

# Spare Part Supplies for Handpumps in Africa

## Success Factors for Sustainability

This field note describes lessons drawn from a review of 25 studies conducted in 15 different countries that looked at handpump spare parts supply, particularly in rural areas of African and non-African countries. The research suggests a number of key factors that are necessary for successful and sustainable handpump spare part supply chains.



## Executive Summary

**Handpump installation is the most widespread solution for supplying water to the many millions of people in Africa's rural areas. However, at any given moment an average 30 percent of all potentially functional handpumps in Africa are not working. In some areas 50 percent or more are non-functional, due in part to difficulties in obtaining spare parts. This field note describes lessons drawn from a review of 25 studies conducted in 15 different countries that looked at handpump spare parts supply, primarily in rural areas of Africa.**

**A number of key factors are identified for sustaining supply chains. These are discussed under the headings of supply chain management, choice of technology, and type of supply chain (whether private sector, public sector, or private/public partnership). Research worldwide shows that overall management of handpump spare-part supply chains is carried out primarily by donors and Governments, although the supply chains themselves generally involve both the public sector and private enterprise.**

**This field note suggests that there is no single best solution to supply chain development and that practitioners continue to develop private, public, and private/public supply chain models. Detailed market assessment techniques are beginning to be used to determine private sector demand. At the same time the value of a process approach, described as a 'learning journey', has been recognized as a realistic way to raise stakeholders' understanding of private and public sector dynamics and capacity. The 'learning journey' is a coordinated stakeholder approach that has the potential to facilitate the development of informed options for the end users.**

### Creating Sustainable Supply Chains

The challenge of creating sustainable mechanisms for supporting handpump repair and maintenance beyond installation has already received much attention in rural Africa. In 1999, the Water and Sanitation Program began a process of systematically identifying the key factors that contribute to successful supply chains, through case study

assessments and 'learning through action' initiatives in Asia, Africa and Latin America (Oyo 2001). The process has continued in partnership with the Rural Water Supply Network (RWSN) under the sustainable handpumps thematic group.

A review of the studies into the working of supply chains, conducted over the past five years, suggests that some recommended approaches from

previous supply chain studies have been adopted, e.g. market assessment in Mozambique (Government of Mozambique May 2003). A coordinated approach to rural water supply has been adopted in Ghana (WMC, WaterAid 2005), which has assisted the process of raising the understanding of stakeholders (Government, donors, private sectors, NGOs) about the private sector's dynamics and constraints. This 'learning journey' for the stakeholders has the potential to begin the process of building a base of knowledge and understanding from which informed options for rural water supply and supply chains can be developed with the end users.

The approach recognizes that solutions for successful supply chains need to go beyond water project boundaries and may in fact need a regional, national, and possibly international perspective. Project timescales mean that it will be some years before the outcomes of these initiatives can be assessed. There seems to be limited adoption of these and other ideas for improving supply chains and in the mean time handpumps continue to fail and fall into disuse, often due to the unavailability of spare parts.

Table 1, taken from the reviewed studies, summarizes the key issues affecting supply chain success. It suggests that supply chain management is predominantly provided by donors and Government through project implementation. It can also be seen that standardization is increasingly the norm. The supply chains listed are mainly public/private.



**Table 1. Key factors affecting supply chain success**

Key issues	Case study evidence of:	Number of countries	Countries (the number '2' indicates that two studies were conducted within a country)
Supply chain management	Existence of a formalized supply chain management role	3	Bangladesh Uganda (2) Vietnam
	Donors providing the supply chain management role in a non-formalized way	10	Bangladesh Ethiopia (report dated May 2003) Ghana (2) Malawi Mauritania Mozambique South Africa Tanzania Uganda (2) Vietnam
Technology choice	Standardization policy defining handpump procurement	9	Ethiopia Ghana (2) Malawi Mauritania Mozambique (2) Pakistan South Africa Tanzania Uganda (2)
	No standardization policies for handpump procurement	2	Ethiopia (report dated May 2003) Kenya
Supply chain type	Private sector supply chains	2	Bangladesh Vietnam Nicaragua
	Public sector supply chains	4	Ethiopia Malawi Mauritania Tanzania
	Public/private supply chains	6	Bangladesh Ghana (2) Mozambique (2) Pakistan Tanzania Uganda
	Demand driven supply chains (using market assessment tools to determine demand)	4	Bangladesh Mozambique (2) Vietnam West Africa, (Vergnet pump*)
'Learning journey'	Adoption of the 'learning journey/approach'	2	Ghana Mozambique



## Supply Chain Management – An Overview

Overall management of any supply chain is critical to its success, and can be broken down into several key action-related components:

- Conduct market assessments.
- Develop the supply chain.
- Identify opportunities for supply chain improvements and new business.
- Market supply chain products.
- Communicate between links in the chain.

- Deliver products to the end user through the chain in the most cost efficient way (to maximize profit for private sector operators).
- Manage the resolution of problems.
- Facilitate or manage price setting through the chain.
- Influence quality control.

Large international companies devote significant resources to managing their supply chains. In West Africa, the pump manufacturer Vergnet (See\* Table 1) (Oyo 2001) provides a complete supply chain management role from

its manufacturing base in France. This extends all the way to the local distributor at district level and to the area mechanics maintaining the installed pumps. Vergnet's success is due in part to the fact that its demand model is effective, and to the fact that the supply chain is embedded in an existing network.

Implementing agencies, often inadvertently, play a supply chain management role in trying to create spares supply networks. They play an important role in the early stages of developing rural water supply chains, with their role diminishing as supply chains are developed. If the implementing agencies are donors, they need to have a clear exit strategy and a replacement structure for the continuation of the management role, whether the replacement structure is private, public or private/public.

Studies in Africa have shown that although the private sector provides a supply chain management role in the agricultural sector, in rural water supply this management is generally provided by donors and project implementers. In Malawi (Alexander 2003), faith-based organizations appear to have achieved some success in managing spare parts supply through their existing networks. Continued success seems to rely on the ongoing commitment of non-profit organizations and the continuation of a subsidized supply of spare parts from donors and Government.

In Vietnam (SDC & HTN Nov 2002), despite the high population density, Independent Development Enterprises

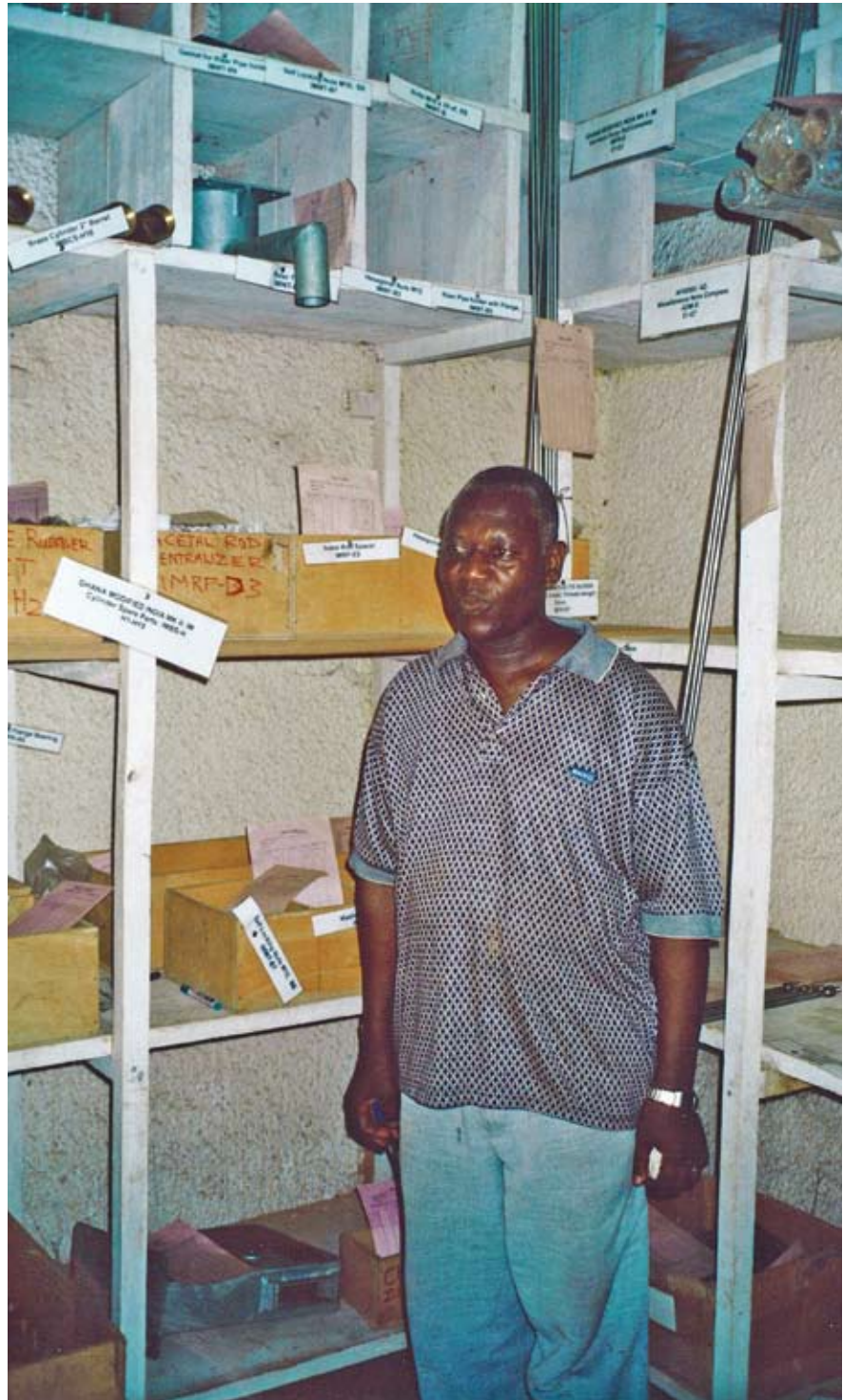


(IDE) played a crucial role in developing the market for handpumps by supporting suppliers (manufacturers and installers) with training, seed capital and product marketing. IDE's management role enabled the supply chain to develop successfully and support subsequent customer demand for new pumps and spare parts, helping to generate a thriving market for handpumps. As IDE reduced its involvement, those in the supply chain were able to provide the necessary management function themselves.

In Ghana (CWSA Ghana 2004, SKAT Foundation 2004) a central distribution agent with four outlets was provided with spare parts and given the responsibility to trade through a distribution network. Although the project still needs considerable donor support, it may provide a level of demand that secures some measure of long-term sustainability. Other projects also in their infancy, for example in Mozambique (Mozambique Ministry of Public Work and Housing 2003) recognize the value of supply chain management, and advocate the use of private sector suppliers to fulfill this role.

### How to achieve sustainable supply chain management?

The need for a supply chain management function seems clear, but what is the most sustainable way to achieve it? The ideal situation would be for a private sector operator to see a long-term commercial incentive to fulfill this role, provided the operator has the necessary business acumen and financial capital as well as existing links to a network of distributors. To date







In countries where there are low population densities and thus low levels of demand, it is unlikely that truly private sector-operated supply chains for spare parts can be viable, e.g. Mauritania (WSP/World Bank Sept 2004) and Malawi (Alexander 2003). In such cases the supply chain management role must fall predominantly on the public sector. Donor and Government-led projects can assist this process in working together to create pockets of demand. This could be achieved through funding market assessments, advocating technology standardization where appropriate, and advocating the reduction of private sector constraints such as registration and taxes. The latter approach was recommended by a DFID-funded project looking at small-scale private sector participation in the rural water sectors of Ghana, Tanzania and Zambia (WMC, WaterAid 2005). The study recommends that Government take on the initial supply chain management role, coordinating donors and the private sector until a point is reached where private sector operators can take over. It is not assumed that Government has the capacity to conduct this role, and for this reason the 'learning journey' is recommended. This would be facilitated by business development and supply chain practitioners, and would provide the process for Government to develop its own capacity to take a lead in supply chain development.

in Africa, studies have generally found potential private sector operators lacking in at least one of these three areas. Typically the donor community supports either the financial capital, or the creation of the network, or both, e.g. Ghana (CWSA Ghana 2004, SKAT Foundation 2004) and proposed projects in Uganda (SKAT Foundation Oct 2002).

One way that may prove effective is to put long-term contractual obligations on the larger installation contractors to create spares supply chains and take on

the management role. This arrangement would put spare parts into the market place immediately after project implementation. The section headed 'Type of supply chain' (see page 10) describes three types of such schemes, whereby a private sector operator contracts to deliver a certain level of service, with a performance regime and a penalty regime for poor performance. These schemes have the potential to provide the required sustainable support, although evidence of implementation is limited at this stage.

Whoever takes on a supply chain management role must recognize that it is a long-term one. It is not appropriate therefore for donor agencies to take on long-term supply chain management roles as it clearly conflicts with a goal to reduce direct country support. If donors

### Box 1. Factors for supply chain management success

- Overall management of the supply chain is crucial to its ultimate success. Without this role being filled, a supply chain is likely to collapse, especially with a complex chain involving numerous role players.
- Whether the role is taken on by private/public sector or Government, it is clear that the role must be a long-term one.
- Private sector operators taking on a supply chain management role are more likely to succeed if they see a long-term commercial incentive and are equipped in terms of business acumen, financial capital and an existing link to a network of distributors.
- Government agencies generally need capacity development to take on the supply chain management role. The 'learning journey' approach can assist this process.
- If donors take on such a role, a clear exit strategy, which includes adequate training initiatives, must be formulated at the project outset.

and external agencies start this process, they need to do so with a clearly defined exit strategy, which includes adequate training initiatives to ensure that the role can be taken over and continued once they are gone, e.g. IDE in Vietnam (SDC, HTN, Nov 2002).

### Choice of Technology

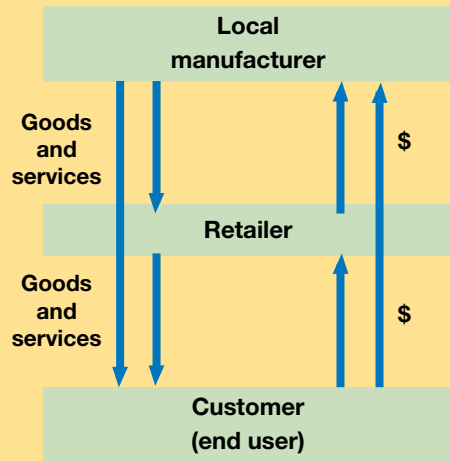
Choice of technology has a fundamental impact on the ability of a supply chain to support spare parts and repair needs. The goal of the technology choice process is to provide end users (the pump user communities) with the means to understand the impacts of choosing each type of handpump – operational and maintenance requirements, costs, and long-term support structures. Simple technologies, such as the rope pump, used most notably in Nicaragua and transferred to Ghana and at least seven other African countries (WSP 2001), have few spare parts, and these parts can often be produced locally. Such technologies normally require a relatively small and simple supply chain. Non-operational time for rope pumps is therefore significantly lower than for more complex technologies.

As water depth increases, more technically complex equipment is required and a more elaborate supply chain is needed, because spare parts, such as washers, which will have to meet higher levels of quality, may need to be sourced. While there may be a variety of handpumps available to meet the geological and environmental challenge (depth and impact of water quality), the technology selection process should always follow the



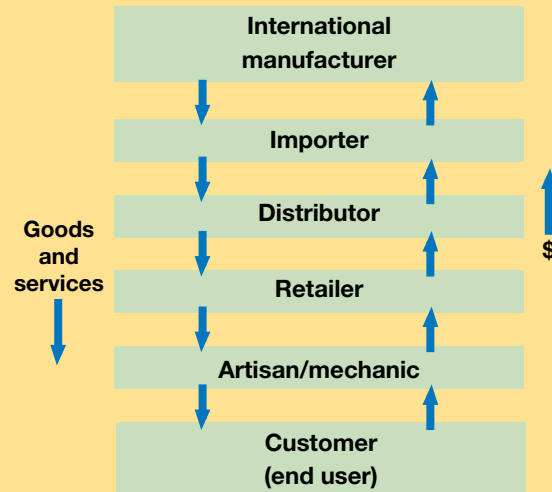


**Fig 1. Simple supply chain**



Goods and services are supplied from the local manufacturer to the customer either directly or through a retailer. The customer is able to effect repairs themselves.

**Fig 2. Technology choice and supply chain complexity**



Goods and services are supplied from the international manufacturer, through four links in the supply chain before reaching the end user. Skilled artisans are required to maintain and repair the technology.

principle of 'simpler technology = simpler supply chain = greater chance of success'. Figure 1 demonstrates this principle. End users (communities) need to be provided with adequate information on a set of suitable options, but overly complex technologies should not be promoted if simpler options are appropriate and available (Figure 2).

One approach to choice of technology is to aim for high volumes of particular pumps within a geographical area, and in this way generate sufficient demand to stimulate private sector interest (Oyo 2001). Standardization of handpumps as a national policy is increasingly widespread in Africa, for example in

Ghana (CWSA Ghana 2004, SKAT Foundation 2004), where only four types of pumps are now permitted in new installations. This policy helps to achieve increased volumes of similar technologies. The increase in demand creates an environment that allows some control and management of quality and possibly of price. At the same time one can standardize spare parts for the selected pumps, thus creating a higher demand for a generic group of spare parts, and increasing the viability of private sector supply.

Governments in many countries regulate the standards and quality control of equipment and services – although

studies in Pakistan (Robinson 2000) and Bangladesh (Robinson and Ajay 2000) suggest that a balance is needed between cost and quality. In Pakistan, implementation agencies achieved considerable success in creating a varied supply market for Afridev handpumps to meet the large donor-led installation programs. In parallel with this, a private user market was established which used the basic design of the original Afridevs, but with some changes to the above-ground components, making the pump cheaper and operationally more appropriate to the end user.

In Bangladesh the treadle pump is a very simple technology for high water table



conditions. The WSP investigation into low cost irrigation in Bangladesh (WSP August 2000) showed that users made economic decisions to purchase lower quality pumps that only lasted two years, instead of pumps 50 percent higher in price (on average) that lasted five to seven years. This trade-off between price and quality, linked to income levels, is an important consideration for development agencies, as it challenges conventional technology development practice to increase quality and reliability. It has implications for supply chains because quality standards have the potential to rule out local manufacturing.

Technology selection is an iterative process. The first step is to determine the geological and environmental requirements. The next step should be to select the simplest technology possible and to conduct a market assessment to determine the viability of a private sector supply chain. In Mozambique (Government of Mozambique May 2003) this process started in Inhambane province. To assist this process Harvey and Reed (2004) suggest an approximate calculation to determine the spares demand for a particular technology per geographical area.

If there is a technology already established in a particular area or region with a functioning supply chain, then it should be considered, as its volume of demand may equate to a viable demand for spares within the proposed new project area. Technology choice must always consider the sustainability of the long-term post-installation support mechanisms, and the benefits



of coordinated regional, national or international approaches.

The assessment of appropriate technology also needs to consider institutional policies and arrangements that might constrain or support the use of certain technology (Box 2). Harvey and Reed (2004) suggest that relaxation of import duties may lead to favourable conditions for technologies which do

not support local procurement or spares support. The policy regime needs to be applicable for the country situation.

The potential move towards greater personal/household ownership of water lifting equipment may create a demand on the private sector for new types of handpump, which a standardization policy may not be able to control. It may also see a move away from



## Box 2. Factors to consider in the technology selection process

Simpler technologies invariably require simpler supply chains, but the process of technology selection should be an iterative one, running in parallel with the assessment of an effective and sustainable supply chain to deliver post-implementation goods and services. The process needs to include consideration of:

- Consumer preferences and demands
- Geological and environmental requirements and constraints
- Potential demand for post-implementation goods and services within a geographical boundary
- Likely supply chain effectiveness to supply support goods and services (private, public or private/public partnership)
- Cost
- Quality
- Reliability
- Operation and maintenance requirements and costs
- Willingness and ability to pay for support services

handpumps towards greater interest in motorized systems. In general, supply chains for diesel and electric technology are relatively well established, even within reach of rural locations. As solar technology develops further and costs come down, solar pumping equipment may also become more viable for rural use.

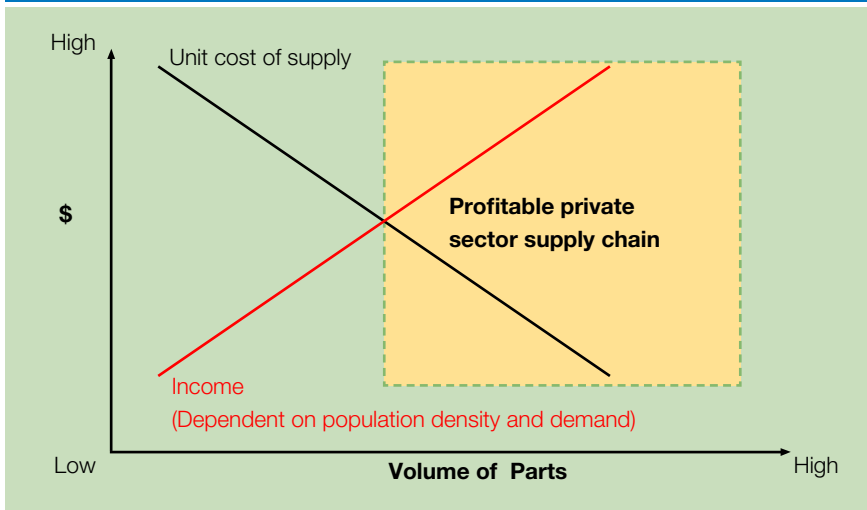
### Type of Supply Chain

The role of a supply chain is to deliver the correct goods and/or services to the user, at the right time, cost, and quality, to achieve the four fundamental elements – availability, accessibility, affordability and appropriateness. Supply chains can be operated by the private





**Fig 3. Profitability of a private sector supply chain**



sector, the public sector (including NGOs, Government and donors), or a mixture of private and public.

### Private sector supply chains

The key driver for a sustainable private sector supply chain is adequate demand. This depends heavily on population density and the replacement rate of spare parts. A simple illustration of this can be seen in Figure 3, which shows that as demand increases, so does the total income from sales. The unit cost<sup>1</sup> of supply reduces until a point is reached where the demand is high enough to make a profit (the yellow shaded area). If the supply chain is unable to trade in the yellow box, the business will not be attractive and the supply chain is unlikely to succeed.

The effect of population density on demand can be seen in Asian studies of the Afridev handpump in Pakistan (Robinson 2000) and the Treadle pump

in Bangladesh (Robinson and Ajay 2000), where relatively high population densities in rural areas have created enough demand to enable private sector supply chains to grow. In comparison, spares supply chains in Africa with its generally low population densities, tend to be public sector operated, e.g. Malawi (Alexander 2003).

Figure 4 (Narkevic 2005) suggests that the viability of unsubsidized privately operated supply chains is largely a function of a country's population density and income levels. On this basis, most countries in Africa will require between 10 to 20 years of subsidized spare part supply chains before the supply of spares becomes self-financing, and even longer in the case of very low income, very low density countries.<sup>2</sup> Demand is also affected by the end user's willingness and ability to pay for water supply and the support services. Therefore, where rural populations are small, such as in Mauritania (Bernage

2000), creating enough demand to stimulate sustainable private sector interest may not be possible. Practitioners need to be realistic about the levels of income needed for water supply services to support given technologies.

### Private /public supply chains

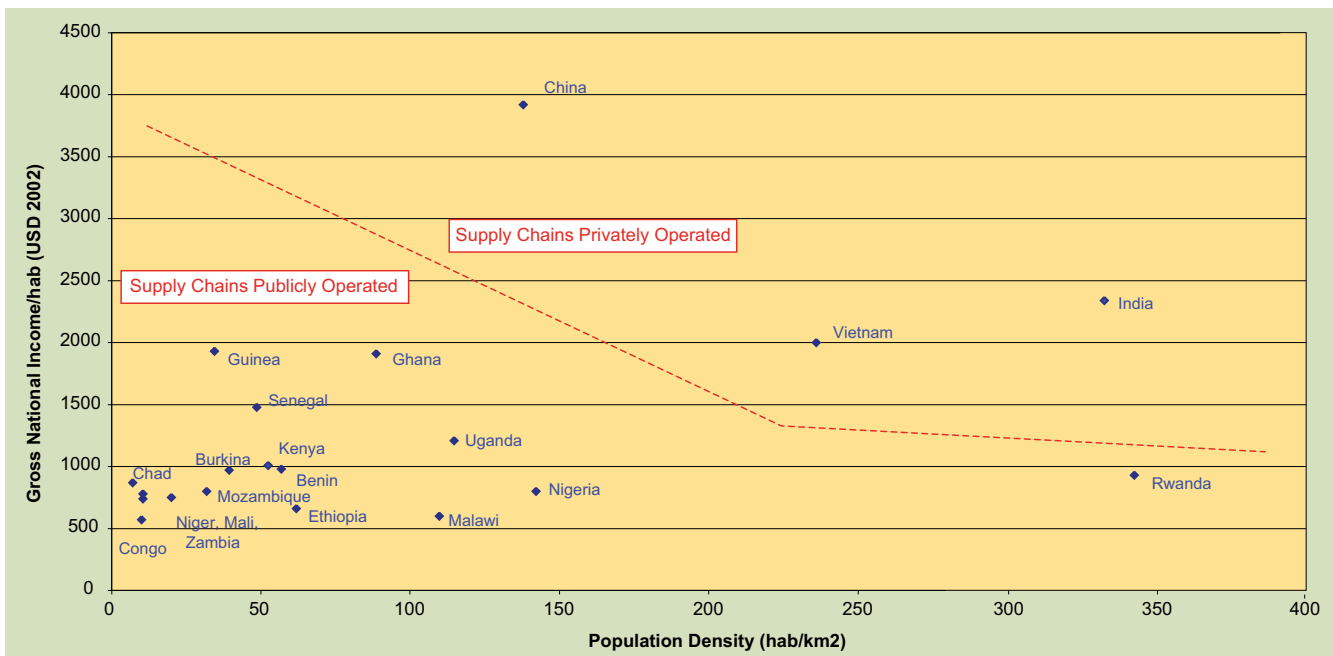
The studies suggest that self-supporting supply chains for spare parts alone will not be viable in rural Africa. Success is more likely if spares supply chains are linked to related water technology services such as pump installation and maintenance services. Public/private operation and maintenance (PPOM) schemes (Harvey and Reed 2004), regulated and contracted by Government, may well provide an effective solution through which spare parts can be accessed in larger regional settlements and taken to the required locations. Three examples of PPOM schemes are:

- Water Assurance Schemes – private companies are contracted by communities who own their own schemes, to provide operation and maintenance services and routine upgrades.

<sup>1</sup> Costs incurred by all links in the supply chain to deliver a product or service.

<sup>2</sup> Harvey and Reed (2004) offer the Handpump Density Breakpoint (HDB) calculation as a way of testing the commercial viability of spare parts supply at the user level. The HDB sets out the minimum handpump demand needed to generate sufficient turnover of spares and sufficient profit for the retailer. The authors admit that this is a somewhat crude method of estimation, but it clearly demonstrates that a relatively high density of handpumps is required to achieve profitability (e.g. 200 pumps within 20 km of outlet). This is rarely found in the low population areas of sub-Saharan Africa.

**Fig 4. Handpump supply chains operation against national income and population densities for select countries**



- Total Warranty Scheme (Harvey and Reed 2004) – pump manufacturers support local enterprises that provide spares and technical services for an annual fee. A warranty contract guarantees a certain level of service and reliability through a performance regime, which includes penalties for poor performance, e.g. pump reliability and non-operational time. Government plays a role in regulation, supporting end-users in managing their suppliers where there is conflict. The Total Warranty Scheme requires strong institutional and judicial support if it is to be effective and not cost-prohibitive to the end user.
- Handpump Leasing Schemes (Van Beers August 2001) – similar to

the Total Warranty Scheme, but communities lease rather than own the equipment. They pay a monthly fee, supported by a contract, for a certain level of service. Again a performance regime with effective penalties would apply.

All three schemes make use of an established private sector operator, who is already involved in the water sector and has the financial support and potential commercial incentive to support the spares network. However, even with contracts, the schemes still rely on the basic private sector requirement of adequate demand, which in turn equates to density of potential customers. National policy using such schemes can help with creating sufficient demand, but at this stage evidence of good application is limited

(WSP August 2000). The Water and Sanitation Program – Africa (WSP-AF) ([www.wsp.org](http://www.wsp.org)) will explore opportunities for similar models under its regional initiative entitled 'Forming Rural Utilities Groups and Leases' (FRUGAL).

In addition to its role of regulator, Government has the potential to influence market incentives to encourage private sector activity, by helping to create an enabling environment for business. For example, tax relief on water technology and import duties can help to reduce transaction costs. So can relaxing the requirements for registration to allow smaller businesses to bid for small private sector support contracts (WMC, WaterAid 2005). If there are Government subsidies for handpump installations and support services, Government has the opportunity to



use the subsidy process in its selection criteria. If it is possible to reduce the subsidy within the terms of the contract life, this may act as a controlled mechanism to move towards a more independent supply chain.

Another way in which the Government intervention is supporting skills investment (Uganda, SKAT Foundation Oct 2002) is through business development services (BDS) providers. International business initiatives such as the United Kingdom's Prince of Wales International Business Forum ([www.iblf.org](http://www.iblf.org)), which links international business with small and medium enterprises in developing countries, may be able to provide general business development support to the private sector, and possibly specific product support.

Since the goal of the private sector operators will be profit, social responsibility incentives alone will not guarantee long-term sustainability. For example, in Malawi subsidies were used to provide handpump spares through a national network of hardware shops. When the network was privatized, the profits from spare parts were not high enough for the new individual shop owners, and the supply chain was broken (Kandulu 2004) (Harvey and Reed 2004).

### Public sector supply chains

Where private and private/public sector supply chains are not viable, the public sector model is the alternative. These supply chains require a long-term commitment to support spares provision. Typically funds will come from donors through Government, and the supply chain can be operated by Government



### Box 3. Summary

- Supply Chains can be operated by the private or the public sector, or through private /public partnerships. Longer supply chains require more management and financial input over the whole supply chain, thus requiring a higher income for each unit sold.
- There is limited evidence of successful stand-alone private sector supply chains for rural water supply support services in Africa, but there is potential for private/public operation and maintenance schemes (PPOM), where Government agencies play a role as supply chain manager initially and as industry regulator in the long term. Where donor-led projects are not able to create adequate demand through a coordinated approach to demand assessment and technology choice, then long-term subsidies may still be required.
- Public sector supply chains may be the only viable solution in some situations (sparsely populated, remote areas requiring complex technology) which require a long-term commitment to support, e.g. through Government agencies or faith-based organizations.
- Tools exist to approximate potential demand for the goods and services delivered by supply chains (measuring spares requirements and population densities per geographical area), but rural water technology services have greater potential for success when aligned with existing supply chains, e.g. handpump installation.

water agencies and non-profit-organizations such as faith-based groups — as in Malawi (Alexander 2003). As with the private sector, these supply chains have a better chance of being successful if existing networks are used and where a degree of supply chain management already exists or can be developed.

## Conclusion

The studies show that there is no single best type of supply chain to deliver hand-pumps and spares and repair services in rural Africa. Implementation of lessons learned from previous supply chain work is at worst limited and at best in its infancy. It will be some years before the impacts of initiatives, such as the upfront use of market assessments, can be assessed.

Effective supply chains need good management and adequate demand for the goods and services, which can be determined by technology choice and geographical density of the handpumps. Supply chains can be private sector, private /public or public. Private/public supply chains, e.g. using large distributors or installation companies to provide supply-chain management and provision of the goods and services, supported by warranty or leasing mechanisms, also need adequate demand in order to be sustainable. There may be potential to sustain private sector interests and develop markets using Government initiatives that reduce transaction costs for businesses, e.g. tax relaxation and making registration easier.

The alternative to private sector operation, where demand is inadequate to stimulate the private sector, is to use the public sector. Faith-based organizations, with an adequate level of interest, have the potential to successfully use their networks to distribute spare parts. In most countries the ultimate responsibility for service provision lies with Government. Where Government is involved in managing the supply chain, this requires a long-term commitment, which may in fact be the most workable solution to sustaining service provision in very sparsely populated areas where no other mechanisms is viable.

Whilst there is no straightforward formula, there is the potential for a logical process to direct those who are implementing projects and programs to success. Described as the 'learning journey' the process simply facilitates all key stakeholders in the assessment of the supply chain options, in parallel with the technology selection, within a geographical boundary. This may be local, regional, or international. Recognizing that supply chains are not constrained by project boundaries, this process allows the stakeholders to reach the same level of understanding regarding the basic dynamics of the private and public sector and to develop a range of informed options, with understood consequences, with the end users. The 'learning journey' continues through program and project implementation.

The following summary outlines a suggested sequence for establishing, managing, and sustaining a spare parts supply chain for handpumps:



#### Box 4. Supply chain development - steps to success

##### Step 1

Define the geological and environmental constraints of the project area.

##### Step 2

Determine the range of technologies available, together with reliability profiles and spares and support requirements.

##### Step 3

Facilitate the coordination of countrywide stakeholders (private, Government, NGO, public, donors) to adopt a 'learning journey' approach to training, in order to understand the dynamics of the private sector in general, and the spare parts supply chain in particular.

##### Step 4

Conduct a market assessment which includes:

- determining potential spares business (see Harvey and Reed calculation Footnote 2)
- identifying all constraints to private sector supply chain development including Government procurement policy, access to credit, business development support for traders, ability and willingness to pay, and attitudes of end users
- determining comparative markets and supply chains already in existence
- determining other projects and donor/NGO approaches to subsidy support of pumps and spares
- identifying options for the supply chain management function
- identifying options for public sector supply chains.

##### Step 5

Decide on appropriate supply chain and technology.

##### Step 6

Influence policy change where required.

##### Step 7

Plan the supply chain management function, and identify a clear exit strategy for external public sector agencies (in particular for donors).

##### Step 8

Plan policy implementation and ensure a continued coordinated approach with other agencies, as part of the ongoing 'learning journey'.

##### Step 9

Implement using project management action planning practice (the plan, do, review, plan cycle).

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