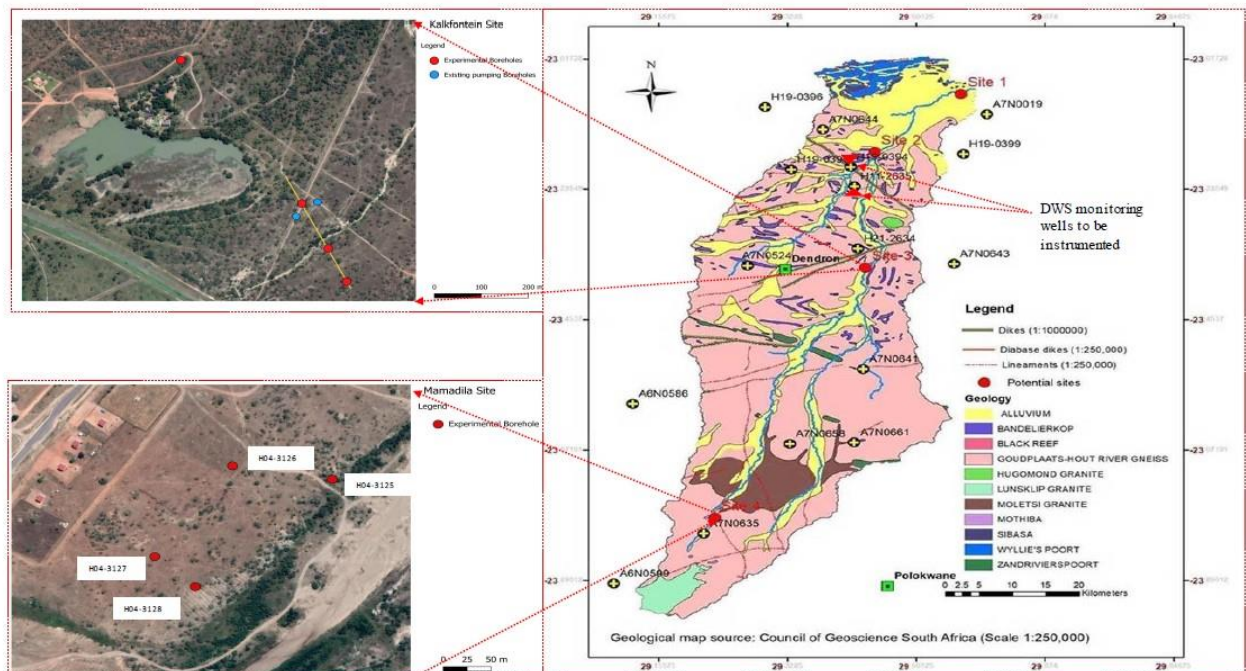


Figure 5: Map shows four borehole that have been drilled in Mmamdila village(upper catchment) and prioritized boreholes to be equipped with data loggers for monitoring in section2.

There is evidence of episodic recharge events depicted on the chart below as well as evidence of two wells from the upper section of the Mogalakwena River, co-inciding with daily flows and groundwater level rises

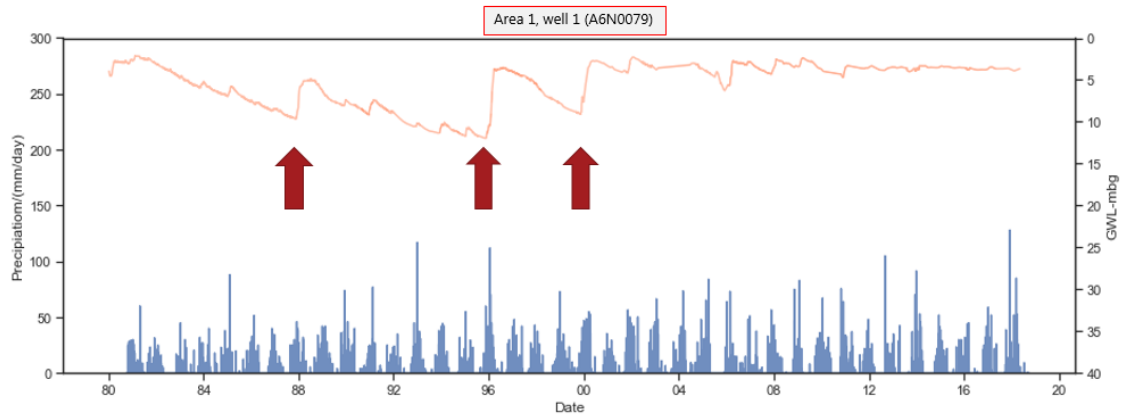
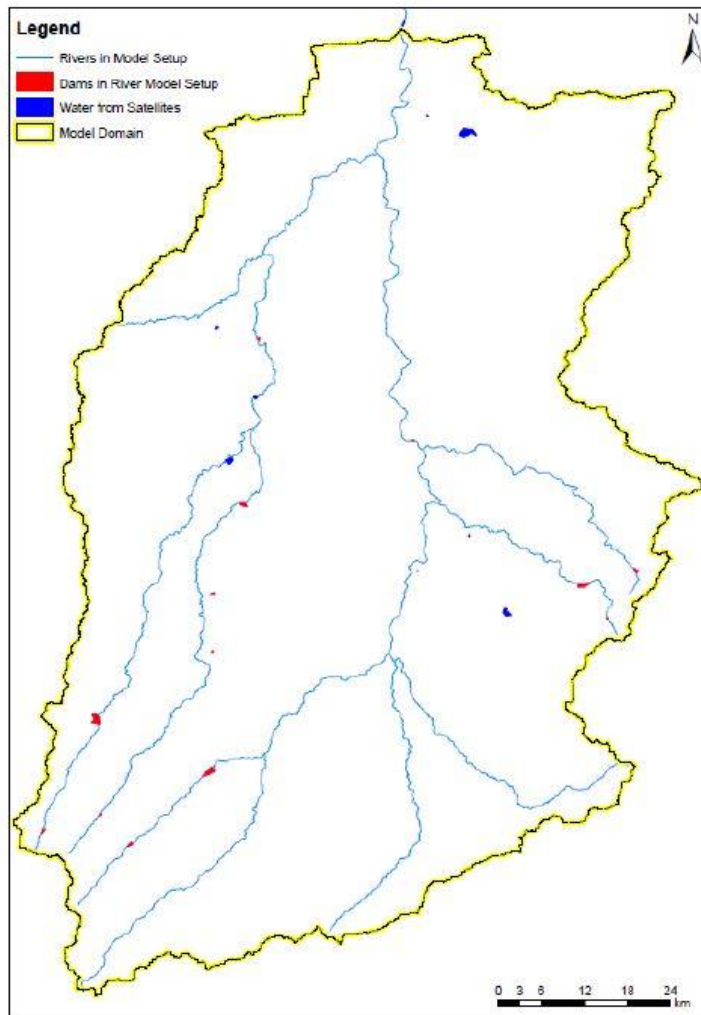


Figure 6: Graph showing episodic rainfall and recharge responses in Mogalakwena River.

### 2.3.2 WP 2 is an integrated hydrological model for the Hout Catchment

This shows sentinel two satellite information and multi-spectral optical imagery. There is a remote sensing derived index that relates to open water. This is the NDWI (normalized difference water index). The spatial resolution is 20 m. The image below shows the satellite identification of farm dams



*Figure 7: Image showing satellite identification of farm dams in the Hout catchment.*

The data hungry model is a MIKE-SHE model depicted in the diagram below

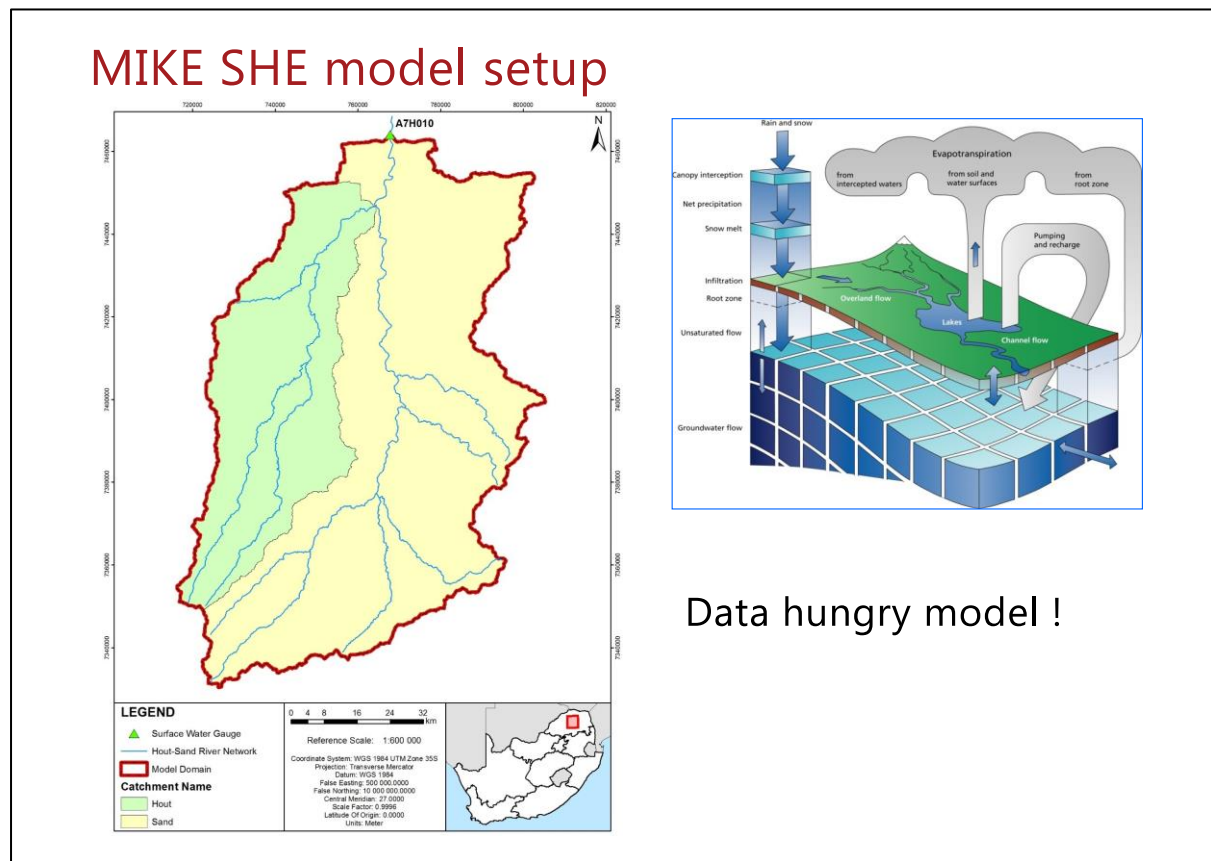


Figure 8: Diagram illustrates visuals from the Mike-She model of the Hout and the Sand Catchment.

### 3. Introduction to Citizen Science (CS): implementation in the Hout and progress to date (Prof Jaqui Goldin, University of the Western Cape)

WP 3 promotes Citizen Science. The aim is to involve volunteers in the collection of reliable and valid data. CS projects have a genuine science outcome. For example, answering a research question or informing conservation action, management decisions or environmental policy.

It was a milestone when “citizen science” appeared in the Oxford English Dictionary in 2014 and was defined as “the collection and analysis of data relating to the natural world by

members of the general public, typically as part of a collaborative project with professional scientists.” The following points are relevant:

- Citizen Science is NOT science about Citizens
- It is not a science that takes place in a laboratory
- It is **real** science done by everyday people

It provides the potential for developing new ways to collectively solve big problems and can fundamentally change the relationship between science and society. It is an approach whereby non-scientists are actively involved – to differing degrees in the generation of new scientific knowledge.

CS programs benefit in many ways from working with volunteers. CS programs work to incorporate the “lived lives” (namely personal observations and experiences) of volunteers into data collection. Datasets produced by volunteer CS can have reliably high quality, on a par with those produced by technical experts. Most types of bias that might be found in CS datasets are also found in professionally produced datasets and can be accommodated using existing statistical tools.

Monitoring rain water, GW levels and river flows is important for effective management of water for productive uses. Datasets collected for a specific purpose and over a wide area often result in unexpected patterns emerging, that can trigger further more focussed studies to improve water resource management. When monitoring for unusual, or declining phenomena, the scale of a large number of CS over a large area increases rates of detection instead of relying only on a few monitoring boreholes owned by DWS in the catchment. Volunteers have the task of:

- Monitoring groundwater level
- Monitoring rainfall
- Monitoring if there is water flowing or not in the river
- Monitoring river water level

Data will be collected as follows

- Every 1 – 2 weeks for groundwater level
- Daily for rainfall or lack thereof
- Whenever there is flow in the river
- Recording the river conditions in general (both when dry and after rain)

Volunteers are invited to attend an orientation and field training to learn the standardized protocol on field data collection and on sharing the data.

Progress on CS thus far

- Two workshops with stakeholders have already been held – one in Polokwane (March 2019), one in Makhado (July 2019). Volunteers have been recruited from Section One and Three of the Hout Catchment
- 4 monitoring boreholes have been dug around Mmamadila – drilling took place in August/September – these boreholes are not yet being monitored
- Volunteers have been provided with the following equipment:
  - 8 Bag packs
  - 8 Rain gauges
  - 8 water level meters (dip meters)
  - 8 tape measures
  - 4 cellphones (section one)

Volunteers are sending data once a week and recording daily for rainfall.



Figure 9: Image showing installation of rain gauge in Mr Ledwaba's home, Manyapje Village.



Figure 10: Image showing Dr Manuel Magombeyi providing rainfall reading training to our volunteer Mr Jack Ledwaba.

Training has been completed in Section 1 and 3 in the following villages:

- Ga-Manamela
- Ditengteng
- Ga-Moeti
- Manyapje
- Buysdorp

Volunteers signed a memorandum of agreement (see ANNEX 3) covering the following points:

- I agree to undertake the Citizen Science Volunteer monitoring role as given below
- I agree to monitor on a weekly basis - or on daily basis if there is heavy rainfall or significant river flow
- I agree to monitor from May 2019 to end of May 2020, subject to possible extension
- I agree to keep the equipment handed over to me in good shape and report any irregularities to my Supervisor
- I agree to ensure airtime on the cell phone for the purpose of uploading monitoring data
- I agree to secure airtime on my cell phone
- I understand that my duties are to cooperate with my Supervisor and other Citizen Science Volunteers in my team
- I agree to regularly report to my Local Chief and Local Counsellor

### 3.1 Emerging challenges and questions pertinent when recruiting Citizen Scientists include;

- Are there enough boreholes in my ward?
- Do people know where the boreholes are?
- Are the boreholes in good condition?
- How can I get more involved?
- Do I want to get more involved?
- What is it you would like to know?
- Would you share this with others?
- How do you collect what you need?

- Why should I do it – I am not getting paid?
- Why should I collect data for others – what's in it for me?
- What will they do with the data that will help me in the end?
- Who will (should) do the collecting?
- Who are we collecting for?
- What data are we expected to collect?
- What happens if a gauge breaks – who will fix it?
- How often am I expected to collect this data?
- Where to from here?
- Are we asking too much?
  - Task too difficult
  - Too frequently
  - Too complex
  - Too far
  - Not enough training

#### 4. Introduction to monitoring tools and volunteer tasks in applied Citizen Science (Dr Manuel Magombeyi, International Water Management Institute)

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Water is essential for human survival and well-being and important to many sectors of the economy. However, resources are unevenly distributed in space and time, and they are under pressure due to human activity. Pressures on water resources are increasing mainly as a result of human activity – namely urbanisation, population growth, increased living standards, growing competition for water, and pollution.

These are aggravated by climate change and variations in natural conditions. More and more, officials are evaluating water quantity and quality together, and coordinating management efforts across borders. It is important to consider how water resources be managed sustainably while meeting an ever increasing demand?

#### 4.1 Emerging challenges and knowledge gaps

- Is there information sharing between upstream and downstream farmers?
- Who do you go to if you have water concerns in the village?
- What incentive would a farmer have to collect data?
- Data not being shared within DWS
- Why should data be collected?
- An individual is likely to ask a very logical question: what is there in it for me?
- Who should collect the data?
- It is important to know what power is necessary – if twice the amount of power is used the pump would have a shorter lifespan
- Follow protocol of licensing and of monitoring
- If volunteers are to be collecting data they need to be carefully introduced to people in the area so that everyone is clear about their role and why they are measuring data at a particular site
- For a person to drill deeper than 80 meters a special license is required
- The borehole is owned by DWS (and not by the individual – even if individual has drilled it)
- Placement of a borehole depends on the hydrogeological conditions (can't have just a pump test on its own – it needs to fit into the ground water system as a whole)

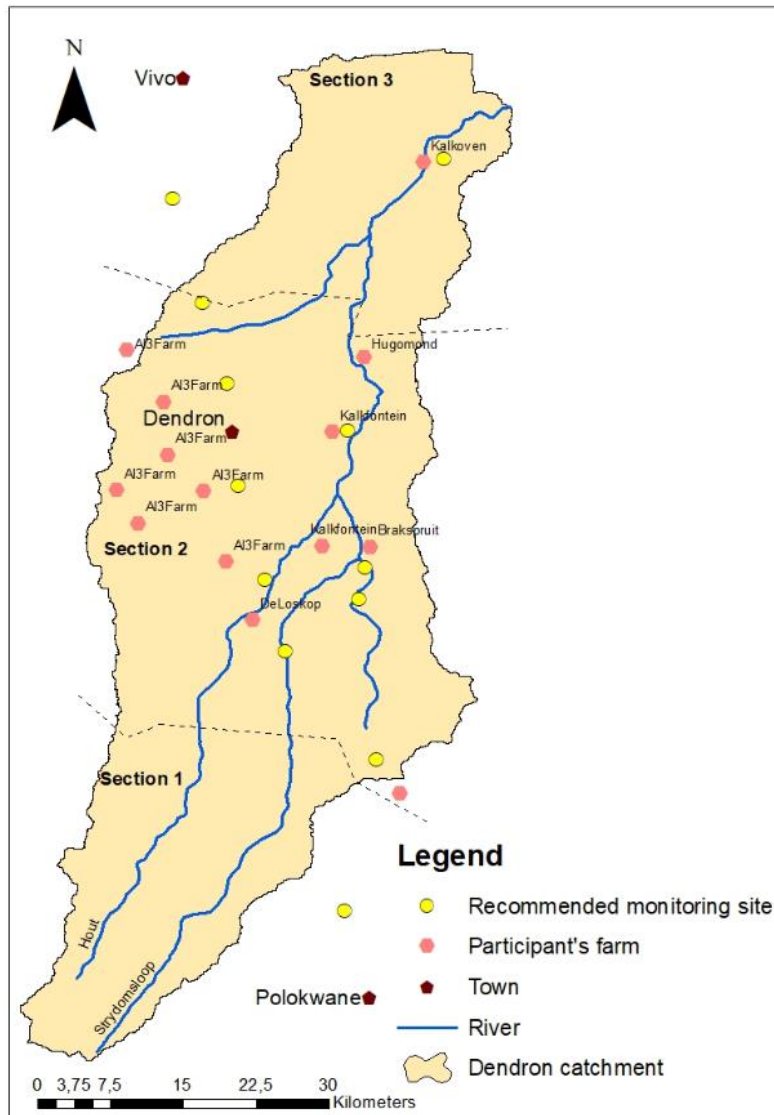


Figure 11: Showing potential recommended sites for water resource monitoring in section 2 which is mostly a commercial farming zone.

Mr Grobber (a local commercial farmer and certified borehole driller since 1969) with extensive experience in drilling boreholes in the Hout Catchment presented invaluable information to the participants. Mr Ste

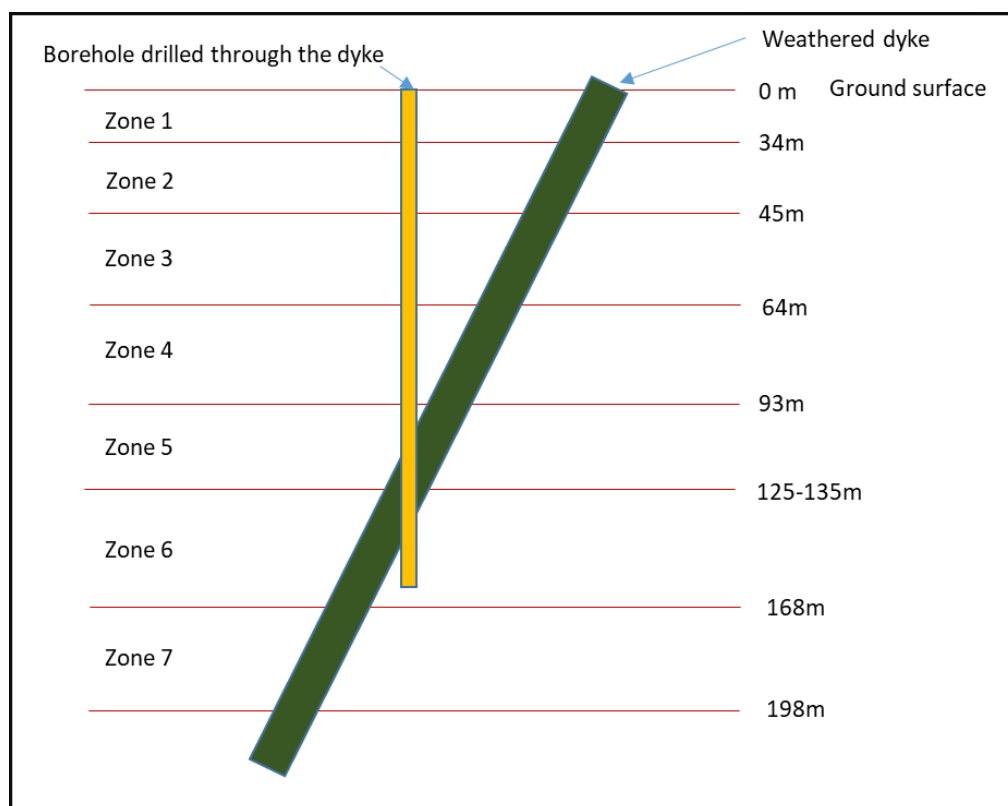
**Recharge in the Hout catchment:** He indicated that sometimes calcrete seals the soil surface and reduce recharge potential

**Dike and geology:** Valklip to Vivo areas the dykes dip to the north, while areas around Buysdorp the dikes dip to the south. The dikes dip  $67^{\circ}$  to south and  $84^{\circ}$  to the north. From his experience and analysis in Hout he noted that using the traditional methods of copper wire

to prospect for groundwater gives a 16% chance of getting water, while with geophysics instruments there is 56% chance. When drilling in the Hout catchment, he has also noted that the presence of irregular and flaky shaped drill chips, indicate there is no water, while square or rectangular shaped drill chips indicate the presence of water.

### **Weathered zones from where groundwater is pumped:**

Generalized zones (1-7) from where different boreholes are tapping groundwater in the Hout catchment is shown in Figure 1 (personal communication with Mr Grobller). The drilled boreholes in different areas can intercept the water holding weathered dyke at different depths in the catchment.



*Figure 12: Typical weathered zones in the Hout catchment (Mr Grobller, 2019, per communications)*

Mr Grobller also advised that he normally drills boreholes to a maximum of 200m if the water strikes are 190-193m to allow for a huge sump area. In case the initial installed pump falls into the borehole he can still put another pump into the same borehole. Hence, it is prudent to always give allowance of about 7-10m below the final water strike in case the pump drops into the borehole, despite the safety rope that should be always used to hold the pump.

**River and groundwater availability:** Mr Grobblers' insights were confirmed by other farmers in the meeting and there was a general discussion amongst the farmers about monitoring groundwater data. The farmers were enthusiastic about the possibility of participating in the project as volunteers and collecting data. They noted that the eastern side of the Sand River has more groundwater, while the western side of the river has generally no groundwater.

**Recommended monitoring sites in the Hout catchment under CS project:** Recommended sites for monitoring in the Hout under CS are presented in Figure 1. These sites were recommended based on the objective to capture groundwater levels from the extensive pumping in these sites and the need to monitor different weathered zones at different depths in the Hout. However, access to each of the recommended sites by the ESGUSA researchers should be arranged with the individual farmer concerned.

**Sustainability groundwater pumping:** Mr Grobblers indicated that as a rule of thumb he pumps about half the calculated yield for his boreholes and he encourages every farmer to do the same to avoid excessive groundwater depletion. He indicated that at his farm he has reduced pumping to 2500-3000 m<sup>3</sup>/day for each borehole. This has resulted in the pumping volume being reduced from 60000m<sup>3</sup>/day to 30000m<sup>3</sup>/day for an average borehole. This approach ensures that the groundwater is not over abstracted.



*Photo: Mr Klaas Grobblers discussing the water strikes in the Hout catchment from his experience from drilling boreholes in the Hout since 1969. (Photo: Manuel Magombeyi, IWMI 2019)*

## 5. Role and engagement of SC volunteers in Hout (Mr Resego Mokomela, IWMI)

A Volunteer/Citizen Scientist is an individual who voluntarily contributes his or her time, effort, and resources toward some scientific research in collaboration with professional scientists or alone which will benefit the community and him in the long term.

These individuals do not necessarily need to have a formal science background.

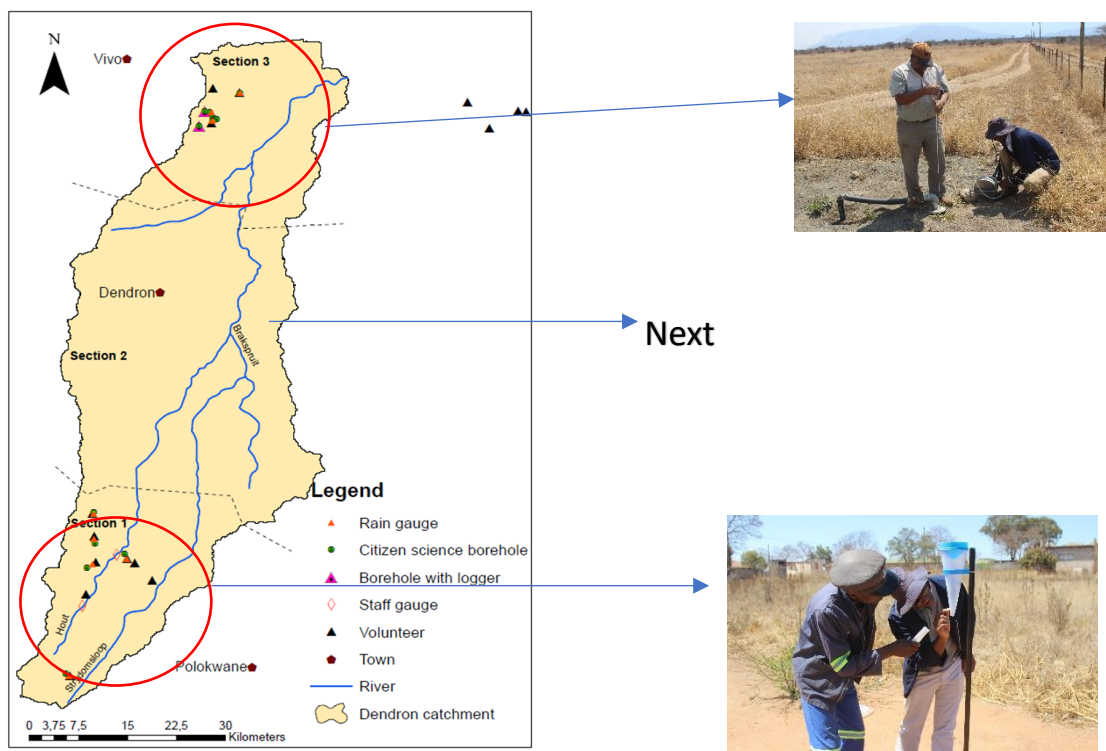


Figure 13: Map Showing the distribution of volunteers in section 1 and 2 of the Hout catchment

### 5.1 Data interchange for citizen science

Volunteers can share and upload data through a mobile App or Webpage:

[www.citizenscientists.biz](http://www.citizenscientists.biz)

The project team has covered two sections (Section 1 and 3) as indicated in the above figure and the aim is to expand on the CS. Component and engage with volunteers in Section 2, so that the project team and the volunteers can understand the hydrogeology of the catchment better. This can be helpful to both local residents, farmers and the DWS in terms of policy implementation and as a means to provide more accurate information to farmers regarding groundwater.

Below (Figure13) illustrates the general conditions that the volunteers undergo for monitoring water resources within the catchment. Each volunteer undergoes training on how to take measurements and also how to upload the results into our MycitizenScience App.

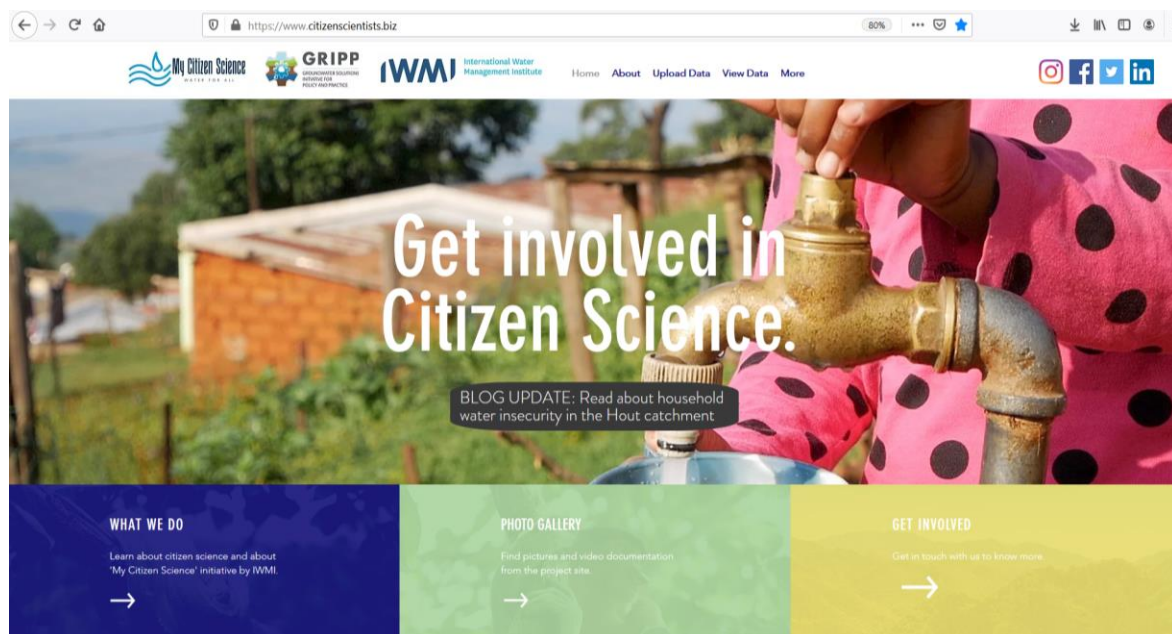


Figure 14: Image showing the homepage of the Mycitizenscience Webpage.

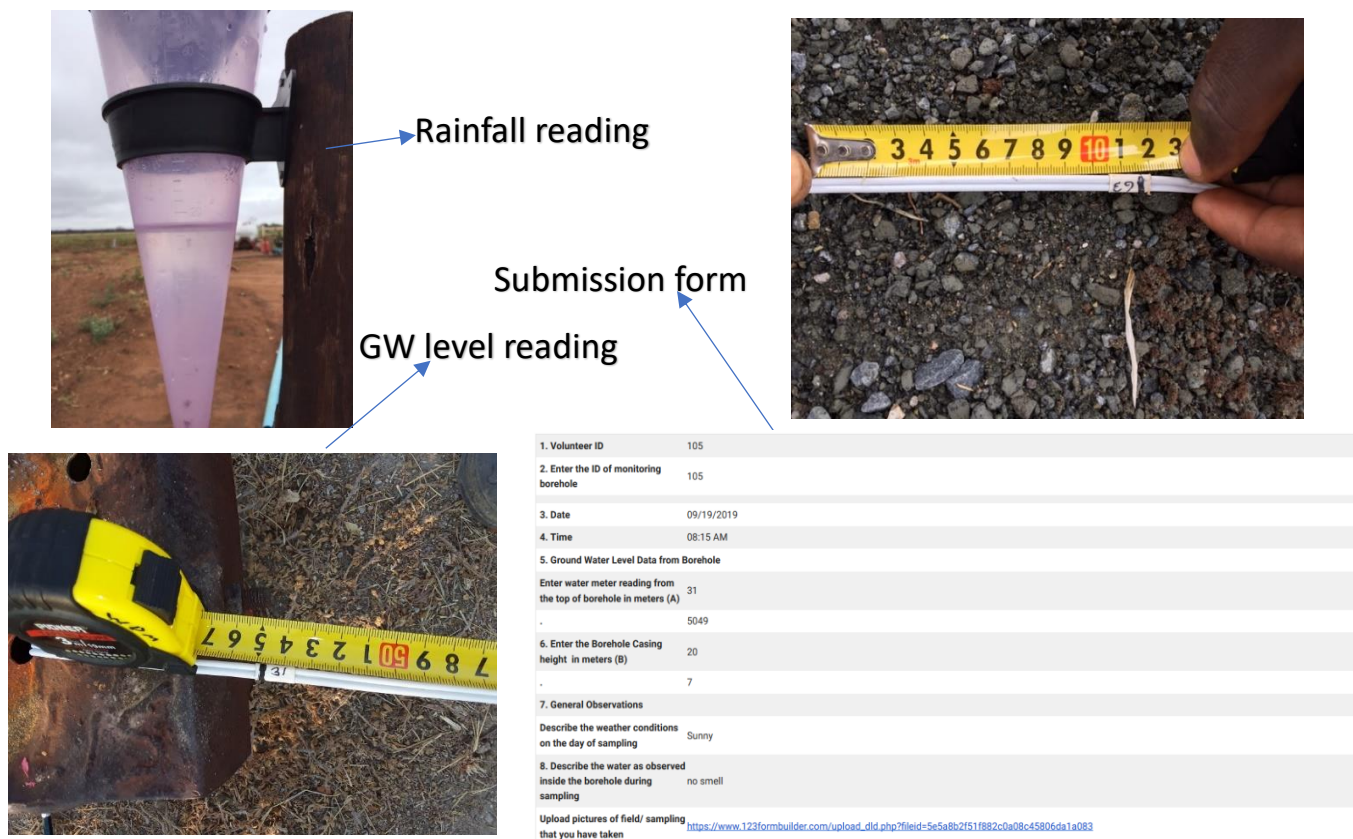


Figure 15: Images illustrates methods on how citizen scientists capture data in the Hout Catchment

## UPLOAD YOUR COLLECTED DATA

You can upload your collected data under four (4) categories by clicking directly on the yellow button or by navigating to the pages separately:

1. **Groundwater level data** as collected from borewells using water level meter;
2. **Rainfall data** as collected from rain gauges;
3. **River flow data** as collected from the river beds.

To know your coordinates, click [Try It](#)

The image above shows the three different categories that the citizen science volunteers are monitoring. Only the volunteers and the ESGUSA team have access and are able to upload data into the system.

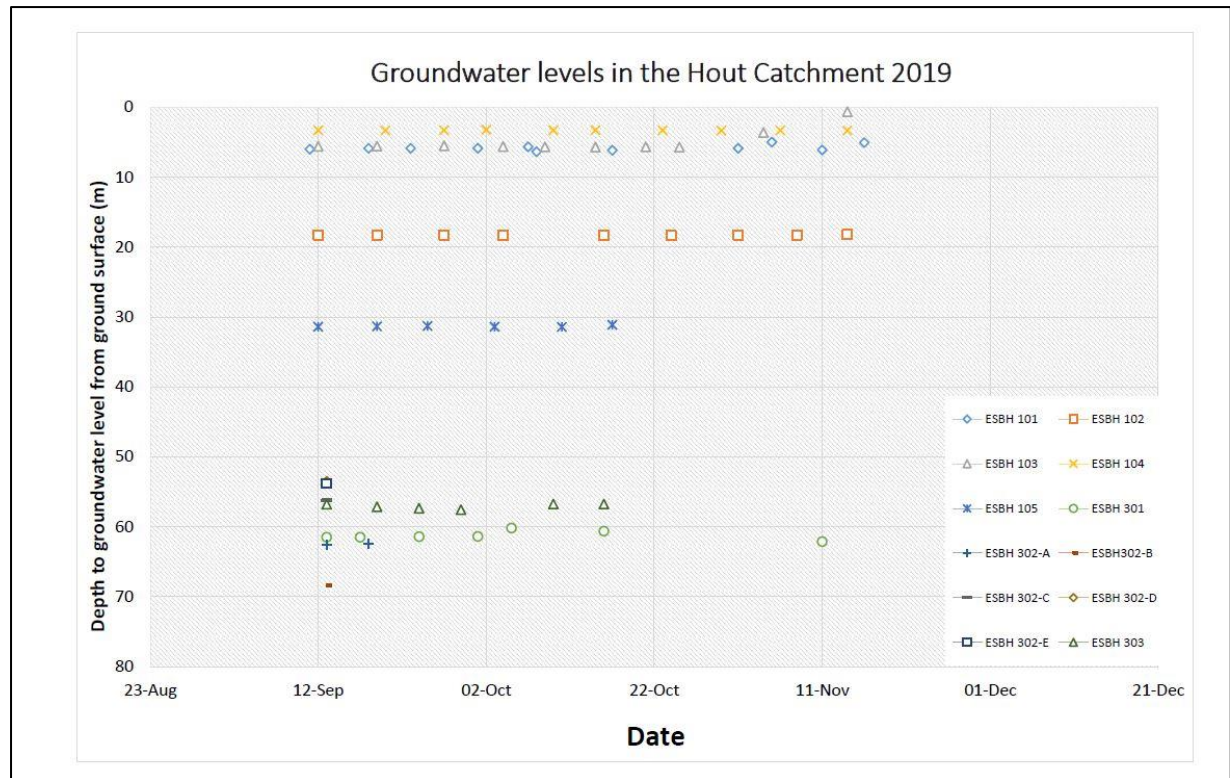


Figure 16: Graph shows results of depth to groundwater levels from all the boreholes that are monitored by the volunteers for months September to November 2019.

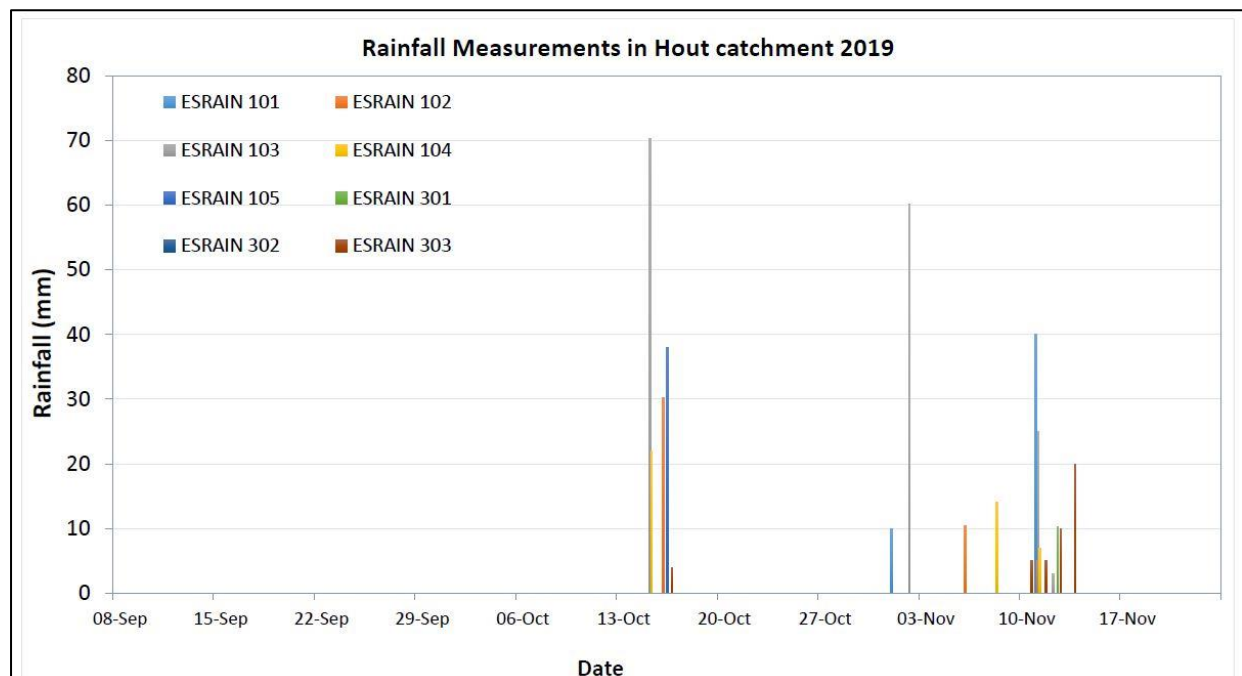


Figure 17: Graph shows results of rainfall measurements that are recorded by the volunteers for months September to November 2019.

The project team will create a database that can be impactful to the farmers and residents in the Hout

- Local communities member can learn the importance and value of water through workshops and training and so that the resource is better protected
- Farmers can make informed decisions based on this information e.g. Drilling a new borehole, buying a farm, hectares of field to irrigate, types of crops, pumping rate etc.

A volunteer qualifies as a CS if the following criteria are met:

- Reside/ have a farm within the Hout-River Catchment or within a radius of 5km out of the catchment
- Have the commitment to work with the team and assist with monitoring once a week
- Have access to one or several boreholes that can be measured (non-pumping or pumping)
- Have a smartphone (android) and be able to download the CS App
- Be willing to learn and engage with other stakeholders
- Be willing to share collected information with communities, farmers and research team

Furthermore, the following applies:

- Ensure that all monitoring equipment given is kept in good working condition
- Ensure that correct measurements are taken at all times
- Ensure honesty in data collection
- Be willing to assist others and guide new volunteers
- Ensure a full understanding of the monitoring process
- Report back weekly to the research team

The ESGUSA team provides the follow equipment (if not already available to the volunteer)

- Rain Gauge
- Groundwater level meter
- Measuring Tape
- Monthly data costs

- Staff gauge (only a few areas)
- Backpack

## Discussions with all stakeholders

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There were a number of important issues raised by the farmers. For instance, one question was why the Hout River was chosen as the site of inquiry for the project. The reason given was that prior to the ESGUSA investigations, the team had conducted some research around Dendron and it was evident from this research that the Hout had been experiencing a water crisis and could run out of groundwater in the future. A better understanding of the Hout could also provide important insights into how to better manage similar issues of water scarcity in other areas of South Africa. Furthermore Dendron is an important zone in terms of farming as it is one of the highest production areas of potato farming and that makes it very important to look at and see how we can continue to have this production despite groundwater stress.

The participants also wished to find out more about the existence and position of dams along the Hout. It became evident from the discussion that there are 'illegal' dams and that these cause problems in terms of river flows and availability of water. The project team indicated that the information they did have was from satellite and remote sensing and that this information is being used for the ESGUSA modelling. However, the research team stressed the importance of tapping into the expertise and knowledge that commercial farmers. This would allow for a better understanding of current usage and availability and to finding out more about the sites where there were dams, thus contributing to a more accurate map of the area and a better understanding of why the Hout River flows were being interrupted. The farmers expressed their willingness to contribute in this way but also stressed the importance of co-operation from DWS to obtain the most accurate information possible about both registered and deregistered dams in the area.

The team confirmed that the Citizen Science website was there to provide information to farmers and that data would be uploaded regularly (on a monthly basis). The accuracy and frequency of new data was critical to maintain accurate and up to date data on the site. The team reassured participants that although at present data on water quality was not being captured, they were aware of the necessity of capturing – in the future – data quality as well as quantity.

The Department confirmed that it was able to plot both registered and unregistered dams and that they are willing to share this information with the ESGUSA team. This meant that satellite images that were currently being used could be updated. The farmers confirmed that they would like to work together with the research team – especially on issues of groundwater monitoring and finding out more about upstream/downstream concerns.

The research team felt strongly that research should not just ‘sit on a shelf’ but that it must be of use to the farmers and the Department. The adoption of a CS framework is designed to address this issue head on by empowering citizens and providing data that could be shared and be made useful so that existing gaps in knowledge about important water concerns in the Hout could be addressed. This project is to provide a baseline where useful and available data can be used as a baseline and built on in the years to come. The project aims to address frustrations that farmers have had in the past – where they give data – and often the same data over and over again – but nothing comes of it. They would like to participate in this project as it seems to be offering something new and is inviting farmers to participate in something that will, in the short and long run, be of use to them. Data can contribute to better knowledge management and an empowered community of farmers. Trust is critical so that all the stakeholders in the catchment are linked and can continue to be linked and share information once the project has come to an end. Trust is needed between farmer groups in different sections, between farmers in the same section and between farmers, the research team, the Department and other stakeholders (such as counsellors, private sector, tribal chiefs) etc. who are concerned about water resources management, use and protection in the Hout.

One of the questions that was asked by the farmer community was why ground water levels have been lowering since 1960. The research team believe that this is because there is more pumping in the area and less recharge – farmers are now mining the water that has been there for years and years and this is now affecting the groundwater table. There was some discussion around this as one of the farmers voiced his concern that the average farmer – 20 to 30 years ago – took most of the water and that stats from DWS show that water is dwindling in the rural areas but that the water table is now stabilizing as farmers have more awareness about water stress and how important it is to look after water. Mr Grobber, for instance, has been monitoring water levels and recovery for all his boreholes (365) on his farm over the past 10 – 12 years. Mr Carel Haupt from WSM Leshika has years and years of experience in monitoring ground water. There is uncertainty however, about the water level

and a concern about how deep the water level has dropped especially after drought – such as the drought that has been experienced over the past 2 – 3 years. However, working with experts such as those identified during this stakeholder workshop in Polokwane, brings hope that the collaboration between the experts working for many years with groundwater issues from various sectors (farmer, private, DWS, research team) will be productive and will allow for the creation of an updated real time groundwater monitoring site.

## Way forward

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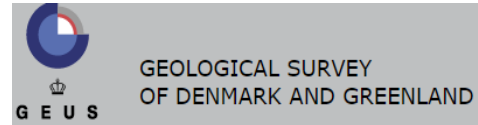
Resego visited **Sections 1 and 3** during the month of December with the purposes of:

- Checking on accuracy of recordings
  - Checking on equipment and its good working condition
  - Training two new volunteers
  - Administering a short follow up questionnaire to tap into perceptions and feelings that the volunteers might have as well as their concerns, experiences, and queries for continued monitoring
  - Making sure that the volunteers include in their tasks visual rendering of the river beds – images to be sent every two weeks when not raining – and when raining weekly images to capture river flows
- 
- Jaqui will follow up with farmers in Section 2 in the New Year
  - The workshop report will be sent to all participant by the beginning of February 2020
  - All contact details of participants to be validated and shared with participants
  - Excel spreadsheet with boreholes and farmer ID's in Section 2 to be completed
  - Workplan for Section 2 to be drawn up in consultation with Chairperson of Farmers Union, DWS and farmers and to be circulated by mid-February
  - Consider how the Water Research Commission (WRC) project that has been awarded to UWC can add value and expand on the CS of this current project

## ANNEX 2 – Workshop Program



Research  
Program on  
Water, Land and  
Ecosystems



water & sanitation  
Department:  
Water and Sanitation  
REPUBLIC OF SOUTH AFRICA



CAPRICORN  
DISTRICT MUNICIPALITY



### 3<sup>rd</sup> Stakeholder Workshop Establishing Citizen Science and Water Monitoring Enhancing Sustainable Groundwater Use in South Africa - ESGUSA



Venue: Bolivia Lodge, Polokwane  
Limpopo, South Africa  
22<sup>nd</sup> November 2019

## BACKGROUND

The Stakeholder Workshop serves to enhance stakeholder collaboration around groundwater and surface water management within and around the Hout River Catchment in Limpopo Province (Figure 1). The ESGUSA project is a Danish-funded research project led by the University of Copenhagen in Denmark together with the University of the Western Cape in South Africa, and IWMI-SA (International Water Management Institute - South Africa). The project will run for two and a half years (starting April, 2018) and addresses the knowledge gaps of aquifer systems, their replenishment and interactions with rivers, wetlands, terrestrial systems, and the management of water resources in Hout Catchment, with the involvement of the local community through Citizen Science. The project seeks to support several sustainable development goals, and particularly “Clean Water and Sanitation”, and contribute to integrated participatory water management in the Hout Catchment.

## OBJECTIVES

The objectives of the ESGUSA project are to:

1. Support sustainable groundwater management in South Africa through effective research partnership with Denmark
2. Improve understanding of hydrogeological processes in typical geological settings in South Africa
3. Develop and calibrate integrated hydrological model(s) for the Hout/Sand catchment, Limpopo Province
4. Involve local stakeholders in the research (Citizen Science)
5. Define sustainable groundwater management schemes based on resource indicators
6. Increase the research and human capacity for groundwater resource assessment and management in South Africa

The objectives of the Stakeholder Workshop are to:

7. Present the ESGUSA project and its objectives
8. Bring stakeholders together around water management in the Hout catchment for consultation and participatory approaches (Citizen Science)
9. Share and discuss scientific and stakeholder knowledge and concerns around water in the catchment
10. Understand current monitoring of water resources in the catchment and gaps
11. Identify scope for Citizen Science and work out practical approaches to involvement of volunteers in water monitoring in Section 2 of the Hout Catchment (see map at the end of this document) with focus on groundwater

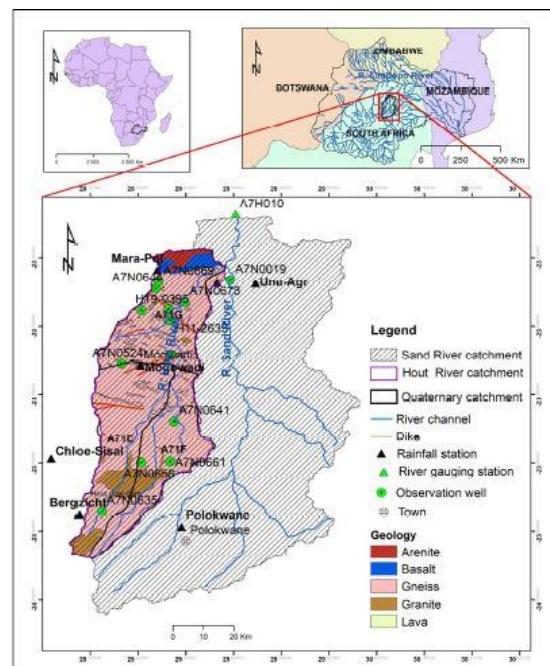


Figure 1: Map of the Hout-River Catchment in the larger Sand River Basin

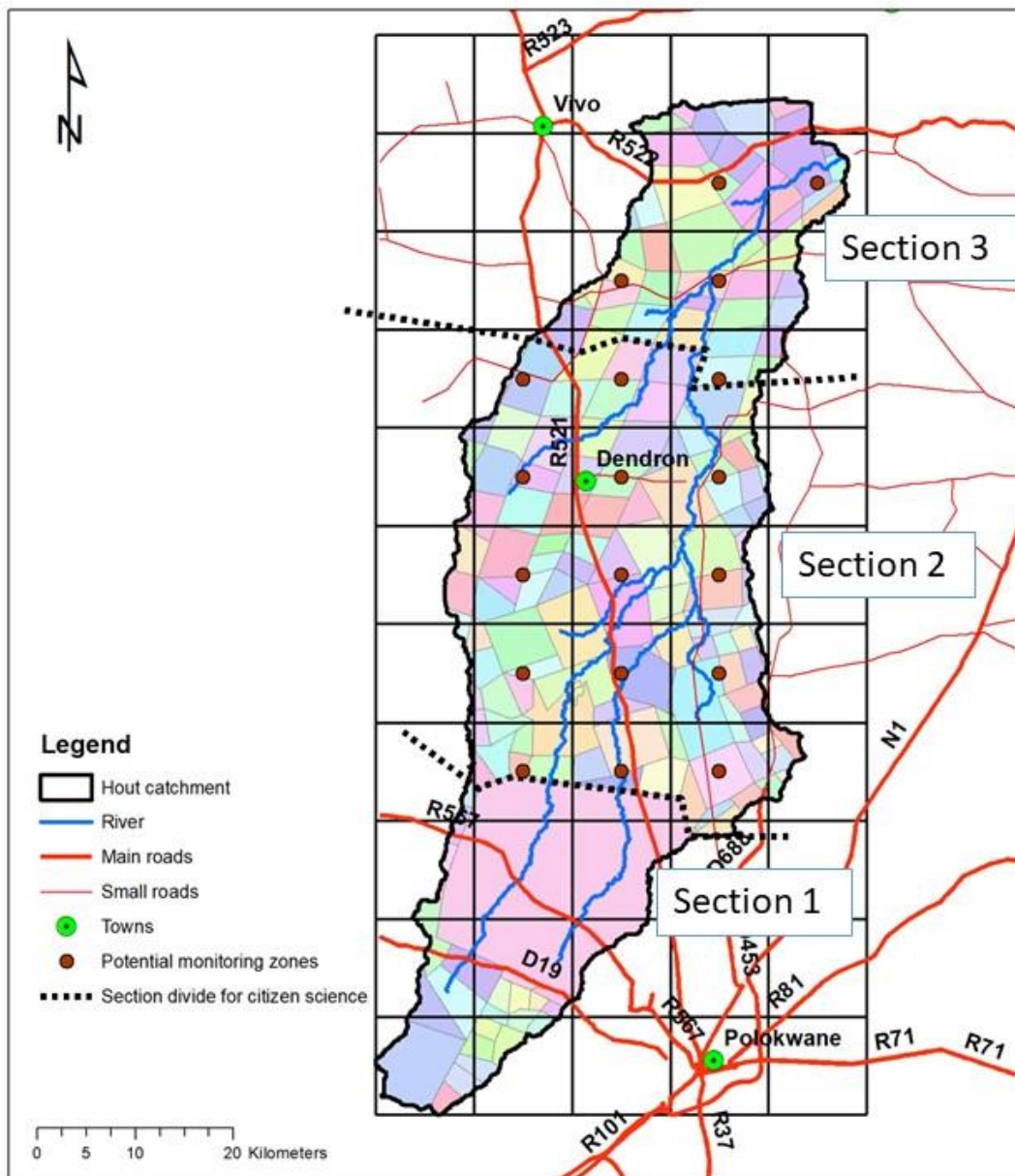
## PROGRAM

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**Friday 22 November 2019**

09:15 – 09:30	<b>Registration</b>
09:30 – 10:00	<b>Opening of the meeting and self-introductions by attendants</b> <ul style="list-style-type: none"><li>- Moderator: Prof Jaqui Goldin, Univ. of the Western Cape</li></ul>
10:00 – 10:15	Introduction and Welcome Remarks <ul style="list-style-type: none"><li>- Mrs Martha Komape, Department of Water and Sanitation</li><li>- Klaas Madisha, Capricorn Municipality</li><li>- Mr Stefan Jacobs, Chairman of the Agricultural Union</li></ul>
10:15 – 10:35	ESGUSA Project: Objectives, Partners, Approaches, and Activities <ul style="list-style-type: none"><li>- Prof Karsten, Univ. of Copenhagen</li></ul>
10:35 – 11:00	Introduction to Citizen Science, Implementation in Hout and progress till Date <ul style="list-style-type: none"><li>- Prof Jaqui Goldin, Univ. of Western Cape</li></ul>
11:00 – 11:20	Introduction to Monitoring Tools and Volunteer Tasks in Applied Citizen Science <ul style="list-style-type: none"><li>- Dr Manuel Magombeyi, IWMI</li></ul>
11:20 – 12:00	Participant Feedback: Current Monitoring Practices and Gaps, facilitated by <ul style="list-style-type: none"><li>- Dr Karen Villholth, IWMI</li></ul>
12:00 – 12:20	Role and Engagement of Citizen Science Volunteers in Hout <ul style="list-style-type: none"><li>- Mr Resego Mokomela, IWMI</li></ul>
12:20 – 13:00	Open Discussion and Enrolment of Volunteers, facilitated by <ul style="list-style-type: none"><li>- Prof Jaqui Goldin, Univ. of the Western Cape</li></ul>
13:00 – 13:30	<b>TEA and packed lunch</b>
13:30 – 15:00	Hands-on Demonstration of Instruments and Monitoring Practice, and Monitoring Manual for Volunteers <ul style="list-style-type: none"><li>- Dr Manuel Magombeyi and Resego Mokomela, IWMI</li></ul>
15:00	<b>Departure</b>

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## Sections for citizen science monitoring in Hout Catchment

### ANNEX 3 – Volunteer Contract

## Enhancing Sustainable Groundwater Use in South Africa ESGUSA

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## Citizen Science Volunteer Agreement

### Background

The ESGUSA project is a Danish-funded research project led by the University of Copenhagen in Denmark together with the University of the Western Cape in South Africa, and IWMI-SA (International Water Management Institute) in South Africa. Other partners include the Geological Survey of Denmark and Greenland (GEUS), EkoSource in South Africa and the Department of Water and Sanitation (DWS) in South Africa. The project runs for 2.5 years (April, 2018 – Sep 2020) and includes research on groundwater, its replenishment and interaction with rivers, wetlands, and terrestrial and human systems. It also involves the local community through Citizen Science. The project seeks to support sustainable water use in the Hout River Catchment.

### This Agreement

This Citizen Science Volunteer Agreement is drawn up between the ESGUSA Project and yourself (*the Citizen Science Volunteer*). It describes the voluntary work that you agree to undertake.

### Your Tasks as a Citizen Science Volunteer

Your role as a Citizen Science Volunteer is to collect data on groundwater and rainfall and possibly river flow in the vicinity of your residence. This information is to be forwarded to the ESGUSA team and Department of Water and Sanitation (DWS) who will use it to inform research on the water conditions in the Hout catchment and to give you information on the water conditions in your area. The aim of the work is to empower you so that you gain knowledge about groundwater and its management. The purpose is also to obtain adequate and accurate data so that groundwater in the catchment can be better protected and managed in the future.

You will be collecting the data entering it into a mobile app called **My Citizen Science**. You will be expected to do this on a weekly basis, and you will receive a reminder when to do this. If there is heavy rainfall or the Hout River is flowing, you will be expected to take daily measurements. You will receive training before you sign this agreement, so you know the details of the tasks expected by you. Training will ensure that you are clear about the project objectives and your role as a volunteer. We undertake that through the training you will be given the necessary skills so that you are able to perform your duties as a volunteer. Each Citizen Science volunteer will be given a special **sim card** with a unique cell phone number for the duration of the project. However, a volunteer can use their existing number which the project can recharge on a monthly basis if terms are agreed.

### Support and Supervision

- A Supervisor from the ESGUSA team will be allocated to you (see info below), whom you can call should you have any problems in performing your tasks
- The Supervisor will be in contact with you on a regular basis and should issues or changes in tasks arise
- The ESGUSA Team will reimburse the following expenses incurred by you in doing your voluntary work in accordance with the procedures set out in the training guidelines:
  - Airtime or data costs to support the transfer of collected data via the **My Citizen Science app**, according to receipt and max 150 Rand /month.

### Roles and responsibilities

By signing this contract, you accept to fulfil the role of Citizen Science Volunteer to monitor water-related data in your area according to the procedures described during the training and in the training

material provided and any subsequent follow-up instructions. You undertake to take care of all equipment handed over in your possession to fulfil your tasks, such as dip-meter, rain gauge and cell phone. You therefore, in signing this agreement, acknowledge that the equipment will be your full responsibility and will not be used by any person except yourself. You will report any problems with the equipment immediately to your Supervisor. Also, you will ensure that you have sufficient airtime to enable the uploading of the monitoring data. You can discontinue your role as Citizen Science Volunteer and terminate this contract with one month notice by contacting your Supervisor. The ESGUSA Team also holds full right to terminate the contract without notice, if the agreement is breached.

Thank you for volunteering and accepting the tasks. We would like to express our sincere appreciation of your volunteering role and the potential this creates to develop grassroots experience with water resources monitoring and management in the Hout Catchment. We believe the information and participatory processes developed as part of the ESGUSA Project will inform policy and improve the management and conservation of groundwater for the catchment and for future generations.

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**Citizen Science Volunteer information:**

Full Name: .....  
ID Number: .....  
Street address: .....  
.....  
Postal Code: .....  
Cell no: .....  
Email: .....  
Citizen Science Volunteer ID: .....  
Citizen Science Volunteer Cell phone number:.....

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**Citizen Science Volunteer consent and signature:**

- ☐ I agree to undertake the Citizen Science Volunteer monitoring role as given below
- ☐ I agree to monitor on a weekly basis - or on daily basis if there is heavy rainfall or significant river flow
- ☐ I agree to monitor from August 2019 to end July 2020, subject to possible extension
- ☐ I agree to keep the equipment handed over to me in good shape and report any irregularities to my Supervisor
- ☐ I agree to ensure airtime on the cell phone for the purpose of uploading monitoring data
- ☐ I agree to secure airtime on my cell phone
- ☐ I understand that my duties are to cooperate with my Supervisor and other Citizen Science Volunteers in my team
- ☐ I agree to regularly report to my Local Chief and Local Counsellor

**Well(s)** (unique ID) to be monitored: .....  
**Rain gauge** (unique ID) to be monitored: .....  
**River site** (unique ID) to be monitored: .....

Name: .....  
Signed: .....  
Date: .....

+++++

**Counterpart information and signature:**

ESGUSA Supervisor name:.....  
Cell no: .....  
Email: .....  
ESGUSA Supervisor signature:.....  
Date: .....

ESGUSA Project Leader name: .....  
ESGUSA Project Leader signature: .....  
Date: .....

## ANNEX 4 – Evaluation Form

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**Establishment of Citizen Science and Water Monitoring - EVALUATION FORM**  
**Bolivia Lodge, 22 November 2019**

Your comments will help improve the manner in which we conduct our workshop interventions in the future. Please take a couple of minutes to complete this evaluation form. Thanks for the contribution.

*(For internal use only)*

- 1) Rate the one-day Stakeholder Workshop by ticking/circling one option below for each aspect

Please rate	1 = poor	2/3 = average	4= good	5 = excellent	
On-screen presentation	1	2	3	4	5
Speaker’s subject knowledge	1	2	3	4	5
Session length	1	2	3	4	5
Hands-on data session(Equipment Demonstration)	1	2	3	4	5
Speakers interaction with participants	1	2	3	4	5
Value of information presented	1	2	3	4	5
Value of discussion sessions	1	2	3	4	5
Overall session evaluation/were all your expectations met?	1	2	3	4	5
Would you recommend a stakeholder engagement such as this one to others??	1	2	3	4	5

Please give any comments, suggestions, on your experience of the workshop:

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2) How will the information that you have gained at this workshop aid you in your work?

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3) Any additional comments (e.g. what should be done differently next time?):

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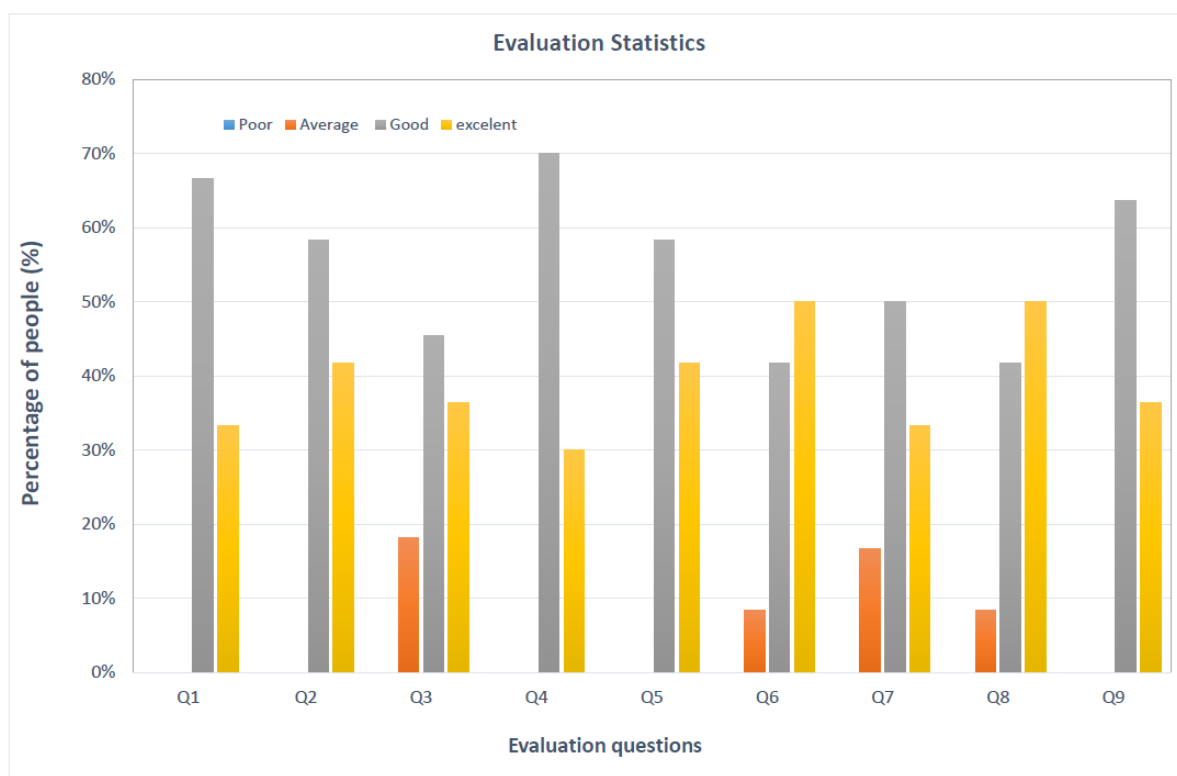


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Thank you!!

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## ANNEX 5 – Farmers committed to Citizen Science

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Farmers committed to Citizen Science Project