8 THE ROLE OF IMPROVED DOMESTIC WATER SUPPLY IN LIVELIHOODS AND POVERTY REDUCTION IN LIMPOPO PROVINCE, SOUTH AFRICA

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Summary

Managing water scarcity represents one of the key challenges in the trade-offs between economic growth, social justice and ecological integrity for developing countries. The poor are disproportionately affected by water scarcity due to their greater reliance on natural resources to generate sustainable livelihoods. Research in Limpopo Province, South Africa, is investigating the linkages between water and poverty. Domestic water supply was analysed as a potential intervention that achieves premised health benefits and a hidden leverage for productive benefits in food security for the poor. A catchment survey at the household level (n=552) is explored to unravel the linkages between domestic water provision and poverty. Findings are disaggregated according to three social cohort groups: Home husband, migrant husband and female-headed households, and by three mean household age profiles: 25-34, 35-44 and >45 years. All social cohorts undertake kitchen-garden farming as a significant livelihood activity. Over 70% of households consume all crops grown indicating the importance of this activity for food security. However, access to domestic water is disproportionately skewed in favour of the male-headed, income wealthier households. The number of kitchen-garden crops grown is significantly associated with private water access. Willingness to pay for improved domestic water reflects current levels of delivery with older, female-headed households reporting higher monetary values associated with lower levels of water access. The authors argue that improved domestic water access offers greater equity and food security benefits to poorer households, but the efficiency and sustainability of such a poverty reduction intervention is questioned.

8.1 Introduction

The livelihoods of the poorest are directly affected by their access to and use of their natural resource base including limited water resources. Globally, four out of every ten people currently live in catchments experiencing water scarcity, and the proportion is increasing. This trend will translate to 3.5 billion people facing water scarcity by 2025 (UN 2002)[1]. Whilst the link between water and health has been transparent since the 19th century, the role and significance of water as a productive good or service for the poorest is more opaque. However, recent evidence (Perez de Mendiguren and Mabelane 2001; KAWAD 2001) has indicated the potential contribution that productive use of domestic water might make to poverty reduction. This paper draws on findings from a research project[2] in the Luvuvhu catchment, Limpopo Province, Republic of South Africa (RSA), investigating linkages between land use change, water and poverty. The focus here is on the relationship between domestic water supply, kitchen-garden farming and poverty.

RSA and its Department of Water Affairs and Forestry (DWAF) have achieved much in reducing the 14 million people without access to safe water in 1994 to 7 million in 2001, while it is projected that the remaining 7 million will be connected by 2008 (Pearce 2002). These figures indicate the aggregates across the nation and conceal the urban-rural, gender, age and class biases on the ground (see Carter and May 1999). Furthermore, leaving aside the health benefits of a reliable, clean water supply, we have little evidence on how improved water supply might have positive livelihood impacts for the poorest. A better understanding of water-livelihood linkages can inform which policies, institutions and processes may best contribute to poverty reduction[3] and sustainable development.

The link between water and poverty is complex and mediated by many conflicting variables that limit a transparent understanding of the relationship. UN (2002:14) talks of raising the social and economic

[1] Water stress exists where annual per capita availability at national level is below 1,600m^3 per annum for all uses (ODI 2002).

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[3] Poverty can be characterized by many attributes (food security, income deficits, well-being etc), this paper is mainly focused on income poverty.

status of the poor so that they can then pay for their water services. This fits the Millennium Development Goal (MDG) of halving the number of people globally without access to safe drinking water to 550 million by 2015. What neither of these two technically-orientated initiatives address is the potentially productive role of water in poverty reduction. More importantly, they do not analyse who gets domestic water first and what benefits accrue as a consequence of improved water access. This paper seeks to provide some insights into these issues by presenting findings from a rural livelihoods survey in RSA.

The following sections consider the context to the water and poverty situation in RSA, water policy in RSA, the research catchment, wealth-ranking and social disaggregation, and the paper concludes with results and discussion of the findings.

8.1.1 Water and poverty in RSA

In any geographical region water is present in multiple forms, and is transformed into numerous consumptive and productive uses. Within a catchment, water is present as stocks (lakes, ponds, reservoirs, aquifers) and flows (river, precipitation) and intermediate points such as soil moisture. These stocks and flows are often mediated by human interventions in terms of both supply management (dams, reservoirs, reticulation) and demand management (water charges, levies and compensation mechanisms). Attempts to bridge the gap between biophysical, technical and human understandings of water can be made using both an Integrated Water Resources Management (IWRM) approach and by the Sustainable Livelihoods (SL) approach. The latter is gaining greater recognition and application in RSA and is the methodological touchstone on which the current research has been based (see Scoones 1998, Carney 1998).

Water can be characterised in the SL's framework terminology of 'capitals' as physical (e.g. reticulated supply), natural (river, precipitation), human (health, water gathering), social (cultural value) and financial (e.g. water unit cost). Water may be represented in the vulnerability context of the SL framework through the impact of drought or flood on households and communities, and in trends of steadily increasing/declining rainfall. The 'user pays' principle represents a potential constraint to the poor if adequate measures are not taken to protect them in regressive water pricing schemes, while the institutional context that mediates the livelihood 'capitals' in terms of policies, institutions (e.g. markets) and structural relationships between water users and suppliers will influence the livelihood strategies adopted. These strategies result in livelihood outcomes that can be evaluated in either quantitative (e.g. income) or qualitative (e.g. well-being) terms. The role and significance of water to the livelihoods of the poorest in Africa has been documented (White *et al* 1972; White 1977; Rosen and Vincent 1999; IWMI 2000; van Koppen 2000; Thompson *et al* 2001; WaterAid 2001). However, to date, there has been little data collected on, or analysis of, the impacts of improved water supply on the livelihoods of different social cohorts within poor rural communities in RSA.

RSA is a middle-income country that is in a challenging phase of developing and implementing new policies and frameworks to redress the historical inequities of the apartheid era. RSA's relative wealth in the Southern African regional context does not diminish the scale of the challenges to hand. Rather, it highlights the need to implement poverty reduction policies that effectively create opportunities for the poorest of its citizens. Critical to this process is the necessity to identify those policies and interventions that can most effectively lift the poorest out of poverty.

Due to historical factors, the landscape of RSA presents a racially skewed distribution of wealth and access to natural resources, including water (Table 1).

Poverty has both rural and gender dimensions. The majority of the poor (71%) live in rural areas. There is an income 'poverty gap'[4] of 76% between the urban and rural population. Rural areas are constrained by infrastructure delivery compared to urban areas, and this includes water supply. Seventy-four%of rural households need to fetch water on a daily basis, while the water gatherers are mainly women and girls. The gender dimension of poverty is highlighted by a 'poverty rate' for female-headed households of 60%, compared to 31% for male-headed households (May 1998).

Access to water and land offers opportunities to the poor to build healthy, secure and sustainable livelihoods (van Koppen 1999). Yet infrastructure and institutions exacerbate the poverty trap since the poor are marginalised in access to irrigation schemes, land, market access and credit. Distribution of access to land and water rights has historically been distorted by the inequitable policies of both colonial and apartheid governments (RSA 1998; Yawitch 1981; Bundy 1972). Four million hectares (3% of total

[4] The poverty gap reflects the scale of the spatial poverty differential calculated from a nationally defined income poverty line (see May, 1998).

land area) of RSA is considered high-potential agricultural land. One third of rural households engage in agricultural production, and although it makes a limited financial contribution to income, agriculture is the third most important livelihood strategy[5] in rural areas after remittances and wages from low-skilled jobs (May 1998). With the current gloomy macro-economic and employment trends, small-scale agriculture offers the poorest a livelihood lifeline as the formal sector suffers, while attention to agricultural genhancement can address the vulnerability context of the poorest. It is argued that women particularly benefit from access to agricultural assets such as community gardens, irrigated plots and secure land tenure (Francis 2000; van Koppen 2000).

Table 1 Poverty and water in South Africa

Development indicator/ Racial group		Black (77%)	White (11%)	Coloured (9%)	Indian (3%)
Poor (<R1,000 per month)		61	1	38	5
Water	Tap on site	20.5	0.7	18.6	1.3
	Tap inside	26.7	95.9	71.8	97.1
	Public Tap	26.3	0.1	4.8	0.4
Electricity		31	98	76	99
Unemployment rate		42.9	4.6	20.9	12.2
Access to medical services		26.7	95.9	71.8	97.1

Source: SSA (1996)

Spatial differentiation also figures in the configuration of poverty in South Africa with significant disparities between and within provinces. Limpopo Province (LP, formerly Northern Province) is one of the poorest provinces across a range of poverty indicators (Table 2). Luvuvhu was chosen as the research catchment due to the high-level of poverty in the province, the existing lack of analysis into the determinants of poverty, and the historical context of the research catchment containing the former Venda homeland (Hope *et al* 2002).

Table 2 Poverty profile of South African provinces

Province/Poverty indicator	Poverty Rate (%)	Africans (%)	Tap inside (%)	Public tap (%)	No access to sanitation (%)
Limpopo Province	59.1	96.67	17.3	40.4	21
Eastern Cape	70.7	86.45	24.6	18.5	28.9
Free State	63.4	8.5	40.1	23.9	8.8
Gauteng	17.3	-	66.7	11.4	2.5
KwaZulu-Natal	51.9	81.75	39.1	18.4	15.1
Mpumalanga	57.3	89.19	36.4	20.1	8.6
Northern Cape	54.9	33.16	49.7	8.4	10.6
North West	62.1	91.17	29.5	31.5	6.4
Western Cape	28	20.89	75.4	7.7	5.4

Source: SSA (1996)

8.1.2 Water policy in RSA

Water policy in RSA is guided by the National Water Act (NWA, Act 36 of 1998). The Act is based on the dissolution of riparian rights and the enshrinement in law of water as an indivisible national asset – that is water (in all its forms) belongs to the nation. The key aspects of the NWA are the establishment of a 'Reserve' (human and ecological) which must be met before any other water use; the development of Catchment Management Agencies (CMAs) and Water User Associations (WUAs), requiring the negotiation of water allocation between competing uses by stakeholders; and the drive for licensing or compulsory licensing (water-stressed catchments) of all water users (RSA 1998). The key tenets of the NWA are social equity, efficiency and sustainability. The Department of Water Affairs and Forestry (DWAF) is the competent authority for implementing (and interpreting) the NWA.

[5] Excluding the contribution of non-market goods and services such as woodland (see Shackleton *et al.* 2001).

In 1994, the democratically elected ANC government identified lack of water as a key symptom of poverty and under-development. The principles of the new dispensation were that basic water services are a human right, there should be equitable allocation of water, water development should be demand (community) driven, water is an economic good (the user should pay), and there should be environmental integrity and integrated development (RDP 1996; RSA 1998).

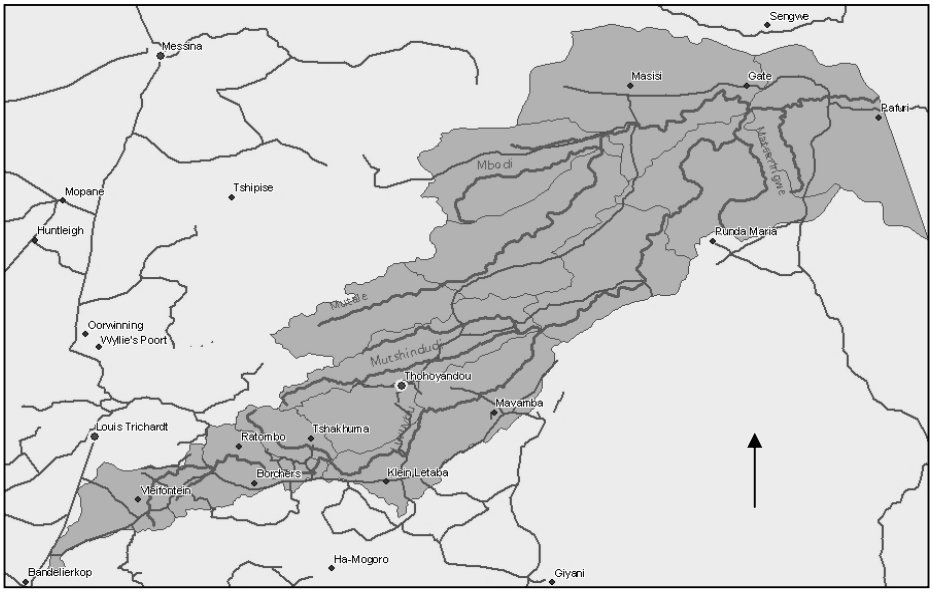
The 1997 Water Services Act (RSA 1997) ratifies the right of access to basic water supply by all South African citizens. This has been realised in the Free Basic Water Provision (FBWP) of 6,000 l of safe water per month to poor households (DWAF 2001). This free allocation recognises the role of water in improving community and household health and of freeing women from the drudgery of collecting water. The FBWP is the responsibility of each municipality. DWAF (2001) estimates that this provision can be provided at the national level to all households, which fall below the 'equity share poverty threshold' of 800 Rands per month (10 Rand = 1 US$, 2002). Constraints to implementation are identified as access to capital funds, cross-subsidisation in poor municipalities, and government financial support. The latter is being supported by the 'equitable share allocation' to local government, particularly targeting those municipalities with limited potential to cross-subsidise. Further issues are targeting the poor through 'poverty lines' (see Ravallion 1998), leakage (literally and institutionally) and the apparent contradiction of water as an economic good that is charged at no cost (Perry *et al* 1997). Whilst cost recovery remains a key objective of local government (DWAF 2001:10), municipalities are left with the challenge of equitable provision, tiered charging and consumer confusion and anger over their rights. This all occurs in the context of a rapid transition to the decentralisation of water management, in which local capacity is considered to be weak.

Whilst implementation remains a thorny problem, the achievements of the RSA government in halving the people without a potable water connection are laudable. However, as we argue later, the social distribution of those receiving connections is less transparent, as is the impact of improved water supplies on reducing poverty.

8.1.3 Study area: Luvuvhu catchment

The Luvuvhu catchment covers 5,940 km² and forms part of the larger Limpopo river system (Figure 1). The catchment is characterised by the Soutpansberg range (>1,500 m) falling from the south-west to the north-east. In the upper, western reaches of the range, the precipitation regime (>1,000mm/pa) is higher, which is reflected by commercial forestry plantations (pine, blue gum) and large-scale irrigated agriculture (>100 ha). Thohoyandou is the main urban settlement contributing significantly to the estimated catchment population of 600,000 people. The north-eastern section of the catchment is marked by lower rainfall and fragmented, rural communities that lead to the border of the Kruger National Park where the Luvuvhu river finally drains into the Limpopo at the Zimbabwe-Mozambique border (Hope *et al*., 2001).

Figure 1 Luvuvhu catchment, Limpopo Province, RSA



Source: CSIR-Environmentek, 2001

The Luvuvhu catchment has above average rainfall, good soils, a sub-tropical climate of high winter and summer temperatures, and, importantly, no frost during the winter/dry season. This makes possible the growing of a wide range of sub-tropical fruits (banana, citrus, mango, paw-paw, avocado, lychee), nuts (groundnuts, macadamia), vegetables (maize, sorghum, spinach, tomatoes, sweet peppers, chillis) and cash crops (tea, coffee). The low altitude areas are, however, extremely hot and dry and only suited to extensive cattle production unless irrigation water is available. The catchment can be divided into four main areas based on tenure and type of land use practice: large scale commercial farming (including irrigated crops, dryland crops, and rangeland cattle production); forestry areas which are principally owned by the State, though there are some small areas of private forestry; conservation areas (including the Kruger National Park); and, areas of the former Venda homeland where ownership and land use has evolved from tribal customary authority. We will refer to this last category as the communal areas and it is this area that is the focus of this paper. Within the communal areas there are complex land use systems and tenure regimes. Rainfall governs the actual land use that is possible, but in general the area is divided into rural villages where the households with associated kitchen-gardens are located. In addition, some residents have access to dryland fields and in a few locations there is access to irrigated fields on government developed irrigation schemes. The woodland surrounding these areas is communal, administered by the tribal authority and available to all villagers for cattle grazing and the collection of woodland products.

8.1.4 Wealth-ranking and social disaggregation

This section explores locally-derived attributes of poverty that were elicited to understand if there were credible and consistent criteria to allocate different household groups (or cohorts) to differing wealth categories. A wealth-ranking exercise (see Grandin 1988) was conducted in Tshiombo community in a scoping phase of the research to explore such poverty attributes from participatory, qualititative data that were intended to inform the later quantitative questionnaire survey on how best to disaggregate the results along locally-defined poverty classifications. The methodological issues of validity, robustness and replicability are discussed within the wider context of poverty diagnosis.

In RSA, poverty diagnosis is largely built upon national survey data that can be analysed statistically (Carter and May 1999). However, there are well-documented problems in relation to survey design, response biases and data-processing errors with such an approach (Poate and Daplyn 1993; Casey and Kumar 1988). Also, the unit of analysis is commonly the household with the respondent required to be the household head. Commentators (Francis 2000; Sen 1990) have argued that the intra-household allocation of resources and responsibilities are both complex and a matter of ‘cooperative conflict’ dependent on bargaining. The ‘household head’ labelling disguises this significant tension within the household, which is often mediated along gender and age axes (Posel 2001; Bundlender 1997). Two further problems arise independent of the validity and robustness of any survey: identification and referencing problems (Ravallion 1998). The identification problem refers to how to weight individual welfare not revealed by market behaviour, for example well-being benefits that have no simple quantitative or numerical value (such as increased income) from improved access to water. The referencing problem refers to the positioning of the welfare poverty line, which then influences the position of the money-metric poverty line. Various monthly income poverty lines have been proposed R353 (May 1998), R800 (equity share poverty threshold) and the state pension stipend of R620.

A South African income definition of poverty is “the inability to attain a minimal standard of living, measured in terms of basic consumption needs or the income required to satisfy them” (May 1998). This largely depends on market integration, which is by no means reflected by the reality of rural livelihoods in Southern Africa (Shackleton *et al* 2001; Francis 2000; Carter and May 1999). In an attempt to tackle some of the difficulties of understanding poverty, and particularly the role of water, in diverse and complex rural livelihoods, a wealth ranking exercise was conducted to provide contextual depth to locally defined poverty criteria within the Luvuvhu catchment in November 2001. The irrigated community of Tshiombo was selected due to its reliance on water for agricultural productivity and its proximity to one of the main Luvuvhu tributaries, the Mutale river. Tshiombo is located in a fertile valley 30 km north east of Thohoyandou, the administrative and urban centre of the Luvuvhu catchment. It is situated 2 km from the Mutale river, which drains into the Luvuvhu further east. In 1962, the Tshiombo irrigation scheme (TIS) was built. Unlike many similar schemes in the area the TIS continues to function and serve a command area of 1,196 ha (Lahiff 1997).

Following tribal authority permission to conduct the wealth-ranking exercise, adult male and female groups were formed and assisted through the process of identifying household attributes that mapped onto wealth classifications they selected (Tables 3 and 4). The findings were tabulated according to SL

'capitals' to reveal no coherent poverty classifications to follow in the catchment survey. The findings did reveal that poverty is characterised differently by gender groups, which differ across the community (tables 3 and 4). The poverty classifications produced four classes for the female group and three for the male group. The women were more holistic in highlighting various livelihood outcomes determined by their poverty attributes. Women particularly highlighted the importance of natural resources to livelihoods. Significantly, no mention was made of access to water as an attribute of poverty by either group even though Tshiombo has one of the largest operational irrigation schemes in Venda. The findings of the exercise underlined the distribution and diversification of livelihood assets across the community and the household level outcomes from these asset portfolios. Key informant interviews in the 8 survey communities later reinforced the inadequacy of applying a simple land, dwelling or asset proxy to determine wealth profiles across the catchment. Applying such proxies was thought to be too arbitrary in definition, difficult to consistently code (by enumerators) and non-replicable elsewhere.

Figure 2 Tshiombo map drawn by male group

Table 3 Male perceptions of poverty and distribution of wealth categories

Poverty determinants by livelihood capitals	Vho-Pfumaho (Rich - 13%)	Vha-vhukati (Average - 47%)	Zwisiwana (Poor - 40%)
Physical	Big, western-style house	Moderate shelter/house	Poor household structure
Natural	Large crop fields	Crop fields < 1 Ha	No crop fields
Financial	Vehicles (cars, trucks, tractors)	Ordinary car/vehicle	No clothing/ "have nothing"
	Many livestock	Afford to send children to school	Can't afford to send children to school
Livelihood activities	Employers (domestic, farming)	Self-employed/ part-time jobs	Not employed/ receive chief's patronage
Livelihood outcomes	Private businesses	Small businesses (petty trading)	Food insecure

Table 4 Female perceptions of poverty and percentage distribution of wealth categories

Poverty determinants by Livelihood capitals	Vha-pfumi (wealthy - 20%)	Vha-vhukati (average - 33%)	Zwisiwana (poor - 30%)	Zwisiwana zwa ufhedza (poorest of the poor - 17%)
Physical	Big, western-style house/ high-quality furniture and TV		Poor household structure (disrepair)	No shelter
	Solar electricity	Private electricity	No electricity	
	Vehicles (tractors, cars, trucks)			
	Private borehole			
Financial	Expensive clothes			No clothing/ blankets; Live on credit
Natural/ Financial	Many livestock (cattle)	Few livestock		
	Domestic and field labour; Big private orchard	Own subsistence crop fields		
Human			Poor health care/ no access to water	Children are always sick/ no access to health care
Social			Social exclusion/ relatives ostracise	Can't join burial society (10 Rs per month)
Livelihood activities	Shop-owner	Employed but lost job: petty trading (corner shop)	Have never been employed	Work at home/ informal employment
Livelihood outcomes	Large stock of food	Food secure	Food insecure	Beg for food/ leftovers
		Healthy children/ afford to send to school	Can't afford to send children to school	Children don't go to school/ develop inferiority complex/ steal

8.1.5 Livelihoods survey

In January 2002, a purposive, random sample of 552 households was conducted in the Luvuvhu catchment. The objective of the survey was to better understand the linkages between water and poverty amongst a representative sample of the research catchment population. Three water variables determined the purposive component of the sampling strategy. They were a rainfall threshold (< or > 700mm/pa), a reticulated supply threshold derived from DWAF data, and irrigation infrastructure (Table 5).

Table 5 Factorial sampling frame with random community selection

	Irrigation scheme (IS)		No irrigation scheme (NIS)	
	Reticulated supply good (need ≤50%)	Reticulated supply poor (need ≥75%)	Reticulated supply good (need ≤50%	Reticulated supply poor (need ≥75%)
<700mm	Makonde	Dzwerani	Mangaya	Mutele A
>700mm	Rambuda	Khumbe	Vondo	Gogogo

The survey was structured to elicit basic demographics at the household (HH) scale (size of HH, gender, age, education level, income, and employment of HH members); HH basic assets (water supply, fuel source, livestock, land); HH use of water resources for differing purposes (cooking/drinking, bathing/washing and laundry), and productive uses specifically related to agricultural production (kitchen-garden, orchard, dryland and irrigated production).

The sampling frame was heavily dependent on data from DWAF in Pretoria (Water Services Directive) and the Department of Agriculture in Polokwane (irrigation infrastructure). A major discrepancy identified during the 'ground truthing' exercise was that, of the four villages reported as having functional irrigation infrastructure, only one (Khumbe) was actually working or without any dispute over irrigation tenure[6]. Given the few operational schemes in the Luvuvhu and the difficulties that occur in those schemes also, the original sampling frame was followed (Figure 3).

Figure 3 Sampled communities in the Luvuvhu catchment

A literature review and a pilot of the survey suggested that identifying a range of disaggregated social groups that conformed to the prevailing social structures might be the most appropriate strategy for understanding poverty-water linkages. HHs were categorised according to three nominal head criteria:

- Home husband (male head at home permanently);
- Migrant husband (male head at home at least once per month and/or holidays);
- Female-headed (husband permanently absent, widow, divorcee or single female).

Additionally, these three categories were sub-divided by the mean HH age (total age of all HH members divided by number of HH members) to provide an age and life cycle filter to the gendered nominal head groups. The age filters chosen reflected cohorts commonly used in RSA: 25-34, 35-44 and >45. The 15-24 age cohort was not analysed as the sample size was too small for statistical analysis (i.e. sample size less than 5).

Complementing the quantitative research, a targeted programme of community participatory research was conducted from September to December 2002. Following Brannen (1992), Carvalho and White (1997) and Kanbur (2001), an integrated approach was chosen as the most robust method of linking the survey data with participant observation and PRA work. Employing the same sampling frame allows greater insights into the qualitative findings by 'hanging' the findings on the quantitative sampling frame, while quantitative data can add robustness to qualitative data. Triangulation of methodologies can also highlight epistemological departures from either positivist (quantitative, universalist laws) or interpretivist (qualititative, individualist) interpretations. This will hopefully add greater texture, depth and rigour to the final analysis later in the project.

8.2 Results and discussion

This section reviews some of the findings that have emerged from the survey data. The main unit of analysis is the social cohorts identified by disaggregating the survey. This social lens is supplemented by

[6]The non-functional status of irrigation infrastructure is common to the state-sponsored and managed small-holder irrigation schemes throughout the catchment and in RSA as a whole due to the removal of subsidies and extension support to the sector in the early 1990s (NDA 2001).

village level analysis and income poverty lines where they are informative. Demographic, basic resources and income profiles of the 8 communities surveyed are presented below (Table 6).

Table 6 Demographic, basic resources and income profiles of communities

	Makonde	Dzwerani	Mangaya	Mutele A	Rambuda	Khumbe	Vondo	Gogogo	mean
Population	6,032	7,260	1,477	830	1,255	1,136	2,036	1,622	2, 706
Mean household size	6.48	5.86	5.93	5.93	6.63	4.34	5.91	5.96	5.88
Adult education index	63	65	69	67	69	67	65	67	66
Pit latrine (%)	80	69	59	59	72	94	71	54	70
Private piped water (%)	34	32	44	2	41	34	26	7	28
Water source <200m (%)	37	50	48	39	53	49	52	38	46
Electricity (%)	89	31	97	91	55	22	45	90	65
Collect fuel wood twice daily (%)	70	43	45	83	81	42	65	74	63
Mean household income (R/pa)	18,790 $1,879	19,227 $1,923	19,479 $1,948	17,716 $1,772	15,862 $1,586	20,971 $2,097	10,491 $1,049	23,269 $2,327	18, 226 $1,823
Below US$1 per day (%)	21	15	28	26	25	21	20	21	22
Pension dependency (>75% income)	26	31	15	9	13	14	22	25	19

Note: Adult education index is computed from adults above (=2) or below (=1) RSA education standard 5, added together and divided by total resident adults; population data are derived from community sources (chief, headman or other community record); all data were collated during the survey (January) and a field visit in April 2002; R10 = US$1.09 (2002).

Results indicate the uneven distribution of income and basic services across the catchment with no significant association between a higher level of improved water supply and household income at the community scale. Further to uneven distribution of improved water access, mean family size is significantly greater than the 4 people per HH used by DWAF to compute the FBWP of 6,000 l of safe water per month per HH. In Southern African terms, the level of rural service provision in the Luvuvhu catchment is high though unevenly distributed between communities.

8.2.1 Poverty by social cohorts

Disaggregating the social cohorts by three income poverty lines reveals differences in the income distribution of HHs (Figure 4). Acute poverty in terms of failing to generate US$1 per day (R353 per month) occurs most in the 25-34 cohort. Here, over 40% of female-headed HHs fail to command this basic income. Over one in three of home husband HHs are equally impoverished. Furthermore, the female-headed group has two thirds of HHs with a monthly income less than or equal to state pension stipend. In contrast, the migrant husband 25-34 group registers only 20% earning less than R620 per month (US$2 per day).

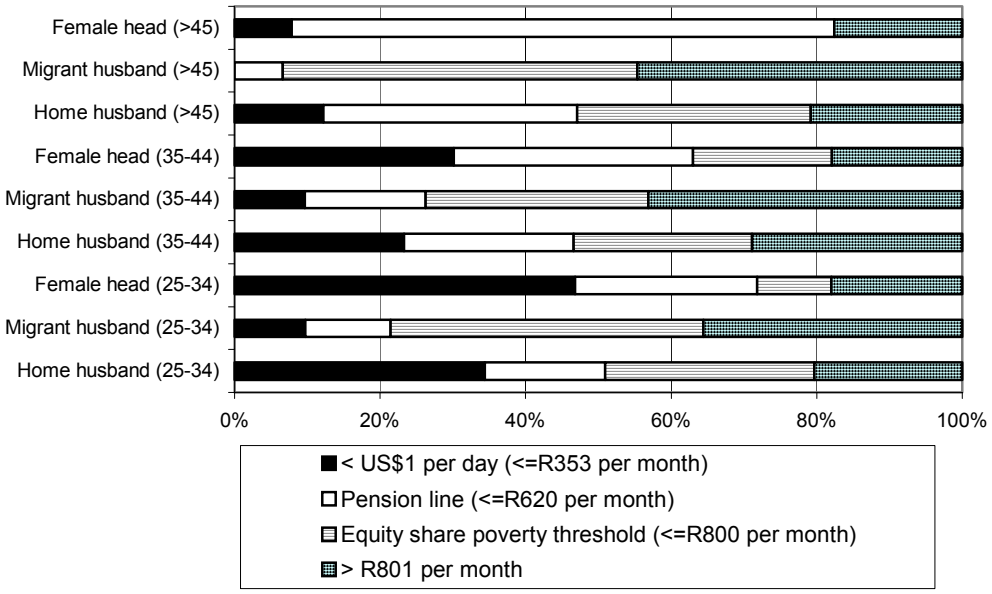
In the 35-44 age group, the situation improves for both the female-headed and home husband HHs. Nevertheless, one in four female-headed HHs generate less than US$1 per day with over 60% on less than R620 per month. The Home husband cohort also registers an income improvement over the younger cohort though significantly less than the migrant husband HHs.

Finally, in the over 45 age cohort, Home husbands reduce their acute income poverty (<US$1 per day) further though the proportion generating more than the pension income line remains static. Of particular note is the severe impact of age on Female-headed HHs as the proportion of HHs on less than or equal to the pension is over 80% though acute income poverty is reduced significantly. Contrasting with the

income impoverishment of the female-headed HHs is the further income power of the Migrant HHs after a minor fall in the 35-44 age cohort.

Poverty by social cohort data reveal that it is better through the 'virtual' life-cycle of the survey that a HH belongs to the migrant husband category on income poverty criteria, and similarly better to belong to a home husband HH than a female-headed HH. Whilst this analysis may be true on income poverty criteria, does it hold when non-income measures (non-market goods and services, see Shackleton *et al* 2001) are included (e.g. expenditure-saving strategies for non-migrant HHs)? This question is currently being investigated in the next phase of the CAMP project.

Figure 4 Distribution of social cohorts by poverty lines (n=551)



We have already noted (section 1.1.1), agriculture is an important livelihood strategy in rural areas, which particularly benefits women and likely includes the poorer female-headed HHs identified in this analysis. Access to water, as well as land, is, of course, critical to agricultural production whether for income-generation or expenditure-saving activities. Land and water alone may not be sufficient to provide successful and sustainable livelihood strategies for the poor. Other inputs, for example finance, market access/capacity, information, technology and social capital, are also likely to be required.

It is to the role of water in livelihood strategies, and the question as to whether improved access to domestic water offers an opportunity to the poor to lift themselves out of poverty through increased agricultural production, that we now turn.

8.2.2 Livelihood strategies and productive uses of water

The relationship between productive uses of water and poverty is a difficult one to unravel due to the multiple sources and varying water inputs that contribute to livelihoods over time (seasonal and cyclical). This section offers a descriptive framework for analysis and further issues for the participatory research. A typology of water-related livelihood strategies has been developed from the existing literature in RSA and key informant interviews in the catchment.

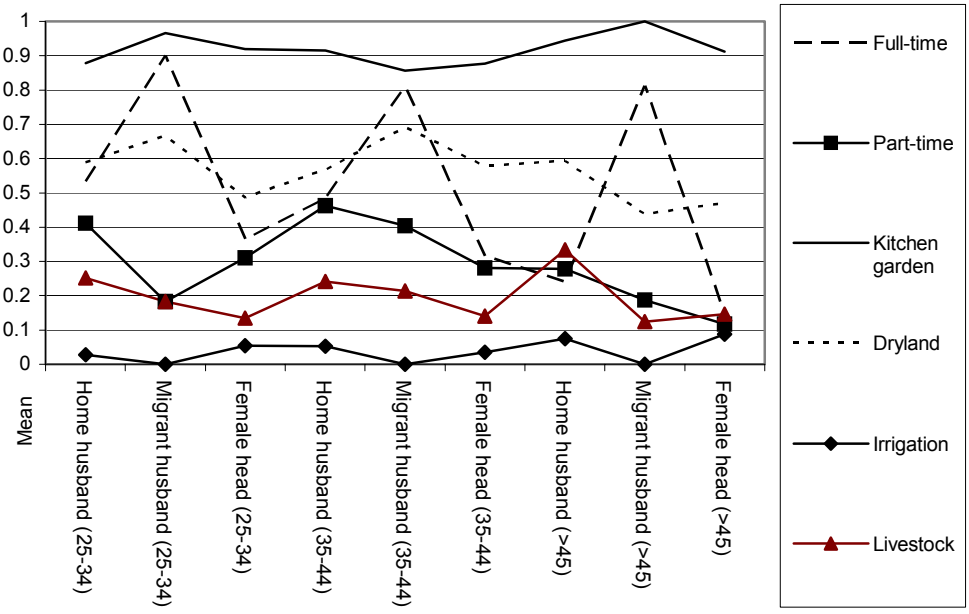
Livelihood activities reliant on water inputs (reticulated, river, rainfall) include:

- Irrigated kitchen-gardens;
- Orchards;
- Dryland farming;
- Irrigated farming;
- Woodfuel collection;
- Non-timber communal land products (i.e. hunting, honey, fruits etc);
- Livestock;

- Formal employment (forestry and full-time commercial farm employment but excluding the public sector);
- Informal employment (brewing, building, brick-making, seasonal farm employment i.e. harvesting, ploughing, weeding etc).

The only categories with a clear link to domestic water provision are irrigated kitchen-gardens, orchards and informal employment. Orchards are a component of food security for many HHs but are seldom irrigated unless they fall in the HH compound (i.e. many orchards are a component of rain-fed dryland farming). Due to the complications of including orchards in this analysis they are omitted, though their contribution to livelihoods is recognised. Informal employment activities can and do utilise other water resources (e.g. river water for brick making). This typology excludes formal, non-water-intensive employment in the public sector and the role of pensions and remittances in livelihoods. These sectors are nevertheless significant sources of income and contributory factors to livelihood security and well-being in the study area. Disaggregating the 'noise' of non-water-dependent livelihood strategies is critical if the unbiased role of water in poverty reduction is to be more fully understood. The survey data does not filter the 'noise' of non-water dependent livelihood strategies (i.e. full time public sector employment) but does provide insights into how livelihood strategies are stratified by gender of HH head and HH mean age (Figure 5).

Figure 5 Livelihood strategies by mean adult household frequency



Kitchen-garden farming is the main strategy across all cohorts with nearly 90% of all HHs pursuing this livelihood activity. A kitchen-garden is that area within the main HH compound, of an estimated 400m^2 size, that often seamlessly becomes the HH dryland field area. Home husbands and female-headed HHs reveal a fairly constant level of activity throughout the HH life cycle.

The relationship between improved water supply and kitchen-garden farming is now explored in terms of access to piped supplies, crops grown, importance of crops to livelihoods and stated benefits of an improved water supply.

8.2.3 How does water access impact on kitchen garden activities?

More than 70% of the surveyed HHs do not have a private water pipe, leading to a level of service provision that is unevenly distributed across the communities within the catchment (see Table 6).

Analysis of water provision by social cohort reveals a pattern of access influenced by both mean age of HH and gender of HH head (Table 7). In the 25-34 cohort, home and migrant husband HHs have a poorer level of water provision than female-headed ones, which fare marginally better though below the expected cohort value[7]. As the mean age of the HH moves into the 35-44 cohort the picture changes

[7] X^2 test, see any standard statistical text book.

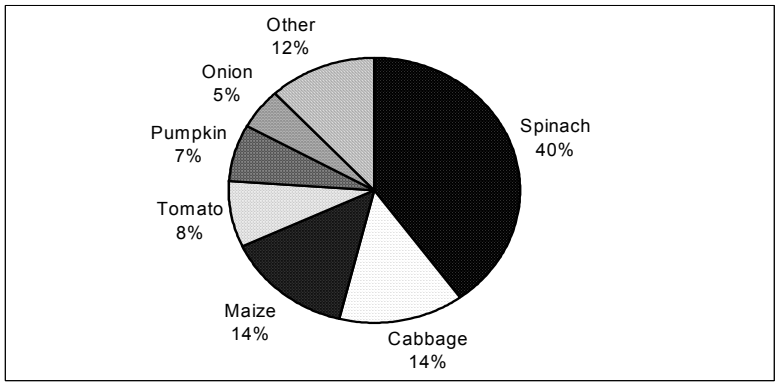
dramatically as both male-headed HHs benefit from a much higher level of service provision whilst female-headed HHs experiences a worsening level. In the oldest (>45 years) cohort, the picture is broadly the same, though female-headed HHs are only marginally below expected levels of provision. The statistical level of association between social cohorts and private water access is highly significant within the sample (P=40.192; df=8; p<0.01). Finally, it should be noted that access to private reticulation does not necessarily guarantee a level of supply that meets the Reconstruction and Development Programme's criteria of 98% availability of supply, a flow rate of 10 l/minute and water of potable quality (RDP 1996).

Table 7 Level of private water access by social cohorts

		Private water pipe		
		No	Yes	Total
Home husband (25-34)	Actual Count	89	18	107
	Expected Count	76.2	30.8	107.0
Migrant husband (25-34)	Actual Count	47	13	60
	Expected Count	42.7	17.3	60.0
Female head (25-34)	Actual Count	55	19	74
	Expected Count	52.7	21.3	74.0
Home husband (35-44)	Actual Count	59	36	95
	Expected Count	67.7	27.3	95.0
Migrant husband (35-44)	Actual Count	23	19	42
	Expected Count	29.9	12.1	42.0
Female head (35-44)	Actual Count	50	7	57
	Expected Count	40.6	16.4	57.0
Home husband (>45)	Actual Count	31	23	54
	Expected Count	38.5	15.5	54.0
Migrant husband (>45)	Actual Count	6	10	16
	Expected Count	11.4	4.6	16.0
Female head (>45)	Actual Count	24	10	34
	Expected Count	24.2	9.8	34.0
Total	Actual Count	384	155	539
	Expected Count	384.0	155.0	539.0

Differing levels of reticulated water provision influence opportunities to grow kitchen-garden crops. Informants reported that they never carried water specifically for kitchen-garden irrigation. The surveyed HHs indicated 23 types of crops grown, with 6 crops representing almost 90% of all crops grown (Figure 6). 'Spinach' (comprising various species) is the dominant crop grown, being significantly favoured to the local staple of maize, which is generally grown in rain-fed, dryland fields. The homogeneity of crops grown by all HHs partly explains the limited opportunity for individual HHs to actively market and sell any of these crops locally. The crops are best understood as contributing to HH food security primarily as an expenditure-saving rather than income-generating strategy, although HHs may seek to market surpluses.

Figure 6 Kitchen garden crops grown by households

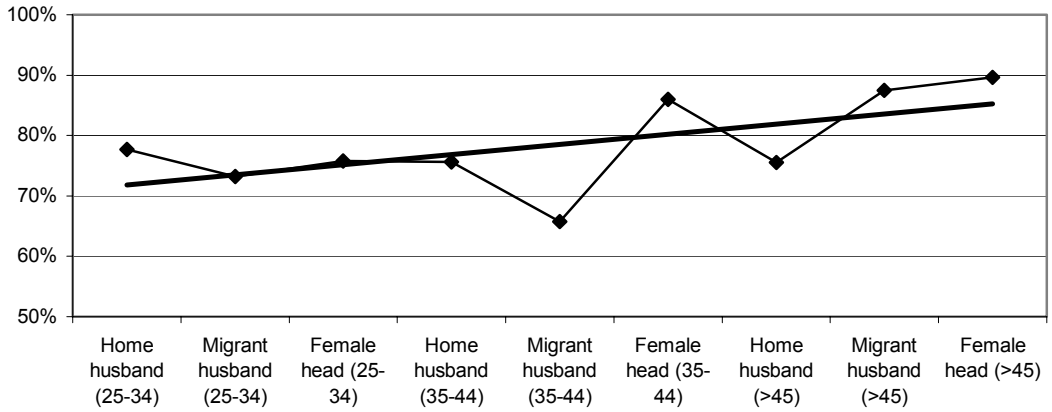


The dominant trend amongst all HHs is to consume the majority of the crops they grow. The trend line[8] indicates that 100% consumption of garden crops increases as mean HH age increases (Figure 7). This trend may be a function both of reducing income (see Figure 4), and the opportunity to spend more time tending the kitchen-garden through the narrowing of alternative livelihood opportunities with advancing age. For example, a smaller proportion of migrant husband HHs than home husband or female-headed

[8] In terms of total population, this may not be significant but in terms of intra-population differences (poor vs. non-poor) this may well be significant to dependency on kitchen-garden food production.

HHs in the 35-44 cohort consume 100% of their garden crops. It is likely that these HHs have increasingly taken the opportunity to seek food security through substituting income-generating strategies for primary food production. Interestingly, migrant husband HHs appear to have a greater dependency on garden crops than home husband HHs in the >45 cohort. This does not necessarily mean they are poorer (they may for example have cash savings built up during the husband's migrancy, while Figure 4 suggests their income level holds up), but it does suggest they now prioritise expenditure-saving through food production. To that extent these HHs - like female-headed HHs in the >45 cohort - have a similar vulnerability to water supply problems.

Figure 7 Percentage of social cohorts consuming 100% of garden crops



The relationship between number of garden crops grown and private water pipes is positively associated and highly significant (P=17.221; df=5; p<0.01). There is a higher frequency of HHs without private reticulation which grow no garden crops at all, and a skewed likelihood of growing a higher number of crops (>3) by HHs with private reticulation. This bias in the relation of crops to reticulation is likely to impact on the food security[9] of those HHs without reticulation, though of course these HHs may be seeking food security through substituting income-generating activities for the perhaps more risky expenditure-saving strategy – given the area's proneness to drought - of food production.

Table 8 Relationship of garden crops to private reticulation

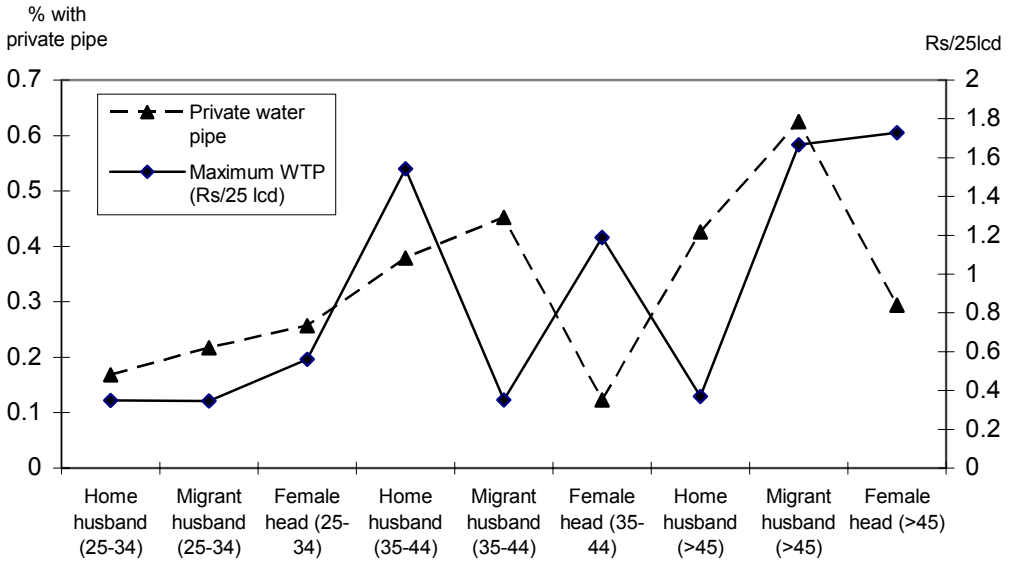
			Private water pipe		
			No	Yes	Total
Total number of garden crops grown	0	Actual Count	93	14	107
		Expected Count	76.2	30.8	107.0
	1	Actual Count	57	23	80
		Expected Count	57.0	23.0	80.0
	2	Actual Count	78	32	110
		Expected Count	78.4	31.6	110.0
	3	Actual Count	57	31	88
		Expected Count	62.7	25.3	88.0
	4	Actual Count	40	22	62
		Expected Count	44.2	17.8	62.0
	5	Actual Count	59	33	92
		Expected Count	65.5	26.5	92.0
Total		Actual Count	384	155	539
		Expected Count	384.0	155.0	539.0

Improved water access is skewed in favour of home husband and migrant husband HHs. These two cohorts are wealthier than female-headed HHs in every age cohort (see Figure 4). Given greater access to private reticulation, there is a strong association with, and ability to, irrigate crops from domestic water sources which contributes to greater food security at the HH level. This relationship favours male-headed

[9] Whilst more crops does not automatically equate with more food, the data do underscore the relationship between growing a wider crop variety with piped water than those HHs without private water connections.

HHs and provides a further constraint to female-headed HHs, particularly the >45 years cohort. This is revealed by plotting the mean number of private water pipes of social cohorts against willingness to pay[10] (WTP) for an improved domestic water source (Figure 8). The graph neatly captures the duality between poor service delivery and the amount of money a HH would be prepared to pay for an improved service in the 35-44 and >45 age cohorts. In the two older cohorts, the relationship mirrors human nature in cognitive dissonance responses to actual water delivery: the 'haves' want to pay considerably less than the 'have nots'. The two older Female-headed HH cohorts underline their stated preference for an improved water supply through a higher stated WTP, which reflects their significantly poorer level of service delivery compared to the respective male cohorts.

Figure 8 Mapping private reticulation and willingness to pay by social cohorts



Improved water supply would deliver two significant benefits to the surveyed communities: health benefits and kitchen-garden irrigation benefits across all social cohorts (Figure 9). An economic benefit (building, brewing beer, brick-making etc.) was also identified but this was minor in comparison, which may be due to lack of opportunities (markets, local economic conditions) or other input constraints (finance, sufficient water, knowledge/information) to develop these small-scale, water-dependent business enterprises.

This paper has addressed the role of improved domestic water supply as a potential poverty reduction lever in Limpopo province, RSA. Three key findings can be drawn:

- Wealth-ranking has proved to be of little value in identifying the poor;
- Poverty appears to lessen with mean age of HHs and
- Kitchen-gardens are important for almost all HHs.

Wealth ranking at the irrigated community of Tshiombo did not provide any robust or replicable proxies of poverty that could be effectively and defensibly incorporated into the later catchment survey. Simple poverty proxies (land, dwelling, assets etc) were found to be less practical than using multiple criteria derived from both exogenous and endogenous variables. Accordingly, and following the need to replicate and validate results in other catchments, social cohorts were considered to be a more appropriate way of disaggregating the data for comparative and analytical purposes.

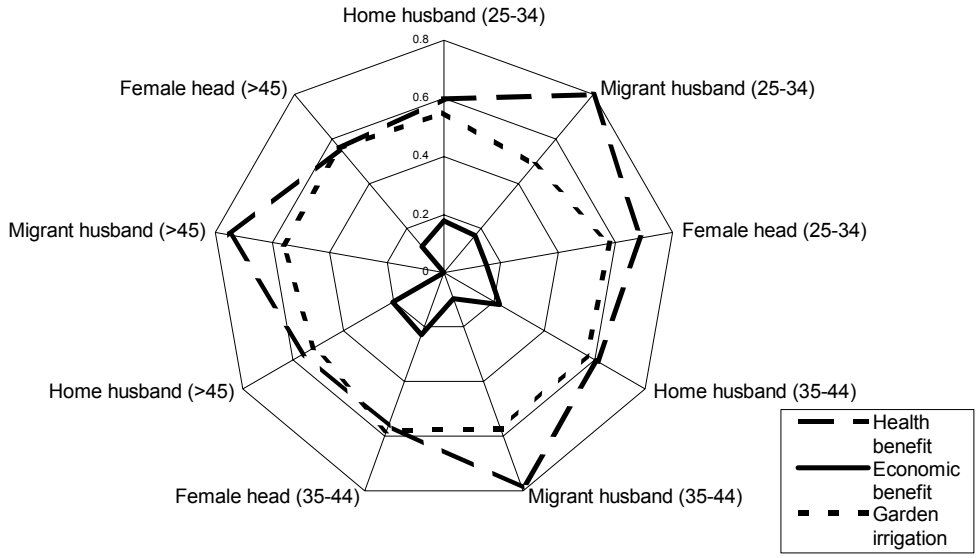
Poverty analysed along social cohort and mean HH age indicates that there is a reduction in the income poverty over time. This is qualified by the evidence that older female-headed HHs (>45 years) were seen to have a greater dependency on the state pension stipend (R620 per month/US$2 per day) than the male-headed HHs, who still have access to other forms of income. Targeted social welfare remittances (pension) provide the older female-headed HHs with an income 'safety-net' that reduces their vulnerability

[10] Maximum WTP for an improved water supply of 25 lcd was elicited in the survey following Arrow *et al* (1993).

in this age cohort. Across all age cohorts, migrant husband HHs enjoyed higher levels of income associated with their access to employment outside the catchment area.

While kitchen-garden farming is important for almost all HHs, the inequitable distribution of reticulation across the catchment favours wealthier social cohorts. The survey indicates that the poorest social cohorts experience food insecurity that could be mitigated by irrigated kitchen-garden farming using an improved domestic water supply. Understanding whether domestic water has been disproportionately and inequitably appropriated by wealthier elites in the Luvuvhu catchment touches upon institutional, cultural and implementation issues that are beyond the scope of this paper.

Figure 9 Stated benefits of an improved domestic water supply



There are skewed benefits from possessing a private as opposed to a communal tap in terms of water collection and the likelihood of HHs irrigating if collection is the only irrigation option. Community informants have reported that they do not collect water for kitchen-garden irrigation. Waste and surplus water may be used for irrigation purposes but this is secondary and minor to the primary water collection purpose – the provision of water for human consumption. Without a regular and reliable water supply for irrigation winter (dry season) kitchen-garden cropping is significantly constrained; while summer crops are rain-fed and dryland communal fields are preferred to kitchen-gardens as there are no physical land constraints in the surveyed communities. The potential leverage for poverty reduction from improved water provision for kitchen-garden irrigation does not currently favour the poor as the survey evidence suggests they are faring less well from the existing distribution of improved water supply network.

The concept of a 'virtual irrigation network' from improved water supplies to poorer, rural HHs as a poverty reduction intervention requires careful consideration of common pool resource (CPR) issues (ownership, management, operation and maintenance etc), demand management (cost recovery, effective demand), competing water allocations and water resource variability (spatially, temporally), all of which may complicate and question the viability, validity and sustainability of such an initiative. Such a network would have the benefits of reaching the poor at the household level, conferring private use rights, reducing 'drudgery' and improving health, however universal targeting is inefficient, implementation is fraught with logistical, financial and institutional issues, and evidence from other countries in Africa indicate that improved water supplies are often allocated to non-productive uses such as watering lawns and flush toilets (Thompson *et al.* 2001).

The irrigation of kitchen-gardens from improved water supply appears unlikely to lift the poorest out of poverty. However, it does offer an opportunity to lessen the burden of poverty experienced by more marginalised groups and improve their food security whilst reaping the associated health benefits. On equity grounds, kitchen-garden irrigation or 'water for food' (NDA 2002) does offer a tangible benefit to poorer HHs. However, the efficiency and sustainability of this intervention for poverty reduction within the demands of national economic growth and development is more questionable. Issues of water scarcity, water allocation trade-offs among competing users (industry, agriculture, human needs, environment,

etc), and demand management of an, often limited, water resource are contested domains that developing countries must reconcile to manage and build an equitable, efficient and sustainable society. Pro-poor interventions that integrate a more holistic understanding of livelihoods with economics, institutions and hydrology at the catchment scale may offer more critical insights into poverty elimination by embracing the efficiency, equity and sustainability criteria that are premised in the NWA and in wider thinking on poverty and development.

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