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# Water Habits and Hygiene Education to Prevent Diarrhoeal Diseases: The Zambezi River Basin in Mozambique*

**Francisco González-Gómez, Enrique Lluch-Frechina and Jorge Guardiola****

***Abstract*:** This research analyses the relationship between certain water-related habits and infrastructure likely to influence the frequency of diarrhoea in children that are five years old or younger. The study is implemented using an ordered logit model with information from 334 households from the Zambezi river in Mozambique, with children who were aged up to five years. The main objective of this paper is to emphasize the importance of hygiene education in the prevention of gastrointestinal diseases in children aged five years old and under, that are affected by poor access to water systems and sanitation. Maintaining hygiene is especially important in households with young children, who are more vulnerable to gastrointestinal diseases. The results of the research reveal that in households that do not know that water transmits illnesses and where they do not wash their hands before preparing a child's meal, the children suffer diarrhoea more frequently. The main recommendation is to invest in hygiene education programmes to reduce the risk of illnesses such as diarrhoea. Improvements in access to water and sanitation may not be sufficient in order to improve life conditions if there is no hygiene education.

## 1. Introduction

There have been important efforts in recent years to improve water and sanitation access in the world (WHO and UNICEF, 2010). However, the situation is far from optimum, particularly in the least developed countries. In those regions, a lack of or underdeveloped water infrastructure, high vulnerability to short and long-term drought and difficult access to reliable water supplies, especially for rural people, are more evident (United Nations, 2008). Bad conditions in access to water and sanitation put citizens in a vicious cycle of poverty, malnutrition and disease (Handoussa, 2009; Conceição *et al*., 2011).

One of the most important problems related to the lack of access to improved water and basic sanitation are the associated gastrointestinal diseases, mainly diarrhoea. Four billion cases of diarrhoea occur annually, of which 88 per cent are attributable to unsafe water and inadequate sanitation and hygiene (WHO, 2002, 2007). Moreover, every year there are 1.7 million diarrhoeal deaths related to unsafe water, sanitation and hygiene (www.who.int/topics/diarrhoea/en). Preventing diarrhoea is basically an objective to avoid human losses, but also to avoid unnecessary suffering, reduce sanitary costs, increase productivity and avoid school absenteeism (Payment and Riley, 2002).

Contaminated water can cause diarrhoea, but the pathogens that provoke diarrhoea can also be transmitted by ingesting contaminated food and other beverages, by person-to-person contact and by direct or indirect contact with infected faeces. That is why diarrhoea prevention includes enhanced water quality and sanitation access, as well as the promotion of hand washing and other hygienic practices (Clasen and Cairncross, 2004; Clasen *et al*., 2006). There is abundant literature that analyses the efficiency of the different measures aimed at reducing gastrointestinal diseases. Literature reviews and meta-analysis provide an accurate perspective on the effect of different measures on the reduction of diarrhoea (Esrey *et al*., 1991; Curtis and

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**Francisco González-Gómez, Universidad de Granada, Facultad de Ciencias Económicas y Empresariales. Campus de Granada, sn, 18012 Granada, Spain. Enrique Lluch-Frechina, Universidad Cardenal Herrera-CEU. C/ Luis Vives 1, 46115 Alfara del Patriarca, Valencia, Spain. Jorge Guardiola (corresponding author), Universidad de Granada, Facultad de Ciencias Económicas y Empresariales, Campus de Granada, sn, 18012 Granada, Spain; e-mail: jguardiola@ugr.es.









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Cairncross, 2003; Fewtrell *et al*., 2005; Arnold and Colford, 2007; Clasen *et al*., 2007; Ejemot *et al*., 2008; Aiello *et al*., 2008; Schmidt and Cairncross, 2009).

Among the various ways of reducing diarrhoea, hygiene education is essential in developing countries. Although improving access to water and sanitation is an indispensable human right that gives dignity to people, it requires large investments. Therefore, it is more realistic in the short term to base the reduction of gastrointestinal diseases on changing the habits of the population in order to improve personal and domestic hygiene. According to Project Concern International, to educate people to maintain basic hygiene and water habits, contributes to better health, food security and increased quality of life. The water habits that should be taught to the population are, among others, to wash their hands before eating, preparing or serving a meal, after going to the toilet, after playing outside and after touching animals. Moreover, eyes should not be touched with dirty hands and raw food should be carefully washed. Personal hygiene refers to the water used by people to clean their bodies, including water for their faces, hands and eyes. Domestic hygiene refers to the water used to clean the house, for example food, utensils and floors (Esrey *et al*., 1991).

The main objective of this paper is to emphasize the importance of hygiene education in the prevention of gastrointestinal diseases in children aged five years old and under in countries with poor access to water systems and sanitation. Maintaining hygiene is especially important in households with young children, who are more vulnerable to gastrointestinal diseases. The incidence of diarrhoea is higher in the two first years of life (WHO and UNICEF, 2009).

In the case of Mozambique, the research highlights the importance of hygiene education to reduce the prevalence of diarrhoea. This country, which is one of the least developed in the world, is also a clear example of the relationship between diarrhoea and the lack of access to water and sanitation. Mozambique has one of the highest mortality rates in the world among children five years of age and under at 135 per thousand (UNICEF, 2011). After pneumonia and malaria, diarrhoea is the third cause of infant mortality, accounting for 12 per cent of infant deaths (WHO, 2010). The water access and sanitation situation in Mozambique still requires much improvement, as 47 per cent of the population does not have access to safe and improved drinking water (WHO and UNICEF, 2010). Moreover, only 8 per cent of the population has access to water through pipes in their houses. However, only 17 per cent of the population has access to improved sanitation facilities and 42 per cent defecate outdoors.

This research analyses the relationship between certain water-related habits and infrastructure likely to influence the frequency of diarrhoea in children that are five years old or less. The study is implemented using an ordered logit model with information from 334 households with children who were aged five years or less. The data for the research come from a field study conducted by the authors in the Zambezi river basin in Mozambique. The study was implemented as part of the project 'The Conditions of Life in the Zambezi River Basin', which began in August 2004 and finished in December 2006. The funding came from the University CEU Cardenal Herrera, the Catholic University in Mozambique and the NGO Cáritas in Spain and in Mozambique.

This research is structured as follows: Section 2 describes the field work and the few water policies implemented in the region, as well as the field study, the variables and the methodology. Section 3 shows the results and in Section 4 a discussion is made in the light of the existing literature. Finally, Section 5 concludes.

## 2. The Region of Zambezi, the Field Work and the Methodology

### *2.1 Study Area*

Mozambique is one of the world's poorest countries. It is ranked 185th out of 187 countries by the Human Development Index (UNDP, 2013) and only eleven countries in the world (all in Africa) had a lower PPP gross national income output per capita in 2012. Other significant figures are as follows: 90 per cent of the total population earn less than $2 a day, child malnutrition stands at 21.2 per cent of children under 5 years, the mortality rate for children under the age of five is 168 per 1,000 and the maternal mortality rate stands at 520 per 100,000 live births (World Bank, 2010).

These figures hide big differences between the regions. Mozambique is a long country with 2,470 kilometres of coastline. Maputo, the capital and the richest area in the country is in the south, less than 100 kilometres from the southern border. In terms of real GDP per capita, the province of Maputo records averages that are three times higher than the national average, and five to six times higher than the per capita GDP of Niassa, Cabo Delgado, Zambezia and Tete. (UNDP, 2006, p. 19). The second largest city in Mozambique is Beira. It is in the province of Sofala and the direct route linking Harare (capital of Zimbabwe) and Beira seaport brings a lot of income to the city and the lands close to this route.

This study was carried out in six districts in the centre of Mozambique: Marromeu, Caia and Chemba in the province of Sofala, Mopeia and Morrumbala in the province of Zambezia and Mutarara in the province of Tete. These six districts are close to the Zambezi river, except for Morrumbala, where the Chire River, an important affluent of the Zambezi, crosses the land. The region studied is one of the poorest areas in the country. It was quite affected by the Mozambique war and has suffered severe flooding over the last few years.

The climate is different in the six districts. Chemba, Caia, Mutarara and Morrumbala have a dry climate with annual rainfall ranging from the 650 mm in the inland area in Chemba to the 1,017 in Morrumbala. The eastern part of Mopeia and Marromeu has a tropical and humid climate and as those areas are closer to the sea, part of the soil is sandy and salty. The period between November and March accounts for some 80 per cent of total rainfall.[1]

When the field work was undertaken, the area had suffered two serious episodes of flooding that concentrated a large quantity of international aid in 2000 and 2001. The area has since suffered more floods at the end of 2005, in 2007 and in 2008. Furthermore, the area was heavily affected by the long war in Mozambique, when a lot of people had to abandon their homes and move to other places (in Mozambique or in Malawi). The war and the floods destroyed water infrastructures. Only in the second part of the 90s did the situation return to normality, but there were a lot of people that had just come back from another part of Mozambique or from the refugee camps in Malawi. The problems of the long war in Mozambique, the floods and the fact that the area was controlled by the political party opposed to that in power (Renamo vs Frelimo), resulted in the infrastructures in the area being poor.

The people in the region of the Zambezi have access to water through fountains, which are the most improved water sources in Mozambique. Some people access water from less safe places such as artesian or improved wells and the river. The improved wells are made of concrete, which improves access to the well and avoids soil and dirt falling inside, contrary to current wells that are nothing more than holes in the ground. The people living in the basin store water in order to make fewer journeys, as they need to transport it. They use either large plastic water bottles, bowls or earthenware pots to store the water. Large plastic water bottles are the best system to avoid the contamination of water, because they can be closed with a screw top in order to prevent dirt and insects from entering. The other systems are less safe as they are open and do not avoid the entrance of external elements in the water. There are not many latrines in the Zambezi region and those that do exist are not very high quality. The best latrines have a cesspool, but many were already overflowing and had not been renewed. Some others were simply four walls to avoid neighbours seeing you go to the toilet.

It is worth highlighting that the area has not experienced substantial changes in regard to improving water access. Some actions are implemented by foreign governments, such as the United Kingdom and the Netherlands, as well as international organizations. It is worth mentioning the recent action taken by the African Water Facility to implement a project as part of the National Rural Water Supply and Sanitation Program (PRONASAR) in the Nampula and Zambezia Provinces in Mozambique (African Development Bank Group, 2010). The main objective of this project is to increase sustainable access to the rural water supply and sanitation, as well as to contribute to reducing rural poverty through increased access to the water supply and sanitation services in the provinces of Nampula and Zambezia. Additionally, some non-governmental organizations such as Caritas Mozambique are implementing improvement programmes for food safety that include the building of water infrastructures in the region.

## *2.2 Data*

Within the context of the analysis described in the last section, characterized by a water and sanitation deficit, we estimate the effect of several hygiene education-related variables on the frequency of diarrhoea. Although our interest lies in hygiene, some water access-related variables are also added. The study involved 334 households that had children who were five years old or less. This subsample was taken from the 1,410 observations that were available in the study.

The statistics on the population of the area of the Zambezi river were not good at the time of the survey. During the years leading up to the study, a lot of refugees returned from other countries and other areas of Mozambique to the areas that were unpopulated because of the war. Taking this into consideration, the villages were selected with the information from the Mozambique national statistic institution and the advice from the people of Caritas of Mozambique who work and live in the area.

The interviews were conducted by six teams, one in each area. The teams comprised one university teacher from the Universidade Catolica of Moçambique (UCM) or from the Universidad CEU Cardenal Herrera in Valencia, who guaranteed the quality of the survey and also interviewed the leaders in each area to take qualitative information about them. The pollsters that

were selected to do the interviews knew the local language and their number changed according to the population of the area, ranging between three (the smallest) to six (the two largest). The team of pollsters (between 4 and 6) arrived at a village each day and were left in different parts of the village (villages are vast). They chose the households randomly but tried not to choose households close to one another. The interviews were conducted in the house where the person interviewed dwelled, so the interviewer could view and check directly if several observable answers were true or not. More information on the field work can be found in Lluch Frechina and Alamá Sabater (2006).

### 2.3 Variables

In the fieldwork, interviewers asked households how often their children suffered from diarrhoea in the following way: they could have *diarrhoea* once a year or less, once a month or more than once a month.

The variables that we assume influence diarrhoea are divided into two groups: water infrastructures and hygiene education. First, the group of water infrastructures — contemplating in the first place whether or not the household has access to a *fountain*. A fountain is a well with a mechanism to remove the water from it. It is not open to the sky and uses some type of manual hydraulic pump. The other water sources are the traditional well, which is an earth hole dug by the family or by the neighbourhood; the improved well, which is a hole with concrete walls, normally deeper than an earth hole; and the river itself or a tributary. Fountains are considered the safest water source, in comparison to the river, a traditional well or an improved well. A second variable reports whether or not the household stores water in *plastic water bottles*. This is the best way of storing water, as mentioned in the previous section. Finally, households were asked whether they had access to a *latrine*. Each variable takes a value of one if the household possesses this technology and zero otherwise.

The second group of variables refers to water habits and hygiene education and is the focal point of this research. This group includes the variable *knowledge*, which takes a value of one if the interviewee knows that water transmits illnesses and zero if he or she does not know. In addition, it includes the variable *hands*, which takes a value of one if the interviewee washes his or her hands before preparing a child's meal.

The variable *diarrhoea* refers to a frequency variable that is grouped into categories. The first category equals one if the children suffered diarrhoea once a year or less, equals two if suffered once a month and three if suffered more than once a month.

### 2.4 Methodology

Taking into account that the objective is to assess the influence of the independent variables on increasing or decreasing this variable, we could perform the estimations using the ordered logit technique, which is suitable for categorical dependent variables, the categories of which follow a natural order.

The estimations are implemented using Stata 11.0. More on this methodology can be found in Cameron and Trivedi (2009). The effect of the independent variables on the dependent variable could be determined by the estimation if the coefficient of each variable is significantly different to zero, in which case the sign and size of the coefficient would provide an idea of the direction and magnitude of this effect.

## 3. Results

In this section the influence of water hygiene and habits on the probability of suffering diarrhoea are estimated, together with some aspects of the infrastructure. Table 1 shows the descriptive statistics of the variables in this study.

In order to solely capture the influence of each group of variables and the joint interaction, we estimate three different models, using *diarrhoea* as the dependent variable: two including each group of variables and one including both groups.

Table 2 presents the influence of each group of variables shown above on the probability of raising the frequency of diarrhoea. In a previous version of the models, the regions were included as explanatory variables, but found to be non-significant. The models have a low pseudo $R$ square, indicating that a large proportion of the variance in frequency remains unexplained. Nevertheless, the chi-square statistic is significant at 5 per cent for every model, which indicates that the model is useful for forecasting.[2] As it is not our intention to fully explain the frequency of diarrhoea, but to assess the influence of habits and water access technology on this frequency, the models are suitable for our purposes. The coefficients of the variables do not differ much

**Table 1: Descriptive statistics (percentages of the variables)**

| Variable | Total | Mutarara | Morrumbala | Caia | Mopeia | Chemba | Marromeu |
|---|---|---|---|---|---|---|---|
| Dependent variable: diarrhoea | | | | | | | |
| Once a year or less | 55.9 | 62.4 | 55.7 | 33.9 | 63.0 | 51.5 | 69.2 |
| Once a month | 32.9 | 27.2 | 37.7 | 53.2 | 33.3 | 12.1 | 28.2 |
| More than once a month | 11.2 | 10.4 | 6.6 | 12.9 | 3.7 | 36.4 | 2.6 |
| Independent variables: Infrastructure | | | | | | | |
| *Fountain* | 11.6 | 10.5 | 8.2 | 3.2 | 59.3 | 9.1 | 2.6 |
| *Latrine* | 26.9 | 15.2 | 32.8 | 24.6 | 51.9 | 27.3 | 41.0 |
| *Plastic water bottles* | 29.7 | 19.2 | 14.8 | 24.2 | 63.0 | 18.2 | 82.1 |
| Independent variables: Habits and hygiene | | | | | | | |
| *Knowledge* | 87.3 | 91.2 | 96.7 | 67.7 | 88.9 | 87.9 | 89.7 |
| *Hands* | 85.3 | 94.9 | 77.6 | 68.9 | 88.9 | 81.8 | 94.6 |
| Number of observations | 347 | 125 | 61 | 62 | 27 | 33 | 39 |
| Percentage of total sample | 100 | 36.0 | 17.6 | 17.9 | 7.8 | 9.5 | 11.2 |

**Table 2: Influence of infrastructure, habits and hygiene on diarrhoea**

| Variables | (1) | (2) | (3) |
|---|---|---|---|
| Independent variables: Infrastructure | | | |
| *Fountain* | 0.2213 | | 0.4820 |
| | (0.3317) | | (0.3451) |
| *Latrine* | −0.1569 | | −0.2502 |
| | (0.2427) | | (0.2594) |
| *Plastic water bottles* | −0.6992*** | | −0.6061*** |
| | (0.2444) | | (0.2555) |
| Independent variables: Habits and hygiene | | | |
| *Knowledge* | | −1.1795*** | −1.1783*** |
| | | (0.3108) | (0.3162) |
| *Hands* | | −0.7279** | −0.7270** |
| | | (0.2912) | (0.2964) |
| Number of obs. | 334 | 334 | 334 |
| Pseudo R square | 0.0145 | 0.0381 | 0.0502 |
| *Wald* test of joint significance ($\chi^2$)[a] | 9.37(0.0247) | 23.63(0.000) | 30.98(0.000) |

*Notes*: Standard errors between brackets, under the estimated coefficient for each variable.
[a] Probability of non-significance of the model in brackets.
* Significant at 10%; ** significant at 5%; *** significant at 1%

between models, and the variables that are significant are the same for the three models. Storing water in plastic bottles, the knowledge of water transmitting illnesses, and washing hands before preparing a child's meal reduces the frequency of diarrhoea, as the coefficient is negative and the variable is estimated to be significant. On the other hand, having access to a fountain and having a latrine do not contribute to reducing the frequency of diarrhoea, as both variables are found to be non-significant by the models.

Concerning the variables related to habits and hygiene, both variables are found to be significant and negatively influence the probability of suffering diarrhoea.

## 4. Discussion

Diarrhoea is one of the main causes of death in less developed countries for children who are five years old or younger. The lack of access to water and sanitation plays a crucial role in the transmission of this illness. This is why different measures aimed at

preventing diarrhoea contemplate accelerating the provision of basic water and sanitation services. However, this measure alone does not appear to be sufficient. In this research, using data from 334 households in the Zambezi river basin evidence is obtained on the need to take preventive and complementary measures such as hygiene education.

Infrastructure improvements in water access have a positive impact on reducing gastrointestinal infections. Thus, the risk of transmitting the pathogens that cause diarrhoea is higher in rivers and community wells than in the water that comes directly through the pipes to the household. In addition, better access to water is related to improved hygiene. Tumwine *et al*. (2002) obtained that households in East Africa that have access to individual piped water connections use more than twice the amount of water for personal hygiene than households that do not have access to piped water. However, in our study there was no evidence that different access to water implies different probabilities of having diarrhoea. Kakakhel *et al*. (2011) explain that the absence of a relationship between the source of drinking water and the frequency of diarrhoea may be caused by improper sanitation and poor personal hygiene. Limitations in our model can also explain the absence of a statistically significant relationship between the water supply and the frequency of diarrhoea. In the absence of data, it was not possible to include a variable that captures water treatment at home to improve quality, a practice that reduces the number of cases of diarrhoea (Clasen *et al*., 2007). Water quality can also deteriorate during storage (Sobsey *et al*., 2003). In the research, fewer cases of diarrhoea are detected when water is stored in plastic bottles. Uncontaminated water at origin that is not stored properly can become contaminated and cause diarrhoea. It is possible to add that babies are often breast-fed, so there could be a possible connection only if they received a formula prepared with non-treated water. There is no way of knowing if the households in the sample could use water from other sources at the same time as drinking water from the fountain.

Sanitation, and more specifically, excreta disposal are key determinants of diarrhoea rates. Bellido *et al*. (2010) obtained evidence that there is a direct relationship between poor sanitation in the household, including half-pipe drains and rudimentary cesspools, and mortality in children under 5 years caused by water-borne diseases. In addition, Barreto *et al*. (2007) conclude that adequate house excreta disposal, no open sewage nearby, good refuse collection and neighbourhood drainage systems and the house being served by a paved road are factors that reduce the rate of childhood diarrhoea. However, according to Cairncross *et al*. (2010), there is generally weak evidence on that relationship.

In the case of Mozambique analysed in this paper, there is no significant evidence of the relationship between sanitation and diarrhoea either. The absence of evidence on this relationship could be because of the fact that the latrines to which households have access are low quality. Some of them are holes in the ground that, when they are full, can be very unhealthy. Children defecate wherever they like and can end up crawling in their own detritus. Sanitation facilities therefore need to be improved in the area.

The evidence obtained that hand hygiene reduces diarrhoea is in line with previous literature. Revisions of the literature uphold that hand washing with soap reduces the number of cases of diarrhoea more than improved water quality and excreta disposal (Esrey *et al*., 1991; Cairncross *et al*., 2010). In addition, Aiello *et al*. (2008) concluded that improvements in hand hygiene resulted in a 31 per cent reduction in gastrointestinal illness. The use of antibacterial soap showed little added benefit compared with use of non-antibacterial soap (Aiello *et al*., 2008). An alternative to soap is alcohol-based hand sanitizers. Similar results are obtained when using soap instead of alcohol-based hand sanitizers, which is the reason it is considered as a hand hygiene option for water-constrained environments (Bloomfield *et al*., 2007; Pickering *et al*., 2010). A worse option than the others, but better than not washing, is hand washing with water alone as it reduces the presence of bacteria on hands substantially (López-Quintero *et al*., 2009; Burton *et al*., 2011).

The findings of the present research also suggest that hygiene education is an important factor to consider. Previous research also discovered an inverse relationship between hygiene education and the frequency of diarrhoea (Nimri and Meqdam, 2004; Barreto *et al*., 2007; Samie *et al*., 2009; Mengistie and Baraki, 2010). If people have no knowledge that water can transmit illnesses, they may drink water from the river, or dirty water that has not been properly stored. In addition, for hand washing it is important that people know how to apply hand hygiene procedures correctly and at the correct time (Bloomfield *et al*., 2007). Hand washing before serving food and hand washing after defecation diminishes the frequency of diarrhoea (Alam *et al*., 1989).

Educating the population in regard to hygiene and water use is essential to combat diarrhoea in the area. Policies such as providing access to soap or teaching the population how to make it themselves at home could be quite useful (World Bank, 2005). Previous research has demonstrated the effectiveness of education campaigns to reduce diarrhoea. For instance, Sandora *et al*. (2005) showed that a hand-hygiene intervention including educational outreach, reminders and a free supply of alcohol-based hand sanitizers can reduce the transmission of gastrointestinal illnesses. Migele *et al*. (2007) show the effects of the involvement of teachers in raising awareness of the importance of hygiene for diarrhoea prevention.

This research has used two proxies for this—knowledge of water sickness and hand washing—but education campaigns should take into account much more. For instance, encouraging women to breastfeed their children, as this prevents them from suffering diarrhoea (Mock *et al*., 1993), as well as educating women to clean their nipples before breastfeeding. As the mother's behaviour is an important factor for children having diarrhoea, education campaigns could reduce this risk (Dikassa *et al*., 1993). It has been shown that when midwives wash their hands, mortality rates decrease by 19 per cent and the risk of neonatal mortality is reduced by 44 per cent if the mother washes her hands before touching her baby (Rhee *et al*., 2008). In addition, some other infrastructure actions could be implemented that go beyond improving water access and sanitation. Examples are constructing concrete floors inside houses instead of soil floors, to avoid children who crawl from dirtying their hands and later putting their dirty hands in their mouths. Another example is to create proper places to store food (Ekanem *et al*., 1991).

Moreover, it is important to note that it is not enough for the community to be aware of the importance of acquiring certain hygienic habits, such as washing hands. The main objective should be to change the community's habits until certain acts become common practice households, schools and communities around the world (UNICEF, 2009). It is also advisable to persist in the implementation of hygiene education campaigns. It is also advisable to persist in the implementation of hygiene education campaigns; and in a broader context to devote public money to health, the latter having a negative influence in under-five mortality (Anyanwu and Erhijakpor, 2009), as well as to invest in improved education (Kiendrebeogo, 2012). Although campaigns are effective the first time they are used, there is no guarantee that the effects are maintained over time (Luby *et al*., 2009).

## 5. Conclusions

The planned investment in forthcoming years in water access and sanitation in Mozambique will improve living conditions. However, it is equally important or even more so to invest in hygiene education programmes to reduce the risk of illnesses such as diarrhoea in the short term. Apart from the good intentions of international organizations that point to the achievement of the objectives over time, it is difficult to predict when adequate access to water and sanitation will be available in Mozambique. In addition, in order to have good access to water and sanitation, hygiene habits are not enough to reduce the incidence of diarrhoea.

Although there is no conclusive evidence of the additive effects of the water supply, sanitation and hygiene promotion on diarrhoea (Cairncross and Valdmanis, 2006; Fewtrell *et al*., 2005), it seems reasonable to design comprehensive programmes that take into account the joint improvement of these three factors. The programmes developed in the framework of the WASH strategy from UNICEF are a good example of joint actions (UNICEF, 2009). Programmes that foster hygiene, such as that implemented in the provinces of Nampula and Zambezia in Mozambique by the National Rural Water Supply and Sanitation Program (PRONASAR) and the African Development Bank is a good example in this direction. However, in the assessment of the implementation of hygiene education, the difficulty of identifying strategies that are sensitive to culture is recognized as a limitation (UNICEF, 2010).

Therefore, in spite of the aforementioned limitations of the model, the results suggest that improvements in access to water and sanitation may not be sufficient if there is no hygiene education. It is recommendable to take into account the following aspects: (1) hygiene education is especially relevant in the most vulnerable areas, with a lower level of education, and in rural areas; (2) hygiene education should not only inform, it should aim to change the habits of the population; (3) the effects of campaigns are limited over time, so a continued effort should be made; (4) programmes should be adapted to the culture and customs of the environment where they are to be implemented.

## Notes

1. This data came from the Ministério da Administraçao Estatal (2005a, 2005b, 2005c, 2005d, 2005e, 2005f).
2. The model that incorporates only the infrastructure-related variables is the only model out of the three that is not significant at 1 per cent. This means that these variables alone do not explain the variance of the variable *diarrhoea* as well as the other set of variables.

## References


African Development Bank Group (2010), 'National Rural Water Supply and Sanitation Program (PRONASAR) in Nampula and Zambezia Provinces', Program appraisal report, Tunisia.

Aiello, A. E., R. M. Coulborn, V. Perez and E. L. Larson (2008), 'Effect of Hand Hygiene on Infectious Disease Risk in the Community Setting: A Meta-Analysis', *American Journal of Public Health*, Vol. 98, No. 8, pp. 1–10.

Alam, N., B. Wojtyniak, F. J. Henry and M. M. Rahaman (1989), 'Mothers' Personal and Domestic Hygiene and Diarrhoea Incidence in Young Children in Rural Bangladesh', *International Journal of Epidemiology*, Vol. 18, No. 1, pp. 242–47.

Anyanwu, J. C. and A. E. O. Erhijakpor (2009), 'Health Expenditures and Health Outcomes in Africa', *African Development Review*, Vol. 21, No. 2, pp. 400–33.

Arnold, B. F. and J. M. Colford (2007), 'Treating Water with Chlorine at Point-of-use to Improve Water Quality and Reduce Child Diarrhea in Developing Countries: A Systematic Review and Meta-analysis', *The American Journal of Tropical Medicine and Hygiene*, Vol. 76, No. 2, pp. 354–64.

Barreto, M. L., B. Genser, A. Strina, M. S. Prado, S. M. A. Matos, L. A. dos Santos and S. Cairncross (2007), 'Effect of City-wide Sanitation Programme on Reduction in rate of Childhood Diarrhoea in Northeast Brazil: Assessment by Two Cohort Studies', *The Lancet*, Vol. 370, No. 9599, pp. 1622–28.

Bellido, J. G., C. Barcellos, F. S. Barbosa and F. I. Bastos (2010), 'Environmental Sanitation and Mortality Associated with Waterborne Diseases in Children under 5 Years of Age in Brazil', *Revista Panamericana de Salud Pública*, Vol. 28, No. 2, pp. 114–20.

Bloomfield, S. F., A. E. Aiello, B. Cookson, C. O'Boyle and E. L. Larson (2007), 'The Effectiveness of Hand Hygiene Procedures in Reducing the Risks of Infections in Home and Community Settings Including Handwashing and Alcohol-based Hand Sanitizers', *American Journal of Infection Control*, Vol. 35, No. 10, Supplement, pp. S27–S64.

Burton, M., E. Cobb, P. Donachie, G. Judah, V. Curtis and W. P. Schmidt (2011), 'The Effect of Handwashing with Water or Soap on Bacterial Contamination of Hands', *International Journal of Environmental Research and Public Health*, Vol. 8, No. 1, pp. 97–104.

Cairncross, S. and V. Valdmanis (2006), 'Water Supply, Sanitation, and Hygiene Promotion', in D. T. Jamison, J. G. Breman, A. R. Measham *et al*. (eds.), *Disease Control Priorities in Developing Countries*, 2nd edn, pp. 791–792. World Bank, Washington DC.

Cairncross, S., C. Hunt, S. Boisson, K. Bostoen, V. Curtis, I. Chung and W. P. Schmidt (2010), 'Water, Sanitation and Hygiene for the Prevention of Diarrhoea', *International Journal of Epidemiology*, Vol. 39, No. 1, pp. 193–205.

Cameron, A. C. and P. K. Trivedi (2009), *Microeconometrics Using Stata*, Stata Press, College Station, TX.

Clasen, T. F. and S. Cairncross (2004), 'Editorial: Household Water Management: Refining the Dominant Paradigm', *Tropical Medicine and International Health*, Vol. 9, No. 2, pp. 187–91.

Clasen, T., W. P. Schmidt, T. Rabie, I. Roberts and S. Cairncross (2006), 'Interventions to Improve Water Quality for Preventing Diarrhoea', *Cochrane Database of Systematic Reviews*, Vol. 3, Art. No. CD004794. DOI: 10.1002/14651858.CD004794.pub2.

Clasen, T., W. Schmidt, T. Rable, I. Roberts and S. Cairncross (2007), 'Interventions to Improve Water Quality for Preventing Diarrhoea: Systematic Review and Meta-analysis', *British Medical Journal*, Vol. 334, No. 7, pp. 782–91.

Conceição, P., R. Fuentes-Nieva, L. Horn-Phathanothai and A. Ngororano (2011), 'Food Security and Human Development in Africa: Strategic Considerations and Directions for Further Research', *African Development Review*, Vol. 23, No. 2, pp. 237–46.

Curtis, V. and S. Cairncross (2003), 'Effect of Washing Hands with Soap on Diarrhoea Risk in the Community: A Systematic Review', *The Lancet Infectious Diseases*, Vol. 3, No. 5, pp. 275–81.

Dikassa, L., N. Mock, R. Magnani, J. Rice, A. Abdoh and D. Mercer (1993), 'Maternal Behavioural Risk Factors for Severe Childhood Diarrhoeal Disease in Kinshasa, Zaire', *International Journal of Epidemiology*, Vol. 22, No. 2, pp. 327–33.

Ejemot, R. I., J. E. Ehiri, M. M. Meremikwu and J. A. Critchley (2008), 'Hand Washing for Preventing Diarrhoea', *Cochrane Database of Systematic Reviews*, Vol. 1, Art. No. CD004265. DOI: 10.1002/14651858.CD004265.pub2.

Ekanem, E. E., C. O. Akitoye and O. T. Adedeji (1991), 'Food Hygiene Behaviour and Childhood Diarrhoea in Lagos, Nigeria: A Case-control Study', *Journal of Diarrhoeal Diseases Research*, Vol. 9, No. 3, pp. 219–26.

Esrey, S. A., J. B. Potash, L. Roberts and C. Shiff (1991), 'Effects of Improved Water Supply and Sanitation on Ascariasis, Diarrhea, Dracunculiasis, Hookworm Infection, Schistosomiasis, and Trachoma', *Bulletin of the World Health Organization*, Vol. 69, No. 5, pp. 609–21.

Fewtrell, L., R. B. Kaufmann, D. Kay, W. Enanoria, L. Haller and Colford, J. M. Jr. (2005), 'Water, Sanitation, and Hygiene Interventions to Reduce Diarrhoea in Less Developed Countries: A Systematic Review and Meta-analysis', *The Lancet Infectious Diseases*, Vol. 5, No. 1, pp. 42–52.

Handoussa, H. (2009), 'Lessons from the MDGs in Africa', *African Development Review*, Vol. 21, No. 2, pp. 213–23.

Kakakhel, Z. M., S. Ibrar, W. A. Khan, H. Bibi, S. A. Zamir, S. S. Khan, S. Khan, S. Khan, W. Tariq, M. H. Tahir and S. Iqbal (2011), 'Assessment of Frequency of Diarrhoea in Relation to Drinking Water among Residents of Nurpur Shahan', *Journal of Pakistan Medical Association*, Vol. 61, No. 9, pp. 934–937.

Kiendrebeogo, Y. (2012), 'Access to Improved Water Sources and Rural Productivity: Analytical Framework and Cross-country Evidence', *African Development Review*, Vol. 24, No. 2, pp. 153–66.

Lluch Frechina, E. and L. Alamá Sabater (2006), *Las condiciones de vida en la cuenca del río Zambeze*, 1ª Edición, Madrid, Cáritas Española Editores.

López-Quintero, C., P. Freeman and Y. Neumark (2009), 'Hand Washing among School Children in Bogota, Colombia', *American Journal of Public Health*, Vol. 99, No. 1, pp. 94–101.

Luby, S. P., M. Agboatwalla, A. Bowen, E. Kenah, Y. Sharker and R. M. Hoekstra (2009), 'Difficulties in Maintaining Improved Handwashing Behavior, Karachi, Pakistan', *The American Journal of Tropical Medicine and Hygiene*, Vol. 81, No. 1, pp. 140–45.

Mengistie, B. and N. Baraki (2010), 'Community Based Assessment on Household Management of Waste and Hygiene Practices in Kersa Woreda, Eastern Ethiopia', *The Ethiopian Journal of Health Development*, Vol. 24, No. 2, pp. 103–109.

Migele, J., S. Ombeki, M. Ayalo, M. Biggerstaff and R. Quick (2007), 'Diarrhea Prevention in a Kenyan School through the Use of a Simple Safe Water and Hygiene Intervention', *The American Journal of Tropical Medicine and Hygiene*, Vol. 76, No. 2, pp. 351–53.

Ministério da Administraçao Estatal (2005a), *Perfil do distrito do Caia, Província de Sofala*, 1ª Ediçao, Maputo.

Ministério da Administraçao Estatal (2005b), *Perfil do distrito de Chemba, Província de Sofala*, 1ª Ediçao, Maputo.

Ministério da Administraçao Estatal (2005c), *Perfil do distrito de Marromeu, Província de Sofala*, 1ª Ediçao, Maputo.

Ministério da Administraçao Estatal (2005d), *Perfil do distrito de Mopeia, Província da Zambézia*, 1ª Ediçao, Maputo.

Ministério da Administraçao Estatal (2005e), *Perfil do distrito de Morrumbala, Província da Zambézia*, 1ª Ediçao, Maputo.

Ministério da Administraçao Estatal (2005f), *Perfil do distrito de Mutarara, Província de Tete*, 1ª Ediçao, Maputo.

Mock, N. B., T. A. Sellers, A. A. Abdoh and R. R. Frankin (1993), 'Socioeconomic, Environmental, Demographic, and Behavioral Factors Associated with Occurrence of Diarrhea in Young Children in Republic of Congo', *Social Science and Medicine*, Vol. 36, No. 6, pp. 807–16.

Nimri, L. F. and M. Meqdam (2004), 'Enteropathogens Associated with Cases of Gastroenteritis in a Rural Population in Jordan', *Clinical Microbiology and Infection*, Vol. 10, No. 7, pp. 634–39.

Payment, P. and M. S. Riley (2002), *Resolving the Global Burden of Gastrointestinal Illness: A Call for Action*, a report from the American Academy of Microbiology, Washington, DC.

Pickering, A. J., A. B. Boehm, M. Mwanjali and J. Davis (2010), 'Efficacy of Waterless Hand Hygiene Compared with Handwashing with Soap: A Field Study in Dar es Salaam', *The American Journal of Tropical Medicine and Hygiene*, Vol. 82, No. 2, pp. 270–78.

Rhee, V., L. C. Mullary, S. K. Khatry, J. Katz, S. C. LeClerq, G. L. Darmastadt and J. M. Tielsch (2008), 'Maternal and Birth Attendant Hand Washing and Neonatal Mortality in Southern Nepal', *Archives of Pediatrics and Adolescent Medicine*, Vol. 162, No. 7, pp. 603–608.

Samie, A., R. L. Guerrant, L. Barrett, P. O. Bessong, E. O. Igumbor and C. L. Obi (2009), 'Prevalence of Intestinal Parasitic and Bacterial Pathogens in Diarrhoeal and Non-diarroeal Human Stools from Vhembe District, South Africa', *Journal of Health, Population and Nutrition*, Vol. 27, No. 6, pp. 739–45.

Sandora, T. J., E. M. Taveras, M. C. Shih, L. Elissa, A. Resnick, G. M. Lee, D. Ross-Degnan and D. A. Goldmann (2005), 'Alcohol-Based Hand Sanitizer and Hand-Hygiene Education to Reduce Illness A Randomized, Controlled Trial of a Multifaceted Intervention Including Transmission in the Home', *Pediatrics*, Vol. 116, No. 3, pp. 587–94.

Schmidt, W. P. and S. Cairncross (2009), 'Household Water Treatment in Poor Populations: Is There Enough Evidence for Scaling up Now?', *Environmental Science & Technology*, Vol. 43, No. 4, pp. 986–92.

Sobsey, M. D., T. Handzel and L. Venczel (2003), 'Chlorination and Safe Storage of Household Drinking Water in Developing Countries to Reduce Waterborne Disease', *Water Science and Technology*, Vol. 47, No. 3, pp. 221–28.

Tumwine, J. K., M. Katui-Katua and K. K. Munguti (2002), *Drawers of Water. II: 30 Years of Change in Domestic Use and Environmental Health in East Africa*, International Institute for Environment and Development, London.

UNICEF (2009), *Soap, Toilets and Taps*, UNICEF, New York.

UNICEF (2010), *Mozambique, Annual Report 2010*, UNICEF, New York.

UNICEF (2011), *Levels and Trends in Child Mortality: Report (2011)*, UN Inter-agency Group for Child Mortality Estimation, New York.

United Nations (2008), *The Millennium Development Goals Report 2008*, United Nations, New York.

UNDP (2006), *Mozambique, National Human Development Report 2005. Human Development to 2015. Reaching for the Millennium Development Goals*, 1st edn, UNDP, Maputo.

UNDP (2013), *Human Development Report 2013. The Rise of the South: Human Progress in a Diverse World*, UNDP, New York.

WHO (2002), *World Health Report 2002 – Reducing Risks, Promoting Healthy Life*, World Health Organization, Geneva.

WHO (2007), *Combating Waterborne Disease at the Household Level: The International Network to Promote Household Water Treatment and Safe Storage*, WHO, Geneva.

WHO (2010), *World Health Statistics*, World Health Organization, Geneva.

WHO and UNICEF (2009), *Diarrhoea: Why Children Are Still Dying and What Can Be Done*, UNICEF, New York and WHO, Geneva.

WHO and UNICEF (2010), *Progress on Sanitation and Drinking Water. Joint Monitoring Programme for Water Supply and Sanitation*, UNICEF, New York and WHO, Geneva.

World Bank (2005), *The Handwashing Handbook: A Guide for Developing a Hygiene Promotion Program to Increase Handwashing with Soap*, Water and Sanitation Program, Bank-Netherlands Water Partnership, World Bank, Washington, DC.

World Bank (2010), *World Development Report 2010, Development and Climate Change*, 1st edn, World Bank, Washington DC.

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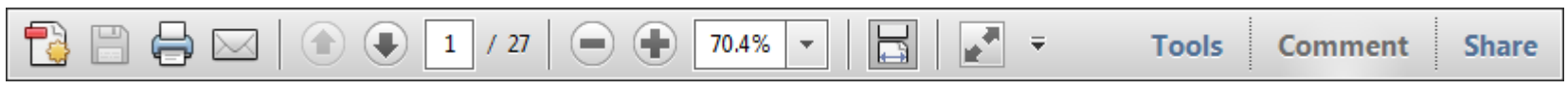
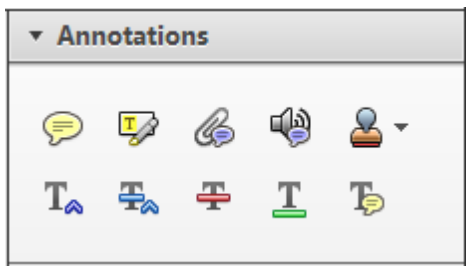
# USING e-ANNOTATION TOOLS FOR ELECTRONIC PROOF CORRECTION

**Required software to e-Annotate PDFs: Adobe Acrobat Professional or Adobe Reader (version 8.0 or above). (Note that this document uses screenshots from Adobe Reader X)**
**The latest version of Acrobat Reader can be downloaded for free at: http://get.adobe.com/reader/**

Once you have Acrobat Reader open on your computer, click on the Comment tab at the right of the toolbar:




This will open up a panel down the right side of the document. The majority of tools you will use for annotating your proof will be in the Annotations section, pictured opposite. We've picked out some of these tools below:

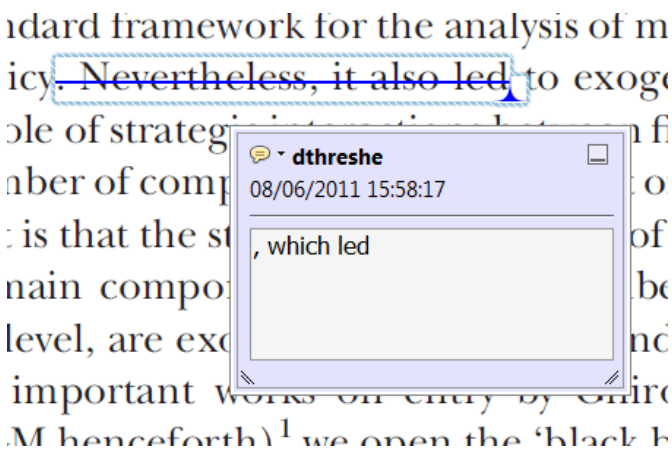



## 1. Replace (Ins) Tool – for replacing text.

Strikes a line through text and opens up a text box where replacement text can be entered.

**How to use it**

- Highlight a word or sentence.
- Click on the Replace (Ins) icon in the Annotations section.
- Type the replacement text into the blue box that appears.

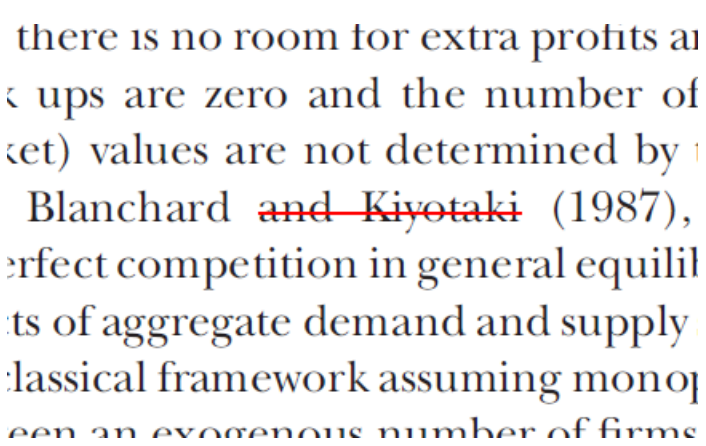



## 2. Strikethrough (Del) Tool – for deleting text.

Strikes a red line through text that is to be deleted.

**How to use it**

- Highlight a word or sentence.
- Click on the Strikethrough (Del) icon in the Annotations section.

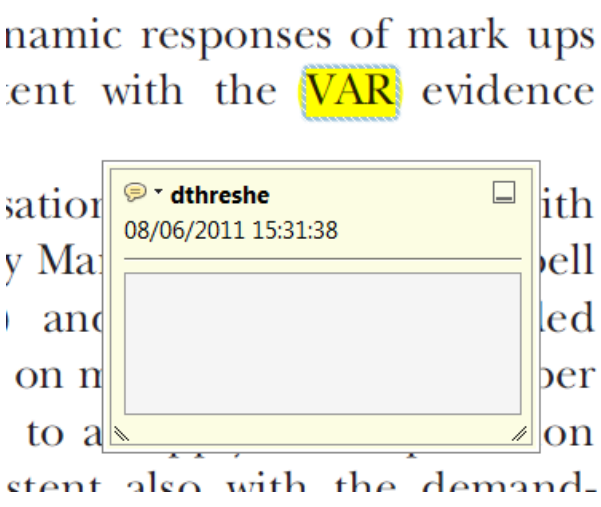


## 3. Add note to text Tool – for highlighting a section to be changed to bold or italic.

Highlights text in yellow and opens up a text box where comments can be entered.

**How to use it**

- Highlight the relevant section of text.
- Click on the Add note to text icon in the Annotations section.
- Type instruction on what should be changed regarding the text into the yellow box that appears.

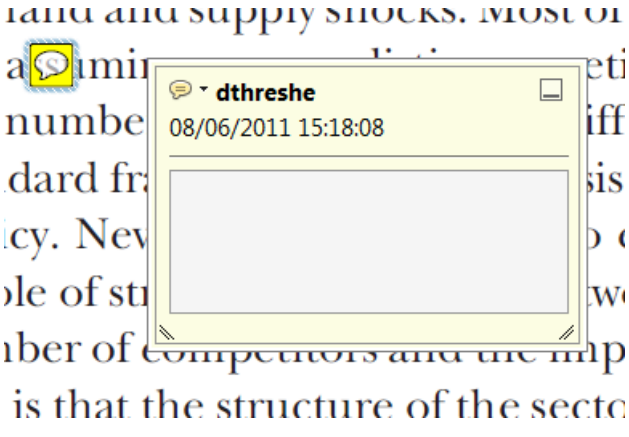



## 4. Add sticky note Tool – for making notes at specific points in the text.

Marks a point in the proof where a comment needs to be highlighted.

**How to use it**

- Click on the Add sticky note icon in the Annotations section.
- Click at the point in the proof where the comment should be inserted.
- Type the comment into the yellow box that appears.



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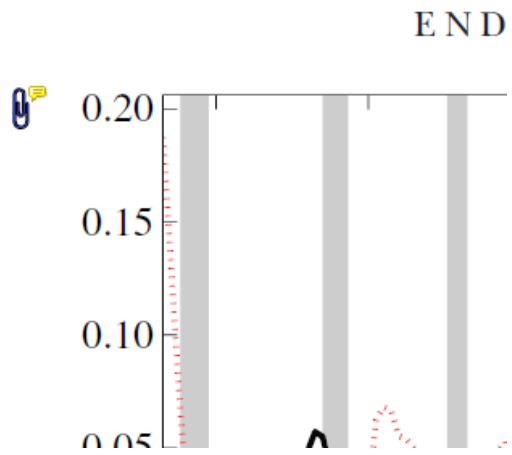
# USING e-ANNOTATION TOOLS FOR ELECTRONIC PROOF CORRECTION

### 5. Attach File Tool – for inserting large amounts of text or replacement figures.

Inserts an icon linking to the attached file in the appropriate pace in the text.

**How to use it**

- Click on the Attach File icon in the Annotations section.
- Click on the proof to where you'd like the attached file to be linked.
- Select the file to be attached from your computer or network.
- Select the colour and type of icon that will appear in the proof. Click OK.

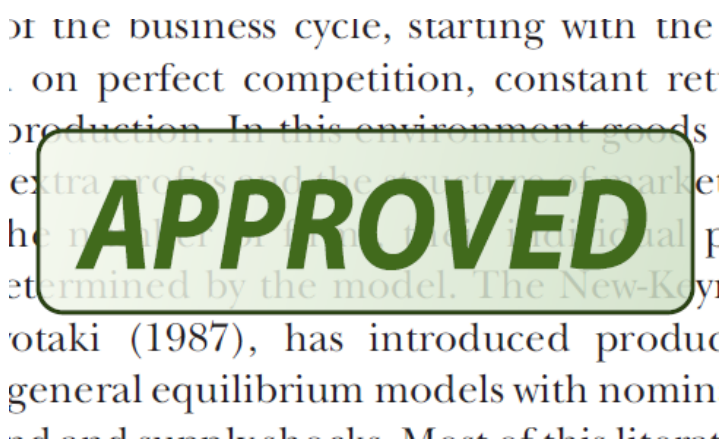


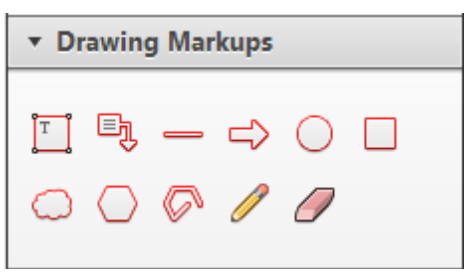

### 6. Add stamp Tool – for approving a proof if no corrections are required.

Inserts a selected stamp onto an appropriate place in the proof.

**How to use it**

- Click on the Add stamp icon in the Annotations section.
- Select the stamp you want to use. (The Approved stamp is usually available directly in the menu that appears).
- Click on the proof where you'd like the stamp to appear. (Where a proof is to be approved as it is, this would normally be on the first page).



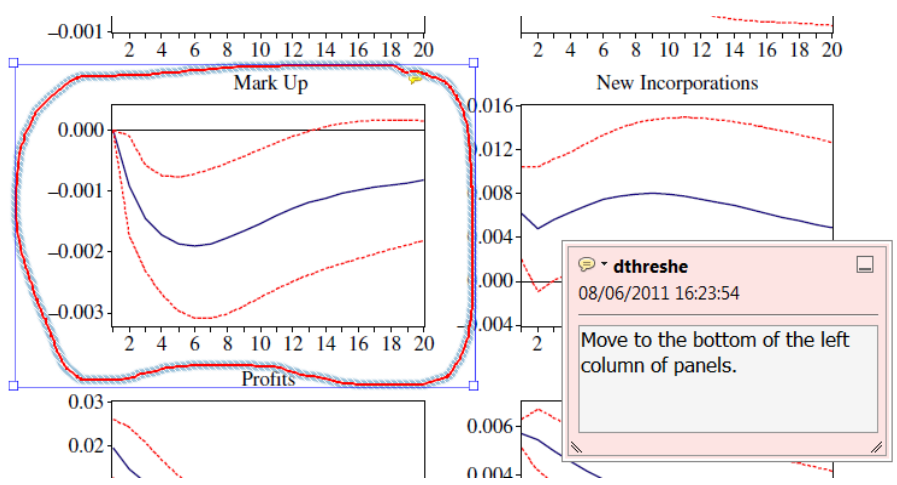




### 7. Drawing Markups Tools – for drawing shapes, lines and freeform annotations on proofs and commenting on these marks.

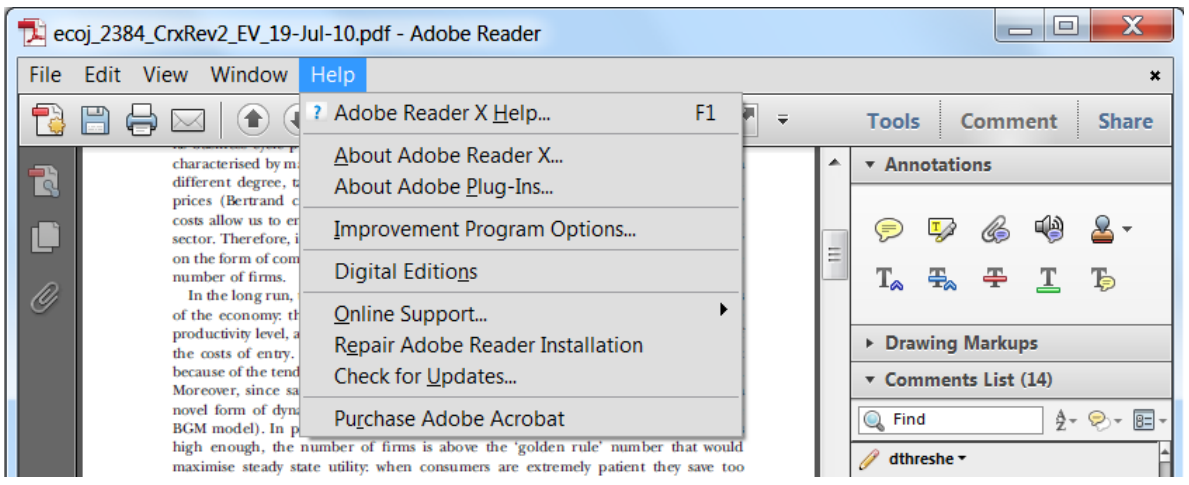
Allows shapes, lines and freeform annotations to be drawn on proofs and for comment to be made on these marks..

**How to use it**

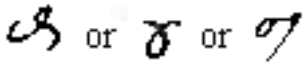
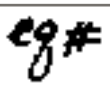
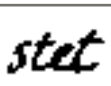
- Click on one of the shapes in the Drawing Markups section.
- Click on the proof at the relevant point and draw the selected shape with the cursor.
- To add a comment to the drawn shape, move the cursor over the shape until an arrowhead appears.
- Double click on the shape and type any text in the red box that appears.




**For further information on how to annotate proofs, click on the Help menu to reveal a list of further options:**



# PROOFREADERS' MARKS

| Symbol | Meaning | Example |
|---|---|---|
|  | delete | take it out |
|  | close up | print as o ne word |
|  | delete and close up | close up |
|  | caret | insert here (something |
|  | insert a space | put onehere |
|  | space evenly | space evenly where indicated |
|  | let stand | let marked ~~text~~ stand as set |
|  | transpose | change order the |
|  | used to separate two or more marks and often as a concluding stroke at the end of an insertion | |
|  | set farther to the left | too far to the right |
|  | set farther to the right | too far to the left |
|  | set as ligature (such as ) | encyclopaedia |
|  | align horizontally | alignment |
|  | align vertically | align with surrounding text |
|  | broken character | imperfect |
|  | indent or insert em quad space | |
|  | begin a new paragraph | |

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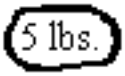
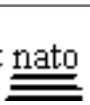
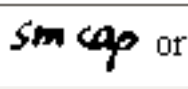
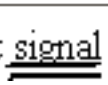
|---|---|---|
|  | spell out | set  as five pounds |
|  | set in CAPITALS | set  as NATO |
|  | set in SMALL CAPITALS | set  as SIGNAL |
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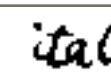
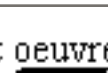
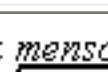
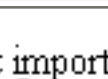
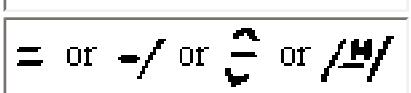
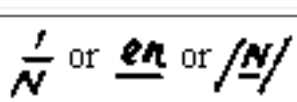
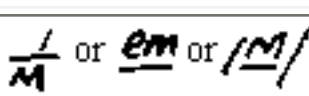
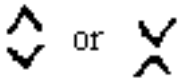
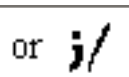
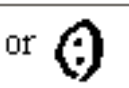
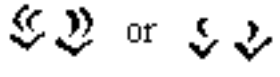
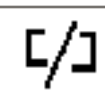
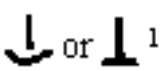
|  | set in *italic* | set  as *oeuvre* |
|  | set in roman | set  as mensch |
|  | set in **boldface** | set  as **important** |
|  | hyphen | multi-colored |
|  | en dash | 1965–72 |
|  | em (or long) dash | Now—at last!—we know. |
|  | superscript or superior |  as in $\pi r^2$ |
|  | subscript or inferior |  as in $H_20$ |
|  | centered |  for a centered dot in $p \cdot q$ |
|  | comma | |
|  | apostrophe | |
|  | period | |
|  | semicolon | |
|  | colon | |
|  | quotation marks | |
|  | parentheses | |

| | | |
|---|---|---|
|  | brackets | |
|  | query to author: has this been set as intended? | |
|  [1] | push down a work-up | an unintended  mark |
|  [1] | turn over an inverted letter | inveted |
|  [1] | wrong font | wrong sie or styl |

[1]The last three symbols are unlikely to be needed in marking proofs of photocomposed matter.