WRC Project nr K5/1778//4

Awareness creation, implementation plans and guidelines for management of sustainable on-farm and on-scheme water measurement

Results of the survey amongst irrigation organisations

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A Survey amongst irrigation organisations

A1 Introduction

One of the aims of the Water Research Commission (WRC) project nr K5/1778//4 *Awareness creation, implementation plans and guidelines for management of sustainable on-farm and on-scheme water measurement* was to interact with stakeholders to "determine the current status and to synthesise the available knowledge on water measurement in practice at irrigation scheme level on a national basis with an appropriate survey technique".

A questionnaire was developed in order to collect this baseline information on the current status, and to collect data for the analysis phase to determine the needs of the users. The questionnaire was sent out to 297 WUAs and IBs, from all 19 WMAs. The questionnaire covered the following sections:

1. Irrigation organisation
2. Water source/s from which the water users have irrigation water rights:
3. Quotas and scheduled areas (per source per water year)
4. Water control infrastructure – Dam, river, canal and pipeline schemes
5. Water control infrastructure – Groundwater schemes
6. Water control infrastructure – On-farm dams
7. Water quality
8. WUA management

A total of 73 completed questionnaires were received. The data were collected electronically by e-mail as far as possible, while mailed and faxed submissions were also received.

The data were captured into an Excel spreadsheet for analysis, and the results are presented graphically below.

A2 Results

A2.1 Responses

Responses were received on the understanding that the confidentiality of the Irrigation Organisations (IOs) would be maintained: IOs would not be named nor would responses be linked directly to any particular IO. 73 of the 297 IOs that were contacted submitted responses to the questionnaire survey. Of these, the majority were IBs, followed by Water User Associations (WUAs), as shown in Figure 1.

It is important to note, however, that the majority of irrigation water users do not belong to *any* IO, and are administrated by DWAF ROs. These irrigation water users were not included and are not covered by this questionnaire.

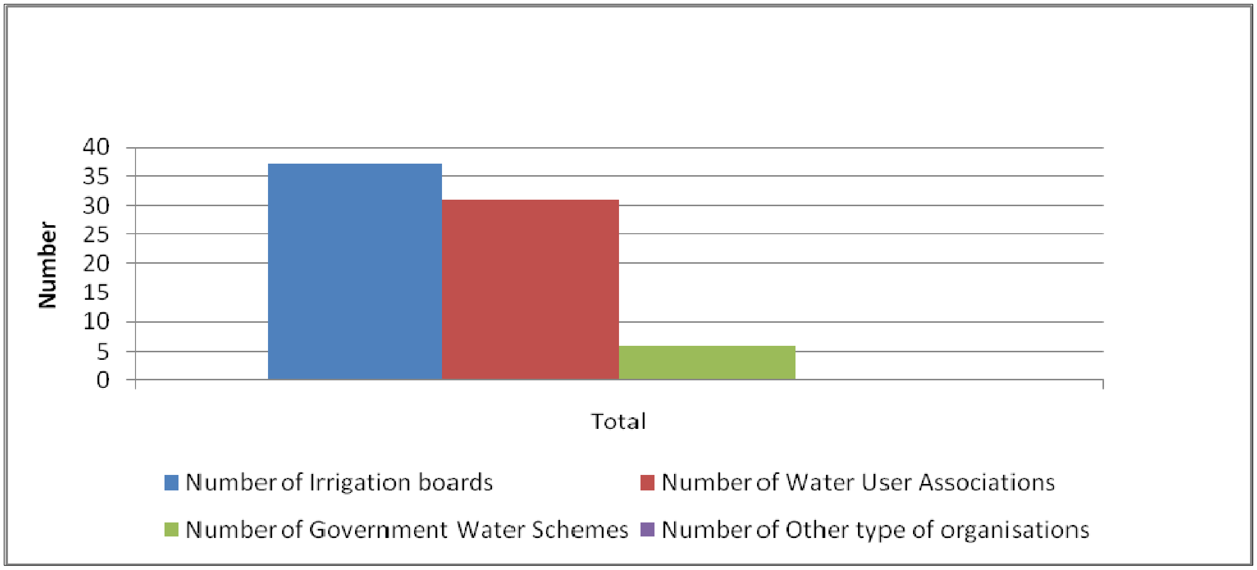

Figure 1: Organisation types that took part in the survey

Organisations from across all nine provinces responded to the questionnaire. The most (>20) responses per province were received from the Western Cape (possibly due to the high number of small schemes in this Province) whilst fewest (<5) responses were received from KwaZulu Natal, Free State and Gauteng Province. The majority of provinces returned between 5 and 15 questionnaires, as shown in Figure 2.

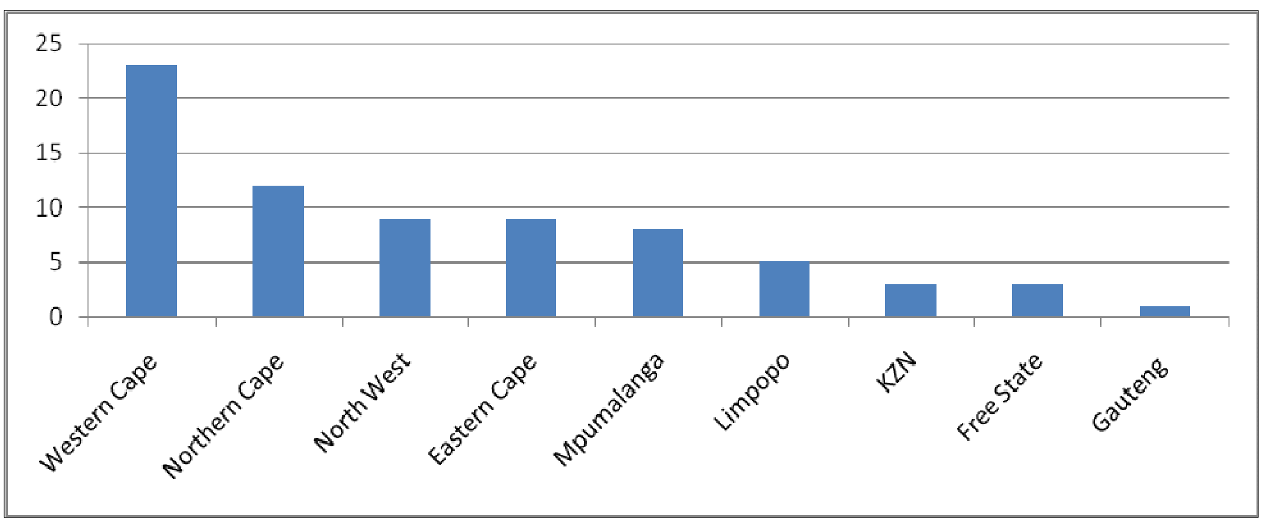

Figure 2: Number of organisations that responded per province

Questionnaires were received from IOs in 15 out of 19 WMAs, as shown in Figure 3. The high number of responses received from the Breede WMA was due to the large number of small IBs in that WMA.

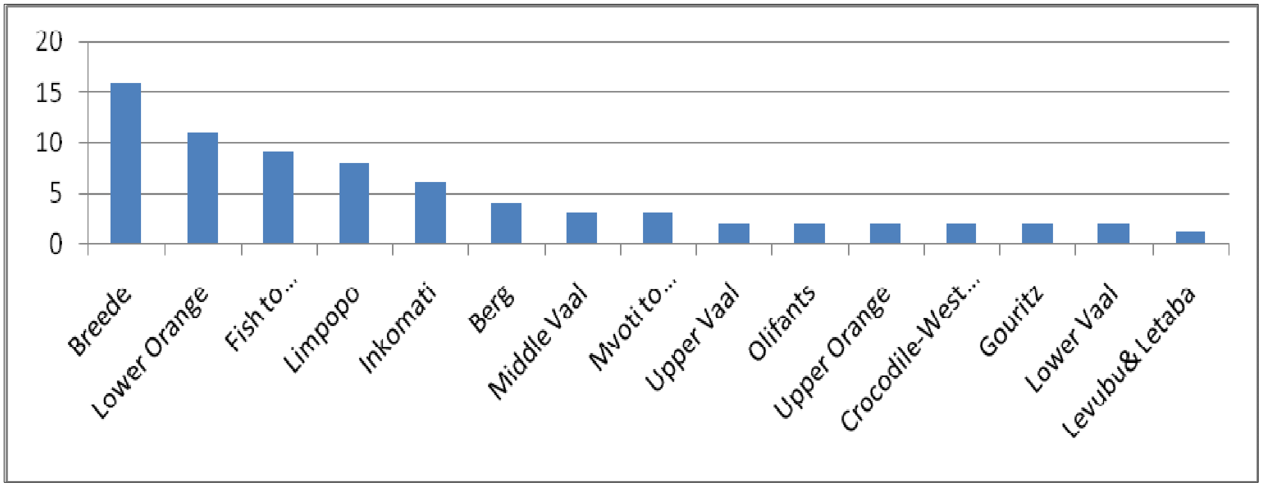

Figure 3: Responses per WMA

A2.3 About the irrigation water use organisations

Figure 4 shows that IOs are by far the dominant type of management authority of water sources across all water source types for the responding organisations.

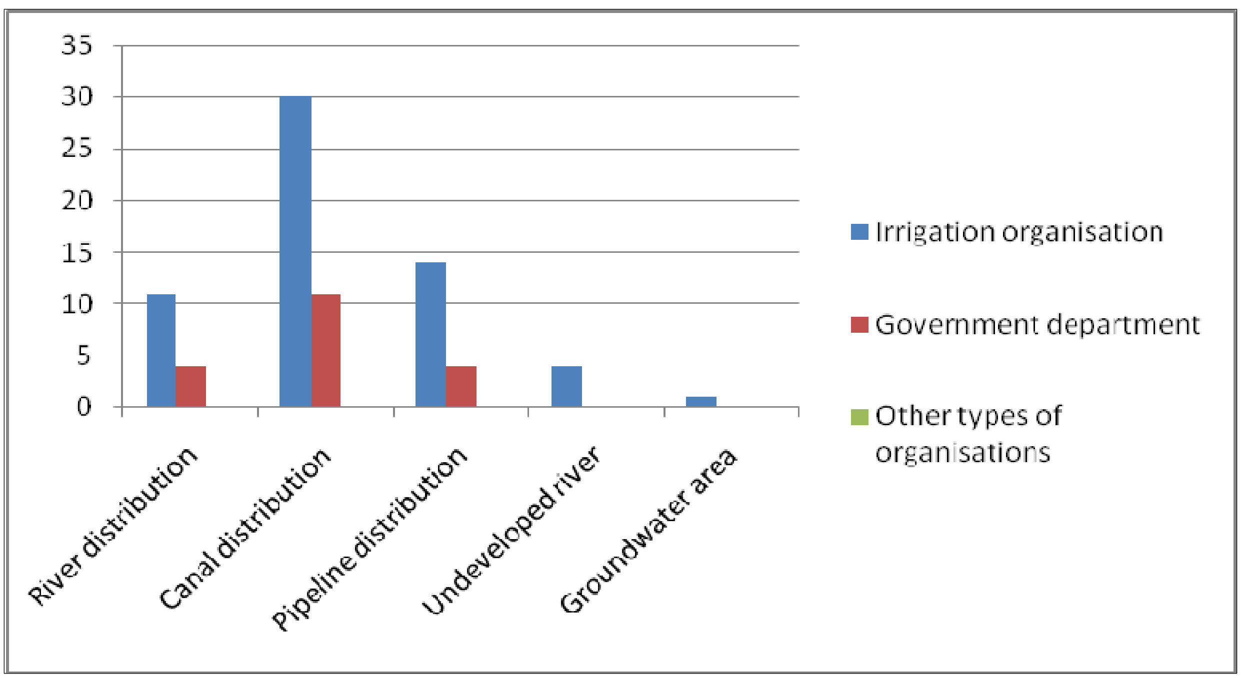

Figure 4: Management authority of water source

Figure 5 shows that the number of water users per IO ranged from almost 1000 to only 4.

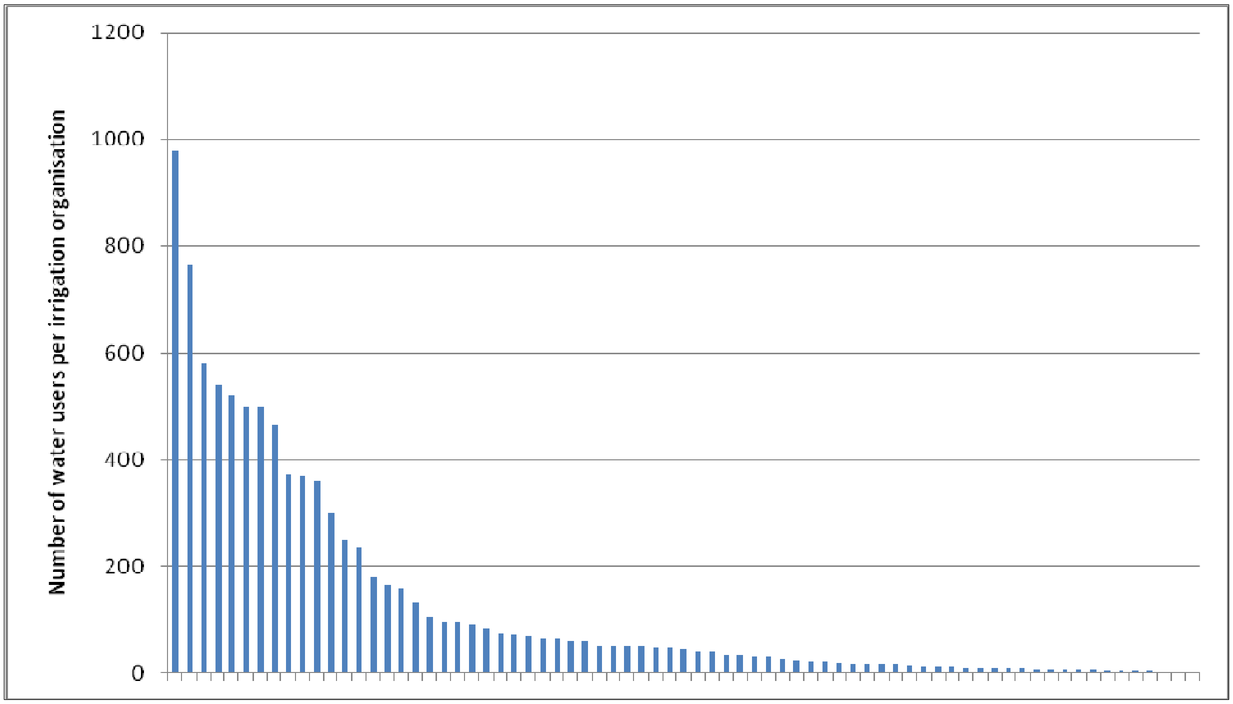

Figure 5: Number of water users per organization

A2.3 Water distribution systems

This section of the questionnare aimed to find out more about the water distribution systems by which the IOs distribute water to the water users. (An IO may use more than one type of distribution system.)

Responses covered the whole spectrum of situations found in the field. Figure 6 demonstrates the variety of situations encountered for which measurement solutions must be found. 41 respondents reported that they distribute water via canals. IOs who use pipelines numbered 17, whilst 15 used rivers. Only five IOs used undeveloped rivers, whilst two respondents represented groundwater areas and only one IO reported on-farm dams as the main source of irrigation water.

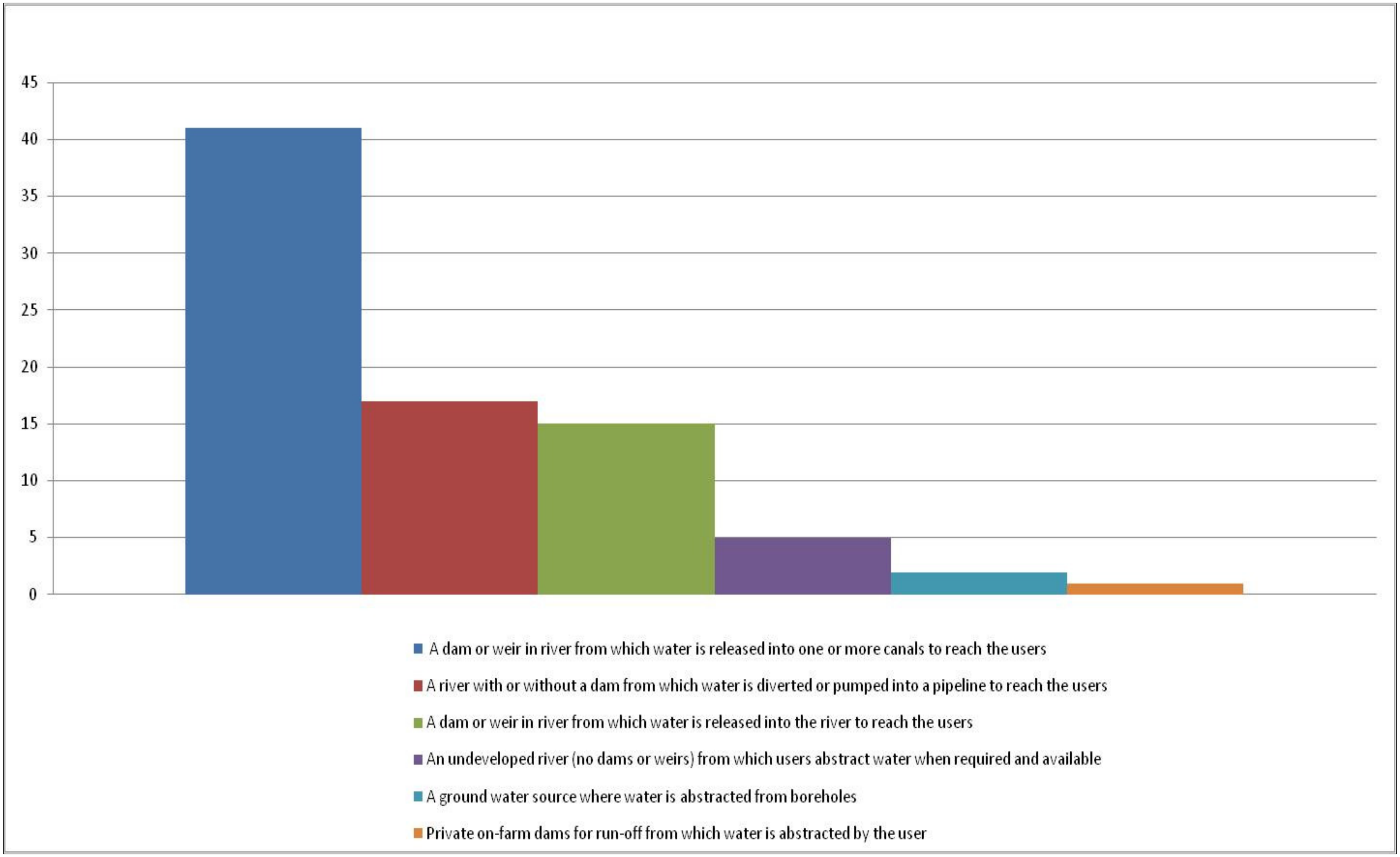

Figure 6: Water supply infrastructure used by respondents.

Of the 41 IOS using canal distribution systems, the majority (30) reported that the canals were lined, as shown in Figure 7. This is a good response in terms of WUE considerations. Only four in this group are using unlined canals.

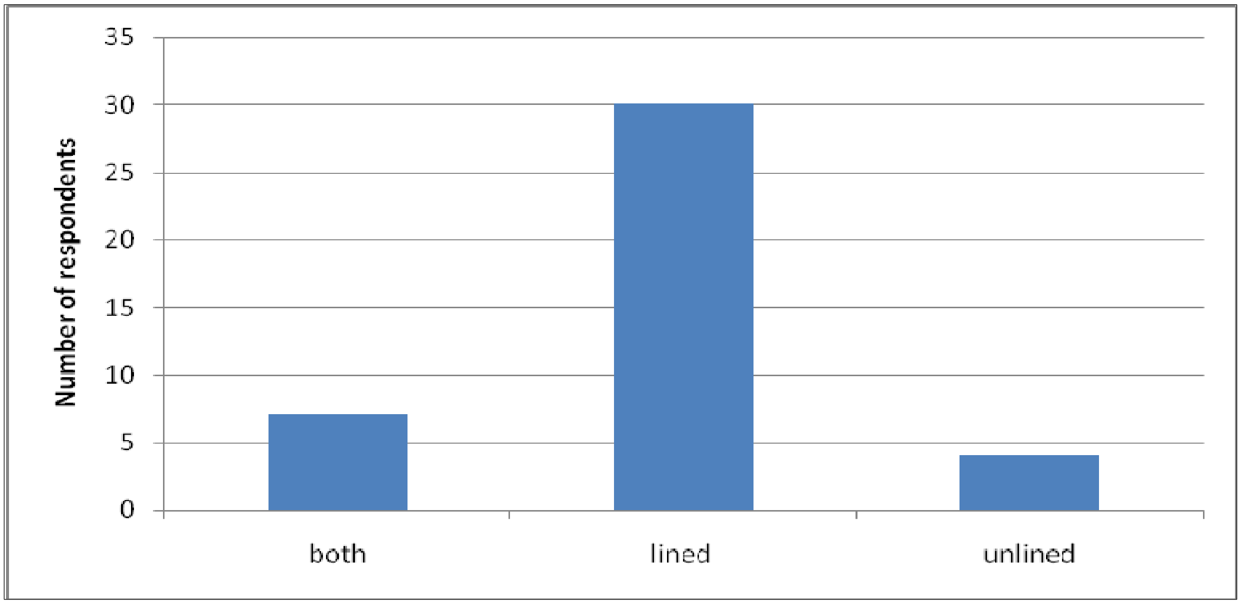

Figure 7: Type of canals used by respondents

A2.4 Water use allocations per water year

Water charges per ha

Figures 8 to 11 compare the water charges/ha for users of rivers, canals, pipelines and undeveloped rivers respectively. Figure 8 shows that water charges for users abstracting from rivers are generally below R400/ha, although in one WMA they are R2629/ha.

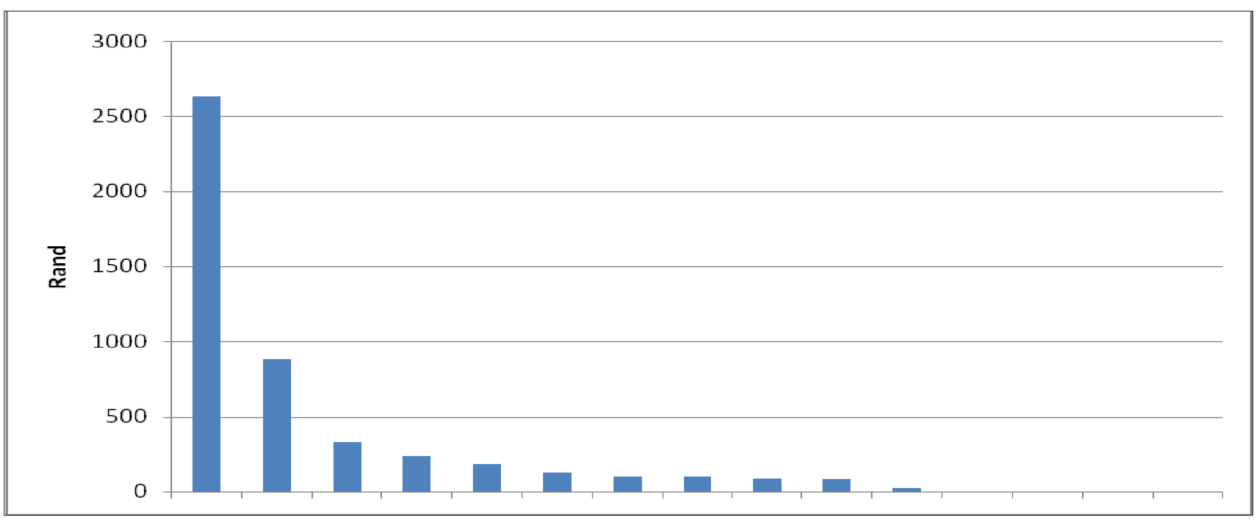

Figure 8: Water charges: River distribution

Figure 9 shows that for canal distribution water charges per ha are nearly all below R1000/ha, with most between R100/ha and R800/ha.

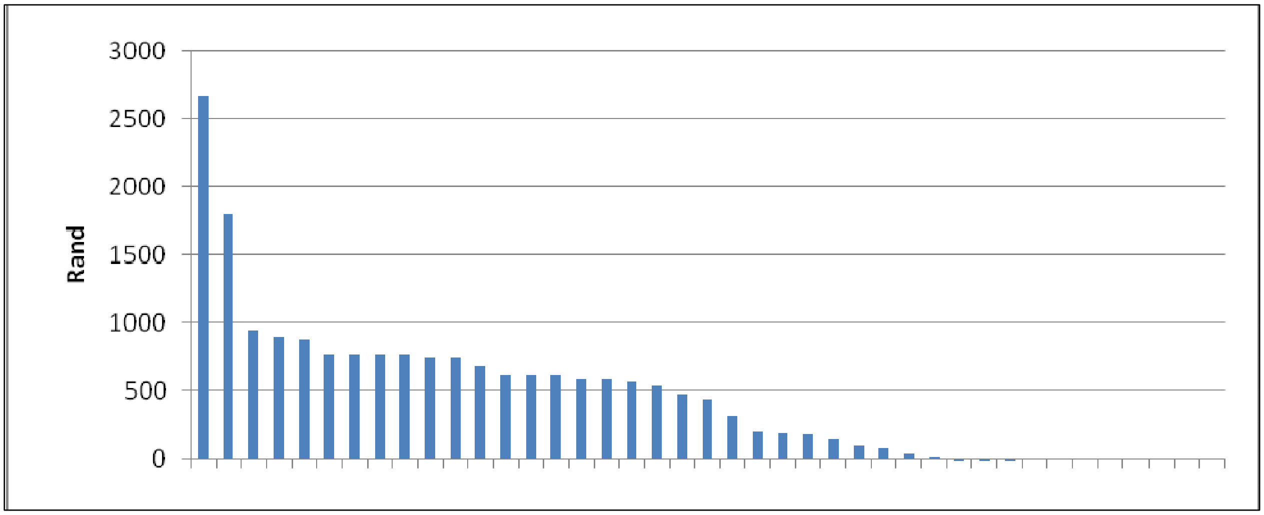

Figure 9: Water charges: Canal distribution

Figure 10 shows that most water charges are below R500/ha for those distributing their water via pipeline, although in one WMA they are R2500/ha.

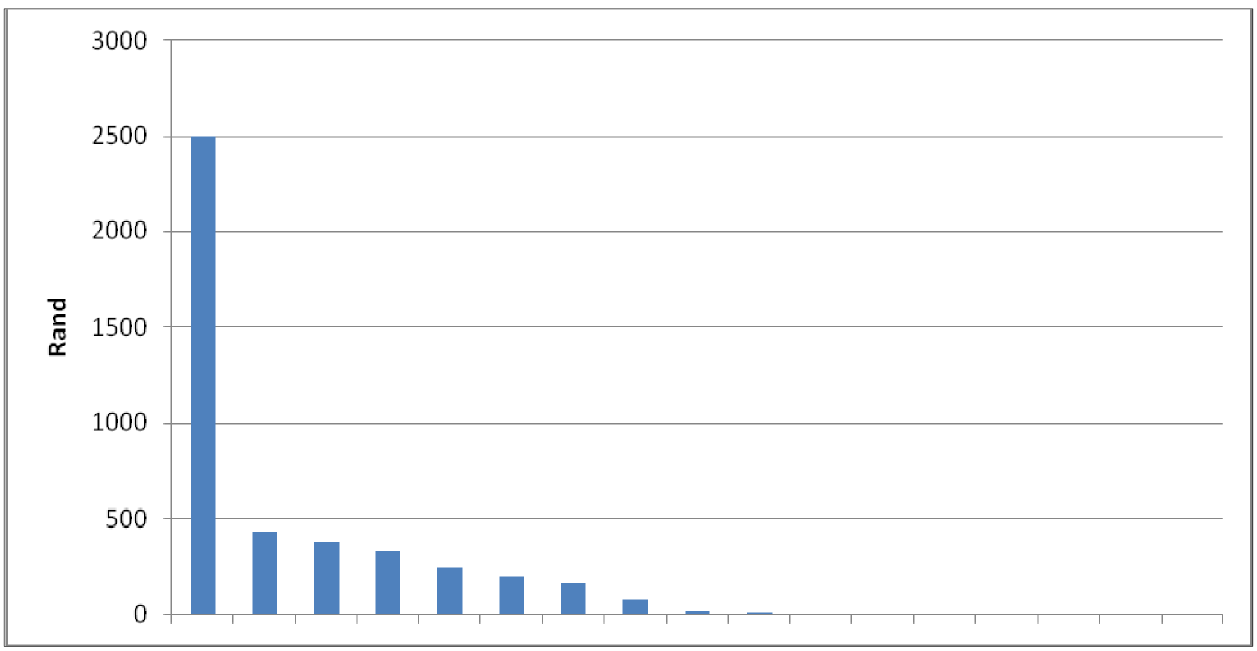

Figure 10: Water charges: Pipeline distribution

The size of the sample represented by Figure 11 is small, but nevertheless it is apparent that water charges for those distributing their water from undeveloped rivers lies between R350 and R150 per ha

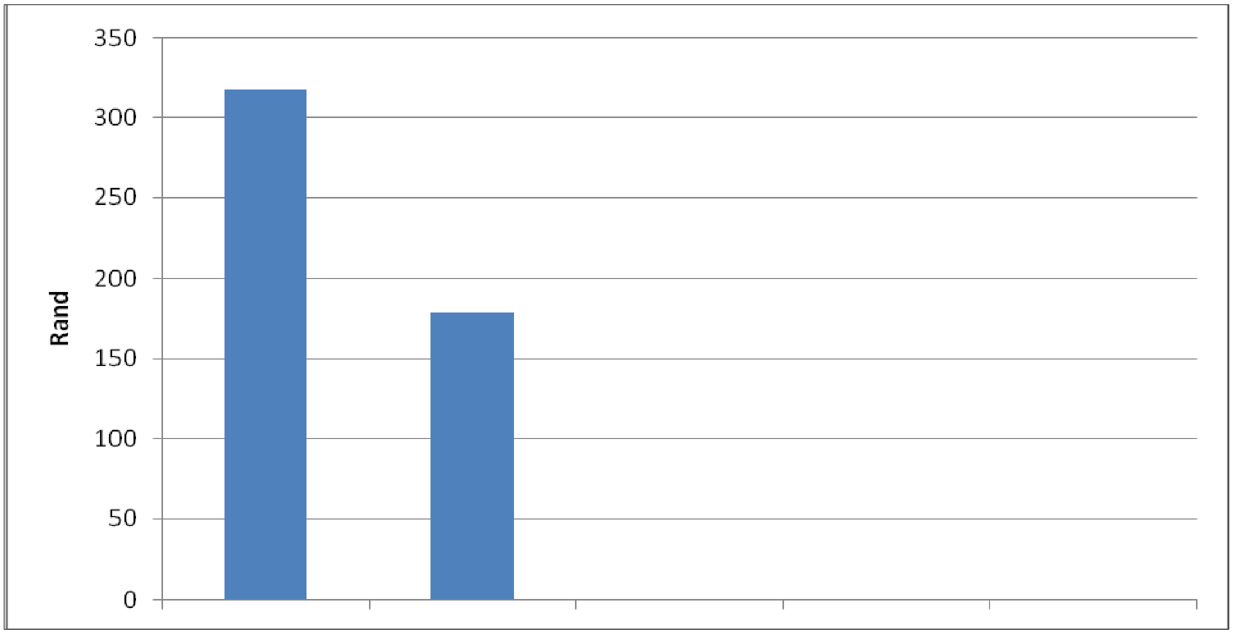

Figure 11: Water charges: Undeveloped river distribution

Figure 12 again represents a small sample, in which water charges in groundwater areas are under R100/ha

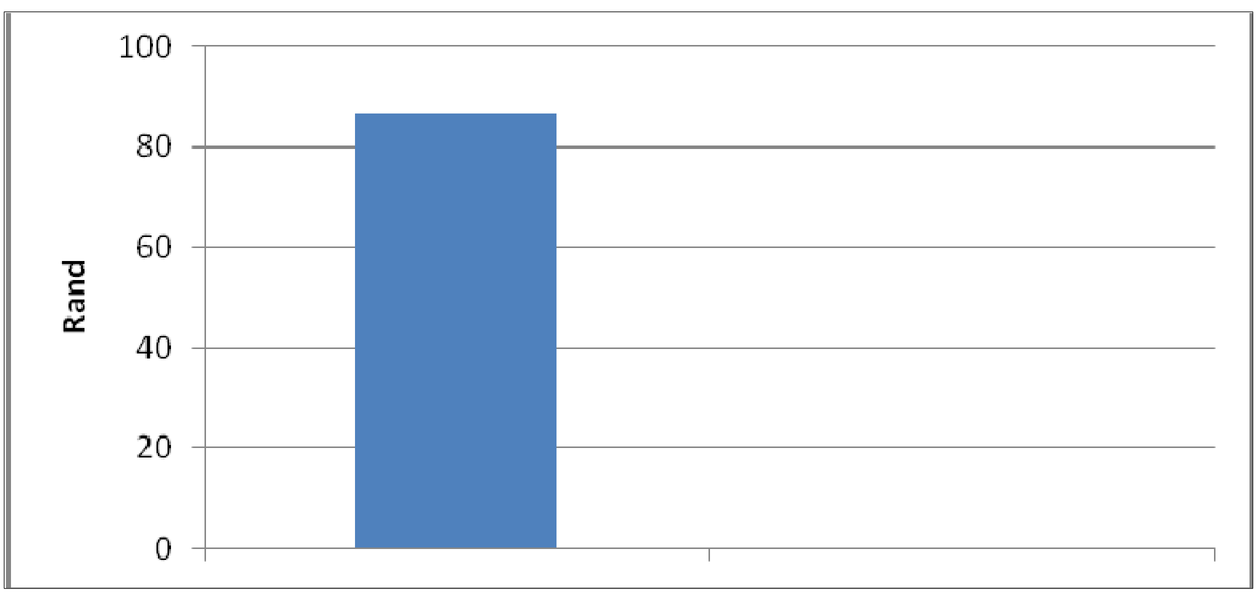

Figure12: Water charges: Groundwater area distribution

From Figure 13 it can be seen that the majority of water users have to pay for their full quota regardless of the amount of water they actually use. There is, therefore, the potential to provide incentives for users to convert to paying for actual use only, but this is difficult to implement due to budget implications for the IO in terms of reduced revenue.

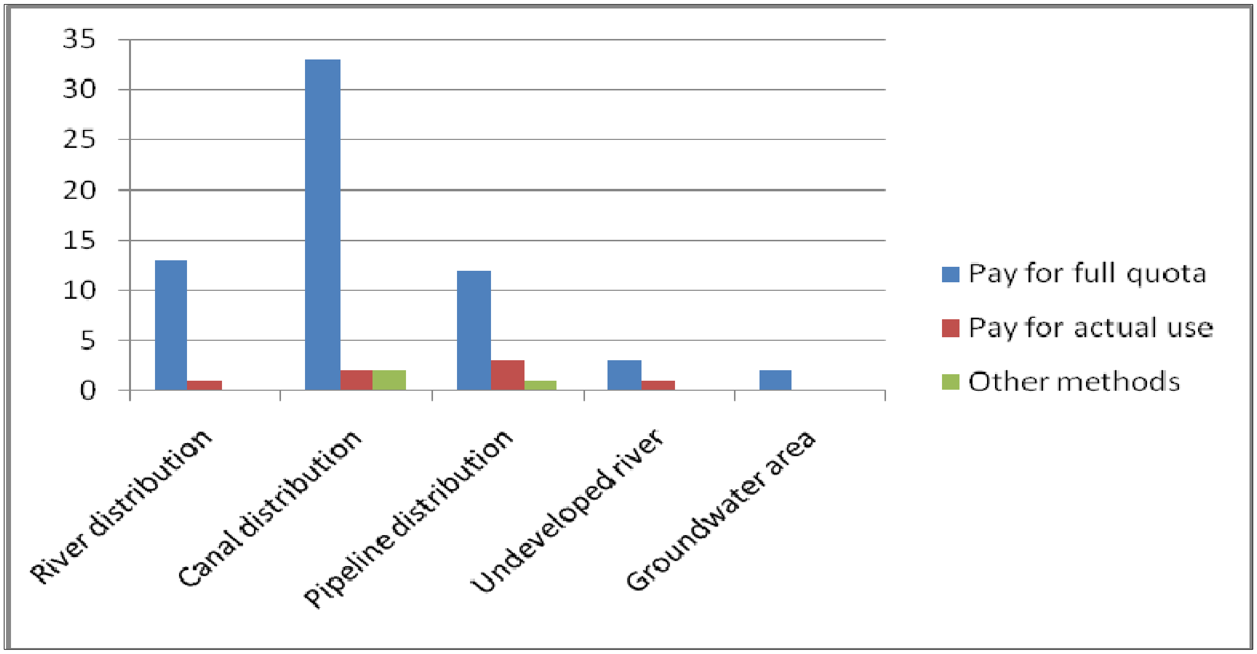

Figure 13: Water charge basis

A2.5 Water control infrastructure

Operating rules

Figures 14 to 17 depict the operating rules employed by IOs distributing water to their users by means of rivers, canals, pipelines and undeveloped rivers, respectively. It is important to note that one IO may a range of operating rules.

Figure 14 shows that of the 15 IOs using river distribution, 5 reported that they use the control of pumping rates as an operational rule, and 2 reported that they control pumping time. Limiting the hectares irrigated, releasing water only on request, and applying fixed pumping schedules were among the other operating rules reported by the respondents

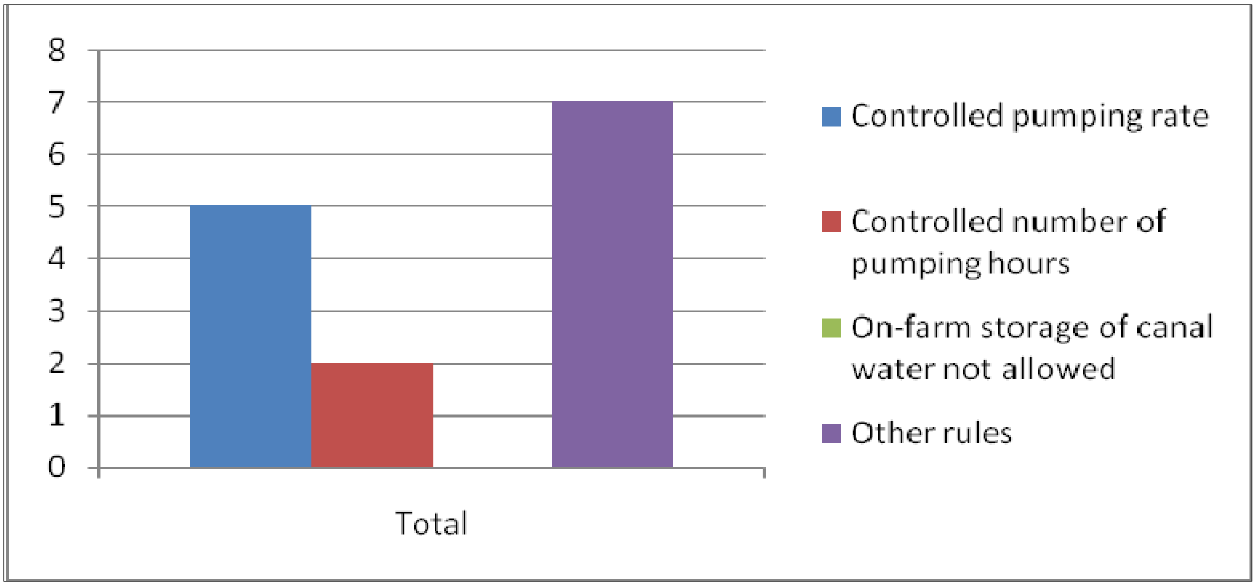

Figure 1: Operating rules: River distribution

Amongst those distributing water by canal, 24 reported that they operate according to a water request system, 11 reported that they use rotational supply, whilst 5 allow water to be available on demand, as shown in Figure 15. Other reported operating rules included the use of calibrated sluice gates, fixed sluice gate settings, and allowable withdrawals depending on water availability (continuous supply system).

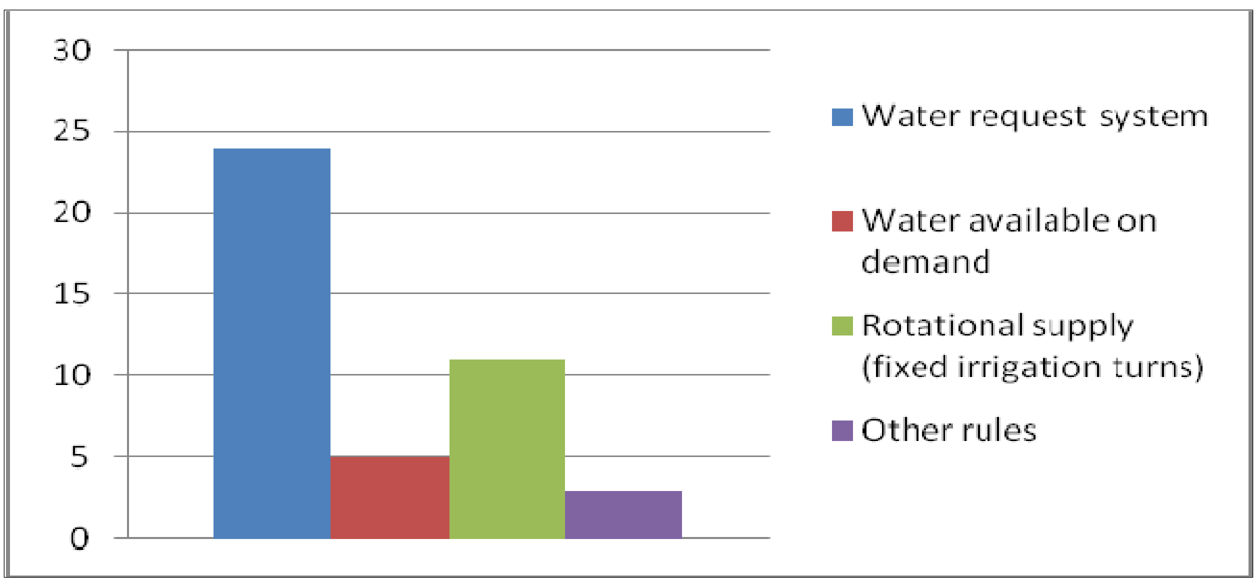

Figure 15: Operating rules: Canal distribution

Figure 16 shows the operating rules employed by the IOs who distribute their water by pipeline. Eight use the control of abstraction rates whilst the control of pumping hours was only reported once. Other reported operating rules included rotational supply, allowing abstractions according to the limited capacity of the infrastructure, or distribution according to crop water requirements.

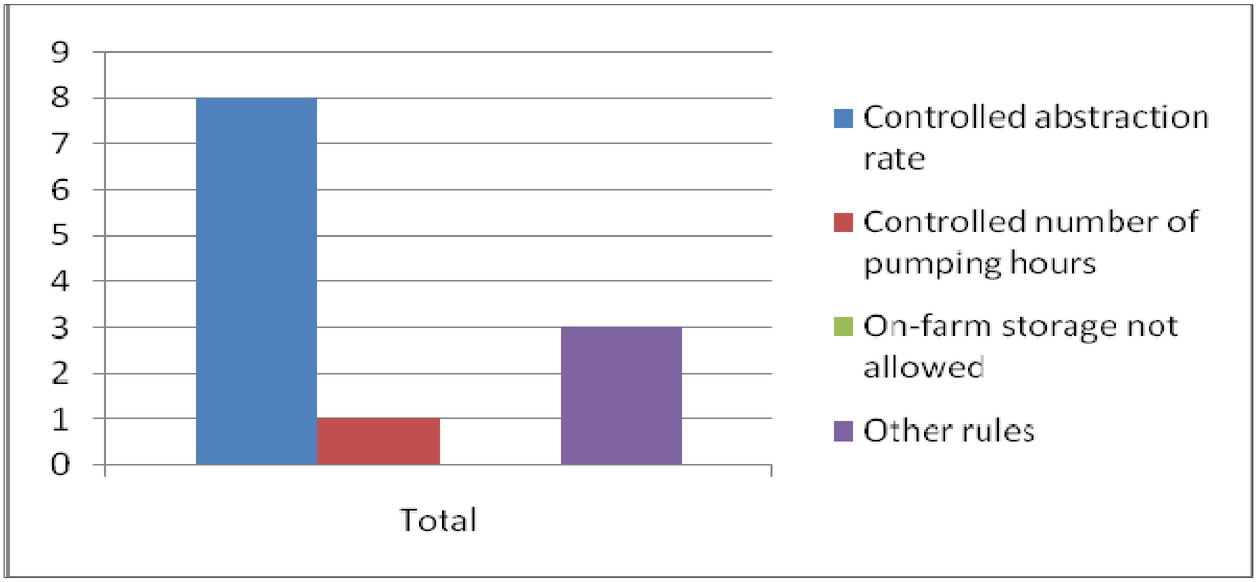

Figure 16: Operating rules: Pipeline distribution

Operating rules employed by those IOs distributing via undeveloped rivers are shown in Figure 17. The other reported operating rules included the imposition of rotational supply (fixed irrigation turns).

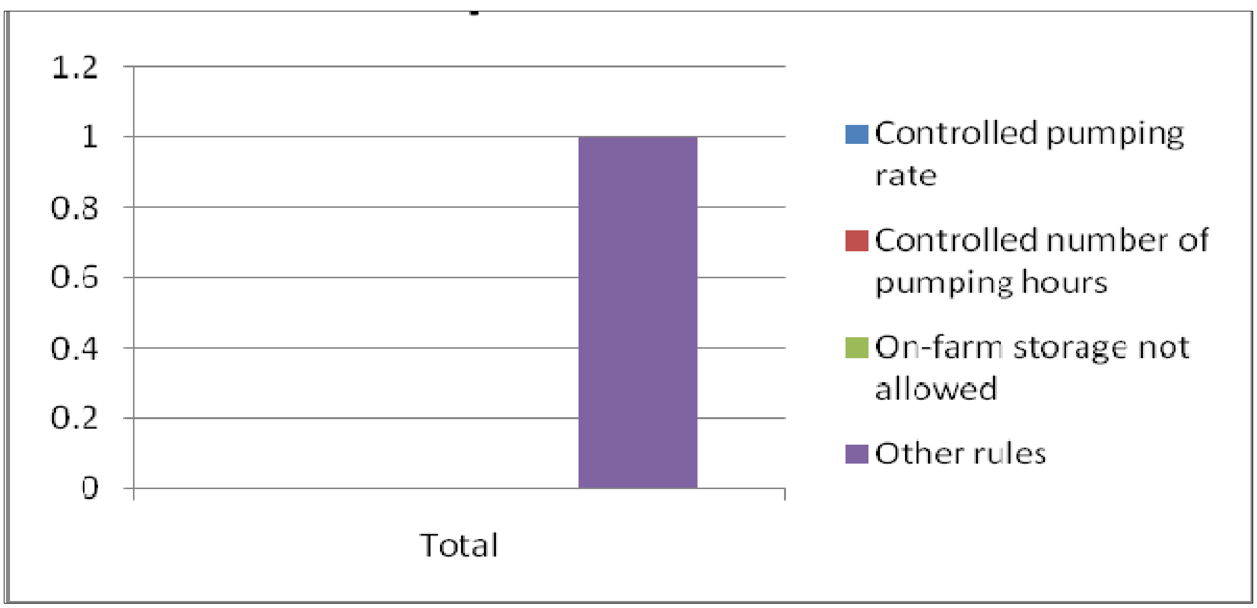

Figure 17: Operating rules: Undeveloped river distribution

Measurement of main inflows

Figure 18 shows that measurement take place at the majority of inflows. The lower figures for pipeline schemes is probably due to the high cost of flowmeters for large diameter pipelines.

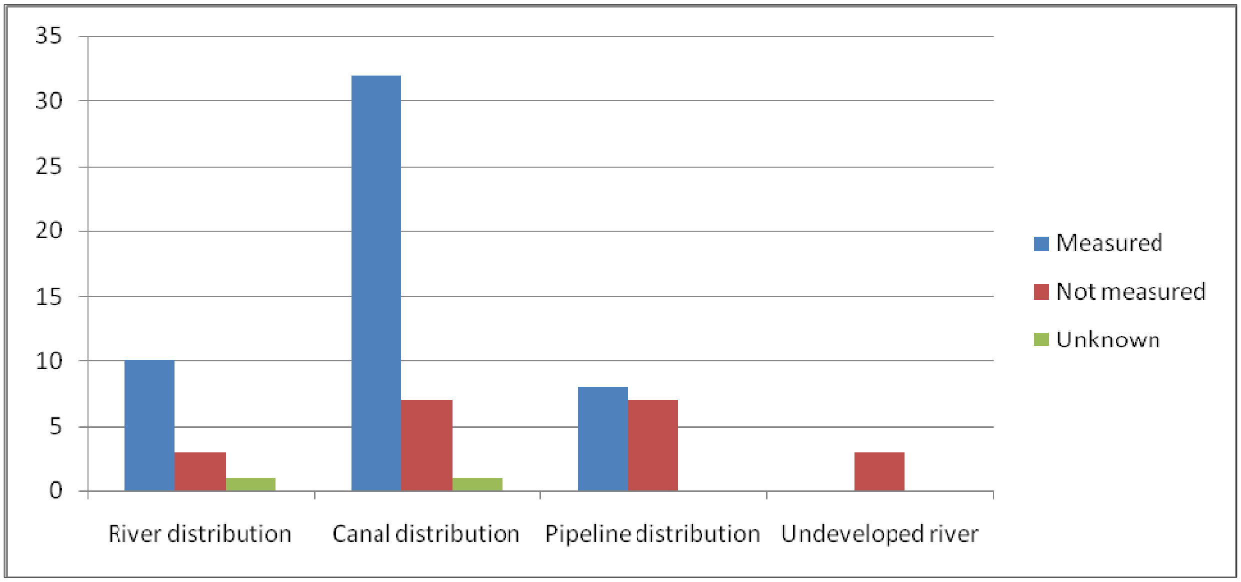

Figure 18: Measurement at main distribution inflow

Type of measuring device at main inflow

Figures 19 to 22 compare the types of measuring device used at the main inflow for rivers, canals, pipelines and undeveloped rivers respectively. Figure 19 shows that though there is no preferred device for measuring inflows to river distribution systems, weirs are more common than Parshall flumes, probably due to the greater range of flow rates that can be handled by a single structure.

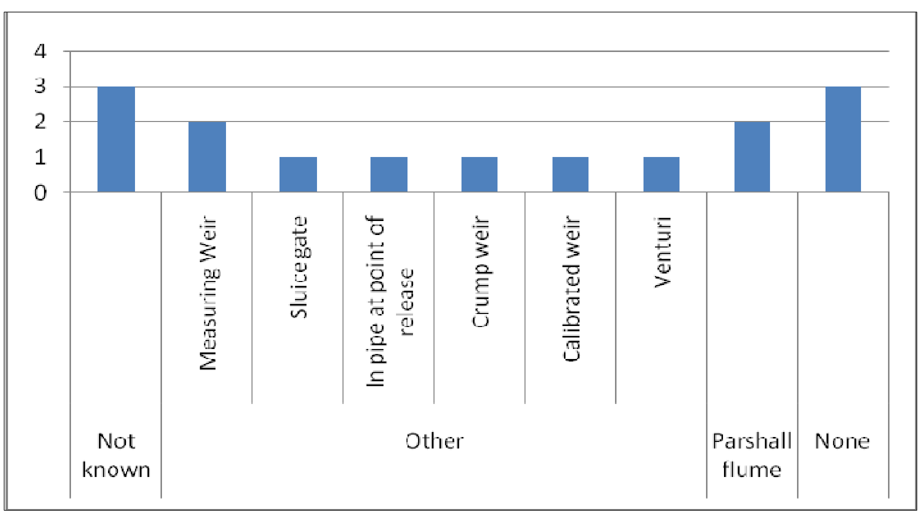

Figure 19: Type of device used at main inflow: River distribution

Figure 20 shows that Parshall flume by far the most common type of measuring device used at the main inflow to canal systems, due to the age of most of the canal systems in the country. Modern scheme managers consider Crump weirs to be more user friendly, as they are easier to install and can handle a greater range of flow rates than Parshall flumes.

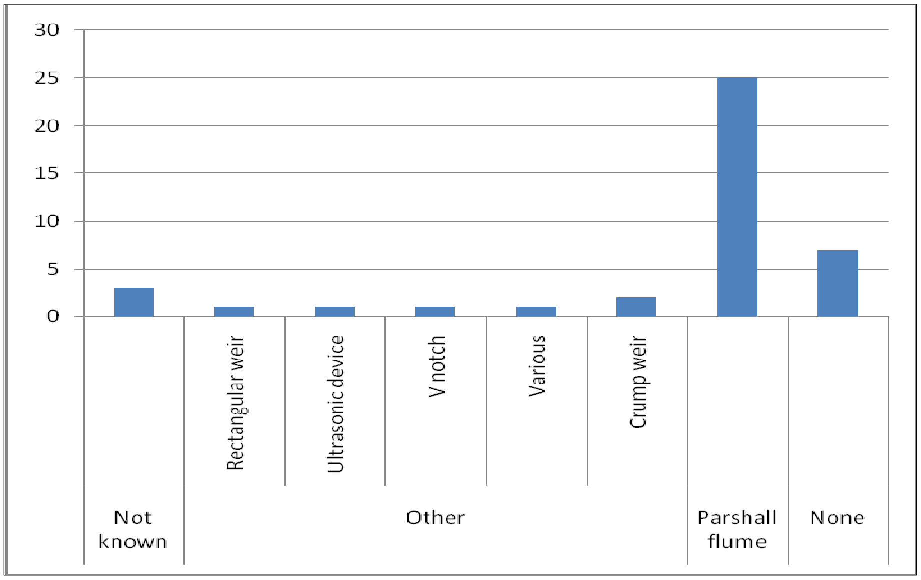

Figure 20: Type of device used at main inflow: Canal distribution

It is interesting to note from Figure 21 that no respondents reported the use of ultrasonic devices on large pipelines, despite the fact that they offer cost effective measuring options that can easily be attached to a telemetric system. This is probably due to the perception that this technology is expensive – however, considering the ease of installation, lack of moving (serviceable) parts and high accuracy of the devices, the benefits are considerable and the cost realistic.

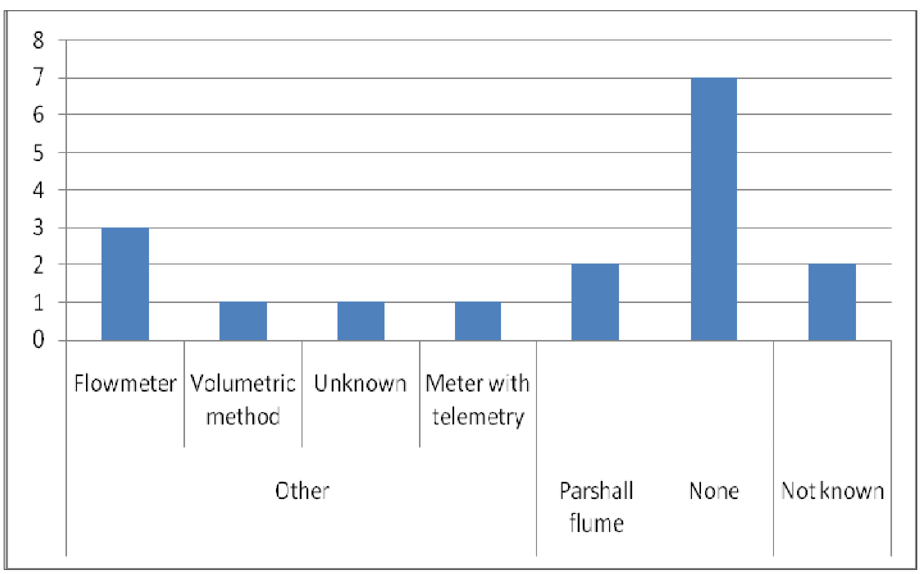

Figure 21: Type of device used at main inflow: Pipeline distribution

No measuring device was used at the inflows to undeveloped river distribution systems in three cases, (Figure 22) whilst electromagnetic devices and Parshall flumes were each reported once.

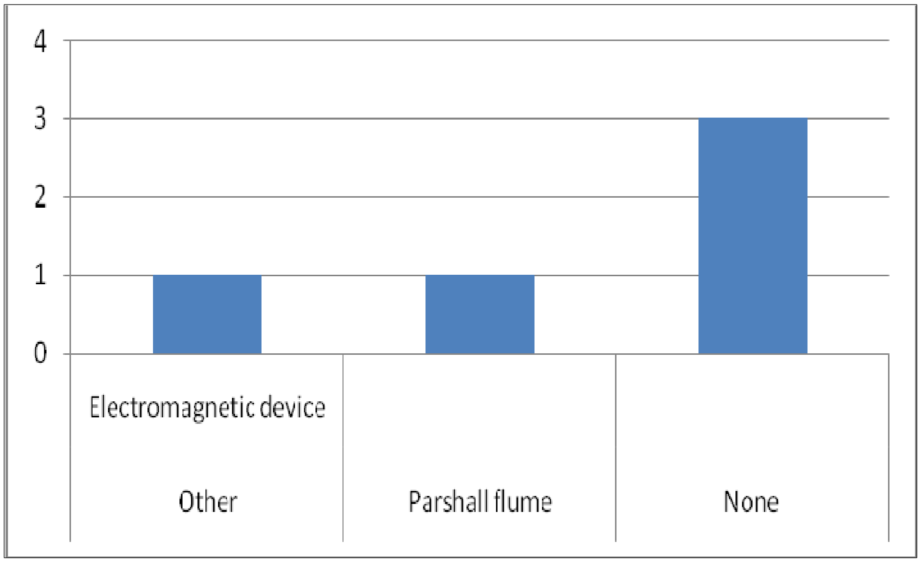

Figure 22: Type of device used at main inflow: Undeveloped river distribution

User abstraction points

It can be seen from Figure 23 that the IOs with canal systems are the most aware of the number of abstraction points through which they deliver water to users, and that they also have the highest number of measured abstraction points (Figure 24).

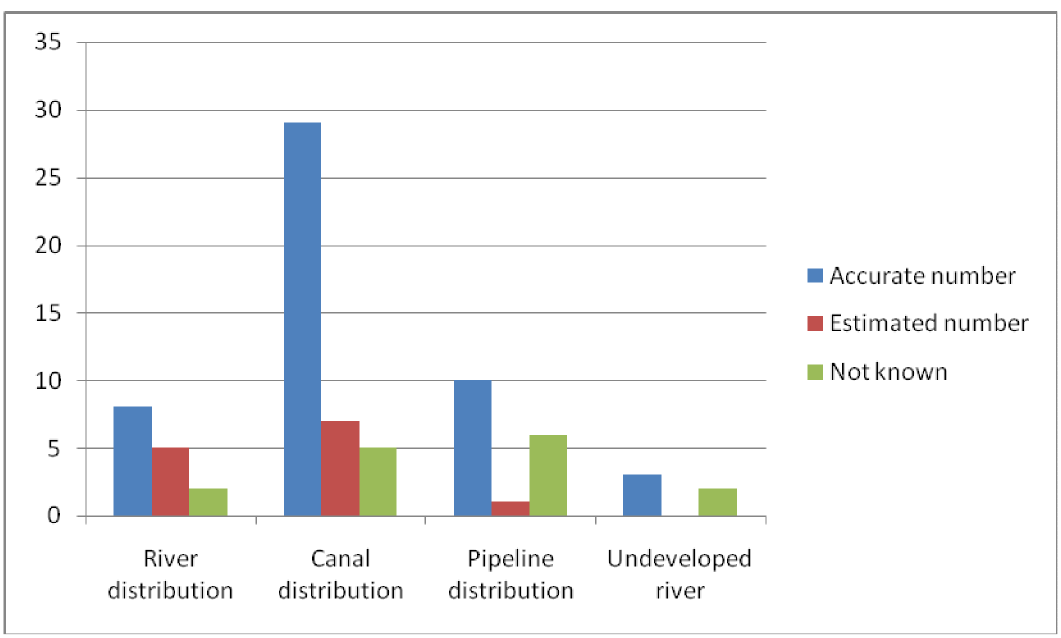

Figure 23: Number of abstraction points known

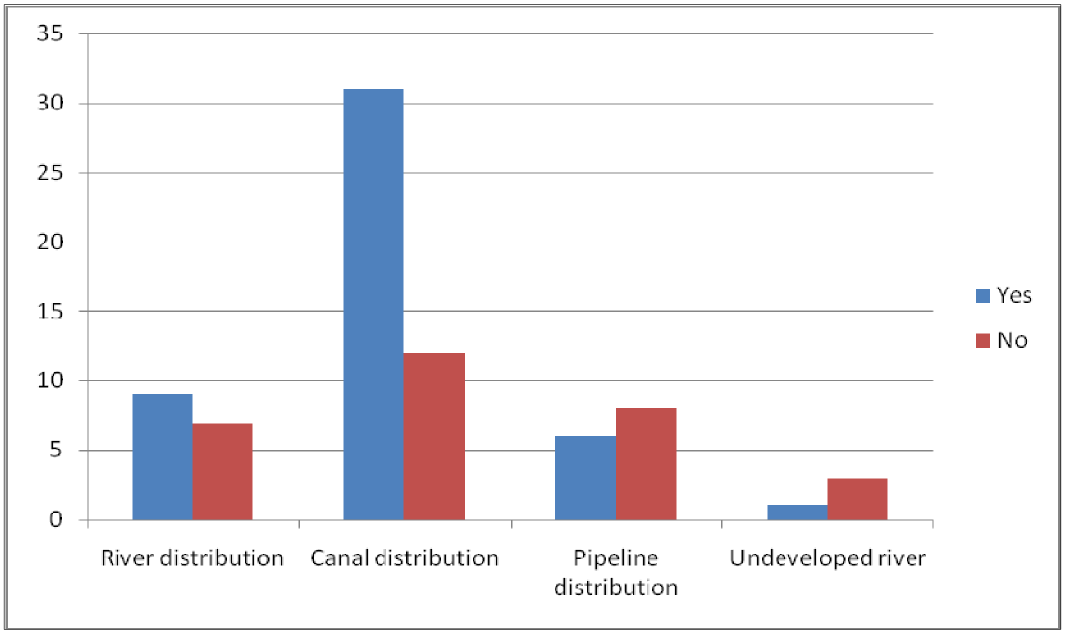

Figure 24: Number of organisations with measuring devices installed at abstraction points

It is interesting to note from Figure 24 that (in contrast to the results for rivers and canals), the majority of pipeline abstraction points are not measured.

Abstraction method by user

Figures 25 to 28 show the types of infrastructure found at the abstraction points where water is taken by individual users from the main distribution systems for rivers, canals, pipelines and undeveloped river system respectively. The respondents in this category reported a total nr of 3212 abstraction points present in river systems, the majority of which are privately owned pump stations along the river banks as shown in Figure 25.

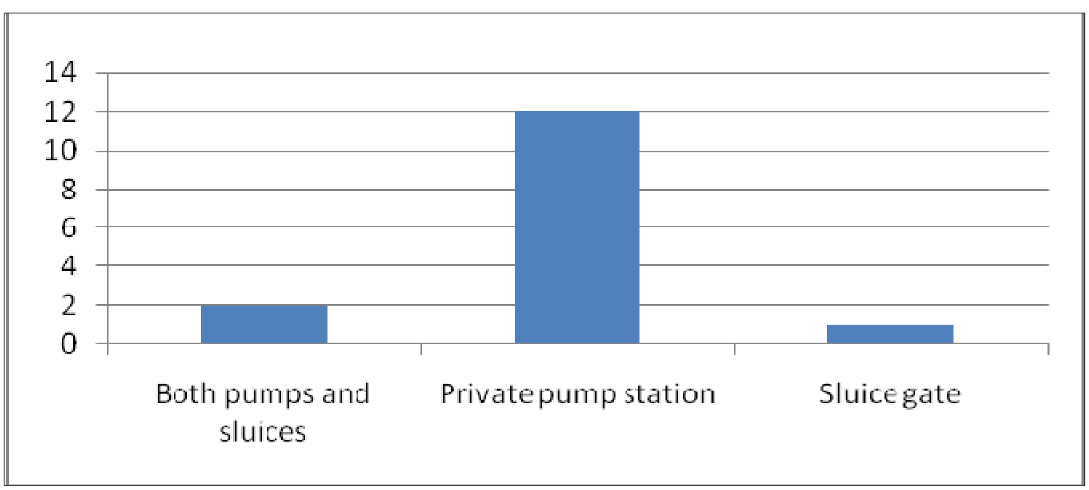

Figure 25: Abstraction types from river distribution

The majority of water users from the canal systems receive water through a sluice gate, as shown in Figure 26, while other infrastructure configurations are found to a lesser extent. The respondents reported a total of 8422 abstraction points on their canal distribution systems.

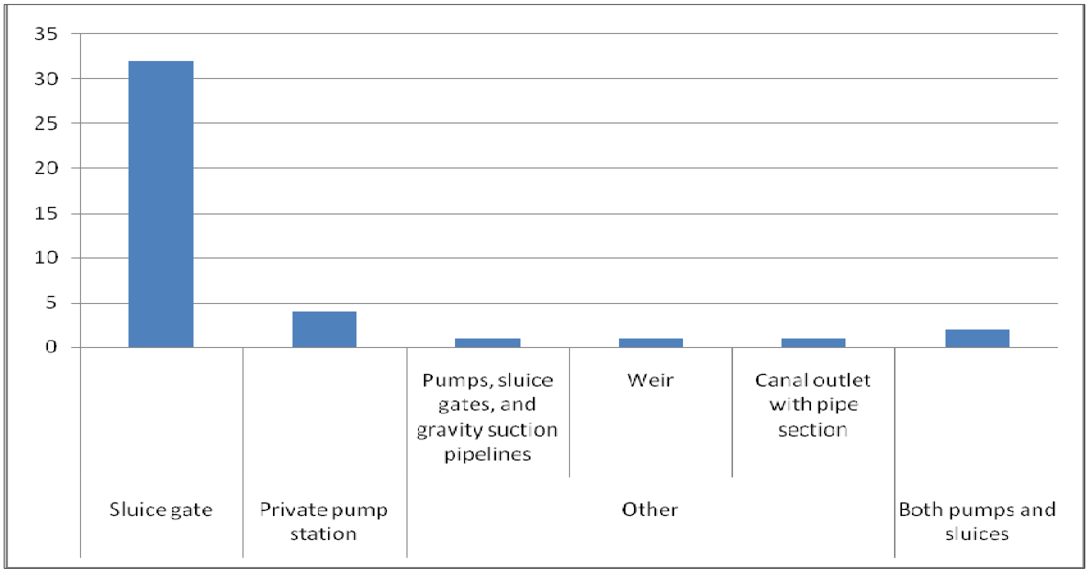

Figure 26: Abstraction types from canal distribution

Two possible situations can occur in pipeline systems; Water can either be supplied under pressure to the user through a valve, for use directly into their irrigation system, or water is delivered under gravity into a farm dam or to the farmer's own pump station. A total number of 1110 abstraction points from pipeline distribution systems were reported by the responding IOs, with the majority receiving water under pressure through a valve, as shown in Figure 27.

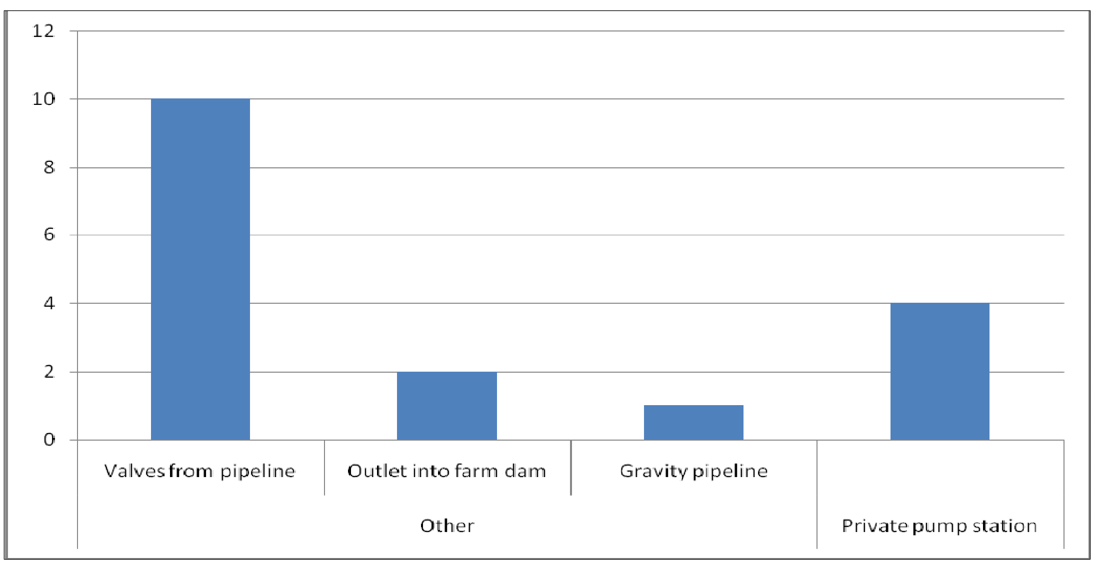

Figure 27: Abstraction types from pipeline distribution

Water can be diverted in a number of ways from an undeveloped river, as shown in Figure 28. Only 5 abstraction points of this type were reported by the respondents.

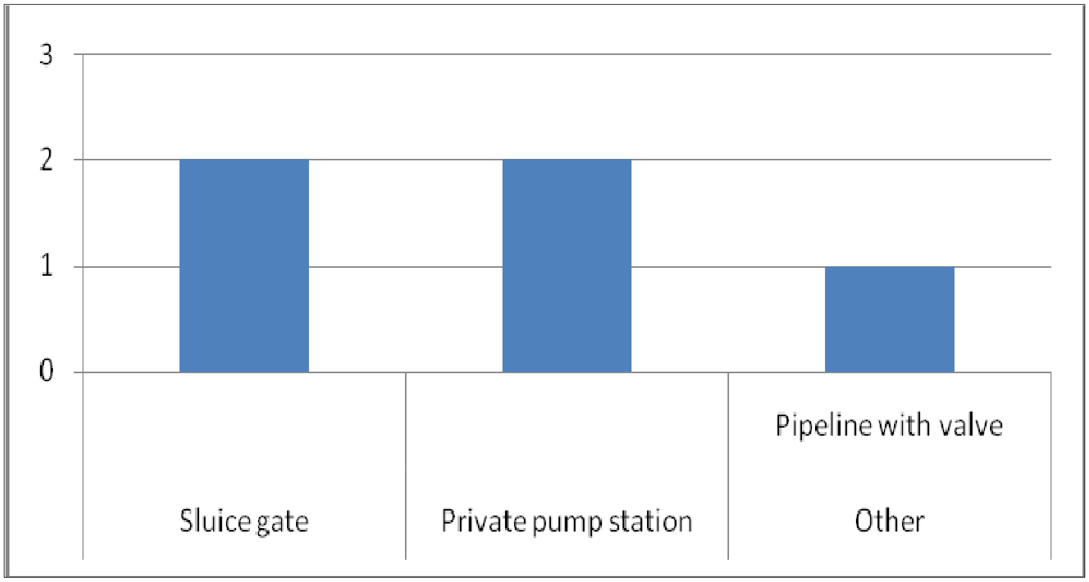

Figure 28: Abstraction types from undeveloped river distribution

Types of measuring devices at abstraction points

Figures 29 to 32 show the variety of measuring devices reported by the respondents at user abstraction points on rivers, canals, pipelines and undeveloped rivers respectively.

Figure 29 shows that most of the measuring devices encountered on river abstractions are flowmeters, mostly on systems where water is pumped from a river, while sluice gates, Crump weirs and Parshall flumes are used where water is diverted under gravity from a river.

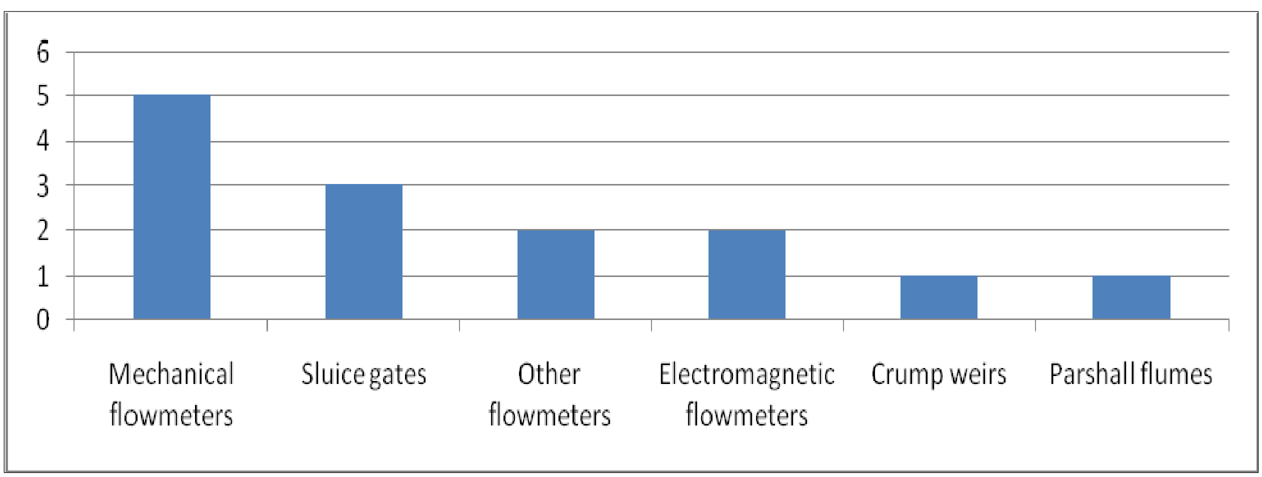

Figure 29: Types of measuring devices at abstraction points from rivers

Parshall flumes are most commonly found on canal schemes, as shown in Figure 30, whilst the number of Crump weirs is relatively low. Sluice gates with long weirs (for upstream pressure control) can be set to allocate water accurately but without the long weir, delivery through the sluice gate will vary as the water level in the canal fluctuates. A small number of schemes also reported using flowmeters at the canal off-takes.

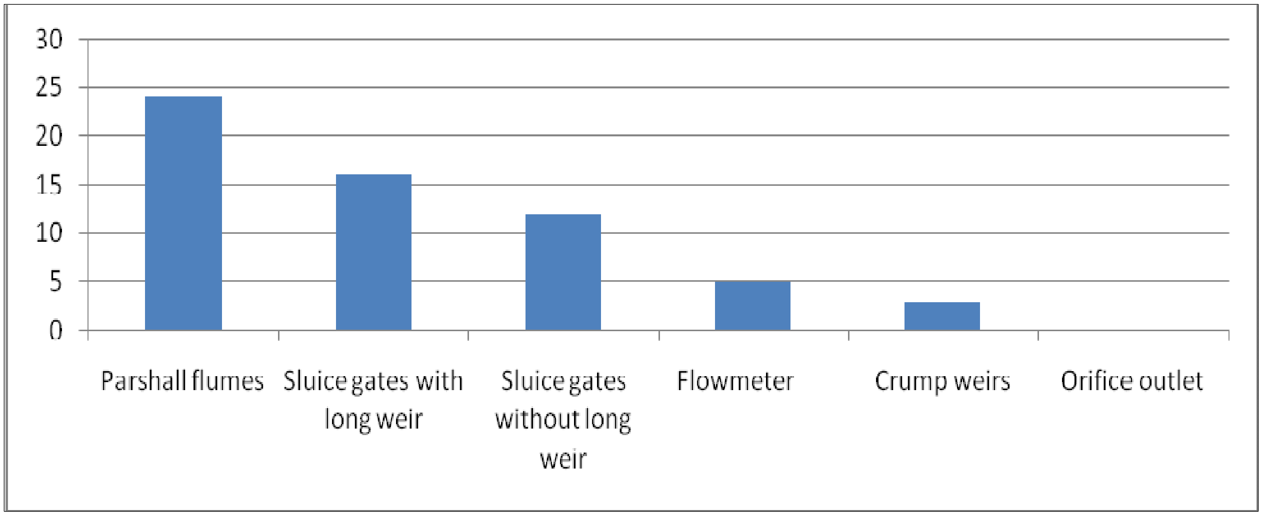

Figure 30: Types of measuring devices at abstraction points from canals

Mechanical flowmeters were the only measuring devices reported to be used by pipeline schemes, as shown in Figure 31.

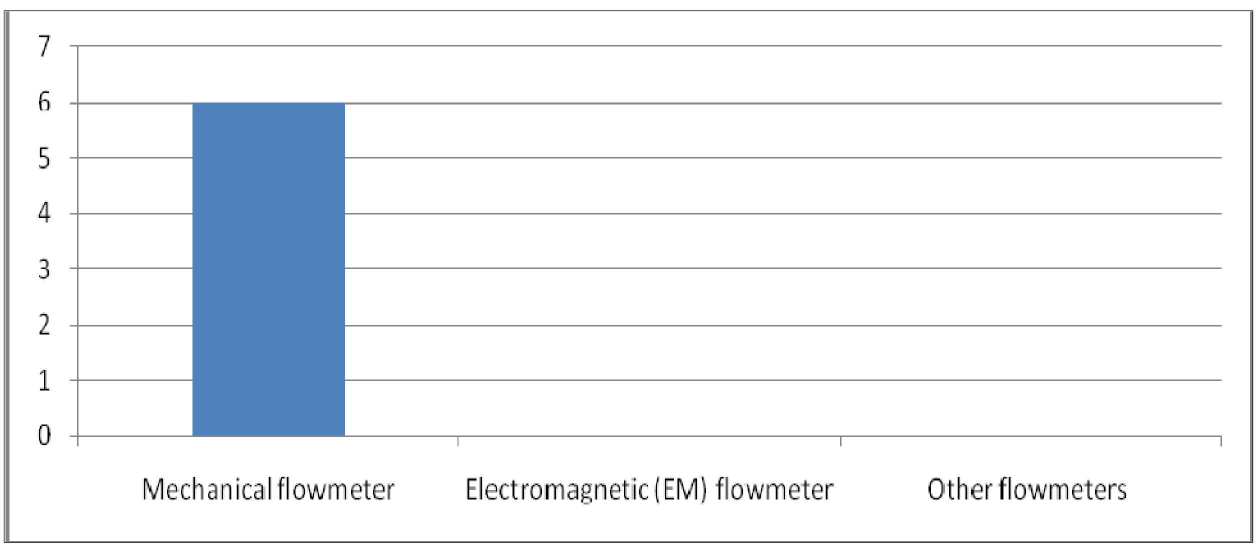

Figure 31: Types of measuring devices at abstraction points from pipelines

Water delivered under gravity from undeveloped rivers is reported to be measured by structures such as sluice gates (upstream control not specified) and Parshall flumes, as shown in Figure 32.

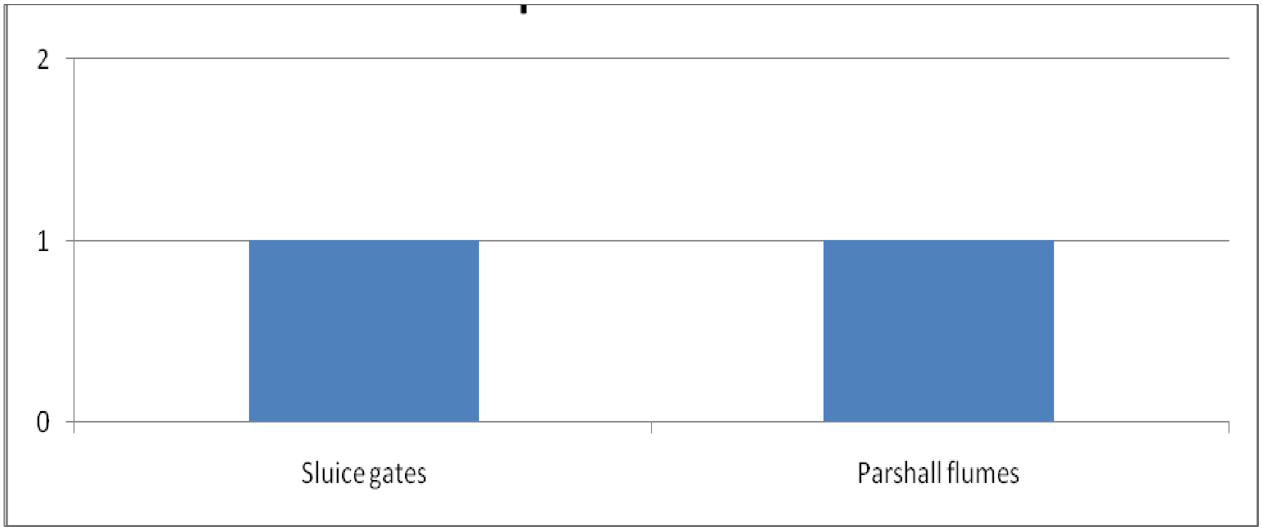

Figure 32: Types of measuring devices at abstraction points from undeveloped rivers

Data collection

Both river and canal based IOs reported more continuous than periodical data recording at abstraction points, as shown in Figure 33. This is probably due to the operational requirements of these systems to ensure water reaches all the abstraction points when required. Periodical data recording is more common at pipeline schemes. It is important to note that the IO, not the user, is responsible for the collection of data at user abstraction points.

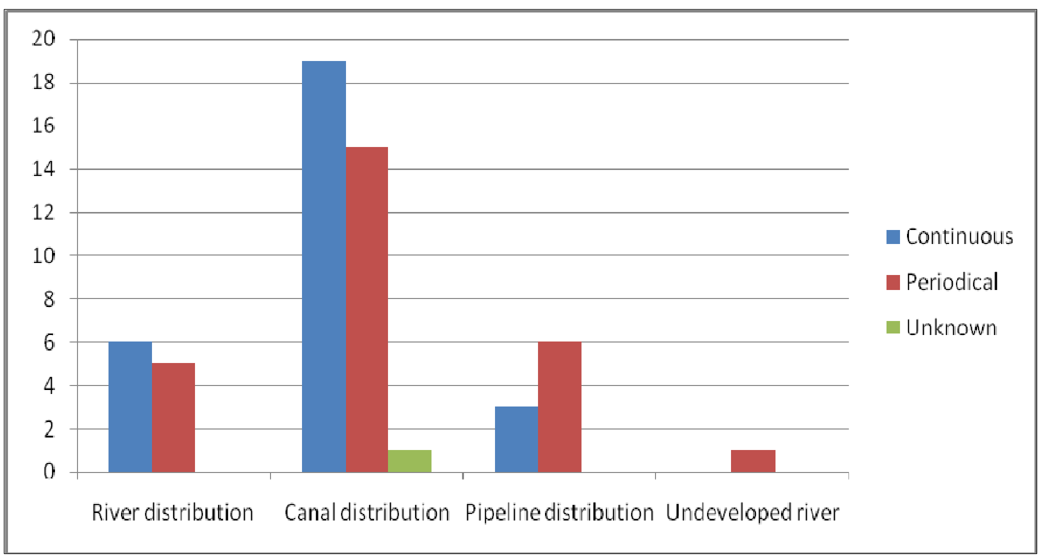

Figure 33: Data collection interval at abstraction point

Figure 34 shows the percentage of responding IOs using telemetry to collect data. IOs with river-based systems (both developed and undeveloped) are making best use of this modern technology to manage water, probably due to the remoteness of monitoring points in their areas. Interestingly enough, the canal-based IOs reported the lowest percentage of telemetry use of all systems, even though their abstraction point management was reportedly better (see Figures 23 and 24).

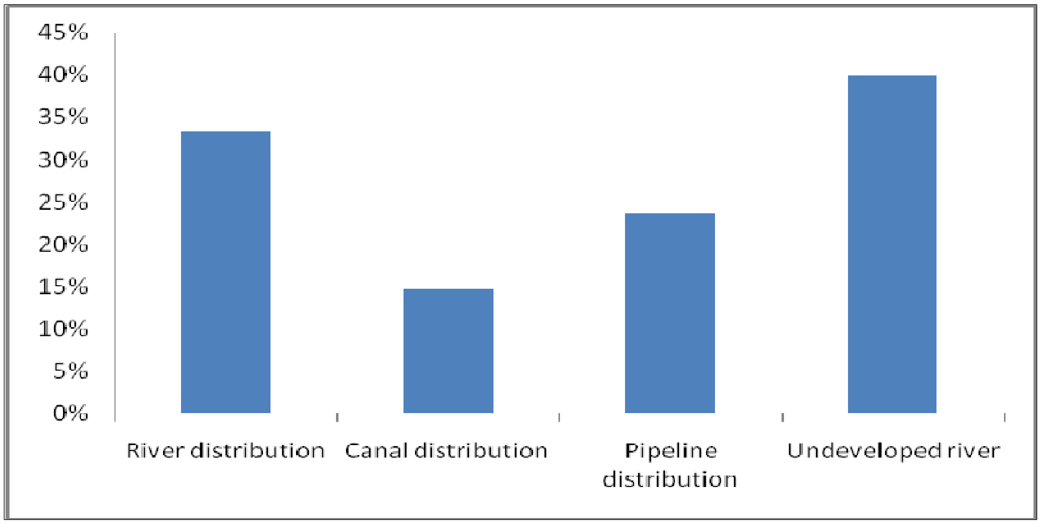

Figure 34: Number of IOs using telemetry

As shown in Figure 35, the river-based IOs were the only group of which the majority considered measurement to be an effective management tool, possibly due to the fact that they cannot manage without it, and therefore the benefits are perceived to be greater. In pipeline systems, where the bulk of the water is well controlled by the distribution infrastructure, one third of the respondents considered measurement to be an ineffective management tool.

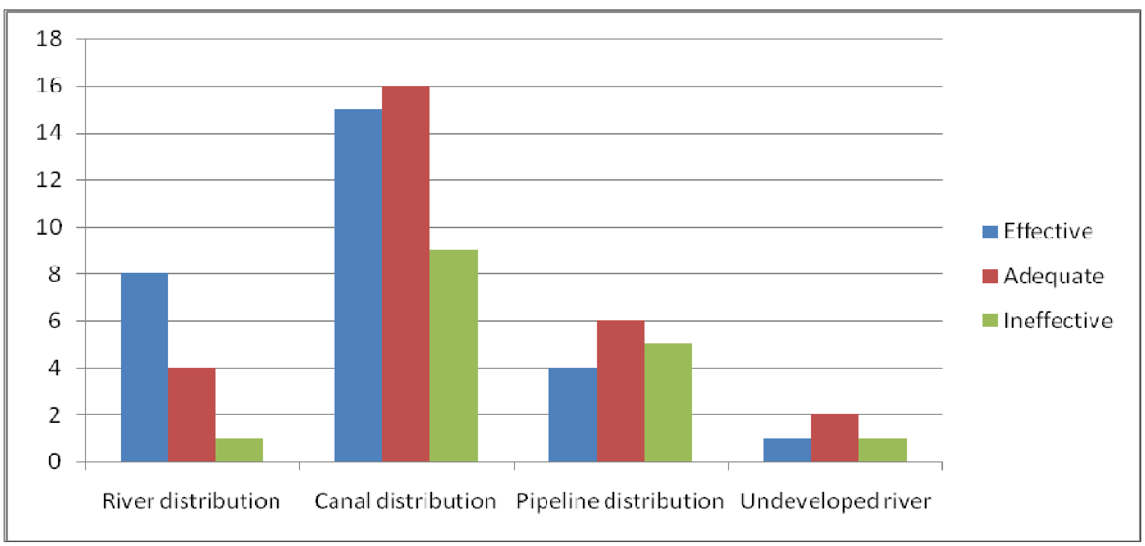

Figure 35: Perceived effectiveness of measurement devices

A2.6 Groundwater

Although based on a small sample size, Figure 36 shows that 50% of the IOs that use groundwater extensively reported that they monitor groundwater levels. However, no measurement of individual abstractions from boreholes is reportedly taking place (Figure 37).

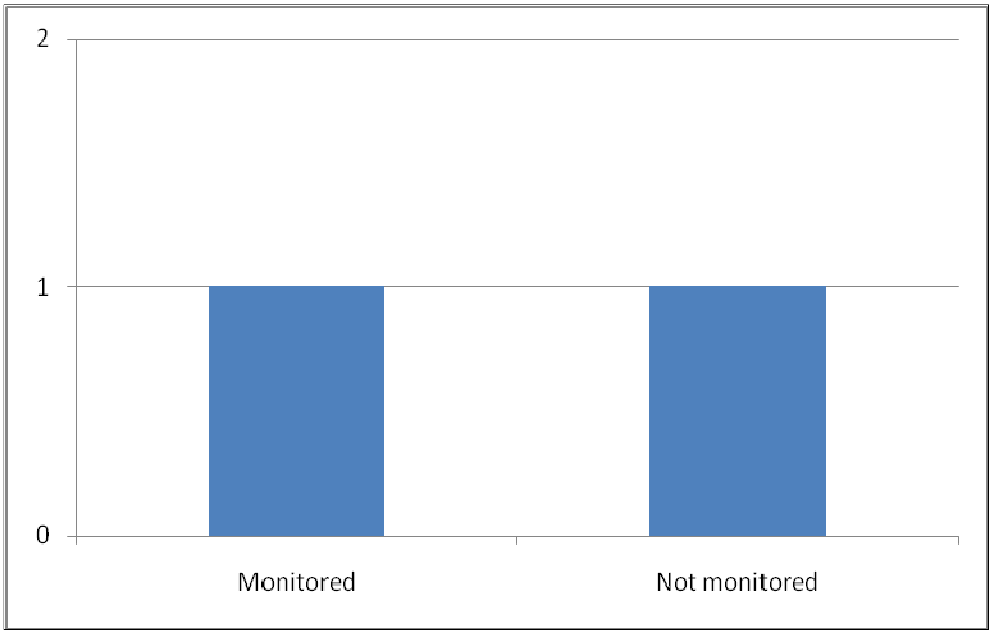

Figure 36: Groundwater level monitoring

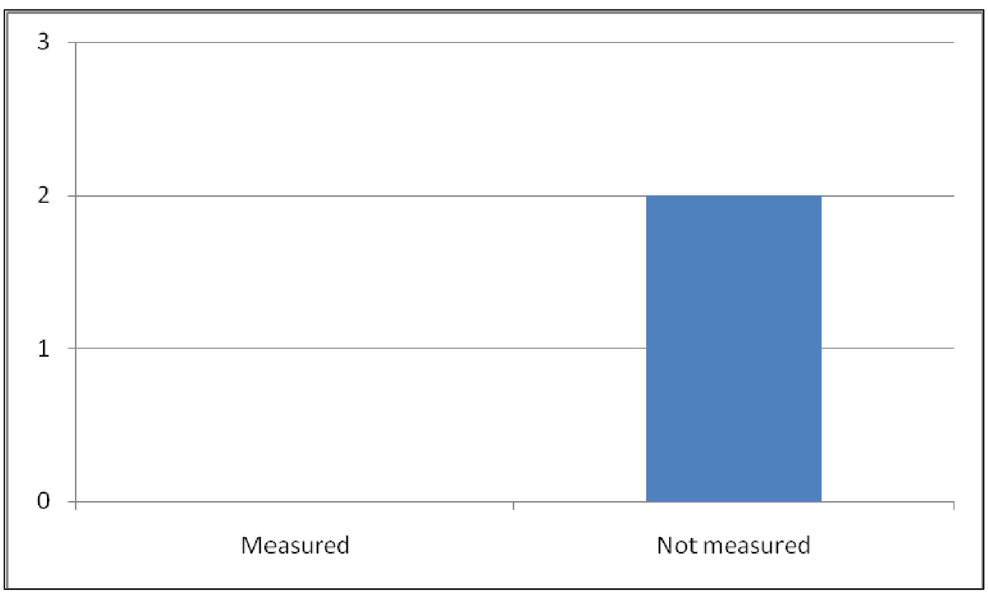

Figure 37: Groundwater abstraction measuring

A2.7 On-farm dams

Only one IO using farm dams as a source of irrigation water responded; they reported that abstractions from the dams are being monitored (Figure 38), and in this case not with in-line flowmeters (Figure 39) but specifically using kilowatt-hour meter readings from the power supply to farmers' pump stations.

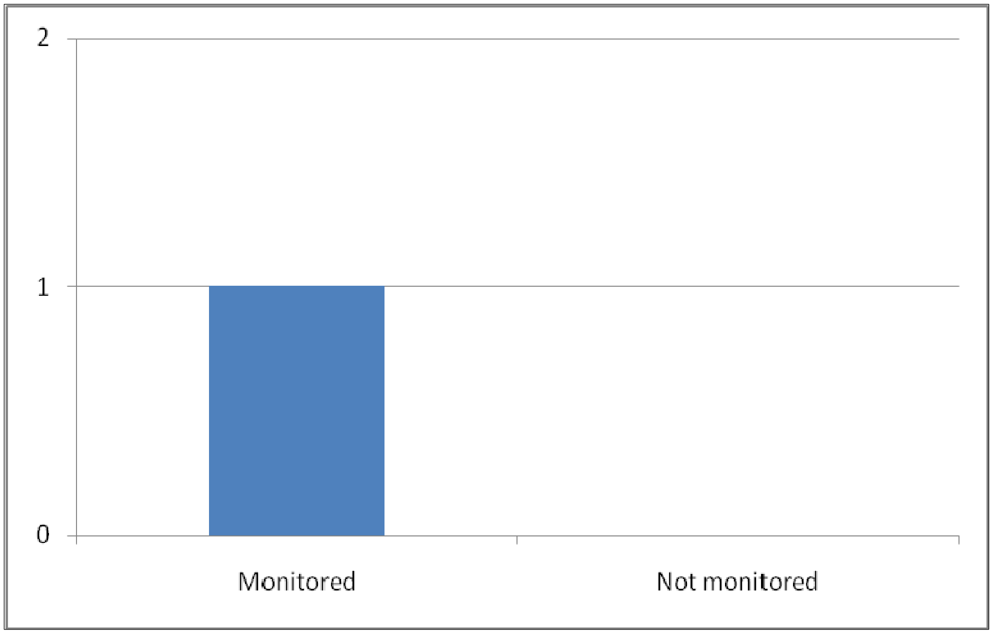

Figure 38: On-farm dam monitoring

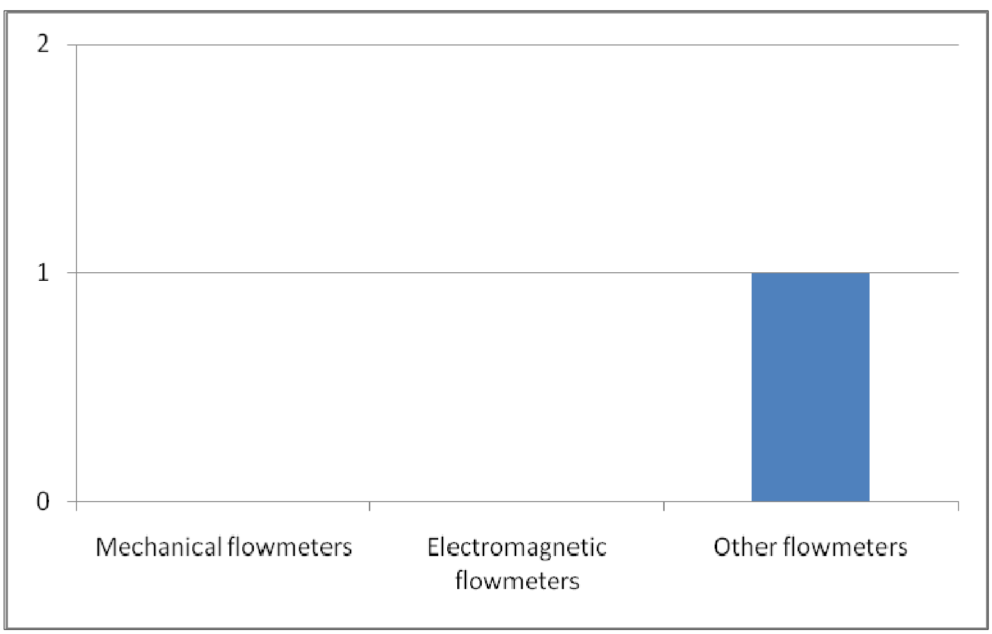

Figure 39: Types of devices used for on-farm dam measurement

A2.8 Water quality

The responses to the questions on water quality are shown in Figure 40. The graph shows which percentage of the organisations with different types of distribution systems reported the various water quality problems listed in the legend.

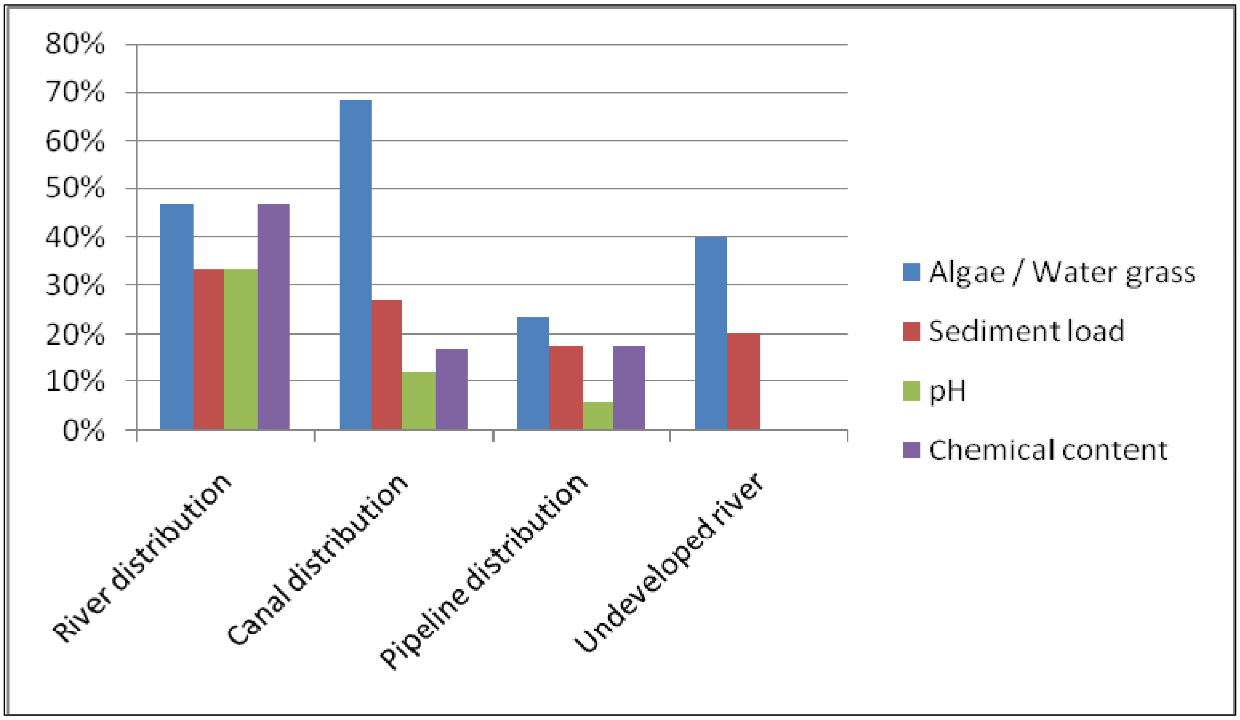

Figure 40: Water quality problems

The results confirm increasing concerns in the water sector regarding the management of our water resources by various stakeholders. Algae and unacceptable chemical content of the water were the most commonly reported problems by all IOs, increased algae also being the results of poor chemical water quality. Other specific problems reported by the organisations include:

- Salinity
- Erosion (causing excessive sediment loads)
- Water hyacinths
- Sewage spills into rivers from municipal water treatment works, industries or private houses on the river banks (6 reports)

A2.9 Management aspects

Human resources

The majority of responding organisations reported that they have adequate human resources to implement and/or operate the measurement systems in their areas (Figure 41). However, this situation may be quite different in the case of emerging farmer irrigation schemes, which were not included in the survey.

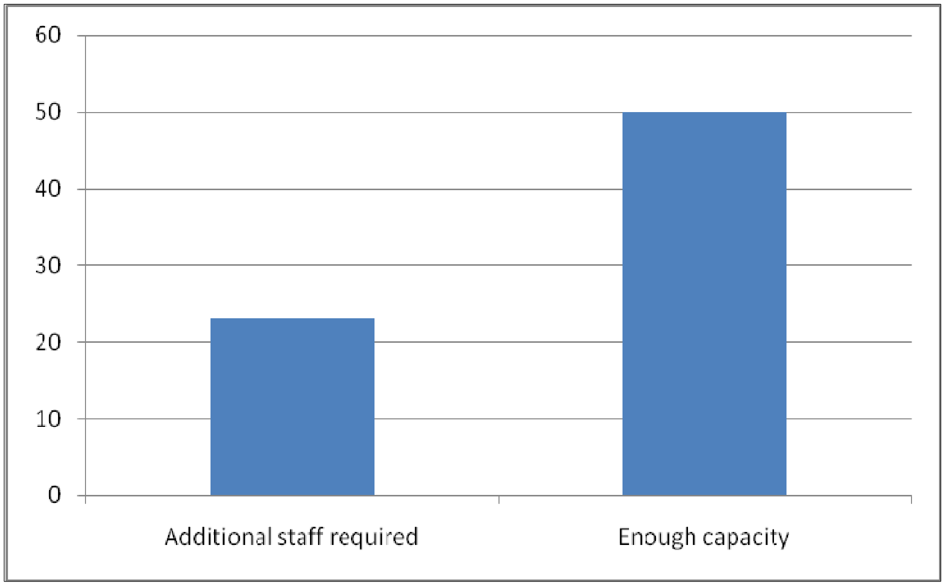

Figure 41: Human resources capacity of IOs

Only 24 out of the 73 responding IOs reported that they employ full time technical staff (Figure 42). This is probably due to the need to keep operating costs low, rather than to a shortage of skilled technical persons, although that has also been reported to be a problem.

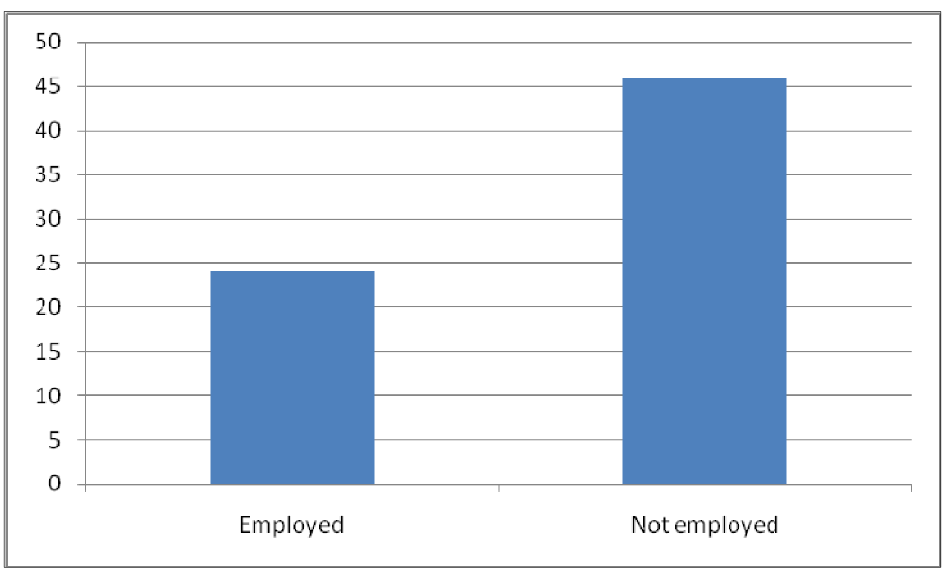

Figure 42: Full time technical staff employed by IOs

The majority of organisations with full time technical staff reported that their staff had received training in water control from DWAF, as shown in Figure 43.

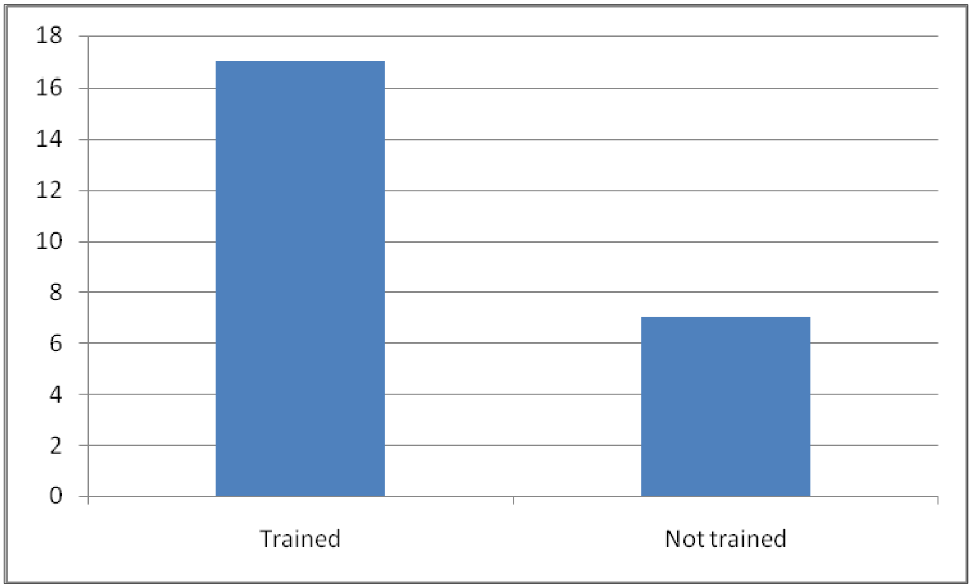

Figure 43: Water control training of IO staff

Financial resources

By far the majority of organisations indicated that they would require financial support to implement measurement in their areas, as shown in Figure 44. This accentuates the need for clear policy from DWAF regarding incentives and rebates for organisations and/or water users that are willing to improve their water management.

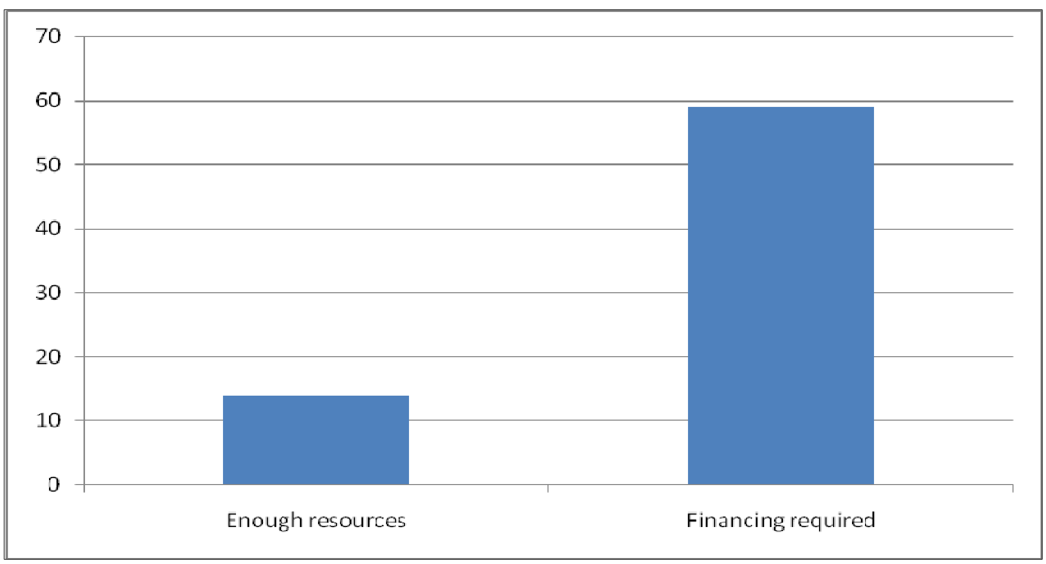

Figure 44: Financial resource availability for measurement implementation

A2.10 Unutilised water

As shown in Figure 45, the majority of IOs, regardless of the type of distribution system they were operating, considered the amount of water leaving their area unutilised to be of little value to other users further downstream in the catchment.

The results also accentuate the fact that in South Africa, in the case of canal systems specifically, our canals are managed to deliver only the water required and many systems are run on a request basis. Only in the case of the river systems was the unutilised outflow considered to be of significant value, by just more than one third of the responding organisations.

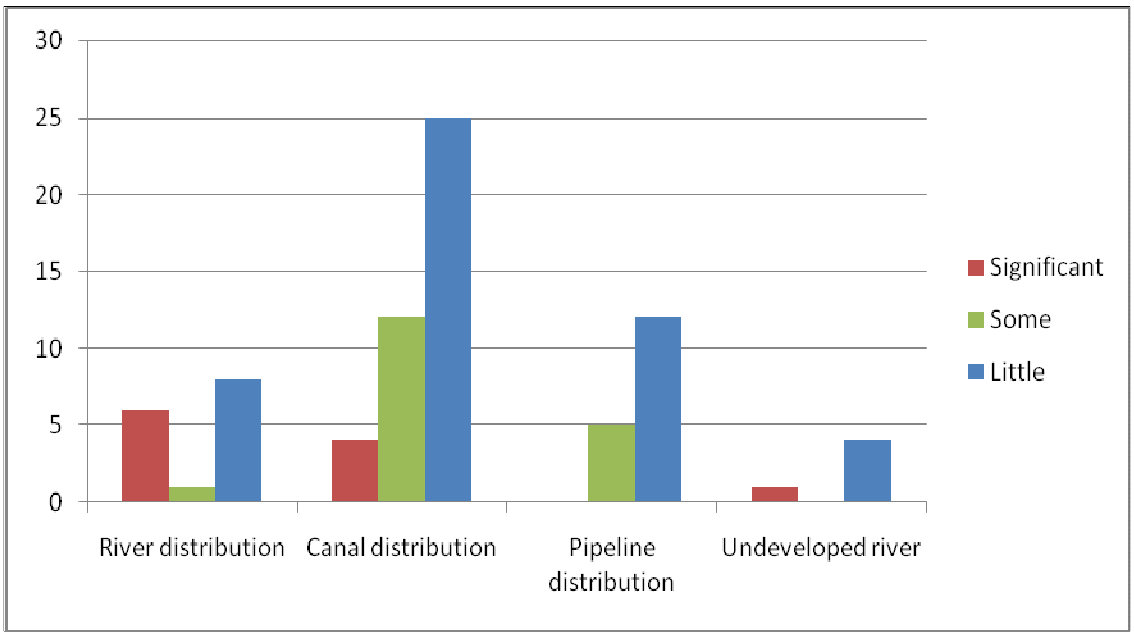

Figure 45: Unutilised water leaving the IO's area

B Contact details and further information

The information contained in this document was gathered and collated as a deliverable of WRC Project nr K5/1778//4 :*Awareness creation, implementation plans and guidelines for management of sustainable on-farm and on-scheme water measurement.*

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