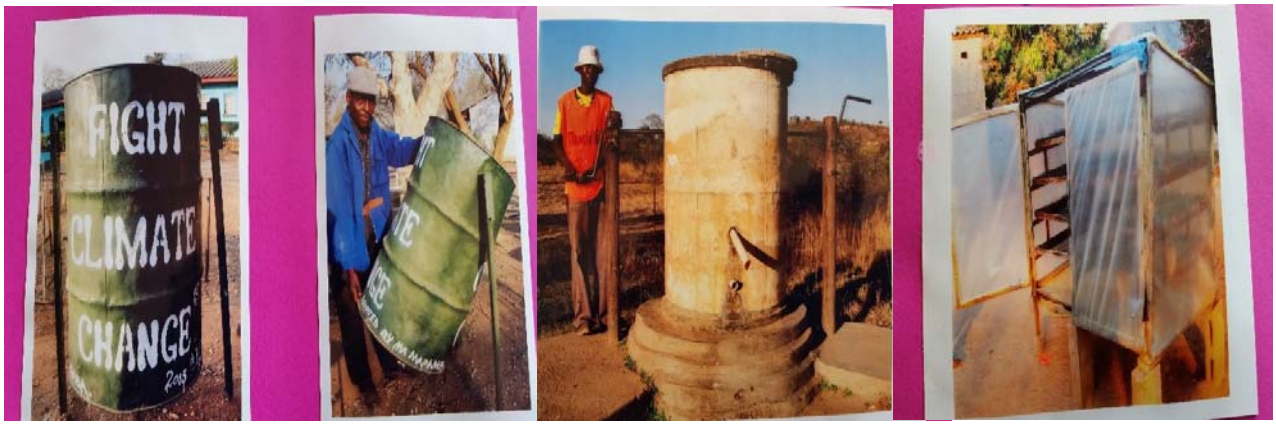
Innovations for health: Use of appropriate technologies in Primary Health Care in Zimbabwe

Report of an assessment



Training and Research Support Centre (TARSC)
with
Communuity based researchers

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1. Introduction

Zimbabwe has had a notable record of innovation and use of appropriate technologies in primary health care (PHC), particularly in environmental health. Primary Health Care (PHC) refers to "…essential health care based on practical, scientifically sound and socially acceptable methods and technology made universally accessible to individuals and families in the community through their full participation and at a cost that the community and country can afford to maintain at every stage of their development in the spirit of self-reliance and self-determination. It forms an integral part both of the country's health system, of which it is the central function and main focus, and of the overall social and economic development of the community." (WHO, 1978). The PHC conceopt thus recognises the role of locally appropriate technology for health. These technologies are generally defined as small-scale, decentralized, people centred, labour-intensive, energy-efficient, environmentally sound, and locally controlled (Hazeltine and Bull 1999).

Strengthening PHC is a key element of Zimbabwe's National Health Strategy 2009-2015 (MoHCC 2009). This raises interest to understand the development and use of appropriate technologies for health in Zimbabwe, particularly given the potential assets for innovation in a population with high levels of education, and the current challenges in the infrastructure and resources for health.

This pilot assessment thus aimed to explore and map specific appropriate technology innovations being developed and used at community level for health in rural and urban districts of Zimbabwe. The assessment looked at the technologies, their materials, purpose and use and related issues around their development and use.

Specifically, the assessment sought to explore in selected rural and urban sites

i. The technologies being used that are small-scale, decentralized, people centred, labour-intensive, energy-efficient, environmentally sound, and locally controlled and that have a purpose related to the improvement of health, whether direct or indirect.
ii. The source of the technology, and where locally developed the motivating factors/ drivers, development steps and whether the technology is meeting the intended needs and purpose.
iii. The materials used, how the technologies work, their cost, maintenance (who maintains, how and at what cost); whether they are being sold or only for own use
iv. The extent of their integration into PHC services
v. Perceptions of the technology relating to its effectiveness (for purpose and health), safety, affordability, sustainability, adaptability, compatibility and complexity.

2. Using appropriate technology in Primary Health Care

Technological innovation has played a key role in health, whether in relation to public health innovations for safe food and healthy environments or new medicines, vaccines, diagnostic technology for curative care or artificial limbs and aides for rehabilitation. The pace of innovation has not slowed, with new information technologies being used for health, such as:

- GPS enabled trackers to monitor inhaler usage by asthmatics with information being reported to a central database and used to identify individual, group and population based trends about known asthma catalysts (e.g. pollen counts);
- applications on smart phones used to track and assist patients with conditions like diabetes or to enable self tracking of exercise, blood pressure and other health issues;
- Geographical information system (GIS) technology used for the design and evaluation of health care programs across countries at all income levels (Groves et al. 2013; Tanser 2006)

The concept of appropriate technology was raised in Schumacher's 1973 book "Small is Beautiful -- Economics as if people mattered" that proposed a vision of human-scale technology that takes into account the economic, cultural, social and environmental needs of the communities and individuals it is designed to serve. Schumacher coined the term "intermediate technology" and sought through its promotion to address economic and social disparities by emphasizing labour-intensive solutions over centralized capital intensive approaches (PATH 2009).

Appropriate technology is technology that is scientifically sound, adaptable to local needs, acceptable to those using it and able to be maintained by people themselves using resources the community and country can afford (Cohen 1989).

Appropriate technology is thus context specific. It can range from simple home produced products, to those made by communities, to those made in local industries and laboratories. It should not be misunderstood as meaning 'poor technology for poor people' but as technology that is *more under the control of and relevant to the needs of the people.*

In this there is a resonance with PHC. It is based on the involvement of individuals and communities in shaping their healthcare and the actions of other sectors in improving health. Some of the key phrases in the Alma Ata declaration, shown in Box1, resonate with the principles informing appropriate technology. and its use by people and by other sectors also has to be considered (WHO, 1989). Innovations in technologies for PHC are thus more likely to be assimilated into the community and the health system, in response to perceptions of their benefit and with feedback on their use, shaping the innovation to 'fit' the context (Rifat et al. 2006)

Box 1: Quotes from the Alma Ata Declaration 1978

Primary health care is essential health care based on practical, scientifically sound and socially acceptable methods and technology made universally accessible to individuals and families in the community through their full participation and at a cost that the community and country can afford to maintain at every stage of their development in the spirit of selfreliance and self-determination.

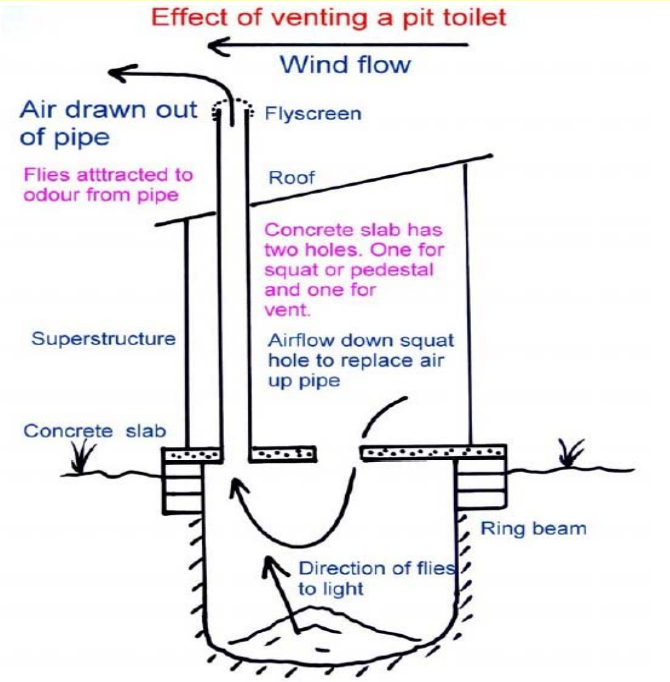
…requires and promotes maximum community and individual self-reliance and participation in the planning, organization, operation and control of primary health care…

Source: WHO 1978

Zimbabwe has made the widest known use of appropriate technologies in PHC in sanitation and safe water supply. Whilst a number of technologies have been invented or adopted in both urban and rural areas, the Blair toilet, or ventilated improved pit (VIP) latrine and the bush pump for water are arguably the most commonly known and used (shown in Box 2 overleaf).

The country has numerous assets for technological innovation to support PHC, including high levels of literacy and education, social organisation, and innovation in local resource use in the informal economy. The technologies developed in the large informal sector can be harmful to health (such as if they generate fumes, use toxic chemicals or produce foods and alcohols that are harmful to health), but can also present simple, effective, cheap environmentally sound and sustainable locally owned/community solutions for some of the health challenges being faced. These include shortfalls in the physical infrastructure, gaps in environmental health facilities, in clean energy, in food storage and processing and in infection control and waste management, including in health services.

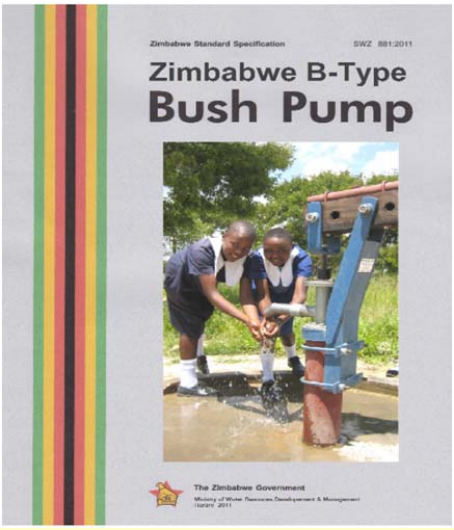
Box 2: The Blair Ventilated Improved Pit Latrine and the Bush Pump



The Blair Ventilated Improved Pit (VIP) Latrine was invented in the 1970's by Dr. Peter Morgan out of the realisation for the need for improved latrines in Zimbabwe. At the time latrines were smelly places where flies bred uncontrollably. This left people not wanting to use them, and often choosing to relieve themselves in the bush instead. The VIP addressed problems of smell and flies which were inherent in the pit latrines design. In total, over 500,000 VIP latrines have been built in Zimbabwe and even more in other countries.

Sources: Picture http://www.hydratelife.org/wp-content/uploads/2013/10/VIP-pit-via-Aquamor2.jpg
http://www.hydratelife.org/?p=1747

The Bush Pump has been serving the people of Zimbabwe for 80 years. The Bush Pump is a lever action pump that uses components that have been available in Zimbabwe for decades to make a simple and reliable pump. It is the standard hand pump in Zimbabwe, and is used in large parts of Africa The Bush Pump's standard depth that It can raise water from is 3-80 meters, but it can go down to 100 meters. Depending on which size diameter pump is used it can yield anywhere from 15-35 litres per minute. There are around 50,000 "B" type Bush Pumps installed in Zimbabwe, and even more spread out through the world.



Sources https://rwsnblog.wordpress.com/2013/03/21/how-three-handpumps-revolutionised-rural-water-supplies-the-zimbabwe-bush-pump/, http://en.wikipedia.org/wiki/Bush_pump, Pictures: http://www.hydratelife.org/?p=1747

Other examples of appropriate technology in PHC from other countries are shown in Figure 1 below

Figure 1: Examples of appropriate technologies from other countries

Bicycle ambulances, like the one shown in the picture have been used widely in countries like Malawi, Namibia and Nepal. It aims to improve emergency transit times for communities where motorized transport is unavailable, and to be affordable to community members, utilizing local materials and trade skills in its construction. Designs in different countries may vary

Source: http://makewealthhistory.org/2009/08/13/what-is-appropriate-technology/.

The Hippo Water Roller was purposely designed to alleviate the burden women and children face when they have to collect water from distant sources. It allows 90 litres of water to be placed inside the "wheel", resulting in an effective weight of just 10kg on level ground. Approximately five times the normal amount of water can be collected in much less time and with far less effort. Bringing more water to homes eraises the possibility of improvements to health, while the reduced burdens and time taken to collect water allows for improved time spent in education and economic productivity.

Source: www.forum2012.org/media/photo-gallery/.

Manual **Water Pump** from Ghana uses a rope that oscillates around the wheel which can be made from used tyres. Source: J Essen: http://globalwellbeinginstitute.org/author/jessen/

There are thus opportunities for technology innovations to strengthen the promotion of health, health care and action on the social determinants of health in Zimbabwe, in a manner which also strengthens social control of technology and supports local innovation. TARSC through its community based research and training programme, after dialogue with Ministry of Health and Child Care, explored this further through an assessment of innovations in and use of technology for different aspects of PHC in two urban and two rural sites of Zimbabwe.

3. Methods

We used a *cross sectional design* to gather qualitative and quantitative data in two urban and two rural sites. Participating districts were *purposively selected* to one large urban area and one small urban area and two rural sites. The number of sites was limited by the resources available, and this assessment may thus be used as a pilot of the methods for a wider national assessment. Given the wide ranging and observational nature of the research, we needed to ensure that evidence was gathered by people with experience in health and research methods. We thus identified the districts where we had community based researchers trained in research methods who had done other assessments for health in the CBRT. From each district, one community based researcher was identified and trained on the methods and the design. The briefing workshop covered examples of appropriate technologies in Zimbabwe and in other countries to enable the researchers to have an understanding of the technologies to look out for and how the data sheets would be completed.

A mixture of *cluster sampling* and *snowball sampling* was used to identify the wards surveyed. In each site, one ward was randomly selected and within each ward ten clusters were made. From the ten clusters, three were selected at random. From these three clusters, researchers obtained information on people who were using technologies that had relevance to PHC. Given that the community based researchers resided in these areas, the first respondents were initially selected based on the interviewer's own knowledge and that of other people living in that area. The researcher then asked for referrals from the initial respondents. In the absence of any referrals, the researchers proceeded with selecting the next household within the selected clusters. When subsequent households were found to be using the same technology as profiled in previous selected households, the researcher skipped questions that described the actual technology and asked questions on perceived advantages, challenges other user specific questions. For households that were using more than one technology, all the technologies that were being used were profiled. After obtaining permission, the researchers took photographs of the technologies. A target sample was set of 20 rural households and 20 urban households (N=40). In the field the number had to be increased to fund use of adequate technologies, so that 73 rural households and 52 urban households were included (N=125), in which 15 rural households and six urban households had technologies that were relevant to the assessment.

To address the *ethical requirements*, the community based researchers introduced and obtained consent for the work at community level from the local chief/headman and councillor. Before the interviews, researchers introduced themselves and the purpose of the assessment. Verbal consent was sought from each participant, and included on the recording form in writing. Participants had the option to withdraw at any point during the discussions provided. Permissions for photographing the technologies and the resultant use of the photographs in reports were also verbally obtained and recorded in writing on the recording form. Permission was denied from only one household from an urban area and this represented 1% of the total sample and 5% of the total households with included technologies. included in the sample.

Data was collected using a standardized questionnaire with a combination of closed ended coded questions and questions with open ended responses. . A likert scale was used to gather respondent perceptions of the effectiveness, complexity, safety and adaptability of the technology. Before the fieldwork, the community based researchers were briefed on the methods and the tools used in the research. In addition, they were provided with information relating to the background to the research, the research objectives and questions and methods on how they would collect the data in the field. For the photographs, the researchers used their cameras. In some cases this affected the quality of the photographs.Researchers were also trained in using cameras and photography, supported by EQUINET training resources on community photography.

The work faced various **limitations.** A wide variation in different small scale technologies in use (not all of which could have been anticipated in the training) meant that researchers needed to use personal judgement on inclusion/ exclusion of technologies in the final sample that may have led to some relevant technologies being excluded. The review of findings with the researchers suggested that this boas was not significant. The assessment included technologies used in households and thus does not include those being manufactured in informal sector sites which could be addressed in follow up work. The reseachers use of own cameras due to limitations of resources affected the quality of the photographs, however the images do still sufficiently show the technologies in use. Should more sites be included there is a likelihood that more appropriate technologies would be found. This assessment was limited in scale by available resources and we would suggest a wider assessment, linked to measures to incentivize technologies that have relevance to health.

4. Results

In all four sites, the community based researchers compiled information on the technologies that they observed being used to promote PHC. The mapping exercise sought to provide detailed profiles of these technologies together with images. The technologies have been presented within three main themes (based on the element of PHC they are promoting; namely

i. Food safety and nutrition
ii. Water, sanitation, waste management and housing
iii. Prevention and control of diseases

The results are presented in form of tables. For each technology, one or more pictures are provided, together with descriptions on what the technology is, how it works, the steps in its development or adoption, its costs and how it is maintained. Responses using a likert scale relating to how respondents perceived the effectiveness, complexity, safety and adaptability of the technology is summarised in the table. While noting the limited size of the sample, the results suggest the wealth of innovations and appropriate technologies that exist, and the possibilities that may be found from a more systematic and wider assessment.

4.1 Food safety and nutrition

A total of six appropriate technologies are profiled in this section. Two of these relate to food preparation and preservation (Tables 4.1-4.2) and four (Tables 4.3-4.6) are used for improving production of food. All were seen to contribute to food security and nutrition. The technologies were reported to have been brought into the community through a mix of non-government organisations, government departments (primarily in agriculture) and by individuals.Those shown in Tables 4.1-4.6 indicate the many local technologies that have been developed for food production, processing and storage that could be invested in and more widely disseminated. There are likely to be more in other districts, such as those shown in Figures 2 and 3 below.

Figure 2: A Honey extractor: A technology that can be used for the extraction of honey. It is made up of a wooden chamber, a lid that can be compressed and a supporting metal structure. It costs $150 and is being sold by the Kwekwe Poly Technic College.

Figure 3 below: A grill pan used to roast meat and fry vegetables. It is used to cook very hard meat like “maguru nematumbu”. These types of meat are cheap and the technology allows them to be cooked easily. The technology facilitates uptake of these protein rich foods.

Table 4.1: Roasting Pan

Picture(s) of the technology	
 	
Name of the technology	Roasting Pan
How the technology works	Raw food is chopped into pieces and placed into the dish. The charcoal below supplies the heat required to roast or cook the food. Mainly used for roasting beef but can also be used for cooking vegetables, dried maize and so on. The technology raises food from ground level and reduces contamination eg from dogs as in ground level devices. It can prepare more food than when using ordinary stoves.
If invented, developer and date	Mr. Chindiyo, date not known
If introduced, introducer, date and cost	Not applicable
Needs assessment done and how?	No, invented by an individual for own use but community finding it useful
Steps taken for development	Not applicable
Materials used and cost	Old tractor dish and iron bars welded together
Maintenance	No maintenance required, clean after use
How technology was communicated to community	Technology first widely used by people who prepared braai at a nearby butchers. So people who were going to buy meat from the butchery were being shown the gadget and those interested ended up buying their own as well.
Perceptions on technology effectiveness, safety, affordability, acceptability, sustainability, adaptability, compatibility and complexity	Very effective- cooks meat in a few minutes. Somewhat safe- the charcoal used for heating does not fall away and injure people. Somewhat affordable- second hand materials are used. Very acceptable- people want to prepare food quickly but in a hygienic environment. Very efficacious- fast and very convenient. Less adaptable and compatible- can only use charcoal for heating. Not complex-very easy to set up and use
Relation to health needs	People now prefer to eat freshly prepared food that is cooked in hygienic environments and the technology supports this. Can be cleaned thoroughly using detergents after use and covered easily
Any other comments	Users should constantly keep an eye on development of rust on it especially if left in the rain and open for longer periods of time

Table 4.2: Fruit and vegetable drier

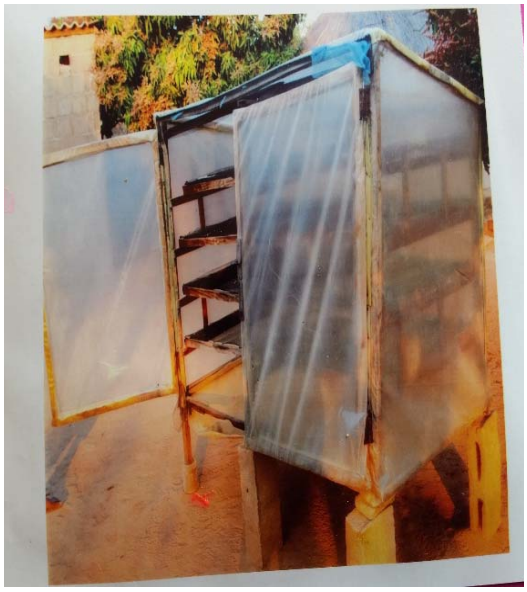
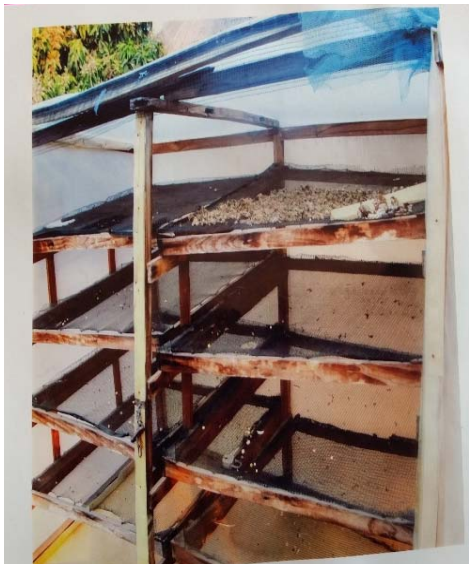
Picture(s) of the technology	
 	
Name of the technology	Fruit and vegetable drier
How the technology works	Vegetables or fruits are chopped into smaller pieces and placed into the shelves in the drier. The drier door is closed and the fruits/ vegetables are left to dry. The contents dry without losing color
If invented, developer and date	Technology adopted in 2004. Inventor not known but donated to community through Agriculture Extension Officers
If introduced, introducer, date and cost	Agriculture Extension Officers
Needs assessment done and how?	A community assessment was done that compared affordability of using electricity
Steps taken for development	Not applicable
Materials used and cost	Timber, plastic, net, nails, lock and key
Maintenance	None required
How technology was communicated to community	It was advertised at a farmers meeting and the best farmers were trained in using it
Perceptions on technology effectiveness, safety, affordability, acceptability, sustainability, adaptability, compatibility and complexity	Highly effective, it dries produce without deforming product. Extremely safe- it preserves and maintains the nutritional composition of the vegetables. Very affordable- materials used to make it are cheap. Very acceptable- causes no dangers to health. Very efficacious, sustainable and not complex to use. Not adaptable - cannot be used with other gadgets
Relation to health needs	It supports food security by preserving food.
Any other comments	People can also sell the dried vegetables and earn income from the technology

Table 4.3: Drip irrigation kit

Picture(s) of the technology	
 	
Name of the technology	Drip irrigation kit
How the technology works	Water from the tank is channeled through gravity to vegetables and plants in the field or garden. Little water can be used to irrigate a sizeable field and the produce can be used for own nutrition needs and surplus sold to generate incomes. The technology assists with economic use of water. Water is a scarce resource and there is need for it to be used effectively
If invented, developer and date	Invented by German Technical Cooperation Agency (GTZ), adopted by the community in 2013
If introduced, introducer, date and cost	Donated and brought into the area by GTZ
Needs assessment done and how?	Yes, a number of studies done including the levels of water in local wells and assessment on suitability of the technology
Steps taken for development	Not applicable
Materials used and cost	Plastic tank, pipes, metal bars
Maintenance	None, except checking for plastics that may leak
How technology was communicated to community	GTZ advertised the technology to the community
Perceptions on technology effectiveness, safety, affordability, acceptability, sustainability, adaptability, compatibility and complexity	Highly effective- it is very good at irrigating crops. Extremely safe- the water tank is at the correct height and does not fall. Very affordable- it's cheap to maintain. Very acceptable-it does not waste water. Very efficacious- supplies water to where it is needed by the plant at the roots. Very adaptable and compatible- can be used for irrigating vegetables, fruit trees, maize crops easily.
Relation to health needs	Drip irrigation has the potential to increase yields and food security
Any other comments	Communities need education on such technologies

Table 4.4: Bush Pump

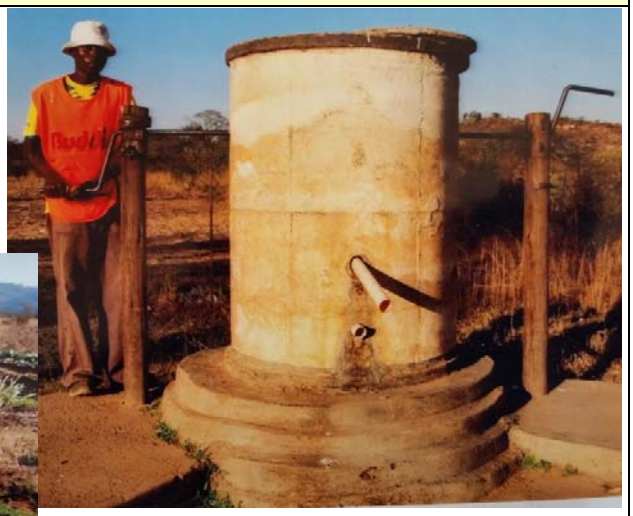
Picture(s) of the technology	
 	
Name of the technology	Bush pump
How the technology works	Cranking or rotating the hand continuously generates the upstroke and down stroke movement of the mechanism that sucks water and water comes out through the outlet pipe
If invented, developer and date	Technology was adopted by household. Household reports that it was invented by the Moslem society
If introduced, introducer, date and cost	Moslem society donated it to the community in 2000
Needs assessment done and how?	Yes, water situation assessment done and options for environment reviewed before technology supplied
Steps taken for development	Not applicable
Materials used and cost	Cement, pump, Iron bar and PVC pipes
Maintenance	Greasing and checking for water leaks. Family members maintain the technology
How technology was communicated to community	A community outreach programme communicated the technology to communities
Perceptions on technology effectiveness, safety, affordability, acceptability, sustainability, adaptability, compatibility and complexity	Highly effective – experience no breakdown. Extremely safe- components well intact and protected. Somewhat affordable- needs reasonable resources to install. Very acceptable –does not harm the environment. Somewhat efficacious- works well. Very sustainable- uses local resources and cheap to maintain. Very adaptable – possible to connect an irrigation system
Relation to health needs	Yes, safe water supply and nutrition needs are addressed by the technology
Any other comments	Small children struggle to use the technology

Table 4.5: Chitsokatsoka pump

Picture(s) of the technology	
 	
Name of the technology	"Chitsokatsoka" Pump (translated to mean a pump that is operated by foot)
How the technology works	The person who operates the pump cycles the pedals. The pedals are linked to a system which includes pistons that then pumps water into the pipe. The system is used for pumping water for irrigation mainly eg vegetables
If invented, developer and date	Technology was adopted by household
If introduced, introducer, date and cost	The technology was developed in Germany in 2004. We bought the technology through a German organisation for $60.00
Needs assessment done and how?	Yes, we were facing food shortages due to poor rains and the technology helps us to improve yields.
Steps taken for development	Not applicable
Materials used and cost	Metal and pipes
Maintenance	Average cost of maintenance is $10 per year. A welder is required to repair broken metal especially the pedal and pulley
How technology was communicated to community	Through community gatherings
Perceptions on technology effectiveness, safety, affordability, acceptability, sustainability, adaptability, compatibility and complexity	Somewhat effective- besides the peddling, it works well. Somewhat safe- there is a risk of falling during peddling and peddling in water exposes the operator to risks like bilharzia. Very affordable- it costs $60 and needs no fuel. Somewhat acceptable- does not infringe on community values. Somewhat efficacious- it pumps water for irrigating crops reasonably well. Very sustainable and not complex- it's easy to use
Relation to health needs	Yes, provides water for irrigating vegetables and encourages exercise in using the machine
Any other comments	Irrigating crops using the pump improves the diet and user is generating income through selling surpluses

Table 4.6: Canal irrigation

Picture(s) of the technology	
   	
Name of the technology	Homemade canal irrigation
How the technology works	Water is siphoned from the well through the pipe and channeled into the canal. Smaller canals channel water into rows of crops
If invented, developer and date	Adopted from method used by Hippo Valley Estates
If introduced, introducer, date and cost	Not known
Needs assessment done and how?	Yes, the ground was checked to see if the slope can work with canal irrigation.
Steps taken for development	Not applicable
Materials used and cost	A ten meter pipe and channels dug in the field near rows of crops
Maintenance	None required
How technology was communicated to community	Not communicated in any way, being used by the headman in his garden
Perceptions on technology effectiveness, safety, affordability, acceptability, sustainability, adaptability, compatibility and complexity	Technology is somewhat safe- when there is too much rain the canals flood. Highly effective- it does not run dry. Very affordable- just a pipe and furrows needed. Very acceptable, sustainable and not complex. Somewhat adaptable and compatible as it can be used with water tanks and pumps as well
Relation to health needs	Owner has managed to meet household food requirements using the technology.
Any other comments	Income generated from the project has also allowed owner to send children to schools

4.2 Safe water, sanitation, waste management and housing

A number of appropriate technologies were found under this theme. Most related to the supply of clean water from boreholes and protected wells, toilets that have been modified by the community to address specific health needs and others for solid waste management and ventilation for housing. A total of seven technologies were identified in the four districts (Tables 4.7-4.13)

Table 4.7: Bush Pump

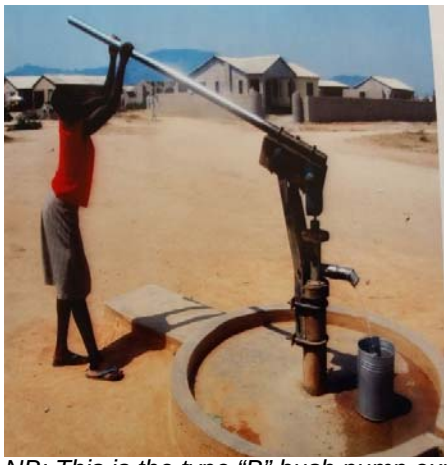
Picture(s) of the technology	
  *NB: This is the type "B" bush pump explained in the background section. However, here we also capture responses as provided by the respondent*	
Name of the technology	Borehole
How the technology works	Uses a mechanical system to pump water, with a piston, rods and valves. Using the metal handle, a person can pump water by lowering and lifting the handle in cycles. Used for supplying water for drinking and gardening.
If invented, developer and date	Adopted for use by community. Inventor not known
Introducer, date and cost	Rural District Council (RDC) donation. Cost unknown.
Needs assessment done, how?	Done by the Rural District Council through consultations
Steps taken for development	Not applicable
Materials used and cost	Pipes, rods, galvanized pipes, valves, wood block, bolts, washers, cement
Maintenance	Usually the borehole needs grease. The RDC and the community maintain the borehole jointly. Estimated maintenance costs of $30/ year if no major breakdowns
How technology was communicated to community	It was communicated through Environmental Health Technicians
Perceptions on technology effectiveness, safety, affordability, acceptability, sustainability, adaptability, compatibility and complexity	Highly effective- a strong and new machine. Extremely safe- causes no danger in use. Very affordable- maintenance costs lower although installation costs may be high. Very acceptable- the community like using the technology as it supports access to safe water.Does its intended purpose very well. Very sustainable, adaptable and compatible- can be used with engines, tanks and can use submersible pumps if you have the resources.Not complex- easy to use.
Relation to health needs	Safe water for drinking, gardening and other domestic uses.
Any other comments	Tanks could be added to have a large storage. It has reliably provided the community with safe water.

Table 4.8: Protected well

Picture(s) of the technology	
    *NB: The two technologies are the same but were found in two different households*	
Name of the technology	Protected/ covered well
How the technology works	Manually operated by winding and unwinding a rope attached to a tin on a metal tube that will be affixed into concrete but with an allowance to allow it to rotate.
If invented, developer and date	In both cases, technology was adopted
Introducer, date and cost	Technology was bought for $50
Needs assessment done and how?	Household was walking a distance of 3km to get water. There was water shortage in the area
Steps taken for development	Not applicable
Materials used and cost	Not applicable
Maintenance	Family members maintain it, costs are low on average costs about $5 per year if no major breakdown occurs
How technology was communicated to community	Household 1: We saw the technology in other wards and decided to construct our own. Household 2: technology was communicated at church meeting, some asked for and bought it.
Perceptions on technology effectiveness, safety, affordability, acceptability, sustainability, adaptability, compatibility and complexity	Both households rated the technology as highly effective- giving adequate water supplies and rarely breaking down, somewhat safe- the handle may cause injuries if it slips whilst pulling up the loaded tin of water, very affordable-purchasing and maintenance costs are low. Easy to use. Limited adaptability due to its design.
Relation to health needs	Yes, safe water for drinking and watering gardens
Any other comments	Have improved living standards for communities

Table 4.9: Modified flush toilet

Picture(s) of the technology	
 	
Name of the technology	Rural Flushing Toilet
How the technology works	The chamber is connected to an outside septic tank through a pipe. When a person finishes using the toilet, he or she pours water immediately and the waste flows into the septic tank outside. The modification was done to accommodate the user who has difficulty walking and had problems in using ordinary Blair toilets. In a normal Blair toilet, it was difficult for the disabled person to enter easily and squat properly.
If invented, developer and date	Household adopted technology in Agust 2013 and modified it to suite her needs.
If introduced, introducer, date and cost	User bought it from Harare and modified the set up during construction
Needs assessment done and how?	Yes, done by the user. It was the realization that it was difficult for the disabled person to use the Blair toilet
Steps taken for development	Not applicable, user just modified existing technology
Materials used and cost	Seat/chamber, two joints (Pvc), 1.5m PVC pipe, 100 bricks and cement. Note that the septic tank does not have a soak away
Maintenance	None, just ordinary cleaning with harpic.
How technology was communicated to community	Through word of mouth
Perceptions on technology effectiveness, safety, affordability, acceptability, sustainability, adaptability, compatibility and complexity	The system is extremely safe- it cannot collapse easily, very affordable- it's cheaper than a Blair toilet, very acceptable and efficacious- it performs its intended purpose well, very sustainable and simple to use and make- no plumber is required
Relation to health needs	Provided a safer sanitation option for a person with disability.
Any other comments	The mechanism is slowly being adopted by schools in the area. It needs to be standardized and communicated.

Table 4.10: Modified Blair toilet to include handwashing facility

Picture(s) of the technology	
	
Name of the technology	Modified Blair Toilet -Hand washing tank added for washing hand on leaving the toilet
How the technology works	An ordinary Blair toilet but a small tank is fitted outside the toilet so that people who use the toilet can wash their hands on leaving the toilet. The water comes out through a small opening created by a pen barrel.
If invented, developer and date	Adopted by household
If introduced, introducer, date and cost	Respondent unsure but thought it was from DAPP in 2010
Needs assessment done and how?	The organisation that promoted the technology undertook surveys in clinics and homesteads.
Steps taken for development	Not applicable
Materials used and cost	Pen barrel (tap for washing hands), bricks and cement used for making the water tank and Blair toilet.
Maintenance	No maintenance required, just adding water to the tank. Family members do this. Toilet may need repainting after some years.
How technology was communicated to community	Builders were trained and then engaged people when constructing Blair toilets to add the water tap.
Perceptions on technology effectiveness, safety, affordability, acceptability, sustainability, adaptability, compatibility and complexity	Technology rated as safe-it operates well as a toilet, somewhat affordable- need to buy cement. Very acceptable, somewhat efficacious- urine does not flow smoothly. Very sustainable and not complex.
Relation to health needs	Washing of hand after using the toilet is important for health and to control diseases such as cholera.
Any other comments	Respondent viewed that some of these technologies should be made as policies or required standards.

Table 4.11: Toilet bathroom combo

Picture(s) of the technology	
 	
Name of the technology	Toilet bathroom combination
How the technology works	People sit on the toilet seat for toilet services. For bathing, a person puts the container containing the path water on top of the toilet seat and bath water is drained into the toilet through a small opening on the base of the toilet seat.
If invented, developer and date	Adopted by household
If introduced, introducer, date and cost	Care International, $100 in 2005
Needs assessment done and how?	Yes, through Environmental Health Technicians (EHTs)
Steps taken for development	Not applicable
Materials used and cost	Cement, stones, bricks, wires and sand
Maintenance	Negligible, day to day cleaning only
How technology was communicated to community	CARE sensitized people through meetings and through EHTs
Perceptions on technology effectiveness, safety, affordability, acceptability, sustainability, adaptability, compatibility and complexity	Extremely safe- no risk of falling into the pit for animals and kids. Very affordable and acceptable, very efficacious and sustainable. Adaptable- putting in a shower is not complex.
Relation to health needs	The technology promotes hygienic practices and is easy to maintain.
Any other comments	The householder feels that the MoHCC should make it mandatory for every homestead to have a toilet.

Table 4.12: Tiltable waste bin

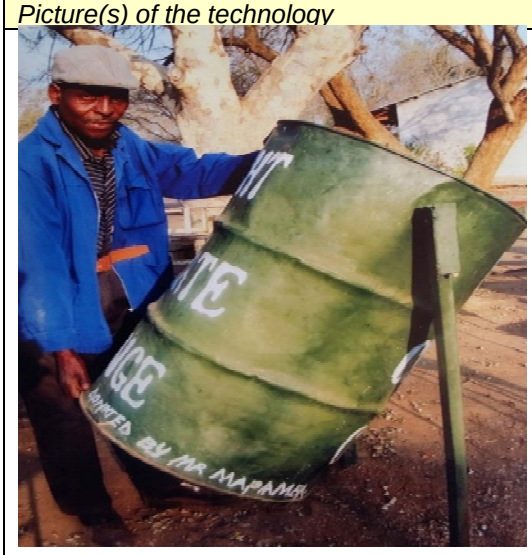
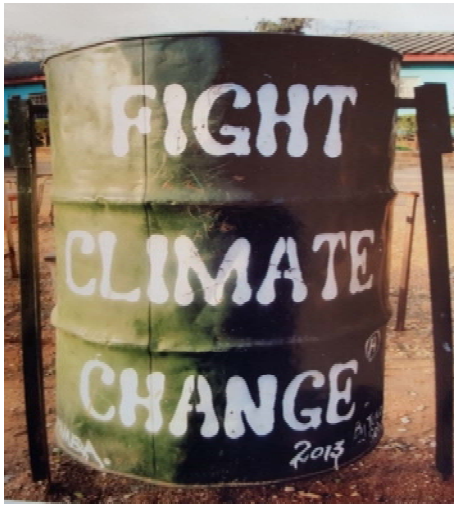
Picture(s) of the technology  	
Name of the technology	Tilting rubbish bin
How the technology works	The rubbish bin is attached to two standing poles using hinges that allow it to tilt. Solid waste can be placed into the bin until it gets full. It's easier to empty the rubbish into a removal truck by just tilting the bin
If invented, developer and date	Technology adopted
If introduced, introducer, date and cost	Technology was donated by Mr Mapamba
Needs assessment done and how?	Yes, the donor visited the school and community to assess sites at the school that were being used in waste management and then decided on the best available and appropriate solution
Steps taken for development	Not applicable
Materials used and cost	Old metal drums, poles and hinges
Maintenance	None except occasional greasing of the hinges and repainting to prevent it from rusting
How technology was communicated to community	It was done through the school staff, School Development Committee and students
Perceptions on technology effectiveness, safety, affordability, acceptability, sustainability, adaptability, compatibility and complexity	Highly effective-keeps surroundings clean if used by all people. Extremely safe-not dangerous as it is secured by the hinges. Somewhat affordable- drums and poles are readily available. Very acceptable- the community love to use them. Serves its purpose well. Very sustainable and adaptable- can be used as advertising space to generate revenue. Compatible-other bin types can be used together with this type
Relation to health needs	Safe waste disposal is a major health need. This technology allows communities to dispose waste safely and can promote waste segregation and recycling if more of these bins are placed on the same place with labels of the type of waste to be put in each.
Any other comments	The bins can provide advertising space generating revenue to buy more bins. Environment promotion messages can also be put on the bins.

Table 4.13 Metal hut chimney/ ventilator

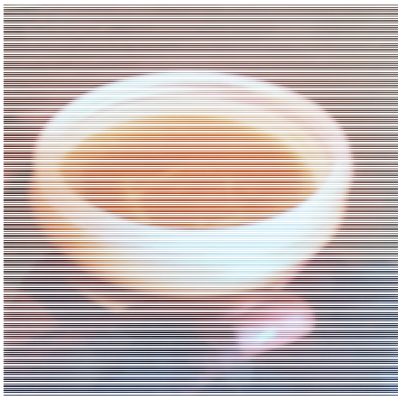
Picture(s) of the technology	
 	
Name of the technology	Metal Hut Chimney, Ventilator
How the technology works	It siphons out most smoke from inside the house through the vent. Within the house, heated air rises together with smoke and the ventilator allows the smoke to escape and fresh air to flow in but the capping on top does not allow rain to seep into the house.
If invented, developer and date	It was adopted by the household. The inventor is not known but was first used in the area in 2014.
If introduced, introducer, date and cost	The technology is now being reproduced by welders in the area. It is being sold for $20 per unit.
Needs assessment done and how?	Yes, there was no adequate grass for thatching huts hence people started using corrugated iron sheets. However, the sheets created problems with trapping of smoke and this was a health hazard to inhabitants
Steps taken for development	Not applicable
Materials used and cost	Iron sheets
Maintenance	No maintenance is required.
How technology was communicated to community	It was advertised at growth points and villagers saw it as user friendly
Perceptions on technology effectiveness, safety, affordability, acceptability, sustainability, adaptability, compatibility and complexity	Highly effective- it brings fresh air into the house. Somewhat safe to use. Somewhat affordable-the cost of $20 is reasonable given people's incomes. Very acceptable-community appreciates the technology. It does its purpose well. Very sustainable- uses local resources. Only usable for one purpose and requires metal fabrication to change it. Not complex- easy to use.
Relation to health needs	Yes, it alleviates spread of respiratory diseases due to poor ventilation.
Any other comments	The technology can be used widely in Zimbabwe as focus could be made for iron roofed houses to reduce deforestation. It is also appealing and improves the standard of the homes in rural areas.

4.3 Prevention and therapy for ill health

Technologies for prevention and care in the health sector were not the main thrust of this round of mapping but some were found and reported in the process. Examples of these practices are reported below for follow up investigation of their health impacts.

Figure 4: Materials being used for preventing and managing ill health

Above: Dry cow dung and Egg tray: The cow dung or egg tray are used to repel mosquitoes. These are burnt inside the house/room and mosquitoes are driven away or killed. Knowledge was passed from their fathers and has been in use for more than five years. However, the health impact of this practice needs to to be investigated to assess whether it raises other risks, including from smoke in homes.



Right: Bees wax is used as a therapy for backaches. The bee wax is rubbed on the affected areas and this reduces the pain. The honey used to make the wax is harvested from local beehives and cooking oil is added to make the medicine. The household has been using this for more than a year and it has helped to alleviate pain. They have told others by word of mouth and other families are now using it. Again the health impact needs further investigation.

Electronic Mosquito repellent. The device is reported to repel and kill mosquitoes. Electricity turns the motor inside the bucket and mosquitoes are attracted by carbon dioxide, warmth and darkness. The technology was invented by engineers in the Engineering department at Kwekwe Polytechnic College. It is currently being used for learning purpose at Kwekwe Polytechnic College. The components include a plastic bucket, electric circuit, metal box, and liquefied carbon dioxide. The technology is reported to be useful to prevent malaria.

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5. Reflections and conclusions

This pilot assessment attempted to map appropriate technologies being used for PHC in communities. The exercise was limited in scope, limiting the findings. Further we did not explore those being used at the health services themselves. However, the technologies found did indicate in general there are a range of local innovations in technologies being used to support health, and particularly key social determinants of health.

While we found a number of technologies in the few districts surveyed, their use was not very widespread, for unclear reasons. The technologies were developed or introduced by local individuals, by those from outside the area, and by state and non state organisations. The technologies that were introduced and promoted by institutions (non government organisations and government) were more widely used than those brought in by private individuals. Public sector resources and leadership appears to have played an important role in widening uptake of innovation. There seemed to be far less support of private sector innovations that depended more on local marjetrs, often in poor communities with limited purchasing power. It suggests a need for some public role or leadership in levering support for health promoting innovations to provide or link to private institutions for technical and market support, to review technologies and support their development and dissemination.

Most of the technologies related to environmental health, especially related to safe water and sanitation, but also waste management and ventilation. There were also interesting innovations on food security. In future assessments it would be useful to explore these areas, but also to assess whether other dimensions of PHC are being addressed, including at health centres, such as for waste incineration. Many of the technologies found were not entirely new but were modified versions of existing technologies.

The assessment raised areas that may need follow up and further dialogue, including a wider survey of other districts, of other areas of PHC and of appropriate technologies being used *within* the health services. This could give greater focus on the resources being used and available to support the development and uptake of the technologies. This could be done by interview with those innovating or bringing in new technologies for health, to find out the enablers and barriers they face. At the same time the innovations found suggest scope for exploring measures for enhancing support for local innovation, for assessing its health impact, and for wider uptake of those with promising contribution to health.

6. References

1. Baumann E, Furey S (2013) How Three Handpumps Revolutionised Rural Water Supplies: A brief history of the India Mark II/III, Afridev and the Zimbabwe Bush Pump, Rural Water Supply Network, Field Note No 2013-1
2. Cohen J (1989) Appropriate Technology In Primary Health Care, Evolution and Meaning of WHO'S Concept International Journal of Technology Assessment In Health Care, 1989, 5, 103-109 USA
3. Elias C (2006), Medicine and Creativity, Lancet 368, S40–S41., available at http://www.path.org/news/press-room/574/ Accessed December 2014
4. Goodyear L, Tsu V, Kaisel D, Lalwani T (2009) Appropriate Health Technologies: Concepts, Criteria, and Uses: Presentation prepared as part of an education project of the Global Health Education Consortium and collaborating partners October 2009, PATH, Seattle, Washington
5. Groves P, Kayyali B, Knott D, Vam Kuiken S (2013) The bid data revolution in heathcare: Acceleratiting value and innovation, Centre for US Health Systems Reform Business Technology Office, Mckinsey and Company, New Jersey
6. Hazeltine B, Bull C (1999). Appropriate Technology: Tools, Choices, and Implications. Academic Press, New York
7. Ministry of Health and Child Welfare (MoHCW) (2009) National Health Strategy 2009-2013. Ministry of Health and Child Welfare, Harare
8. Programme for Appropriate Technology in Health (PATH) (2009), Appropriate Health Technologies: Concepts, Criteria, and Uses: Education Project of the Global Health Education Consortium and collaborating partners October 2009, PATH, Seattle, Washington
9. Rifat A, Kyratsis L, Gordan J, Drazenka R M, Ipek G U (2006) Diffusion of complex health innovations - implementation of primary health care reforms in Bosnia and Herzegovina, Oxford University Press in association with The London School of Hygiene and Tropical Medicine, Journal of Health Policy and Planning 2007;22:28–39 London
10. Tanser F (2006) Geographical Information Systems (GIS) Innovations For Primary Health Care in Developing Countries, Africa Centre for Health and Population Studies; Mtubatuba, South Africa
11. Training and Research Support Centre (TARSC) Community Working Group on Health (CWGH) (2009) Health where it matters most: An assessment of Primary Health Care in Zimbabwe March 2009 Report of a community based assessment: TARSC Harare
12. World Health Organisation (WHO) (1978) Declaration Of Alma-Ata, International Conference on Primary Health Care, Alma-Ata, USSR, 6-12 September 1978
13. Zenelika I, Pearce J M (2011), Barriers to Appropriate Technology Growth in Sustainable Development Journal of Sustainable Development Vol. 4, No. 6; December 2011