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Self-Supply as a Complementary Water Services Delivery Model in Ethiopia

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ABSTRACT: Self-supply, where households invest to develop their own easily-accessible water supplies, is identified as an alternative service delivery model that is potentially complementary to more highly subsidised community-level provision. The approach is widespread in Ethiopia with family wells bringing additional benefits that are in line with wider government objectives, such as supporting small-scale irrigation. However, two recent studies show the current performance of traditional or family wells to be far below potential with most sources providing unsafe water in the absence of adequate protection. Wider formal recognition of Self-supply in policy and the development of the government-led Self-supply Acceleration Programme (SSAP) aim to extend access and improve aspects of performance including water quality. However, a key finding of the paper is that successful uptake of this programme requires a transformation in the attitudes of donor agencies and the roles of government regional- and *woreda*-level staff, amongst others. Necessary shifts in mindsets and revision of planning mechanisms, as well as the day-to-day operational support requirements, represent a challenge for an under-resourced sector. Other household-focused development interventions such as Community-led Total Sanitation (CLTS) and Household Water Treatment and Storage (HWTS) face some similar challenges, so the processes for the development of one approach could help in the scaling up of all.

KEYWORDS: Self-supply, groundwater, water supply, water quality, Ethiopia

BACKGROUND

Investment in new infrastructure has been rapidly extending protected rural water supplies to more and more Ethiopians over the past two decades. Rural water coverage is now reported by the government as 49% based on the findings of the National Water, Sanitation and Hygiene (WASH) Inventory which undertook data collection in 2010/11, compared to 15.5% in 1991 (Butterworth et al., 2013a). These estimates are based on the inventory of the number of communal water points and estimation of the number of people served (Butterworth et al., 2013b) excluding household-level sources and provision, which is the main focus of this paper. The World Health Organisation (WHO)/ United Nations Children's Fund (UNICEF) Joint Monitoring Programme reports a similar trend in the use of improved water facilities, based on household survey data and potentially including some household-level sources if adequately protected, from 4% in 1990 to 39% in 2011 (WHO and UNICEF, 2013).

Despite this progress, the government and the water supply sector face multiple challenges. While more than half the rural population still lack access, the rural water supply coverage target to be achieved by 2015 is 98% (MoWE, 2011a). At the same time as extending supplies even faster to the un-served population, there is a need to sustain services where systems have already been provided, and to improve water quality. With such an ambitious target to provide access to water rapidly to all, and looking for alternatives, since 2009, the policy of the Ethiopian federal government has been to give more emphasis to lower-cost technologies and Self-supply for water supply in rural areas (MoWR, 2009).

Self-supply relies upon households to take the initiative and to largely finance their own investments in the development of a water source. This is typically a hand-dug well although other possible technologies include manually drilled wells and rainwater harvesting (Sutton, 2004, 2009a). Households may also make improvements and further investments over time such as protection, lifting devices and HWTS. Conventional service delivery in rural water, in contrast, concentrates on communal systems, with external financing being provided for everything except a small initial capital contribution and operation and maintenance costs. While households are the key actors in Self-supply, the approach requires a supporting enabling environment (at various levels in both public and private sectors) in order to encourage its wider uptake and better performance and safe use of such facilities. Developing this enabling environment has been termed Self-supply Acceleration (Sutton, 2011; Smits and Sutton, 2012).

Family-owned wells are fairly widespread in some parts of Ethiopia, although the digging of wells does not appear to have as long a tradition as might be expected or as in some other countries. Levels of groundwater exploitation still remain well below the potential in most parts of the country and there is much scope for further development. While in general, aquifers are not high yielding (Kebede, 2013), they are mostly more than adequate for household-level exploitation and there are huge resources available given the size of the country and reasonable recharge rates. Ethiopia is reckoned to hold the largest stored groundwater reserves in Africa apart from Botswana and countries associated with the Nubian sandstone aquifer that underlies most of northern Africa (Macdonald et al., 2012). The limited water requirements of small-scale irrigation and domestic supply will be often met from aquifers mapped as low yielding and overlooked by classical hydrogeological investigations. In such hydrogeological conditions, multiple access points provided by relatively low-yielding hand-dug or manually drilled wells are most appropriate. Self-supply, being a widespread mechanism for developing shallow groundwater resources potentially has a large role to play in the future development of Ethiopia's water resources.

This paper reflects critically on the outlook for Self-supply as a service delivery model in Ethiopia and the government's incipient SSAP. The SSAP was started in 2012 to develop a nationwide programme to promote Self-supply. However, until now, the SSAP has received little funding and activities have been limited to policy development, coordination between stakeholders, planning for pilots and wider implementation, and the development of proposals for funding.

The paper draws upon two main sources of information. Firstly, the key findings of two studies of existing traditional wells used for drinking water supply in the Southern Nations, Nationalities, and People's Region (SNNPR) and Oromia Region are presented. These included extensive water-quality sampling, and household surveys that included questions on the performance and motivations for investing in traditional wells. Secondly, it sketches a brief institutional analysis and reflects on the policy development process for Self-supply in Ethiopia, including the findings and follow-up of national conferences, campaigns and working groups on the issue.

PRACTICES AND PERFORMANCE: KEY FINDINGS OF STUDIES IN OROMIA AND SNNPR

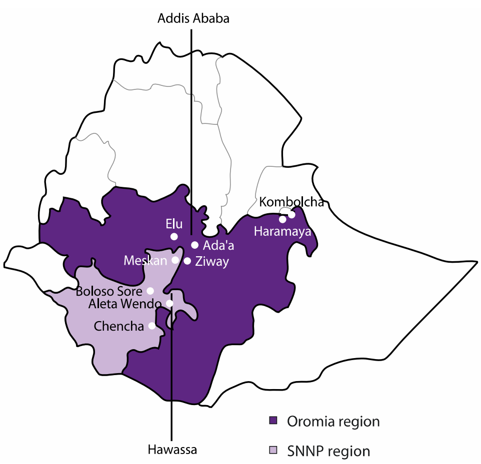
Two studies undertaken in 2010/2011 focused on the existing use of traditional wells and provide a baseline on which current efforts can be built; firstly, a study in the Oromia region with support from UNICEF (Arma Engineering and Sutton, 2010) and secondly, in the SNNPR, a study with the support of the RiPPLE research programme (Sutton et al., 2011). Both studies involved extensive collaboration or were carried out with government support at regional and *woreda* (district) levels. The studies employed similar methodologies including water-quality analysis (using portable bacteriological field kits), source surveys and household surveys. The studies aimed to investigate the major questions associated with Self-supply, i.e.; the risks and performance in comparison to community water sources, as well as examining the ways in which family wells are currently developed and the related socio-economic issues. The overall aims of the studies were to:

1. Propose an acceptable benchmark/standard (or options) for family wells based on an analysis of (microbial) water quality and well characteristics.
2. Develop approaches (e.g. using sanitary surveillance to estimate water-quality risks, and also taking account of other key aspects of performance) for use in promoting family well development and upgrading.
3. Better understand processes of family well development in order to identify how best to support and accelerate their contribution (including equity issues) to water supply access in ways that build upon the existing practices and capacities.
4. Examine progress with rope pump introduction as a technology that is highly complementary to family well development.

The sampling strategy was to identify *woredas* and *kebeles* (a sub-district administrative level) where traditional wells were known to be used for drinking, and then to sample most sources used for drinking in those areas. Further information is available in a combined report (Sutton et al., 2012), the full study reports (Arma Engineering and Sutton, 2010; Sutton et al., 2011) and on rope pump introduction by Mammo (2010) and Sutton and Hailu (2011). In total, the surveys included bacteriological water-quality analysis from 722 family wells (including 85 fitted with rope pumps) and 58 communal sources (with hand pumps). More than 700 household surveys were completed including households that owned wells, shared family wells or relied on communal sources. Most surveying was undertaken in the rainy season (61% samples) when contamination would be expected to be most severe, with further samples (39%) being taken in the dry season, 90 of which were duplicates of the same sources for purposes of direct comparison.

Thermo-tolerant coliform level (TTC/100 ml) was taken as an indicator of contamination. The Rapid Assessment of Drinking Water Quality by WHO and UNICEF (2010) also uses TTC as its main indicator, and counts 0 TTC/100 ml as 'very low risk' and <10 TTC/100 ml as 'low risk'. The location of the study sites in Oromia and SNNPR is shown in Figure 1 together with the location of the regional centres, Addis Ababa and Hawassa.

Figure 1. Location of study woredas.

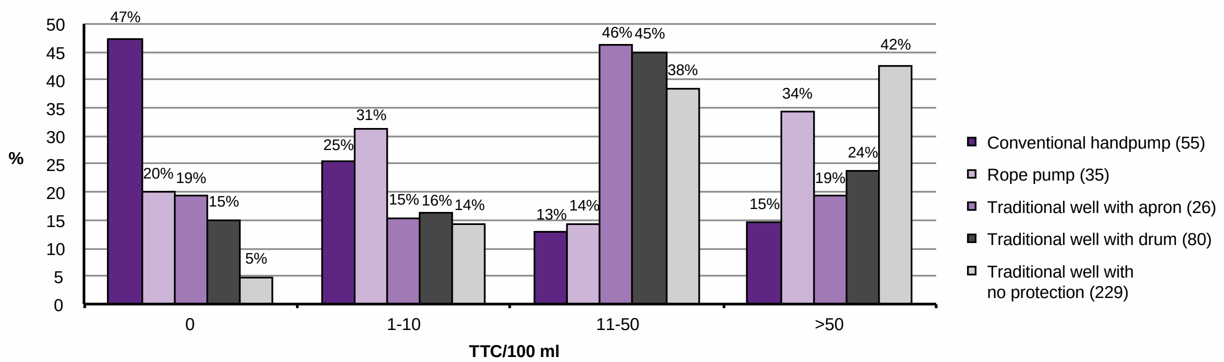


Water quality of household and community sources

The benefits of protection, and potential for improvement

As might be expected, a progressive improvement in water quality was found among the main supply types as levels of protection (and cost) increase (Figure 2). Samples taken in the wet season were assumed to represent the worst case scenario. At that time, some 72% of conventional hand pumps on fully protected wells provided water of low health risk (combining wells in the categories 0 and 1-10 TTC/100 ml), and 47% of very low risk (0 TTC/100 ml). In contrast, only 5% of unprotected wells and around a fifth of semi-protected wells (a common construction being to use an oil drum to form a parapet, which is then sometimes joined to an impermeable apron) or rope pumps gave water with zero TTC/100 ml. However, more than half of all rope pumps (52%) and a third of semi-protected wells (34%) offered a low health risk. This can be viewed in two ways. One view is that risks are very much higher from traditional wells, even when fitted with a rope pump. However, it may also be inferred from the significant number of traditional wells with little or no contamination that lower-cost solutions can provide good water. There have generally been few efforts to provide technical advice or other support to well owners to reduce contamination. No traditionally constructed wells were found to have adequate aprons, a key factor in protection.

Figure 2. Water quality in different source types (wet season).



Although hand pumps show the best water quality with increased protection from contamination, hand pumps on boreholes and sealed fully lined wells with drainage did not consistently provide safe water and just over one in six was found to be significantly contaminated. This pattern of risk levels is comparable with country-wide results for hand pumps from the Rapid Assessment of Drinking-Water Quality (RADWQ) project (WHO and UNICEF, 2010) and from a more local study in Shebedino, Sidama (Plan International, 2006).

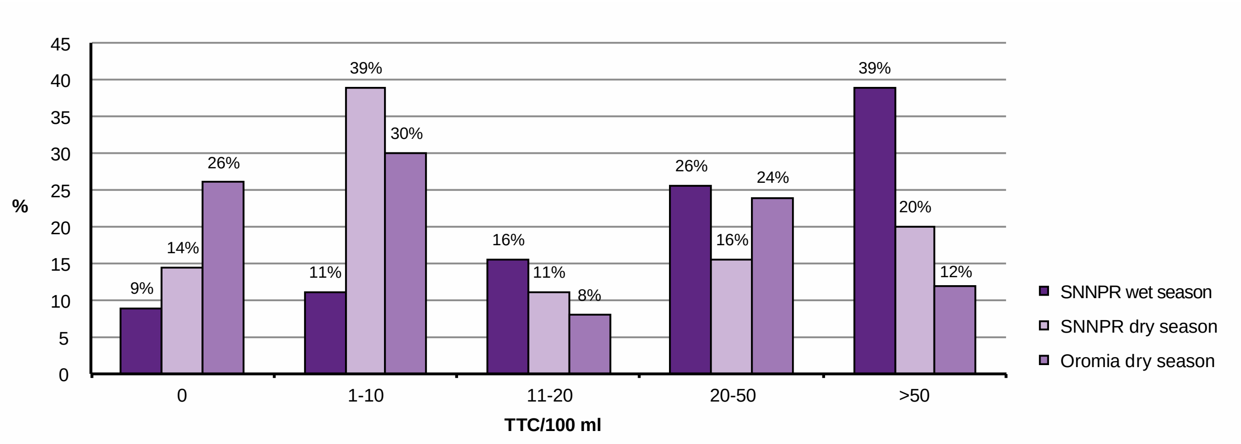
In the first wet-season surveys, in Aleta Wendo, Boloso Sore and Chencha, 52% of rope pumps delivered water of less than 10 TTC/100 ml. In Ziway, a follow-up survey in the dry season found only 39% supplied water at low risk. Most of the rope pumps sampled were not installed to a standard suitable for drinking water supply. In some cases, especially in Ziway, they were installed primarily for irrigation, but were also used for domestic purposes. In other cases, where rope pumps were meant for domestic purposes, simple precautions to reduce risks of contamination were still lacking. Often, the tops of wells with rope pumps were below ground level or with the ground sloping towards the pump (all of the pumps in Chencha were like this) so that water could accumulate around the top slab and seep into the top of the well. There were seldom any aprons or drainage systems around the top slab (<10%), and water spilling from the rope or inadequate spout on the riser pipe could therefore easily return to the well. However, in Aleta Wendo the four rope pumps sampled were found to be better sited above ground level on well-drained slopes with good site hygiene, and gave consistently good quality (0-2 TTC/100 ml) in both wet and dry seasons.

Practices in protecting traditional wells were found to be woreda-specific, probably not only because of ground conditions but also partly because well owners tend to copy their neighbours' ideas. Many wells, especially in parts of Boloso Sore, Meskan and Elu had little or no protection against run-off into the well. Low abstraction rates would imply that contamination from animal dropping and debris could have long-lasting effects. However, in wells protected under the Productive Safety Net Programme in Boloso Sore, and through the efforts of many well-owners in Haramaya and Ada'a, better protection was found to be afforded by oil drums or masonry parapets with small aprons, thereby reducing the risks of returning contaminated water from the surface. A drum or masonry parapet plus apron were found to significantly reduce contamination in the wet season, halving the proportion of water with high levels of TTC (from 42 to 19%), and increasing those with no faecal coliform by a factor of almost four.

Seasonal fluctuations in water quality

In SNNPR, 90 traditional wells were sampled both in the wet and dry seasons, and in Oromia a further 50 were sampled in the dry season. Wet-season patterns of water quality in SNNPR showed a steep rise towards high contamination levels with 9% having no thermo-tolerant coliform (Figure 3). In the dry season the same wells showed a much more gradual increase in risk, with 14% having no TTC and a larger proportion (53% vs. 20%) found to contain water of low risk. With over half of traditional wells in both SNNPR and Oromia having less than 10 TTC/100 ml, these supplies performed equally well in the dry season as the 319 protected springs sampled in the RADWQ study (WHO and UNICEF, 2010). The latter technology is counted in 'coverage' according to national statistics, but the former is not.

Figure 3. Comparative wet and dry season bacteriological water quality in 90 unprotected traditional wells in SNNPR and Oromia during the dry season.



Observed seasonal variations – with dry-season water quality generally improving in most well types, but worsening in some others – indicate that contamination in traditional wells has complex causes. Overall, it appears to arise mainly from very local sources of pollution including run-off, dirty ropes and buckets and debris falling or being blown into wells. Such contamination will be short-lived unless there is much organic material in the well or when abstraction is much less than storage leading to long residence time of water in the well. Other factors may include seasonal practices of animal watering, local aquifer contamination, or reducing thickness of the unsaturated layer in the wet season. On the other hand, low housing density, wider distance from any points of pollution, and thickness of unsaturated ground all reduce the risks of widespread aquifer contamination in rural settings. If general aquifer contamination were to be blamed, quality improvement to zero TTC on a seasonal basis would not occur, but this is widely found. Measures that could reduce surface water seepage back into the well include stabilising and sealing the well head (including adequate apron) from the well shaft and keeping the rope and bucket cleaner. Such measures can be as simple as providing a hook on the well cover or nearby, so the rope and bucket can be hung off the ground when not in use.

Wells with mechanised pumping

A follow-up to the main survey targeted mechanised (diesel or electric submersible) wells in locations of high agricultural potential. Fifty such wells were sampled together with a similar number of wells with rope and bucket in the same areas. Water quality with mechanised pumping was found to be high, attributed to water not coming into contact with the rope and bucket and associated dirt, and the high turnover of water for irrigation and home use, drawing freshwater faster from the aquifer. This is despite the minimal protection of such wells. Over half of these pumped wells fell into the very lowest risk category (0 TTC/100 ml) and 82% of samples had <10 TTC/100 ml which exceeds even the performance of conventional wells fitted with hand pumps (Table 1).

Table 1. Water quality in Oromia traditional wells (with rope and bucket or with mechanised pumps) in the dry season.

TTC/100 ml	Unprotected rope and bucket wells	Semi-protected rope and bucket wells	Mechanised pumps
	% (n. 30)	% (n. 20)	% (n. 50)
0	27	25	56
1-10	23	40	26
11-20	10	5	8
20-50	30	15	0
>50	10	15	10

Other aspects of the performance of family wells

Reliability

Three indicators were included in household surveys to assess the reliability of wells. Firstly, the surveys in Oromia and SNNPR asked about the absolute reliability of sources, in terms of whether a supply had ever dried up or whether it had dried in the last five years. Additionally, for all supply types, SNNPR users were asked about the number of days in the past year the supply had not provided water. For wells with bucket and rope, this would be the time the well would run dry, whilst for those mounted with pumps that had failed, it was the length of time the pump had not been working. A third indicator used was that provided by the Bureau of Water Resources (BoWR), which gave the regional proportion of functioning and non-functioning rope or hand pumps. This is an unbiased and less-localised indicator of performance, since the Oromia and SNNPR surveys only included wells which were functioning at the time of the study. Only the second indicator was applied to all supply types. In the case of 'drying up', users were not necessarily able to differentiate between a pump not delivering water because it had broken down, or because the source was dry.

The available BoWR statistics for SNNPR showed levels of functionality in 2008/2009 of 79% for hand pumps on drilled boreholes or hand-dug wells, 59% for rope pumps on dug wells and 72% for spot spring sources.

Traditional wells are often assumed to be very unreliable, partly because they are usually constructed without de-watering pumps and lining which would allow deeper penetration of the aquifer. Lifting devices (bucket and rope) however are less likely to break down than a hand pump. In the six woredas surveyed, there was a range of source reliability (see Table 2). The overall number providing water throughout the last five years (in SNNPR) or since construction (in Oromia) was 79%. The second follow-up survey in Oromia in Haramaya and Kombolcha, was biased by the numbers with mechanised pumps (half the wells surveyed) and the fact that well owners are unlikely to put additional funds for a pump into a well which anyway goes dry. Some 96% of the 100 traditional wells in Oromia surveyed during the second survey had not run dry during the previous five years. Overall, an average of four out of five wells of the wells surveyed, were said never to have run dry in the previous five years or in the case of the first Oromia survey since construction (which was, on average, nine years ago).

Many of the family wells surveyed appear to be in areas where the ground is consolidated but not very strongly cemented, so wells could be dug easily but have not collapsed over many years. Water-level fluctuations appear minimal, or the water level could be followed down as droughts progressed so that after a few years the depth of the well was sufficient to provide supplies even in the driest years. In Aleta Wendo for instance, half the wells that have been deepened no longer go dry (despite average seasonal water-level fluctuations of almost five metres), but the other half still need further deepening to become reliable. Half of all the wells surveyed in SNNPR have never needed deepening after initial excavation.

Table 2. Ranked reliability of traditional wells surveyed in Oromia and SNNPR.

Woreda	Number of wells surveyed	Wells that never dried in past 5 years %
Ada-A*	113	97
Kombolcha	119	96
Haramaya 2	50	96
Meskan	119	92
Haramaya 1*	127	87
Boloso Sore	106	75
Aleta Wendo	111	67
Elu*	157	42
Total/ average	902	79

Note: * = Oromia first survey (wells never dried since construction)

Reliability refers not only to sources which have provided water all the time, but also to the speed with which those which fail can be brought back into operation (length of down time). In SNNPR, information was collected from all source types on the number of days a functioning supply was out of action in the previous 12 months. Of the hand pumps which were working (around 80% of the total, if the BoWR figures for 2008/2009 are still approximately representative), 72% provided an uninterrupted service over the previous 12 months. Thus, overall, some 59% of all installed hand pumps were estimated to have provided a reliable service over the previous year.

Of the rope pumps visited, 83% had provided an uninterrupted service in the previous year (but only functioning pumps were visited). Again using BoWR figures from 2008/2009 that showed 41% of all installed pumps were not functioning at that time, it was estimated that some 50% of all rope pumps installed provided an uninterrupted service. Some 80% of all traditional wells with a rope and bucket had provided uninterrupted service.

Many pumps took longer than a month to repair, and 25% of hand pumps and 18% of rope pumps had been out of action for more than a month. Maintenance systems seem to perform less than perfectly in many woredas, but some such as Meskan (262 out of 268 hand pumps functioning) show that higher efficiency is possible.

Overall, traditional wells were found more likely to deliver a year-round supply of water than conventionally constructed wells with hand pumps, even in Meskan where functioning levels of hand pumps are at their highest. Because people can and do maintain the facilities themselves, traditional family wells were the most likely to provide a year-round supply.

Adequacy and user satisfaction

Family wells were also found to perform better than communal sources in terms of adequacy, defined as a supply sufficient to meet user needs (Table 3). There was no difference in the responses of those using semi-protected or unprotected traditional wells, with 76 and 75% of users of such wells indicating that the supply was adequate all year, while very few (less than 5%) felt it was never enough at any time. Rope pumps scored similarly (78%). Conventional hand pumps provided adequate supplies for 70% respondents. There are, however, big differences in the purposes for which such supplies are used. Relatively few users (fewer than one in five) of communal supplies took more than drinking and cooking water from these sources so adequacy does not refer to all uses as it does for most family wells. Communal well users tended to regard hand pumps as only providing a part of their needs, with other sources being used to help satisfy their total domestic demand. Queuing and distance deter people from using hand pumps for all purposes, and traditional wells therefore appear to provide an integral part of overall service delivery.

In Oromia, a slightly higher level of adequacy was found among family-owned wells, whether mechanised for irrigation uses, and/or providing for animals and domestic purposes. Dry-season surveys in Kombolcha and Haramaya found wells to provide an adequate year-round supply for all uses in 90 and 82% cases, respectively.

In some areas of Oromia (e.g. Walisso) people dig wells to have their own more easily accessible supply even when they know that the supply may only be sufficient for a few months each year. If these months are the ones which are critical for having as much time as possible in the fields, the well is still worth having even if it does not provide water all year. Here, the idea of conjunctive use of several sources for different purposes and different times of the year is again the norm when looking at family practice in water collection and use. Future measures of coverage and service delivery could do more to consider these patterns, and how different supplies may contribute to an adequate overall domestic supply.

User satisfaction provides a fourth dimension of performance (Table 3). Rope pumps were rated the highest in terms of user satisfaction despite their generally poor installation. Conventional hand pumps were also highly valued.

Overall performance

If water quality and the three other measures of performance are equally considered it is possible to gain a more holistic view of service delivery from the user's point of view (see total scores in Table 3). This analysis shows that hand pumps do provide better service than other options, and that rope pumps and traditional family wells can offer a service that is not generally so inferior as to be easily dismissed, especially at the household level. Taking comparable data from the survey, it is apparent that since the rope pump performs better in terms of reliability, adequacy and user satisfaction than the hand pump, this compensates to some degree for its lower water quality, but highlights the priority which needs to be given to improving protective measures and installation standards. Rope pump performance was only one point below that for hand pumps, because of the latter's poorer reliability and user satisfaction. Greater attention to better maintenance systems for both conventional and rope hand pumps is needed.

At woreda level, the analysis shows where user satisfaction is compromised by lack of promotion of better lifting devices and protection for family wells, as in Meskan, and that pump maintenance systems bring down scores in Aleto Wendo, which are compensated for by better water quality. The scoring helps to emphasise that a pump capable of producing good-quality water is of little value if the supply itself is interrupted for significant lengths of time. The comparatively high score for privately owned mechanised pumps in Oromia shows the potential strength of private ownership combined with productive use.

Table 3. Different dimensions of performance by source type.

Supply type	Water quality %	User satisfaction %	Reliability %	Adequacy %	Total score (maximum possible 400)
Conventional hand pumps	72	91	72	70	305
Rope pumps	43	100	83	78	304
Semi-protected traditional wells	34	80	68	76	258
Unprotected traditional wells (wet season)	19	82	87	75	263
Unprotected traditional wells (dry season)	53	82	87	75	297
Mechanised wells (Oromia)	82	98	94	92	369

Notes: Total score is integer sum of the percentages
Water quality: samples with low risk (deemed capable of simple improvement to zero TTC/100 ml)
User satisfaction: users satisfied with supply
Reliability: supplies which did not break down in the last 12 months
Adequacy: supplies providing adequate water for needs from that source

Recommendations from benchmarking family wells and the use of sanitary surveillance

Comparing the performance of family wells and communal water supplies, with particular attention to water quality, the key conclusions and recommendations are that:

- The performance of traditional wells with mechanised pumps for irrigation was found to exceed that of communal hand pumps and protected springs, suggesting that these wells ought to be counted when deriving coverage figures. Such a well should have an impermeable parapet, a sealed top slab and an apron if water accumulates around the well.
- Rope pump water quality and reliability were both found to be weak, but have the potential for improvement. In SNNPR (except Aleta Wendo), installation was generally sub-standard. User satisfaction was however found to be very high among those who have the necessary contacts and links to keep their pumps working. Properly installed rope pumps can also provide safe water and could be justifiably counted towards coverage. Installation guidelines and retraining appear to be needed.

- Semi-protected traditional wells at household level, with an adequate impermeable apron and parapet, also significantly reduce health risks as compared to unprotected wells, and could also be counted towards coverage. Results from the survey show that it is perfectly possible to obtain water with zero TTC/100 ml (and certainly less than 10 TTC/100 ml) from wells using a rope and bucket. This is easier in the dry season, which suggests that moves to decrease risks of contamination from wet, dirty well surroundings and water-drawing equipment can lead to low-risk supplies, and ones which are adequate for household use. New, simple standards using minimum cement (to keep costs low) need to be developed as prototypes for training and promotional purposes. A suggested target would be to aim at achieving at household level a water-quality profile of <10 TTC/100 ml initially in 50% of cases, but aiming for 90% to meet that low risk standard within five years.

Decisions on what should be considered safe, and the best strategies to promote safety, should be based on an informed debate about the risks. The water-quality performance of traditional wells appears to have much potential for improvement, although whether this can be achieved and sustained requires testing. It is also necessary to bear in mind that many protected communal sources were also found to deliver unsafe water, and that water is known to be frequently contaminated between source and home. What can be concluded is that the association of improved sources with the provision of safe water appears too simplistic, and that there is a need to promote water safety across all source types and to consider progressive improvements in service in terms of other aspects as well, such as convenience of access and reliability. It is also necessary to more widely accept realities in the complexity of supply as not being necessarily only one source, and not only one purpose to fulfil demand.

A further complication associated with monitoring traditional wells is that conventional sanitary surveillance, designed for conventional wells, may not be appropriate. Sanitary surveillance scoring normally uses observation of ten elements of well construction and hygiene to indicate relative risks of contamination. It is a partial substitute for expensive water-quality analysis and can highlight aspects of a source which needs improvement (WHO, 2005). The studies therefore also looked at the degree to which this scoring system reflects actual measured water quality for different sources types including family wells.

Comparison of the standard sanitary surveillance system against measured wet-season water quality in communal (hand pump) sources resulted in a reasonably good fit. It was found to predict risks for installation of standard hand pumps with a fair degree of confidence (80%). The results for traditional wells were much poorer however, with only weak correlations identified between score and TTC counts. The sanitary surveillance system pinpointed hardly any of the wells providing water without contamination, and these wells, indicated as being at highest risk, could actually have any level of TTC count. A broader system is recommended, replacing the standard 'yes' and 'no' answers with a five-point scale of increasing protection for 15 aspects of traditional wells. The scoring identified the elements with greatest impact in reducing risk on observed wells as: 1) an apron, 2) an impermeable parapet, 3) no solid or faecal waste within ten metres and 4) a well mouth sealed from ingress of dirt or surface water (Westbury, 2011). However since all observed aprons were inadequate, greater improvements can be made than those which were observed.

Factors driving family well development

Understanding the reasons for families to take up Self-supply is key to developing marketing-based strategies and should be a central component of development efforts such as the SSAP. The development of family wells is mainly driven, among other factors, by householder’s desires to have water for different purposes, privacy and convenience such as proximity to the house. The studies examined to what extent availability of finance, wealth status and education played a role.

Making investments

Costs incurred by households in developing family wells were found to vary enormously. In richer farming areas, the investment in a traditional well may exceed US$1000 (assuming a nominal exchange rate of Ethiopian Birr [ETB]17 to US$1), but averaged about ETB7000 (about US$400) for the well and its protection, rising to ETB13,000 (about US$750) if a mechanised pump is installed. In poorer areas, simple completion of a well with minimum protection may cost only some US$10-40, with most work done by unskilled labour. Most well owners in SNNPR were found to employ unskilled labour, but in Oromia, well owners employed skilled labour. It was only in Meskan in SNNPR, but more widely in Oromia, that the owners and families were found to carry out much of the work themselves to reduce costs. Few owners looked beyond the family for unpaid inputs, as this may reduce the ownership of their supply.

Loans for excavation and development of wells were found to be rare since micro-credit institutions and traditional savings schemes do not tend to recognise water supply as a good investment. Even where large investments are required (e.g. for mechanised pumps) families tend to raise the money from their savings and from selling agricultural produce. Most well owners (80%) expected to recover the cost of investing in a mechanised pump within one year in Oromia, and of a rope pump in SNNPR in six months. Possible ways to support capital investments include: 1) making available micro-credit that allows bridging between one harvest and the next; 2) building more on savings schemes, both traditional and modern; and 3) establishing smaller incremental steps in the Self-supply technology ladder, which allow income-generation with less initial cost, from which bigger investments are then made possible. The rope pump, for example, may be best promoted in the beginning as an affordable interim step between rope and bucket and mechanised pumps, but one which enables small-scale irrigation and so increases income for further investment.

Wealth and education

It may be assumed that only the richest people will be able to invest in a well, and that Self-supply is not possible for the poorest or most disadvantaged households. The surveys investigated this access issue relying on woreda-specific wealth ranking of well-owning households and sharers (so comparisons cannot be made between woredas).

In SNNPR, over a third (37%) of well owners fell in the poorest wealth quintile, compared with 18% in Oromia. Some 26% of SNNPR well owners and 10% in Oromia were in the top two wealth quintiles. The majority of owner households had no, or only one, indicator asset (58% in SNNPR, 61% in Oromia). Overall, these findings suggest that initiative rather than wealth might be the main enabler in constructing a well. It was also apparent that it is not so much the best educated but the most motivated who have invested in wells. Just under half the number of wells (42% in SNNPR, and 47% in Oromia) were owned by households whose heads are illiterate, and two-thirds have not completed primary education (87% and 58%, respectively).

Overall, it appears that ownership of a well is not at all confined to the richest, but that further investment in the well is linked to greater wealth, without being able to say which leads to the other. Generally, greater access to water allows more income-generation, and so more potential to invest in further improvements to supply and to other aspects of the household.

DEVELOPMENTS IN WATER SUPPLY POLICY AND PLANNING

Over the past decade there has been consistent and developing interest in Self-supply within Ethiopia (Sutton, 2010; Mamo et al., 2011). Nevertheless, with a few exceptions, the kinds of water supplies developed by households and described in the first part of the paper have generally received little sustained support from government or NGO programmes. The second part of the paper reflects on the recent history of implementation and policy development with respect to Self-supply and assesses the outlook for national efforts to establish the SSAP, based on an analysis of the institutional context.

A major government-led implementation effort – the Family Well Campaign of 2004-2006 – resulted in the construction of a remarkable 85,000 family wells in Oromia (and almost 10,000 community hand-dug wells). This raised awareness on the potential contribution of family wells to water supply, but the campaign was not continued or wholly successful (Mammo, 2010; Arma Engineering and Sutton, 2010). While it highlighted demand and potential, there was a need for more careful scaling-up and to sustain efforts over the longer term. Perhaps most critically, the Family Well Campaign illustrated that targets and monitoring indicators need to be in line with implementation efforts. These new family wells were not, according to the sector's monitoring efforts at the time, counted towards improving coverage. This proved a major disincentive to continuation of the campaign.

With the support of international agencies such as UNICEF and the World Bank Water and Sanitation Programme, the country then received technical assistance to develop its Self-supply strategies, particularly from the Rural Water Supply Network (RWSN) which has been an international champion of Self-supply as an approach to water supply. International gatherings have also been used to promote consideration of the approach in Ethiopia. Papers on the topic were presented with Ethiopian government participation in major sector conferences such as the 2009 Water, Engineering and Development Centre (WEDC) Conference held in Addis Ababa (Sutton, 2009b; Workneh et al., 2009) and the 2011 Rural Water Supply Network Forum held in Uganda (Mamo et al., 2011). Commitments on Self-supply have also been made at international gatherings such as the World Water Forum and the Sanitation and Water for All High Level Meeting by leading government representatives (see Table 4).

Table 4. Some recent milestones and policy developments

Time	Milestone
2004-6	Family Well Campaign resulting in the construction of over 85,000 family wells in Oromia (Mammo, 2010; Arma Engineering and Sutton, 2010).
2008	National Consultative Workshop on Self-supply held in Wollisso agreed on a definition of Self-supply as "Improvement to water supplies developed largely or wholly through user investment usually at household level" (Workneh and Sutton, 2008).
2009	Revised Universal Access Plan (UAP 2009-2012) specifically promotes low-cost technologies at both household and communal levels (MoWR, 2009).
April 2011	Draft national WASH implementation framework includes Self-supply as a service delivery model with some key implementation principles outlined (MoWE, 2011b).
October 2011	Findings of debates at the second National Workshop on Self-supply based on Oromia and SNNPR research studies (Sutton et al., 2012) results in government and stakeholder commitment to the SSAP.
January 2012	Federal Democratic Republic of Ethiopia/Ministry of Water & Energy national policy guidelines for Self-supply in Ethiopia (Guidelines to support contribution of improved Self-supply to the WASH Growth and Transformation Plan (GTP)/UAP) published (see Sutton et al., 2012).
March/April 2012	Commitments made by the Government of Ethiopia at the 6th World Water Forum (March 2012, Marseille, France) and at the Sanitation and Water for All High Level Meeting (April 2012, Washington, DC, USA) to establish "Self-supply as a service delivery mechanism for rural water within the national WASH programme" (Sources: Anon.; 2012; Butterworth, 2012).
July 2013	Self-supply included as a Strategic Intervention Area within the draft One WASH National Programme (planned Sector-Wide Approach or SWAp) (FDRE, 2013).

But what about developments in national policy, and even more critically, the uptake of Self-supply at regional level? In decentralised Ethiopia the regions have considerable powers. Following a national workshop held in 2008 (see Table 4) Self-supply was included in national policies such as the 2009 Universal Access Plan which has guided sector development over recent years. Despite this, there is little evidence of implementation at regional level. The strategy and implementation modalities for accelerating construction and use of family wells have been missing, with limited piloting of approaches (beyond technology options) to develop these. Self-supply was reflected much less prominently in draft updates of the UAP (MoWE, 2011a). Widely held concerns about the approach, including water-quality risks, were also not addressed until the results of research studies were reported in 2011 (Sutton et al., 2012; and summarised earlier in this paper).

It is fair to say that there has been a reluctance, and indeed resistance, to the idea of more widely supporting Self-supply. The concern expressed most frequently by many sector professionals has been about the safety of water for drinking from family wells. With fewer data available for traditional family wells than 'improved' communal sources, but with relatively little data about either, there has been much uncertainty about water-quality risks. Views have then been put forward and consolidated without much supporting evidence. Although often only based on anecdotal evidence, concern is also widely expressed that promoting Self-supply, other than for domestic purposes, might lead to over-exploitation of limited groundwater resources that are also vulnerable to climate change and land degradation.

Here there appear to be some major discrepancies in the perceptions and driving forces of households involved in the development of family wells, and professionals engaged in promoting better (and largely communal) water supplies. While the willingness of households to invest in Self-supply is evidence that families as end users often value the advantages of water provided by family wells much more than the disadvantages, the lack of implementation and funding of Self-supply acceleration reflects remaining concerns of many sector professionals (although there are important exceptions and champions) and donors.

As we have seen, traditional or family wells are often not protected sufficiently to be considered safe supplies by experts or officials; nevertheless, they are valued and invested in by people with scarce resources and frequently used by their owners and neighbours as drinking water sources (all the sources surveyed in the studies reported in the first part of the paper were used for drinking). Improved community-managed sources (run usually by a locally selected Water, Sanitation and Hygiene Committee [WASHCO]) are, in contrast, widely considered to provide safe water, despite the fact that often they do not, and in practice quality is not monitored either systematically or regularly. Communal systems are also prone to breakdowns and seldom provide for all domestic needs. The functionality of improved sources (generally recently constructed or rehabilitated) is reported as 74.5%, or, in other words, at any given time about a quarter of systems are not working (MoWE, 2012). This leads to people collecting water from a poorer-quality or less convenient and more distant source. Significant levels of contamination are also known to affect a proportion of water transported from the source to the house potentially undermining the quality of all supplies (Wright et al., 2004; WHO and UNICEF, 2010).

Time-savings have been shown to be the dimension of water supply and sanitation that generates the greatest economic benefits (Hutton and Haller, 2004); so it should not be a surprise that households rate the convenience of more local family wells highly. Convenient household supplies are also considered to favour the more vulnerable (sick and aged) and significantly reduce the burden of water collection, which is mostly borne by women. Being located closer to the home, the water drawn from family wells may also be used for productive activities such as vegetable gardening, food processing, and irrigation of seedling as well as for livestock, drinking and other domestic uses. Such water uses, and the development of private-sector support services and markets are therefore likely to support food-security goals and economic development objectives. These are set out in the GTP (MoFED, 2010) which, in theory, provides the overarching framework to guide national development including water. However, the water sector remains focused on a single main indicator of a supply of 15 litres per capita per day from a protected source within 1.5 km.

In 2011, a key document which is now widely informing the sector – the draft WASH implementation framework or WIF (MoWE, 2011b) − clearly identified Self-supply as a service delivery model alongside woreda-managed projects (to be handed over for management by communities) and community management projects (community projects that feature community-managed grants for contracts to develop sources). The 'WIF' also set out some key principles on how this should be done including the reliance on household investment (in hardware) and the facilitating and advisory role of government.

Yet there has again been little take-up of Self-supply within the annual plans of regions, or the programmes of NGOs. Important exceptions would be an integrated project by UNICEF and government aiming to link WASH, nutrition and small-scale irrigation, and more technology-led interventions supported by International Development Enterprises (an NGO) and the Japanese International Cooperation Agency (JICA) focusing on rope pumps. This lack of uptake may just be a matter of time but there have also been other constraints. Since regional government budgets (as collated in the UAP plans) focus on capital investments to be made by government in new construction (family wells carry a zero price tag in these spreadsheets since the hardware costs are met by households), there has been little incentive for regions (and woredas) to include Self-supply as an option in their plans. Outside donor-funded projects there have not been any specific and operational mechanisms (e.g. dedicated budget lines) for regions and woredas to request or allocate funding for Self-supply accelerating or 'software' activities (such as promotion, training and advisory support). The budgets that are generally available for promotion and training tend to be very limited.

Opportunities to link Self-supply to the prevailing community water-supply interventions in training, monitoring, and promotion have also been little developed, as are potential links with health. However, Self-supply requires a similar household-based approach to sanitation and hygiene interventions such as CLTS and HWTS (Harvey, 2011) and the agriculture sector is also more familiar with household-level interventions. Both health and agriculture sectors have greater capacities at the grassroots than the water sector which will need to develop similarly (this has been proposed by MoWE) or rely on the development of private-sector capacity. However, private-sector capacity is low. In this context, Self-supply may even best be promoted as an add-on to watershed development or small-scale irrigation programmes but with greater attention to water quality.

Promotion of Self-supply at scale is also hampered by the fact that family wells are not counted by government as contributing to coverage. The new National WASH inventory (NWI) now includes a question whose answer will yield information on the number of family wells used as the primary household drinking water source (MoWE, 2011c). This may yield important new information on the reality of access to water in the country, although it will still not reflect the true density of family wells (many wells are used as secondary or seasonal sources). Furthermore, there is no agreement yet on which family wells should be considered as safe sources, and therefore contribute to coverage.

OUTLOOK

So now what is the outlook for Self-supply as a service delivery model in Ethiopia? Is it likely to make a major contribution to water access and development over the coming decade and beyond? Will the idea be able to move from the policy documents to widespread implementation? And how could its contribution be maximised? Table 5 attempts to summarise some key strengths and weaknesses, as assessed by the authors in areas including policy, capacity and evidence, and some opportunities and threats related to current initiatives and attitudes.

Table 5. SWOT analysis of institutional context for Self-supply Acceleration in Ethiopia.

Level	Strengths	Weaknesses	Opportunities	Threats
National	Self-supply incorporation in key policy documents including One National WASH Programme. Focal person for Self-supply in MoWE with dedicated team Working Group on Self-supply established Developing evidence-base on Self-supply in Ethiopia Large number of NGOs active in WASH, many with track records in innovation	No agreement on benchmark for safe family wells (to include in coverage calculations) or need for phased approach to improving water quality Less evidence available on the performance of small group investments (compared to family wells) Limited piloting of implementation approaches to date Relatively little experience of NGOs with Self-supply (with some important exceptions, e.g. International Development Enterprises)	Potential to learn from promotion of household-led investments in sanitation (CLTS) and HWTS Self-supply fits well into development programmes that emphasise integrated approaches, private-sector development, and the leveraging of investments Self-supply being piloted in some new WASH implementation projects, e.g. UNICEF-led 'NUWI2' project which takes an integrated approach to water, sanitation and hygiene including Self-supply, Community Managed Projects and productive uses, and JICA-funded rope pump project Collaboration with agricultural development efforts (ambitious targets for private investment in rope pumps)	Pressure to scale up before piloting undertaken or capacity requirements addressed Independent actions of different sectors (e.g. Water and Agriculture) targeting the same farmers and resources (shallow groundwater), with different policies. Sources of contamination other than microbial, e.g. fluoride may be hard to manage through Self-supply
Regional	Several regions have specific interests and experience with Self-supply (e.g. Amhara, SNNPR, Oromia), and training and support have been provided by the national focal person	Self-supply not appropriate in some regions (family wells need shallow groundwater or plentiful rainwater)	Potential for micro-finance institutions to lend for household investments (new sources and upgrading) in productive assets like family wells	Lack of planning and financing mechanisms for the 'software' activities needed for Self-supply Acceleration
Local (woreda/ kebele)		Private-sector capacity (well digging, masons, supply chains for pump parts) poorly developed	Markets for high-value horticultural products developing in some areas	Confusion at household/ community level between different approaches

Around the time of writing, in August 2013, Self-supply was further recognised and included in the Sector-Wide Approach (or SWAp) known as the One WASH National Programme (OWNP) as a 'strategic intervention area' with a substantial (but yet un-funded) US$8 million budget line (FDRE, 2013). This provides an opportunity to develop implementation models and align Self-supply with sector monitoring efforts amongst other constraints. This section tries to assess whether this further policy development is likely to lead to greater levels of implementation.

Ethiopia is sensitive to international sector trends in WASH, participating in fora like the Sanitation and Water for All partnership, and the major international agencies such as UNICEF, World Bank and DFID should be expected to exert considerable policy influence on the final shape of the OWNP. Ethiopia will also depend on international support to help finance the programme. The attitudes of these actors to Self-supply will therefore be important.

There is (and will remain) obvious concern amongst donors, government and NGOs about being associated with poorly protected sources that do not meet standards and that are currently more likely than not to deliver contaminated water. This is in fact the prevailing view, and leads to frequent exclusion or ignorance of family wells as a water supply option. It stems from thinking within government and development partners about water supply systems rather than services, a narrow focus on improved communally managed sources which are assumed to be always safe (sometimes ignoring the evidence that communal sources need water-quality improvement too and with frequent breakdowns), and a perhaps unrealistic desire to deliver quick results. The end result is implementation strategies that focus on providing the safest possible water to some rather than making more widespread and continual improvements, even if these might arguably reach more people and be more sustainable. Well-documented pilots, which demonstrate water-quality improvements over time associated with the upgrading of Self-supply sources, and the complementary contribution alongside communal supplies are needed to inform implementation strategies. Support for Self-supply may come from international policy trends and the proposed post-2015 Sustainable Development Goals with their focus on equity (part of the vision is that everyone should have safe water, sanitation and hygiene at home [WHO and UNICEF, 2013]) and making progressive improvements as required by the human right on water and sanitation.

The approach in Self-supply is fundamentally different from current practices: not to provide for construction of improved communal supplies that should (by their design) be safe, but to promote the gradual improvement of household-level sources that present risks that can be identified with low-cost improvements and behavioural changes possible to reduce risks. The multiple-barrier approach as promoted in wastewater irrigation – including by agencies like WHO with its key role in WASH – offers lessons on how this could be approached (WHO, 2006). Embracing such an approach requires a major shift in mindsets, and in a context of limited capacities this may yet be the biggest challenge for the government's SSAP.

Given the increasing focus of key funding agencies, particularly DFID, on cost-effectiveness and value-for-money in decision-making, further evidence will be required on the actual costs of Self-supply Acceleration and its impacts. A rapid analysis by the authors of seven Self-supply Acceleration programmes in Zambia, Zimbabwe and Uganda shows an average cost of US$8 per capita public investment (range US$2-20) which leveraged US$1.9 (range US$0.2-4) private investment for every dollar. In contrast, community water supply programmes (costs of two programmes in similar areas in Zambia and Uganda) cost US$39 (range US$35-45) and with little leverage, i.e. only 2.5 cents (range 1-5 cents).

National policy priorities are likely to remain focused on achieving universal coverage through rapid (and necessarily low-cost) infrastructure development. At the moment, SSA offers a potential way to accelerate progress in improving rural water supplies in a context of quite low coverage and frequently widely-scattered households. Here, a constraint is finding space to spend a few (e.g. 1-3) years developing the enabling environment and capacities needed. In some other countries with already high coverage, and where Ethiopia will hopefully find itself over the coming decades, Self-supply is also of interest in serving the last 10 or 20% where the costs of extending other facilities to the hardest to reach may be prohibitive (Smits and Sutton, 2012). Countries that have already reached universal access have nearly always done so by including Self-supply as one option within a mix of service delivery models (Smits and Sutton, 2012). Self-supply has a role to play in almost all countries, although it is more often formally recognised in high-income countries.

The future development of sector monitoring efforts in Ethiopia – and the inclusion or otherwise of indicators related to household provision in the National WASH Inventory – will also be critical. This requires government to find ways to calculate the contribution of Self-supply that is consistent with the key indicators and where counting safe Self-supply sources is the key issue. In the longer term, innovation in service-delivery approaches – where the approach embraces all the people within an area and the services (including water quality, convenience, reliability and adequacy) they receive – will perhaps encourage recognition of Self-supply with NGOs adopting area-based and integrated implementation models likely to be the first to experiment.

Ending with some more research questions seems appropriate: beyond technical issues the development of traditional or family wells has been a neglected field of research in Ethiopia, and there remain critical questions about how the approach can be accelerated to address its problems without losing the advantages. These might include:

- What rates of update are possible through supporting Self-supply Acceleration measures? How far will ideas spread or will they need repeated piloting and introduction in new locations? There may be similarities to donor-dependent CLTS, or does ignition of Self-supply have different characteristics?
- What are the tensions and positive synergies between household and communal sources? Do household-level options undermine community supply (e.g. through reduced payments) or help take pressure off overstretched sources? At what level of community supply will people give up their household sources? Could community institutions like WASHCOs have a role to play in promoting Self-supply?
- What are the actual multipliers of investments with Self-supply, e.g. the per capita cost of the acceleration activities needed to leverage private investments and over what periods do support activities need to continue to help build up markets sufficiently?
- What is needed to sustain private-sector capacity in services to both community and private water supply? Is integration possible or are different tiers of private-sector capacity needed?
- As households move up the technology ladder towards mechanised pumping with energy costs, should owners be allowed to generate income from water sales (rather than sharing freely with neighbours) as is happening in some peri-urban contexts? Direct income could help encourage micro-finance institutions to lend for new investments but it could also threaten equity in what is currently a highly egalitarian approach with access to wells generally shared freely for drinking water.

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