A Situation Analysis of Existing Sanitation Infrastructure in Fort Dauphin, South-east Madagascar

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This work has not been previously submitted in whole, or in part, for the award of any degrees. It is my own work. Each significant contribution to, and quotation in this dissertation from the work, or works of other people has been attributed, and has been cited and referenced.

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Abstract

Due to historical and current national and international politico-economic activities, present day south-east Madagascar is characterised by poverty, inequality and underdevelopment. As a result water supply and sanitation provision, as one of the cornerstones of primary and preventative healthcare, has been neglected.

A year of participant observation in the rural south-east provided a foundation for developing a strategy to assess the current geography of defecation and sanitation infrastructure, prevailing patterns of latrine use, alternative sources of faecal-oral disease and residents perceptions regarding improved sanitation in the port town of Fort Dauphin.

A mapping exercise defined the geography of defecation and showed that the level of environmental faecal contamination is very high. There are approximately 60 open defecation sites in and around town, a number of them close to schools, clinics, the local hospital and fresh water sources. A structured observation schedule and household questionnaire including participatory research tools defined the geography of latrines. The structured observation schedule was administered over ten of Fort Dauphin's eleven fokontanies and the household questionnaire to 1000 households spread proportionally across the fokontanies depending on population size. Closed and open ended, single and multiple response questions featured on the questionnaire, which was administered by a simple random sampling method.

The questionnaire indicated that ≈65% of residents own a latrine and that ownership is partially dependent on status as defined by household assets. Latrines were shown to reduce open defecation although almost half of the latrine owners in the household questionnaire also used open defecation. Respondents preferred not to use latrines other than their own, but results regarding the appropriateness of public latrines were inconclusive. The structured observation schedule showed that many of the existing latrines are in poor condition and as such may represent a serious threat to public health.

Other prominent sources of faecal-oral disease included the improper disposal of children's faeces, a severe lack of hand-washing facilities and a variety of natural products used as anal cleansing materials. Latrines reduced the impact of children's

faeces and anal cleansing materials on environmental contamination. However, the use of hand-washing facilities by latrine owners was less frequent that among non-latrine owners.

There was overwhelming evidence supporting the notion that an extensive improved sanitation programme is urgently needed in Fort Dauphin and approximately 85% of respondents to the household questionnaire confirmed that latrines were an acceptable method of improving sanitation infrastructure. However, respondents also commented that latrines might cause bad smells, raised the possibility that they may cause friction between neighbours and cautioned against the use of pit latrines in sandy soil.

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1 Terminology

Azafady	meaning 'excuse me'. Also the name adopted by Azafady NGO, London and Fort Dauphin.
Boty	the polluting effect of rotting material.
Fady	meaning taboo.
Fofona	the polluting smell emanating from rotting material.
Fokontany	meaning a district or suburb of town with an elected president.
PRA	Participatory Rural Appraisal.
Razana	are the ancestors to the present day Malagasy people.
SAP	Structural Adjustment Programme.
Tavy	the Malagasy practice of slash and burn agriculture.
Teeva	a more serious form of pollution to *boty* as a result of direct contact with rotting material.
Tohina	the fady act of polluting oneself through touching rotting material.
Tolagnaro	meaning 'place of bones', is the Malagasy name of the port town of Fort Dauphin named such by the French.
Vazimba	the first occupiers of Madagascar before the coming of the Razana.
Vasaha	the commonly used term for non-Malagasy. However, it can also be used to refer to Malagasy born strangers to a region.
VIP latrine	Ventilated Improved Pit latrine.

2 Introduction

2.1 Project background

This situation analysis is regarding data taken in June 2000 in Fort Dauphin, south-east Madagascar. The study was designed and conducted before the author began postgraduate studies. With hindsight and the benefit of further study the author acknowledges that the creation of a truly meaningful picture of sanitary practices in Fort Dauphin would require complimentary qualitative research. As it is, this thesis tries to make the most of existing quantitative data that lacks the benefit of professional guidance in its conception. However, these results are analysed and discussed with the benefit of more than a year's practical experience of living and working in Fort Dauphin, south-east Madagascar and are a positive addition to the platform of knowledge begun by Steve Williams in 1999.

The study is based in the Anosy region of south-east Madagascar and conducted while the author was working as projects co-ordinator for Azafady NGO based in London and Fort Dauphin. The principal focus of the author's work was a rural health and sanitation initiative named 'Evatraha Health and Sanitation Project, Latrines', (Azafady NGO, 2000) – originally proposed by Azafady in 1999 and informed by research conducted by Steve Williams (1999). Evatraha Health and Sanitation Project Latrines is part of Azafady's continuing drive towards the development of health and sanitation services in south-east Madagascar, (Azafady NGO *et al.*, 1999). Perhaps, having read this report, qualitative research is the next step that will be undertaken by researchers who find themselves in a similar position to myself i.e., working for Azafady in south-east Madagascar and finding that they want to contribute to a long term public health solution for Malagasy people.

The coastal village of Evatraha, 45km Northeast by road from Fort Dauphin (see Figure 3) had benefited from improved water supply interventions funded by Azafady in 1996 and 1997. The intention of the sanitation project was to augment the benefit

of improved water supply with the additional benefit of improved sanitation facilities and hygiene practices through two closely related objectives[1].

1) To encourage local residents to integrate the use of a ventilated improved pit (VIP) latrine into their daily routine thus encouraging,
   a) protection of drinking water from contamination,
   b) safe disposal of human waste.
2) Hand-washing at critical times.

It is traditional for the Malagasy to use open defecation as their principal method of excreta disposal. As reported by ASOS (1997), 97.2% of the population of south-east Madagascar practice open defecation. This leads to a high incidence of death from sanitary related diseases especially amongst infants and children, diarrhoea being the second most common cause of illness in southern Madagascar after Malaria, (Action Sante Organisation Secoures (ASOS), 1997). During the yearlong period in Evatraha many issues were addressed which led to the acceptance of improved sanitation facilities by key members of the Evatraha community. The Evatraha Health and Sanitation project is ongoing in 2003, with more than 50 VIP latrines now in daily use.

However, open defecation practices are also used by the 14,000 strong urban population of Fort Dauphin where clean water demand outstrips supply and very few improved sanitation facilities are available.[2] In Fort Dauphin alone it is estimated that 6,000 people daily use the beaches for latrines. Approximately 2,000 use Ambinanikely beach and another 4,000 mainly use the Bai de Galions [and Anse Dauphin] – see appendix 1 for local geography, (CRD Anosy, 1999). There are also a large number of defecation sites inside the residential areas of town.

[1] For more information regarding the origin of these objectives with respect to Azafady's sanitation initiative see William (1999).

[2] There are no public records that describe demographic, employment or income patterns in Fort Dauphin. However, observation shows that the vast majority of its citizens live in extreme poverty. Town governance is organised around 11 presidential committees, each residing over one of 11 districts or 'Fokontanies'.

2.2 A situation analysis of health and sanitation in Fort Dauphin

Clean water supply and sanitation provision are two key developments that contributed to the dramatic decline in infectious disease throughout Europe and North America in the last 130 years, (Seager *et al.*, 1996). If the contribution made to public health by water supply and sanitation provision is well recognised why is the south-east of Madagascar so underdeveloped in this regard? To apply some perspective to underdevelopment in the south-east its current infrastructure and economy is described in brief and contextualised by a regional politico-economic history in chapter 3. The discussion highlights two long-term contributors to present day poverty, inequality and underdevelopment in Anosy. Firstly, the long-term exploitation of the region by multiple actors; and secondly, the current politico-economic relationship between the ruling high plateaux and the coastal peoples.

A review of faecal-oral health issues in chapter 4 emphasizes the role played by improved water supply and sanitation facilities in reducing infectious disease. The chapter discusses the symbiotic relationship between water supply and sanitation and shows that the benefit to public health from access to improved sanitation facilities outweighs that brought by clean water supply but that water supply and sanitation together are of greater benefit than either alone. Chapter 4 also considers the role of macroeconomics in determining the health status of populations. It suggests that a combination of international pressure on the foremost health NGO's during the 1980's coupled with structural adjustment programmes adopted by the Malagasy government under the auspices of the IMF and World Bank have been detrimental to the health of the Malagasy people.

Chapter 5 introduces a developmental approach to sanitation in the south-east. The need for this situation analysis was recognised through experiences in implementing rural sanitation initiatives in Evatraha village. Chapter 5 discusses the importance of development theory and approaches used in the field during the course of working on the 'Evatraha Health and Sanitation Project, Latrines' (Azafady NGO, 2000). It also recognises the need for research if development interventions are to be successful by drawing attention to the value of the lessons learned in previous research (see Williams, 1999), how they applied to sanitation in Evatraha and will likely apply similarly in Fort Dauphin.

2.2.1 The research questions

In the spirit of research prior to action the Fort Dauphin Sanitation Survey was designed to build on the knowledge base begun by Steve Williams (1999) for Azafady NGO. Four principal research questions were posed in order to provide evidence that could inform a sanitation intervention in Fort Dauphin.

1) What is the geography of defecation and latrines in Fort Dauphin? Is there evidence of a need for improved sanitation in Fort Dauphin?

   1.1) Where are Fort Dauphin's main defecation sites and how close are they to public amenities such as schools, churches, hospitals, stand pipes, crop growing and residential areas?

   1.2) Where are the existing latrines situated, how many are there, who are they owned by and what condition are they in?

2) What are some of the prevailing behaviour patterns regarding the use of latrines? Are public latrines likely to be a successful intervention in Fort Dauphin?

   2.1) Do latrine owners share their facility with others, if so, how many people regularly use the latrine and who are they?

   2.2) Are latrines the exclusive form of excreta management amongst owners or do these owners continue to contribute to the pool of open defecation practitioners?

3) What other prominent sources of faecal-oral disease might there be besides a lack of latrines in Fort Dauphin?

   3.1) What are the practices concerning hand-washing and disposal of infant and child faeces?

   3.2) Are the commonly used anal cleansing materials likely to increase the infectious disease burden as a source of faecal oral disease?

4) What are resident's views on improving sanitation in their fokontany?

   4.1) What form(s) of intervention do residents feel would be most likely to improve sanitary conditions in their fokontany?

4.2) How do residents feel about the introduction of improved latrines in their fokontanies and what benefits or problems do they think latrines would bring to their neighbourhood?

4.3) How would residents react if their neighbour built a latrine?

4.4) Where would residents build a latrine?

Three research tools were used to answer the questions;

- A map of Fort Dauphin was drawn which details fokontany borders, prominent public meeting places, water stand pipes and defecation sites (see appendix 1).[3]
- A household questionnaire (appendix 2) with accompanying research tools (appendix 3) administered to 1000 households in Fort Dauphin.
- A structured observation schedule administered across each of the 11 fokontanies in Fort Dauphin (appendix 4).

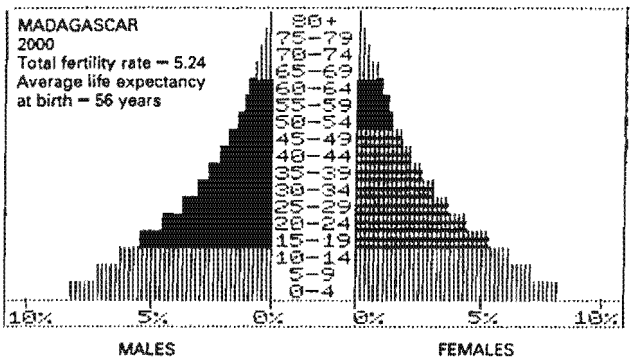
[3] This map is a unique drawing by Lahery, Azafady's administrator. No previous maps exist which detail fokontany borders, public buildings and services or defecation sites. Lahery used a road map supplied by Fort Dauphin's local government cartographer as a template and spent many hours of his leisure time walking Fort Dauphin and asking questions of residents in order to achieve the degree of detail seen here.

3 Madagascar in context

The Malagasy language is largely a Malayo-Polynesian derivative that has its roots in the eastern part of the Indonesian archipelago. There are many conflicting theories regarding both the origins and time of arrival of the Malagasy people to the island. Current thinking suggests a blend of two predominant theories. The first theory suggests that separate groups arrived on Madagascar within a similar period after having settled for a period along the Indian, Arabian and African coastal trading routes. Current differences in dialect, customs and ethnic identities are therefore variations on a single underlying theme. The second theory suggests that the Malayo-Polynesians arrived first and dominated the central plateaux region followed by immigrants and slaves who brought African influences. The Arabic and Indian influences are much less dominant having come from later, separate migrations. In this case, differences in appearance, dialect and customs arise from the imperfect assimilation of later arrivals into a 'Malagasy' culture.

Madagascar is part of an archipelago 400km off the eastern seaboard of Mozambique. It is the world's fourth largest island with a population of 15,982,563 (July 2001) and 147th out of 174 countries on the on the Human Development Index, (United Nations Development Programme, 1999). Approximately 70% of Malagasy people earn less than $1 a day. The poorest 10% of households earn 1.9% of the country's income and the wealthiest 10% earn 36.7%. Approximately 45% of Madagascar's population are between 0-14 years old, 52% are between 16-64 years old and only 3% of the population are over 65 (see Figure 1). Life expectancy at birth in 1999 was 58 years. Infant mortality (1992-1999 estimate) was 92/1000 live births, which in 2001 dropped to 83.58/1000 live births. Only 29% of Madagascar's population live in urban areas, (Eldis).

Figure 1. A projected demographic distribution of Madagascar's population in 2000



Source. (Covell, 1987)

Madagascar is one of the worlds most heavily indebted countries, external debt figures reaching 4.4billion in 1999 with a population growth rising faster than the rate of GDP growth, (United Nations Centre for Human Settlement, 1999; United Nations Development Programme, 1999). Madagascar's main industries include meat processing, soap making, breweries, tanneries, sugar processing, sisal growing, textile manufacture, glassware, cement production, automobile assembly, paper making, petroleum refinery, processing of domestic agricultural products and tourism. The mainstay of Madagascar's economy is agriculture, including fishing and forestry which account for 30% of GDP and contributing more than 70% to export earnings, (CIA, 2001). In 1998 imported commodities included intermediate manufactured and capital goods, refined petroleum, consumer goods, and food (mainly rice, the staple food).

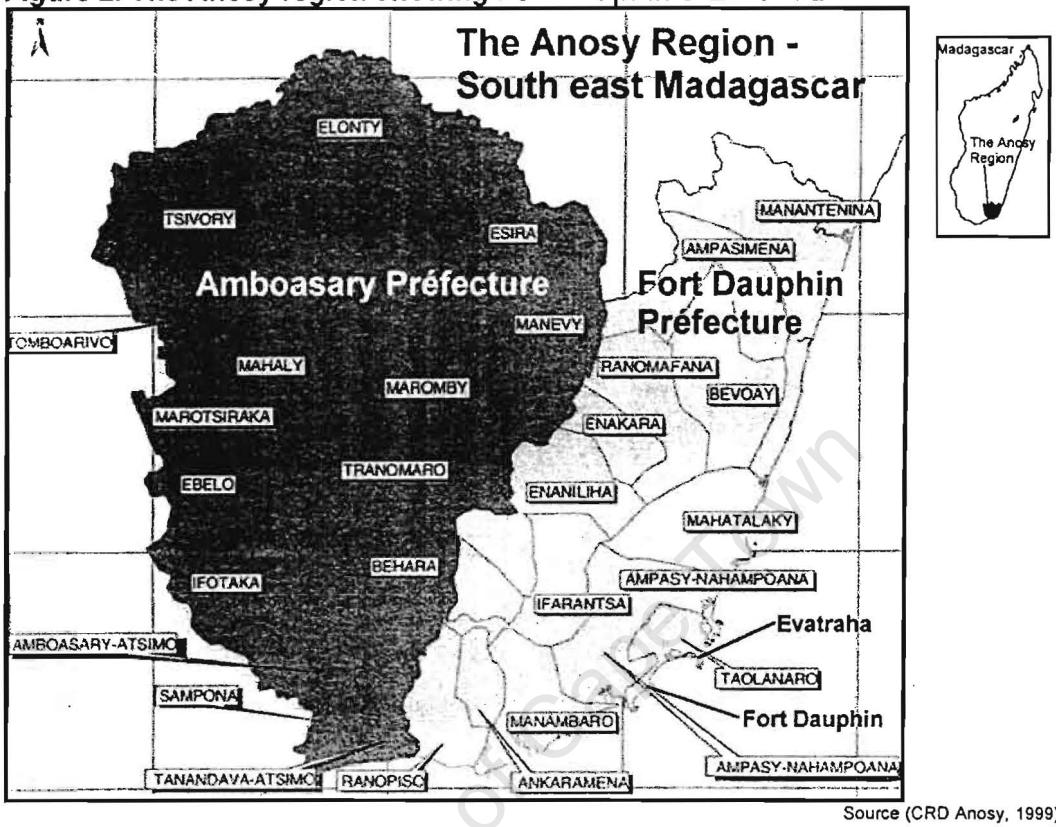
In terms of its transport network Madagascar has three railway lines. Two run from the central station in Antananarivo to the East coast and one between Fianarantsoa and Manakara. All three lines are rarely in working order. The most recently available figures indicate that only 5,781km of Madagascar's highway network is paved, (Mukonoweshuro, 1994). Since the political unrest in 2001 useable road surface is very likely to have reduced.

3.1 The Anosy Region

The Anosy region is 16,173km^2, has a coastline 194km long and a population of approximately 360,000. There are two distinctly different populated ecological zones delimited by the Vohimena Mountain range which runs between the Amboasary and

Fort Dauphin préfectures, the former being much more arid. Fort Dauphin préfecture is ≈5,95km^2 and home to ≈197,495 people, (CRD Anosy, 1999).

Figure 2. The Anosy region showing Fort Dauphin & Evatraha



Source (CRD Anosy, 1999)

Anosy has two urban centres, Amboasary, the Anosy regional capital situated in southern Amboasary préfecture and Fort Dauphin which is the regional point of entry for all air and sea traffic. Fort Dauphin is vastly more commercialised than Amboasary and has a much larger population.

There are no paved roads connecting south-east Madagascar to the capital, Antananarivo. The best routes are via either Toliara or north across country on unpaved routes from Ambovombe. Between Toliara and the south-east the R13 (see Figure 3) is the only piece of paved road but is very poorly maintained. The European Union between 1998 and 2000 financed a number of road building projects around Fort Dauphin. However, all other roads in the south-east are neither paved nor rehabilitated and during the rainy season most are unusable leaving the majority of rural communities cut off altogether. Reports from Azafady NGO in Fort Dauphin indicate that since the 2001 political unrest many of the bridges in the south-east have also been destroyed or tampered with making road travel even during the dry season unsafe at best.

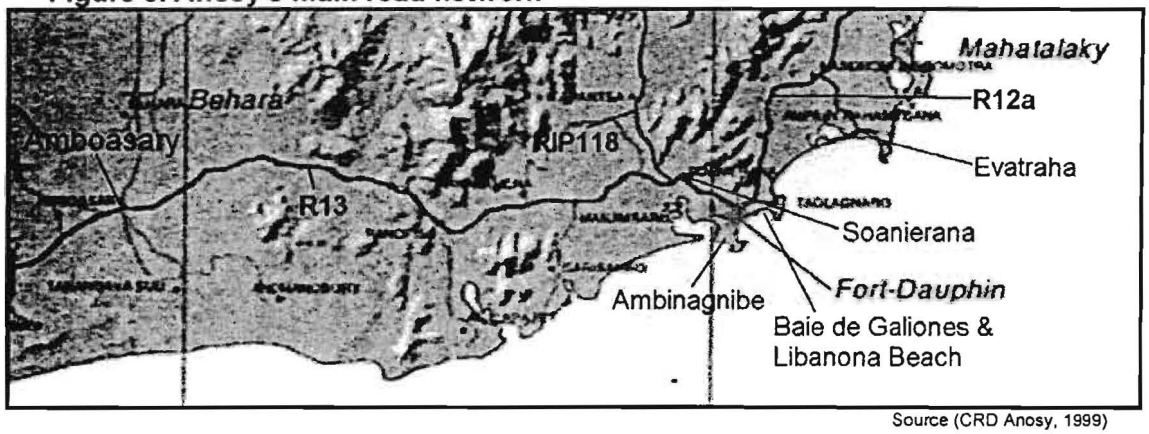
Fort Dauphin préfecture has only two hospitals, the Philbert Tsiranana hospital in Fort Dauphin and a second in Manambaro. There are also three small medical centres in Fort Dauphin town. As the urban centre of the prefecture, Fort Dauphin has 16 State schools, all of which are under funded, poorly equipped and improperly maintained. Most of the smaller towns and villages in Anosy also have schools, all of which are severely lacking in resources.

The only water treatment plant in Anosy is situated in Fort Dauphin and draws water from both lake Lakandava (95%) to the northwest and from lake Lanirano (5%) just outside Fort Dauphin. The quantity of water drawn from the two lakes is enough to meet the needs of ≈6,000 members of Fort Dauphin's population (out of a 360,000 regional population) for most of the year depending upon the intensity of the October to August dry season, (CRD Anosy, 1999). Sanitation provision in Anosy is scarce.

3.1.1 The Anosy Economy

Domestic and international export goods produced in the south-east are few and far between. There are however, well established Sisal plantations along the R13 between Amboasary and Ambovombe (see Figure 3). The sisal industry is the driving force of the Anosy regional economy employing around 5000 full time workers. It is the principal supplier of raw sisal to the European market place, exporting 90% of its annual production. The second most important export group from the south-east are seafood products such as lobster, shrimp, eel and seaweed, which were responsible for netting 20% of the region's economic gains in 1999. There is also a growing seasonal Litchi industry based in and around Fort Dauphin that was responsible for 1.5% of Anosy's regional income from international markets in 1999. Mica is a mined product from Northern Anosy whose production quantities will soon be overtaken by an expanding illminite mining industry from approximately 2010. A growing tourist industry - 19,200 visitors in 1997 to 24,700 in 1999 - provides greater access to cash incomes for small business owners and entrepreneurs in Fort Dauphin as the region's main point of entry and exit, (CRD Anosy, 1999).

Figure 3. Anosy's main road network



Source (CRD Anosy, 1999)

Many households grow a small surplus of cash crops such as Tomatoes, Peppers, Onions, Carrots, Cassava, Sweet Potatoes, Maize, seasonal fruits, and rice, which are sold locally at village markets or in greater abundance and variety at the central market in Fort Dauphin. Fresh fish is also sold in the coastal village markets and again in Fort Dauphin market. Other than this small degree of petty commodity production the majority of peasants living in the predominantly rural south-east live close to the level of subsistence producers, (CRD Anosy, 1999). In times of famine, drought or more often cyclone-damaged crops, rice is imported to the south-east at increased cost.

Due to the extremely poor road network, manufactured consumer goods, (all of which must be transported to the south-east from Antananarivo) come by air, sea or overland 4x4 to Fort Dauphin and are more expensive than in many other parts of Madagascar. Food brought to Tolagnaro from Antananarivo, like consumer goods, is also more costly.

3.2 The Origins of Poverty and Underdevelopment in Anosy

In order to design and implement appropriate and therefore effective development interventions in any context it is important to understand the historical context and current circumstances of the intended recipients. Without this knowledge of Evatraha's historical and current contexts in terms of trade, income, employment, and kinship or political relationships between Evatraha's two distinct settlements – Anena and Ambanihampy, and with other neighbouring villages an effective and sustainable sanitation intervention would have been impossible to achieve. Designing an effective sanitation intervention for over 14,000 residents in Fort Dauphin will undoubtedly require the collaboration and support of multiple actors including both local

government and civil society organisations in some capacity. It would therefore be of great benefit to project designers and practitioners to understand the historical context of the relationships between these actors and to appreciate the origins of the region's underdevelopment.

The Anosy region and its people are considered among the poorest in Madagascar and have traditionally had an elected administration that is in political opposition to the Presidency. Although the link between water, sanitation and health is well understood there has been little effort to relieve the burden of infectious disease in Anosy that arises as a consequence of severely underdeveloped water supply and sanitation services. Due to a monopoly hold on the sisal industry by a syndicate of three French and two Malagasy companies the regional population do not greatly benefit from sisal production except in terms of access to wage labour opportunities. Anosy's lack of employment potential, paved roads or railways, health care services, properly resourced schools, nutrition, adequate sanitation, clean water supply and good hygiene behaviour is likely to be a hindrance to regional expansion of commerce, industry and tourism. What then are the underlying causes of present day poverty, inequality and underdevelopment in Anosy? Why has it become known as the most poverty stricken region in Madagascar?

For centuries, the South and south-east of Madagascar have been a Sate driven source of wealth generation for other parts of the country. These politico-economic activities in conjunction with modern global economics are the principal cause of Anosy's impoverishment and underdevelopment. There are three obvious periods in Malagasy history that are important to understand in order to contextualise Madagascar's present day regional social, political and economic circumstances. The first period is pre French colonisation up to 1895, the second is under French colonial rule (1895 - 1960), and the third a post-colonial period up to the present day. Here we discuss the most prominent documented activities and policies that impacted on the development of the Anosy region during each of these periods and pay particular attention to the historical plateaux/coastal conflict between the Merina and Madagascar's other ethnic groups. As one would expect each period can be seen as a precursor to the politico-economic and socio-economic circumstances of the next.

The Merina homeland 'Imerina', is situated on the high plateaux region in central Madagascar. Up to the late 18th century Imerina did not extend further than about 40

miles north, 35 miles south, 30 miles east and 30 miles west of Antananarivo, (Bloch, 1971a). Merina people today divide themselves into two distinctive castes, the *fotsy* or 'white', who are the descendants of 'free' Merina; and *mainty* or 'black' Merina who are regarded as the descendants of slaves, (Bloch, 1971a).

Figure 4. Progression of the Merina kingdom

Source (Bloch, 1971a)

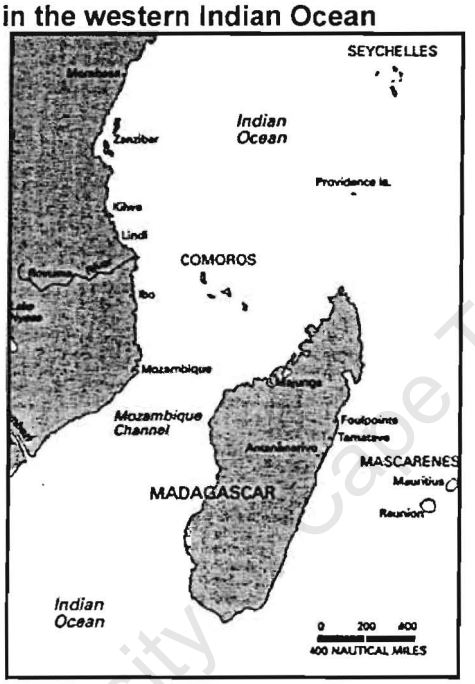
The traditional view of Malagasy history is that Madagascar underwent one of its most prominent political and economic transformations during the reign of Imerina's greatest king *Andrianamponimerina* (c. 1790-1810), (Bloch, 1971a). He intensified the use of two established practices, those of domestic slavery and the Malagasy cultural practice of *fanompoana*, (Campbell, 1988) a form of tribute labour, (Bernstein, 2000). These policies allowed *Andrianamponimerina* to use his 'free' male subject's *fanompoana* labour to build a standing army and co-ordinated labour force, develop a centralised state administration, advance trade and agriculture within surrounding Imerina, encourage Merina people to become teachers and use slave labour from other Malagasy ethnic groups to drive the subsistence economy.[4]

Andrianamponimerina's successor *Radama I*, (c 1810-1828) used the same labour regime under autocratic principles to encourage the growth of an industrial base in the

[4] For a fuller account of how the practices of slavery and fanompoana were used to restructure the Malagasy state see Campbell (1988)

kingdom. However, under *Andrianamponimerina* the supply of slaves came from all the subjugated ethnic groups but under *Radama I* and his successor *Ranavalona I* the pattern of slave procurement became centred in the south-east. *Radama* also began trading slaves internationally. Calculations suggest the export of up to 66,500 slaves from Madagascar and East Africa between 1811 and 1827, (Toussaint, 1967). A Mauritian government census between 1816 and 1818 suggests that 3/4 of these slaves originated from Madagascar, (Allen, 2001).

Figure 5. Madagascar in the western Indian Ocean



Source (Allen, 2001)

In 1807 the Indian Ocean slave trade came under great pressure from Britain's prohibition of the slave trade. In 1814 British forces took the Seychelles and Mauritius from the French leaving the politics of the South west Indian Ocean slave trade radically altered, (Allen, 2001). Following suit in 1817, the French Imperial State who still held Île Bourbon (La Reunion) also formally abolished the practice. The pressure on the slave trade from Britain and France resulted in talks in 1820 between the Robert T. Farquhar, the British Governor in the Mascarenes and *Radama I.* The talks produced the Anglo-Merina accord that banned international trade in Malagasy slaves. The economic importance of the slave trade to *Radama* was enormous, in 1817 taxation on exported slaves amounted to approximately $33,000, (Allen, 2001) but between 1821 and 1822 revenues from the slave trade fell by more than a third, (Campbell, 1988).

The tremendous loss of tax revenue to the Malagasy State resulted in *Radama's* autocratic *fanompoana* regime. He used the schools to train Merina youth in basic literacy skills after which they were channelled into the army or government administrative positions. Merina who studied under European artisans were directed into *fanompoana* units.

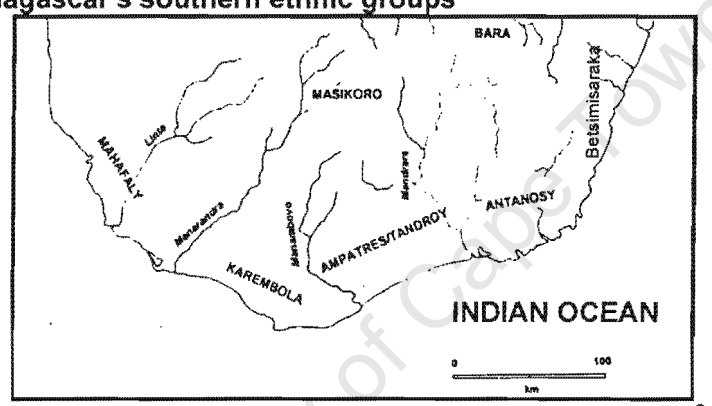
Service in the army under *Radama* became long term and the structure of the Merina armed forces came to represent "more of a commercial than a military organisation", (Campbell, 1988). Groups organised themselves into *deka,* responsible for their own welfare through plunder from raids. "Soldiers joined military expeditions in the expectation of plunder, and moved to provincial garrisons in the hope that they could exploit provincial resources", (Campbell, 1988). Between 1825 and 1861 "the imperial army constituted a huge and elaborate commercial organisation which was used to exploit the empire's resources and channel them to the imperial heartland [of Imerina]", (Campbell, 1988). The non-Merina population suffered greatly from the tremendous increase in the number of raids coupled with the increased size of *Radama's* army.

Imperial Imerina's period of industrialisation[5] that began in the 1820's further exacerbated the massive forced labour migrations from the south-east. The Merina used Sihanaka labour to carry wood from the northern part of the Great Eastern Forest and Betsileo labour for timber from the southern parts. Bezanozano people were summoned to supply rounded timber and *hafotra* used in rope making. Large numbers of men were involved in the portage of construction wood. A *Fanompoana* unit of 5,000 were used to transport a single trunk 39 meters long for use in building Manjakamiadana Palace. In preparation for a possible French invasion of Imerina a *fanompoana* workforce 30,000 strong transported stone and lime from the quarries of Sirabe to fortify the port of Ambohimanga, (Campbell, 1988). The Betsimisaraka, native to the East coast were also increasingly involved in the industrial experiment on the Merina high plateaux leaving the Antanosy, native to Tolagnaro, (Sharp, 2001) to work as East coast plantation slave labour.

[5] The narrative concerning industrialisation in Imerina is taken from Campbell (1988).

From 1822 *Radama* pursued the policy of obtaining slaves from internal wars with vigour, dispatching ten campaigns annually into the provinces, primarily to capture slaves and cattle", (Campbell, 1988). The Southern Malagasy suffered tremendously, in the south-east in 1825 the Antanosy (see Figure 6) found that Merina forces had taken control of the French built post of Fort Dauphin, (Pearson, 1997). For the 70 years that the Merina occupied the south-east (1825-1895), it became one of the most heavily exploited regions due primarily to the domestic slaving expeditions, (Campbell, 1988). One missionary source estimates that in a 12 year period, between 1828 and 1840 200,000 slaves were taken to Imerina's productive zones from the south-east alone, (Campbell, 1988).

Figure 6. Madagascar's southern ethnic groups [6]



Source (Pearson, 1997)

It was the intensity of *fanompoana* and slavery that became the ultimate downfall of Merina industrialisation. The orientation towards a forced labour dominated industry disallowed the possibility for new technology to spread in the labour intensive environment. Industry was concentrated in specific localities, activities were forcibly directed and labour was monopolised by the Merina elite. Possibly the most damaging of all restrictions placed on a Malagasy industrial revolution however, was that the restricted wage labour sector placed limitations on the growth of a domestic market, which had so far been based entirely on the luxury needs of a wealthy elite. The rise of the Merina kingdom off the back of *fanompoana* and slave labour laid the foundations for the current political rivalry and economically repressive relationship that exist between the central high plateaux and coastal populations to the present day.

[6] The traditional homelands of the Sihanaka, Betsileo and Bezanozano are too far North to appear in Figure 6.

In 1895 the French attempted to establish a protectorate over Madagascar but the ensuing revolts against their rule brought a full military conquest and direct rule of Madagascar which lasted until 1960, (Bloch, 1971a). Imerina was the first region to be taken by the French General Joseph Gallieni who did not reach the South and complete France's conquest of Madagascar until 1900 (Pearson, 1997).

French colonisation resulted in the establishment of a dominant discourse on the 'native' framed in terms of ethnicity, "each [group] allegedly characterised by a particular temperament and level of social and political evolution" (Cole and Middleton, 2001). The Merina almost exclusively constituted the country's ruling elite and large numbers of Merina spoke French or English due to their education and previous contact with foreigners. These were qualities valued by European colonial regimes and set the course of France's relationship with Madagascar's marginalised ethnic groups and reinforced the notion for both the Merina and the French of the characteristically 'native' coastal tribes. "The people of the South figure [in French colonial discourse] as the most primitive and least evolved of all the Malagasy" (Cole and Middleton, 2001). Ethnic classification thus determined much in terms of French policy concerning Madagascar. In the South people were "left deliberately unschooled in order to create a pool of cheap 'unskilled' labour" (Cole and Middleton, 2001). Gallieni's predecessors were not particularly farsighted and remained "contented to have most of the post primary schools centred around Antananarivo. Greater wealth also enabled the Merina elite to send their children to France for further education. The net result was a Merina domination of Malagasy civil service posts during occupation and at independence" (Pryor, 1990). The seeming Merina co-operation with French colonial forces served only to exacerbate the split between plateaux and coastal political allegiances.

France's plans to use the Southern population as Madagascar's unskilled labour pool did not go well at first. Attempts to mobilise [southern] local land and labour for the colonial economy initially failed. Early emissaries of French imperialism described how the deep South of Madagascar was covered by dense stands of Prickly Pear cactus or *Raketa.* This non-native plant which the French dubbed the Malagasy Cactus formed the basis of the local economy, providing a valued source of food and water for both people and their cattle in times of scarcity (Middleton, 1999). It also

made military conquest difficult, creating a barrier which protected [inhabitants] from 'pacification' and other colonial projects (Cole and Middleton, 2001).

In 1924, Governor General Marcel Olivier arrived in Madagascar charged with the responsibility of making the colony more efficient and profitable. His plan was to disposes the native Malagasy of land by increasing the rate of colonisation and drive them into participation in the market economy through a need for food and a cash income to pay imposed taxes. It became the conviction in both Paris and Antananarivo that behind the Malagasy Cactus lay vast herds of cattle waiting to come to market (Middleton, 1999). Furthermore, it became the belief of a man close to the Governor General named Pierre de la Bathie that 'with a little water' the lands of the South "would not only yield quantities of produce a thousand times greater than at present [but also] become some of the most productive lands in the world" (Middleton, 1999). Olivier's own interests in the deep South probably lay less in its agrarian potential than the contribution its peoples would make to solving the labour problem (Middleton, 1999). However, expansion of the colony in the South and south-east was not going to be a simple process as the prolific Malagasy Cactus was an almost impenetrable barrier to colonial settlement.

Perrier de la Bathie recognised that the inhabitants of the South were dependent on the Malagasy Cactus as a staple subsistence resource for themselves and their herds. On November 24th 1924, he sent a consignment of an imported cochineal beetle South to his friend who propagated them on his land in the Southwest with the intention of clearing it for development. By 1929, the cochineal had spread across the whole of Southern Madagascar and resulted in the total extermination of the cactus.

> "The eradication of the Malagasy Cactus had a profound impact on the political economies of southern Madagascar, causing extensive hardship to local peoples and their cattle and changing irrevocably the relationship between this arid region and the colonial state" (Middleton, 1999).

The land was opened up for Sisal plantations as far east as the Vohimena Mountains in Amboasary préfecture and the local population began to enter both the local and migrant wage labour markets on a large scale. However, the fine future of the South predicted by de la Bathie did not materialise. Colonisation of the arid Southern region was abandoned but local inhabitants were to be maintained as a pool of cheap,

unskilled labour for 'useful' Madagascar. The only real investment the French colonial era brought to the South and south-east was an attempt by authorities to replace the Malagasy Cactus, Southern Madagascar's most important subsistence resource, with Opuntiae [cactus] which became central to France's labour project because it enabled the deep South to produce people, cattle and taxes for export at a minimal input" (Middleton, 1999).

The Antaimoro continued to abide by migratory habits laid down under Merina rule. The Karembola migrated for the first time in great numbers in search of wage labour on the East coast plantations due to the famine and destitution caused by the loss of the Malagasy Cactus (Cole and Middleton, 2001). The Sambirano Valley north of Antananarivo in Sakalava country was transformed into a complex array of plantations and is today among the most fertile and prosperous regions of Madagascar dominated by cocoa and coffee crops (Sharp, 2001). The Antandroy of the South are historically among the first of the non-Sakalava to come to the Sambirano Valley as migrant labourers. The Antandroy were joined by Karembola and Antaimoro, all of whom were forced to work for contract periods as sharecroppers by the loss of the Malagasy Cactus in the South (Sharp, 2001). To this day; the Antandroy have not been culturally integrated into Sakalava society. "Migrants [in the Sambirano Valley] typically occupy economic niches that both sustain existing and generate new preconceptions of ethnic difference" (Sharp, 2001). The Antandroy migrant's main role remains at the bottom of the wage economy as night watchmen and field hands and as market traders in the informal economy.

In 1945-46, the Constituent Assembly in France offered the Malagasy people French citizenship and provincial assemblies but not national self-determination. However, Merina belief in 'Malagasy times' when life was lived according to Malagasy customs and the perception of an imposed '*Vasaha*' (foreigner) way of doing things which included various forms of imported Christianity resulted in a traditionalist anti-côtier element among the Merina who wished to return to Malagasy times, to honour their own spirituality and to re-identify themselves and Malagasy culture with the ancestors. From the beginning of French rule Merina traditionalists found it easy to gain an education, establish themselves within the colonial administration, civil service and other professions. These people were discrete leaders of the French opposition and extensively involved in a dramatic anti-colonial revolt in 1947 that

was crushed by France with unparalleled brutality. It is known as one of the bloodiest episodes of state repression in African colonial history, leading to some 100,000 deaths (Cole and Middleton, 2001). After the 1947 rebellion, Malagasy politics remained for all practical purposes dormant until 1958 when Charles de Gaulle offered all the Fancophone African countries either full independence or restored nationhood with maintained links to France. Madagascar, by a 77% vote, took the latter of the two options and was quickly recognised as its own sovereign state. However, Merina domination of civil service posts at independence, the forced dependence on a wage labour economy amongst Madagascar's other ethnic groups including the complete destruction of the mode of production in the South ensured the continuation of Merina political and economic dominance.

Until 2002, Madagascar's post-colonial political history had three obvious periods. The first period was under the leadership of President Philbert Tsiranana, who took office in June 1960 as head of the Parti Social Democrate (PSD). The 1960's were a time of relative prosperity for Madagascar. The GDP growth rate stayed above population growth figures. The net result was an average increase in per capita GDP of 0.9% per annum. Tsiranana's government maintained strong links with France but the proliferation of French personnel presented a problem for the advancement of Malagasy politics due to political support for the French arising from ethnic political rivalries between the Merina and the rest of Madagascar's ethnic groups. In short, the coastal/plateaux division prevented the immediate expulsion of French personnel since nearly all the Malagasy able to take over French held posts were Merina.

Tsiranana's pragmatic political leadership led to the development of light industry and grass roots agricultural projects. In rural Anosy however, agricultural sector investment remained disappointingly low. Cash-crop plantations received the bulk of investment whilst the Anosy peasantry still practised subsistence agriculture using traditional tools. The cost of basic necessities increased with inflation while prices to farmers stagnated. Unlike that of the urban population, peasant's standard of living actually declined (Brown, 1995). In 1971, an anthrax outbreak followed by a prolonged period of drought hit the south-east. Cattle herds were decimated causing great hardship and famine. Cattle tax collectors paid on a commission basis continued to demand taxes based on the previous number of cattle. The government ignored peasant protests against the livestock taxes. This led to armed peasant assaults on

Gendarmerie posts and government buildings. In the capital opinion swayed against the government and led to the eventual stepping down of Philbert Tsiranana partly because of attempted government repression of reports concerning the appalling conditions in the South.

In 1972 Tsiranana named General Gabriel Ramanantsoa president and a Senate referendum granted him the power to govern for five years. Plateaux/coastal political tensions were strained over Ramanantsoa's appointment. Both côtier and coastal supporters were acutely aware of the increased likelihood of new Merina appointees to government. Ramanantsoa instigated the Malgachisation of the education system, which was felt by coastal students to be detrimental to their education. Lessons were taught in the Merina dialect leaving coastal students at a relative disadvantage and led to violent anti-Merina demonstrations. In 1973 rural peasants were dealt a further blow by the formation of the 'Société d'Interest National Pour Productis Agricoles' (SINPA) established to intervene in rice marketing. SINPA replaced independent Asian crop buyers (Covell, 1987). However, the new parastatal proved to be less efficient than the independent middlemen. It became riddled with corruption, and did not advance funds to peasants or pay on time.

Ramanantsoa began to loose support and in 1975 after a bloody struggle Didier Ratsiraka assumed the Malagasy leadership (Brown, 1995; Covell, 1987). In 1976, Ratsiraka founded the AREMA (Avente-Guard de la Revolution Malgache) party and began a programme to nationalise estate sector farming and drive out private capital operations. Abandoned plantations were taken over by the state and the "few active foreign owned plantations in the south-east were expropriated and run as state farms or co-operatives" (Sharp, 2001). The nationalisation of private agriculture, marketing and distribution resulted in the serious reduction of crucial Sisal and Vanilla exports from the south-east and East coast plantations, resulting in a tremendous regional loss of wage labour opportunities. Ratsiraka's government capitalised on SINPA and centralised agricultural marketing and distribution. This led to independent peasant farmers and those running co-operatives on expropriated plantations experiencing further difficulties; selling their crops as produce collection and payments to farmers became more erratic and unreliable.

It has been recently reported that upwards of 95% of south-eastern Malagasy livelihoods are based on rural petty commodity production of farming and fishing

goods (CRD Anosy, 1999). Anosy's overwhelmingly peasant and estate sector agricultural economy was hit especially hard by the impact of estate sector nationalisation and the inefficiencies introduced by a forced dependence on SINPA. Betsimisaraka and Karembola remember Madagascar under President Tsiranana as a time of relative prosperity contrary to President Ratsiraka's second Republic as a time of increasing hardship (Cole and Middleton, 2001). During the late 1970's, Madagascar's economic decline led to the procurement of IMF loans. The resulting economic liberalisation brought with it the increased cost of staple foods such as manioc, beans and rice while the market price to producers remained low (Barrett, 1997a; Mukonoweshuro, 1994). Ratsiraka's government favoured urban populations by maintaining low staple food prices in the city via SINPA, to the detriment of the rural producer. In response to the fixed low market prices for agricultural produce and the high retail cost of crops, rural peasants began to concentrate on subsistence food crop production (Mukonoweshuro, 1994).

In 1983, marketing and distribution inefficiencies and a fall in production led to a famine in Southern Madagascar whilst the North enjoyed a bumper harvest.[7] Again, in 1989, drought covering much of Southern Africa deeply affected Southern Madagascar causing serious famine with no government relief. These other pressures placed on the livelihoods of the southern peasant population have fuelled the continued migration of people away from the impoverished South. There is no rigorous push-pull type of analysis of migration patterns available, but there is little doubt that such a study would show these migratory patterns to be strongly influenced by simple economic factors (Pryor, 1990).

Southern Madagascar has experienced considerable hardship both created and exacerbated by ruling party economic policy from the times of *Andrianamponimerina* to the present day. The Merina slave trade dramatically changed the demography of many regions but none were exploited to the same extent as the south-east. French colonial 'ethnic politics' was defamatory towards the people of the South resulting in catastrophic regional policies. Both the Merina and the French expropriated land in order to develop large-scale agricultural projects at the expense of the Southern

[7] For an in depth discussion of the impact of AREMA government policy on the agricultural, manufacturing and industrial sectors of the Malagasy economy see Mukonoweshuro (1994).

landowners and used various forced or coerced labour regimes to encourage participation in, and eventual dependence on, a wage labour market. The importation of exotic species altered the subsistence economy of the Southern region in such a way that subsistence livelihood strategies became redundant and migrant wage labour the only alternative. Nowhere in Madagascar did the combination of Merina and European colonial politics disastrously alter both the primary means of production and subsistence more so than in the South and south-east.

The post independence Malagasy government has been overwhelmingly Merina dominated and the political relationship between the plateau and coastal ethnic groups continues to be fraught with confrontation. These historically founded differences have continued to have a negative impact on the rural southern population and the development of the southern infrastructure and economy by concentrating existing wealth and power within particular social niches. In post colonial south-east Madagascar economic liberalisation as a result of IMF loans reduced agricultural production and wage labour opportunities, raised the cost of imported goods, increased the price of staple foods, led to a diminished access to public services and provided an opportunity for the wealthy elite to expand and consolidate their power base (Covell, 1987).

Bernstein (2000) and Pryor (1990) note that within poorer countries urban middle class interests gain influence at the cost of the rural population. Shifts in the urban-rural terms of trade result in a supply of cheap goods for the urban population and relatively more expensive goods for the countryside through investment in urban industries and services. At a local level, rural areas suffer through landowners, moneylenders, bureaucrats and merchants with the ability to consolidate their power and wealth,

Urbanisation in the south-east was minimal but the State became more biased towards urban areas which further tipped the terms of trade. Meanwhile, both foreign and State investment in the south-east remained negligible. There were traditionally few raw materials to take advantage of other than the sisal industry. The vast majority of Madagascar's industrial and service sector investment was in Antananarivo which meant that the terms of trade between the overwhelmingly rural south-east and the core economic zone in the capital left south-eastern Madagascar with no direct road

access and as the furthest geographic point from the centre of trade, at a considerable disadvantage.

There are few local landowners in Anosy. The largest of them are the sisal growers, the hotel owners and local politicians, these roles most often not being mutually exclusive. Concentrating the wealth in the hands of a few combined with the power to appropriate local resources ensures the continuation of low wages and inequality. Poverty in the south-east is further exacerbated by population growth and increased pressure on environmental resources. As livelihoods become increasingly scarce migration to the urban centre will increase. The urgency of providing adequate access to public services such as hospitals, schools, clean water and sanitation facilities for an ever-growing population in Fort Dauphin grows with its ever-increasing population.

4 Health and Health Care in Androy

The 1980's were declared, the "International Drinking Water and Sanitation decade". By 1996 the number of people in the world with access to safe water exceeded the number of those with access to adequate sanitation facilities (Esray, 1996). In the same year safe water coverage globally was beginning to catch up with population increase but sanitation coverage was slipping (Esray, 1996). Approximately 82% of the global population had been served with some form of improved water supply by 2000 but the proportion of the world's population with access to improved excreta disposal facilities in the same year was only ≈60% (World Health Organisation, 2000). At the beginning of 2000, one-sixth of the world's population was without access to improved water supply and two-fifths lacked access to improved sanitation. A large proportion of these people live in Africa.

In Africa 135 million people gained access to improved water supply between 1990 and 2000. The vast majority of these people live in urban areas. For sanitation, the increase in the number of people with access has been smaller than that for water coverage. In total, 98 million additional people gained access to improved sanitation services between 1990 and 2000, again the vast majority of them lived in urban areas (World Health Organisation, 2000). These figures reflect the results of at least twenty years of concerted effort and publicity to improve water supply and sanitation (WS&S) coverage. To achieve World Health Organisation (WHO) 2015 targets in Africa an additional 197 million people will need access to sanitation and 188 million will need access to a clean water supply (World Health Organisation, 2000). In effect, this means providing water supply services to 39,620 people and sanitation facilities to 41,517 people in Africa every day for the next 13 years (Esray, 1996).

Clean water supply and sanitation are considered to be one of the cornerstones of primary and preventative healthcare (Okun, 1988). Global patterns of the most common infectious diseases closely associated with a lack of improved water supply and sanitation are detailed by the WHO (2000) as;

- Approximately 4 billion cases of diarrhoea each year cause 2.2 million deaths, mostly among children under the age of five. These deaths represent approximately 15% of all child deaths under the age of five in developing countries. Water, sanitation, and hygiene interventions reduce diarrhoeal disease

on average by between one-quarter and one-third (World Health Organisation, 2000).

- Intestinal worms infect about 10% of the population of the developing world. These can be controlled through better sanitation, water supply and hygiene practices. Intestinal parasitic infections can lead to malnutrition, anaemia and retarded growth, depending upon the severity of the infection (World Health Organisation, 2000).

- It is estimated that 6 million people are blind from trachoma and the population at risk from this disease is approximately 500 million (World Health Organisation, 2000). Esrey *et al.* (1991) found that providing adequate quantities of water reduced the median infection rate of trachoma by ≈25%.

- 200 million people in the world are infected with schistosomiasis, of which 20 million suffer severe infections and consequences. The disease is still found in 74 countries of the world (World Health Organisation, 2000). Esrey *et al.* (1991) found a median 77% reduction in schistosomiasis from well-designed water and sanitation interventions.

Improving water supply and sanitation brings with it not only the valuable benefits of disease prevention but also improved primary health care, improvements to nutritional status, time released for women, strengthening of community organisation, promotion of commercial activity and improved quality of life (Okun, 1988). Both separately and together water supply and sanitation are known to be controlling factors in preventing communicable disease outbreaks of a number of common bacterial illnesses such as dysentery, cholera, typhoid, leptospirosis and diarrhoea as well as protozoic illnesses such as amebiasis and giardiasis, and a variety of the helminthic diseases *i.e.* Ascariasis, hook worm, liver fluke, roundworm, schistosomiasis, tapeworm and whipworm (Esray and Habicht, 1986; Franceys *et al.*, 1992; Okun, 1988). Many of these diseases are prevalent and endemic in the South east of Madagascar, especially diarrhoea and the helminthic diseases (Action Sante Organisation Secoures (ASOS), 1997; Howarth, 1988). In March 1999 Cholera was detected in Madagascar and caused more than 2200 deaths countrywide (Reller *et al.*, 2001). As recently as 2000 cholera was also detected in the south-east in and around Fort Dauphin. As previously reported sanitation provision in Anosy is scarce. "Poor water quality and sanitation

infrastructure are major contributing factors to high rates of Diarrhoea and vulnerability to cholera in Madagascar" (Dunston *et al.*, 2001).

Table 1. Water supply and sanitation coverage in Madagascar

Total Population 1000's	15,942
Urban Population 1000's	4,721
Rural Population 1000's	11,221
% Urban Water Supply Coverage	85
% Rural Water Supply Coverage	31
Total Water Supply Coverage	47
% Urban Sanitation Coverage	70
% Rural Sanitation Coverage	30
Total Sanitation Coverage	42

Source (World Health Organisation, 2000)

Essential to the effective use of water supply and sanitation facilities is hygiene education (Aung Myo Han and Thein Hlaing, 1989; Black, 1981; Okun, 1988). The simple act of washing hands with soap and water can reduce diarrhoeal disease transmission by one third (Okun, 1988). However, the difficulties of providing hygiene education in the absence of adequate water supply or improved sanitation need little elaboration (Okun, 1988).

4.1 Clean water supply and health

There are four categories of water related disease these include water-borne, water-washed, water-based and water-vectored diseases. Outbreaks of **water-borne** disease continue to occur across the developed and developing world. Disease transmission occurs by drinking contaminated water and has been a major contributing factor towards many outbreaks of faecal–oral diseases such as cholera, typhoid, diarrhoea, dysentery and infectious hepatitis (Seager *et al.*, 1996).

Water-washed disease occurs when there is a lack of sufficient quantities of water for washing and personal hygiene (Aung Myo Han and Thein Hlaing, 1989; Black, 1981). Without sufficient water people cannot keep their hands, gastrointestinal tract, body and domestic environments clean and hygienic. Without enough water, skin and eye infections (including trachoma) are easily spread, as are faecal–oral diseases such as diarrhoea (World Health Organisation, 2000).

Water-based diseases are those where the pathogen spends an essential part of its lifecycle in an aquatic host and includes diseases like schistosomiasis. There have been several studies of the effects of schistosomiasis in western Madagascar that show women to be particularly vulnerable (Leutscher *et al.*, 1997; Leutscher *et al.*, 1998).

"Many individuals experience lesions, spiking fever, chills, generalised weakness, anorexia, diarrhoea, myalgia, vomiting, nausia, urticaria and cough...Nutritional deficiencies and anaemia are the commonest sequelae of established [schistosomiasis] infections" (Wood, 1994).

Water-vectored diseases are transmitted via insects which either breed in water such as the malaria carrying mosquito or insects which bite near to water such as the riverine Tsetse Fly (Seager *et al.*, 1996). Malaria is commonly reported to be south-east Madagascar's single most common cause of illness and death especially among the undernourished, infants and children under 5 years old (Action Sante Organisation Secoures (ASOS), 1997).

The type of water source also impacts on the incidence of disease (Esray, 1988; Esray and Habicht, 1986; Howarth, 1988). Seager *et al* (1996) found that poorer water quality was detected in communal taps resulting in a comparatively higher incidence of child diarrhoea in areas served by communal taps on the Cape Flats in the Western Cape, South Africa. It was also noted, that water tested after a period of storage was significantly more contaminated than at the source.

Further data from Seager *et al* (1996) supports the growing body of evidence that water quantity and sanitation facilities are of greater importance than water quality in reducing diarrhoeal disease. Adequate quantities of safe water for consumption and use in promoting hygiene measures such as combating water-washed diseases are complementary measures for protecting health (World Health Organisation, 2000). The quantity of water people use depends upon their ease of access. If water is available through a house or yard connection people will use large quantities for hygiene, but consumption drops significantly when water must be carried for more than a few minutes from a source to the household (Seager *et al.*, 1996).

Table 2 demonstrates the importance of access to quantity of water for washing rather than quality drinking water as well as access to sanitation facilities. Adequate sanitation reduces the likelihood of contracting diarrhoea and a number of the helminthic diseases that are endemic and prevalent in south-east Madagascar.

Table 2. Potential relation between water and sanitation interventions and morbidity from selected diseases

	Intervention			
	Improved Drinking Water	Water for Domestic Hygiene	Water for Personal Hygiene	Human Excreta Disposal
Diarrhoeal Disease	1	2	2	2
Ascariasis	1	2	0	2
Hookworm	0	0	0	2
Schistosomiasis	0	2	2	2

(Esray *et al.*, 1991)

0 = little or no impact, 2 = greater impact than 1

4.2 Sanitation provision and health

Sanitation facilities prevent human faecal contamination of water and soil thus interrupting the transmission of many faecal–oral diseases at their source. From epidemiological evidence, Esray (1996) suggests that sanitation "appears overwhelmingly to confer broader and larger benefits to health than improved water supply". Often however, incorporating improved sanitation measures into daily routine involves both behavioural and infrastructural changes at significant financial cost to the household.

Examples of the diverse difficulties encountered when attempting to introduce improved sanitation measures are exemplified by the Evatraha Health and Sanitation Project (Azafady NGO, 2000; Azafady NGO *et al.*, 1999). An investigation into the beliefs and attitudes associated with sanitation in south-east Madagascar was conducted in 1998 by Williams (1999). As a result of Williams' findings sanitation facilities were successfully provided for a number of Evatraha's residents over a one year period during 1999-2000.

During the year many issues were addresses, such as;

- the supply and cost of materials,
- the cost of and construction techniques associated with latrine sanitation platforms and methods of payment,
- the type and extent of community participation in the project,
- cultural suitability of latrine superstructure design and location,
- suitable pit construction methods to suit varying soil qualities,
- the introduction of good hygiene practice, and

- inter and intra village political relations.

In 2003, ventilated improved pit latrines are still being supplied in Evatraha and many of the solutions to issues addressed during the introductory period are still evolving and require the constant attention of project staff. A reasonable estimate for the elapsed time before every family in Evatraha has a latrine is around 5 years. The long-term commitment needed by both NGO staff and the local community to make such a project sustainable and to achieve the successful implementation of improved sanitation facilities for all plays a very significant role in the practical cost of such a project and highlights the necessity of stable financial resources.

For improved sanitation to be effective good hygiene behaviour must be practiced (Aung Myo Han and Thein Hlaing, 1989). The whole family, not just the adults, must be encouraged to incorporate the necessary behavioural changes into their daily routine.

> "Children are the main victims of diarrhoea and other faecal–oral disease, and also the most likely source of infection.... Adequate quantities of safe water and good sanitation facilities are necessary conditions for healthy living, but their impact will depend upon how they are used" (World Health Organisation, 2000).

Children are the most vulnerable to infection and death from faecal-oral diseases (Esray, 1985; Esray, 1988). Those who are regularly exposed to these illnesses suffer stunted growth due to nutritional deficiencies. Many of the bacterial, protozoic and helminthic faecal-oral diseases are responsible for reductions in host nutrition levels through various mechanisms. One method of measuring the health status of children is by their height to age, weight to age, and weight to height ratios.

From a multi country study in eight countries in Sub-Saharan Africa, North Africa, Asia and the Americas, Esray (1996) found that children most susceptible to diarrhoea were among families without improved sanitation. He also found that the change in diarrhoea prevalence was greater when the level of improvement to sanitation facilities changed than when the level of improvement to water supply facilities changed. In fact, Esray found that changes in the level of improvement to the water supply did not affect the prevalence of diarrhoea regardless of the type of sanitation available. Using height:age ratios amongst children Esray (1996) concluded that

"sanitation had a larger effect on urban dwellers [and that] the effects of sanitation were consistent and large...For water supply the effects found were small...[and] positive only in rural children and when improved sanitation was present".

Weight:age ratios were similarly affected in that "the effects of sanitation were always positive, and the effects of water were found only when optimal supplies were present and sanitation was improved" (Esray, 1996). In all cases Esray's (1996) study showed that "improvements in water did not result in health impacts if sanitation remained unimproved". He also showed that "improvements in water and sanitation together were synergistic in producing larger impacts than either alone". Table 3 shows water supply and sanitation technologies that are considered to be improved and those that are not considered improved.

Table 3. Improved and not improved water supply and sanitation technologies

'Improved' Technologies:	
Water supply	**Sanitation**
Household connection	Connection to a public sewer
Public standpipe	Connection to septic system
Borehole	Pour-flush latrine
Protected dug well	Simple pit latrine
Protected spring	Ventilated improved pit latrine
Rainwater collection	
'Not improved' Technologies:	
Water supply	**Sanitation**
Unprotected well	Service or bucket latrines (where excreta are manually removed)
Unprotected spring	Public latrines
Vendor-provided water	Open latrine
Bottled water	
Tanker truck provision of water	

Source (World Health Organisation, 2000)

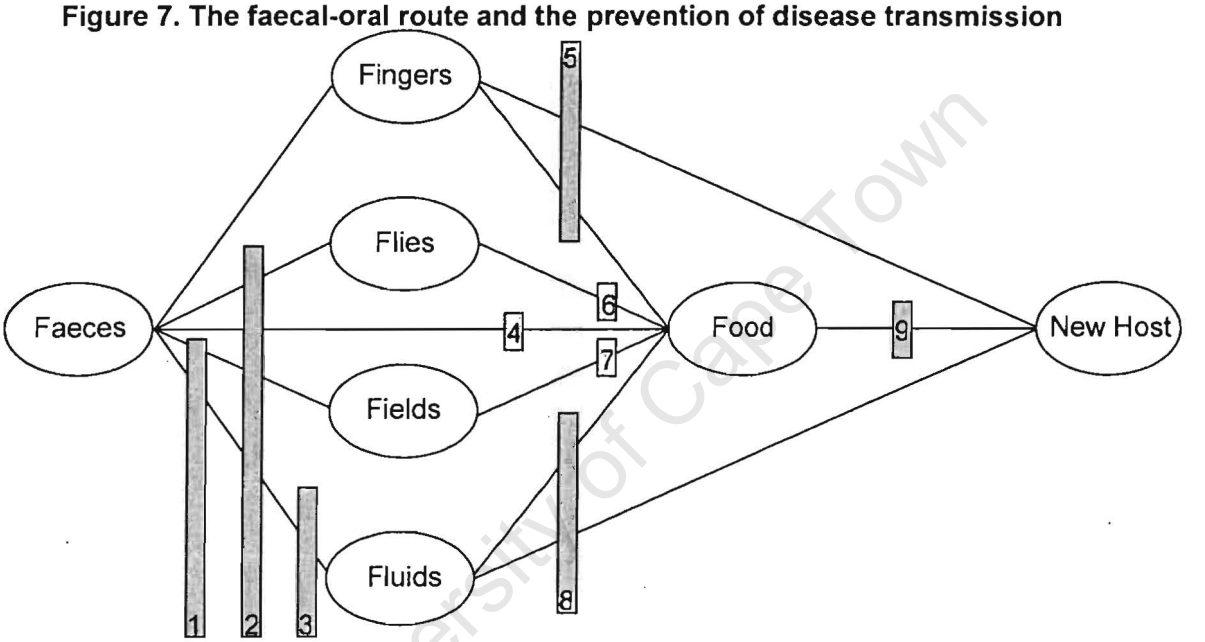
4.3 The faecal-oral route

The most prevalent faecal-oral diseases are diarrhoea and the helminthic diseases. With regard to these infections there is an important and distinct difference between a person who is infected with one of these illnesses and a person who is symptomatic and ill. A sick person may not be at a stage in the lifecycle of the disease where they carry the threat of infection to others. Visible symptoms also inform others of the presence of infection and precautions can be taken against its spread. An infected person who shows no signs of illness and is unaware that they are a carrier may however, infect others (Cairncross and Feachem, 1983). Three attributes of the infecting pathogen affect the probability of infection from one person to another. Its

latency or the interval of time between a pathogen being excreted by a carrier and its infection of another host; the pathogen's *persistence* relating to the length of time it can survive outside the host body; and its *multiplication* rate inside a new host (Cairncross and Feachem, 1983; Williams, 1999).

Figure 7 shows the multiple ways in which faecal-oral disease pathogens may infect or re-infect a host. It demonstrates that an integrated approach to water supply and sanitation plus hygiene education is necessary for the prevention of faecal-oral disease.

Figure 7. The faecal-oral route and the prevention of disease transmission



Barriers to Disease Transmission

1. Pit Latrine
2. Ventilated Improved Pit (VIP) Latrine
3. Protected Water Sources
4. Protected Food (safe re-use)
5. Hand-washing at Critical Times (after defecation, after cleaning children's bottoms, before handling food, before eating and feeding)
6. Protected Food (storage)
7. Protected Food (handling and preparation)
8. Protection of Water in Transit and in the Home
9. Safe Eating (washing fruit & Vegetables before consumption etc)

Source (Williams, 1999)

4.4 Nutrition and health

50 to 90% of illness and death amongst the populations of the developing world are accountable to a combination of nutritional deficiencies and communicable disease. A population's susceptibility to communicable disease is greatly affected by their nutritional status. "Undernutrition is a major contributing factor in communicable

disease. It impairs normal body responses to disease thus reducing any immunity created by infections" (Sanders, 1985). Undernutrition impairs normal body responses to disease and reduces any immunity previous infections have created (Sanders, 1985).

Studies have shown that severely undernourished children suffer up to four times more attacks of diarrhoea than their adequately nourished counterparts. These repeated attacks of illness amongst the undernourished impair appetite making it more difficult to increase the body's metabolism thus further increasing nutritional deficiency (see Ascoli, 1967; Esray, 1996; Esray, 1987; Sanders, 1985).

A mother's nutritional status before and during pregnancy is an important factor in determining the weight of the baby at birth, an undernourished mother will most likely give birth to a small baby. Immature babies or those born at a low birth weight are the most vulnerable to communicable disease and death (Sanders, 1985). "Malaria in pregnant mothers is an acknowledged cause of infection of the placenta and thus of low birth weights" (Sanders, 1985). ASOS (1997) reported malaria to be the most common cause of illness amongst the population of Fort Dauphin préfecture in 1997. The high prevalence of both malaria and undernutrition in Anosy most likely intensify the impact of the few improved water supply and sanitation facilities on the high prevalence of diarrhoeal related illness and death amongst children in the south-east. The average birth weight of newborn babies in Anosy is an area that requires further study. Improved water supply and sanitation will help reduce the incidence of diarrhoeal illness and the pressure of communicable disease on the health status of infants and young underweight children.

> "Individual nutrition and health status are the outcome of multiple household factors, including economic and social resources, hygienic environment, cultural notions of what constitute adequate food nutritional needs and vulnerability to illness for different age and gender categories, and resource allocation rules" (Messer, 1997).

In a study based in Ranomafana in Anosy in 1990-1991, Hardenbergh (1997) illustrates that unlike most developing countries there is little gendered difference in the quantity and quality of food children and adults in south-east Madagascar receive. However, the data did show that food resource allocation is weighted by age in that

parents eat more than children and due partly to the quality of food infants are likely to be deficient in all aspects of nutrient consumption. The regular occurrences of famine in the south-east and the lack of State ability to bring adequate relief can only augment nutritional deficiencies amongst people in the south-east.

4.5 Macro-economics, structural adjustment and health in Anosy

It has been demonstrated that adequate water and sanitation provision and appropriate hygiene practices are among the key components of any primary health care programme. The particularly exploitative historical relationship that has existed between the state and the South of Madagascar has played a significant role in the current lack of investment in water and sanitation infrastructure for southern people. The last 20 years has also witnessed a shift in international policy towards the health of developing world populations. This is as a result of a changing balance in power between the principal health and economic development organisations and has had a direct impact on the health and nutritional status of the Anosy population.

During the 1980's the World Bank, the IMF and the WTO became the predominant developmental power brokers. These USA accountable organisations insisted on a shift in thinking from the more Keynesian socially regulated, state interventionist economic strategies to a neo-liberal and monetarist method. Neo-liberal economic policy has its origins in global dominance of free-market ideas and has been promulgated in Africa principally by the IMF and World Bank through lending policies associated with structural adjustment programmes (SAP's). These typically involve reductions in public spending and taxation, privatisation, and a move from State to private provision in public services (Bardill, 2000; Said, 2001).

In the 1980's the Anosy region, like the rest of Madagascar, was experiencing the effects of economic liberalisation imposed by structural adjustment. These policies included the complete liberalisation of agricultural marketing. "Madagascar's [economic] liberalisation was viewed as one of the most comprehensive and durable in the low-income world (Barrett, 1997b). It was assumed that the liberalisation programmes would shift the internal terms of trade in favour of agriculture in that prices received by farmers would increase with the dismantling of state structures used to suppress food prices. However, the real result of liberalisation was the aforementioned dramatic increase in the price of staple foods such as dried beans,

maize and manioc, Madagascar's second most important source of nutrients. The cost of rice, the cornerstone of Madagascar's economy and society also rose with liberalisation as did the seasonal variability in all staple food prices. The income of peasant farmers however, did not increase with the rising cost of living induced by liberalisation and as their standard of living fell so did their nutritional consumption. Liberalisation had the additional effect of creating bottlenecks in Malagasy food marketing niches such as wholesale crop collection, inter-regional transport and inter-seasonal storage which reduced access to marketable food surplus (Barrett, 1997a) and exacerbated both the impact of the rising cost of living and the 1983 and 1989 famines in the south-east.

During the 1980's, there was much debate over the effect of structural adjustment programmes on health. "The WHO was advocating the expansion of primary health care facilities while the World Bank and the IMF were insisting that indebted countries should cut these along with other public services...They also insisted on currency devaluation, denationalisation, the ending of food subsidies, wage restraint and the introduction of user fees for health and education" (Carpenter, 2000).

Primary health care spending was particularly degraded during the structural adjustment era because it was easier to reduce spending on the preventative sector than on curative services due to the reduced chances of public outcry (Woelk, 1992).

The annual budget of the Malagasy Ministry of Health was destabilised during the long economic recession and period of structural adjustment. As a consequence all of Madagascar's health services have been undermined. The primary health care centres are less frequently attended than before the period of structural adjustment because equipment is ageing and drug supplies are short. Only about a sixth of the need for medicines is being met. Health agents no longer receive a travel allowance so have lost their motivation to make home visits, promoting sanitation and imparting health education (Andrianarisoa and Rampanjato, 1994).

In response to the neo-liberal change in development policy, organisations such as the WHO and UNICEF abandoned programmes of social change and empowerment and shifted from policies of 'comprehensive' to 'selective' primary health care. From the mid 1980's selective care in the form of Oral Replacement Therapy (ORT) began to displace the more comprehensive water supply and sanitation programmes. ORT is

relatively easy to administer, is cost effective and has a dramatic life-saving effect. However, it does not prevent water borne or faecal/oral disease epidemics or replace the long-term loss of nutrition brought to many by imposed agricultural structural adjustment programmes. Many critics claim that ORT campaigns have commercialised and commodified health through the sale of packets to poor parents, impoverishing them further while failing to address the underlying causal problems of undernutrition and lack of access to improved water supply and sanitation (Carpenter, 2000).

4.6 A summary of current health provision in Anosy

Madagascar displays a typical developing country profile in terms of its patterns of disease, morbidity and mortality. The most prevalent diseases in Anosy are malaria, diarrhoea and helminthic infections. The prevalence of diarrhoea and the helminthic infections can be radically reduced by the introduction of improved water supply and sanitation facilities as can the health risk from faecal-oral diseases to low birth weight babies born as a result of malaria infection in mothers.

The type of water source has an impact on rates of faecal-oral disease transmission by affecting both the quality of water and the quantity available for use. Since quantity is more important than quality in reducing the incidence of faecal-oral disease the distance from the water supply to the point of use is important since the quantity used decreases with increased distance from the supply.

Improvements to water quality have not been shown to reduce the incidence of faecal-oral disease unless improved sanitation is available (Esrey, 1996; Esrey, 1985; Esrey, 1988; Esrey and Habicht, 1986; Hall, 1991; Mann and Wilson, 1982; Okun, 1988; Smet, 1993). Access to improved sanitation has a greater effect on reducing faecal-oral diseases incidence than either water quality or quantity, although improved water supply and sanitation together have a greater impact on the incidence of faecal-oral disease transmission than either alone. Esrey (1996) notes that sanitation has a greater effect on the health of children in urban areas than those living in rural areas.

Infants and children without access to improved sanitation are the highest risk age group to infection, serious illness and death from diarrhoea. Nutrition levels also play an important role, whereby the undernourished are more susceptible to infection. Those members of the population most at risk from communicable disease therefore,

are undernourished infants and children who do not have access to improved sanitation facilities. The vast majority of children living in the south-east of Madagascar are included in this group.

The opportunity for improved health status for the population of the south-east has been progressively eroded by the activities of both the State and key development organisations. Structural adjustment programmes have led to the dilapidation of Madagascar's existing health care facilities and reduced nutritional status among the predominantly rural subsistence Anosy population. Furthermore, the Government's reorientation of health care policies towards short-term solutions has failed to address the urgent need for adequate water and sanitation infrastructure provision in the South of Madagascar.

5 The Role of Development

Culturally suitable ventilated improved pit latrines were installed and accepted by the residents of Evatraha village outside Fort Dauphin. This and other methods of excreta management are a key element in any strategy to raise the health status of the Anosy population.

However, members of Azafady NGO were aware of several previous failed attempts to establish latrine use in Evatraha one of the most poignant of which was instigated by the Fort Dauphin garrison of the Malagasy army. At approximately two yearly intervals the Army stage clean-up campaigns in the rural villages surrounding the town. In 1997 before Azafady's Health and Sanitation Project began the army were invited to Evatraha by the president of the village to scare people into cleaning up. One of the villagers living in Evatraha at the time told Azafady "Everyone was afraid of the soldiers", (in Williams, 1999).

The Army ordered villagers to dig rubbish pits, collect all the rubbish in the village and bury it. The soldiers also made villagers construct ad-hoc latrines using whatever tools and materials were available. Although the rubbish pits were a success, after the army left the villagers celebrated and destroyed all the latrines. Like each previous attempt to encourage the use of improved sanitation in Evatraha, the army failed, and most likely only served to increase people's resistance to any future sanitation initiatives.

Ferguson (1990) observes that development projects are scattered liberally across the African continent and beyond. In nearly every case they seem on inspection to be planned, implemented, and justified in very nearly the same way. What is more, these projects regularly seem to fail. Here we discuss the pattern of regular development failures and the developmental theory behind the successful intervention in Evatraha in the hope that future initiatives that build on this research learn from previous experience.

5.1 'Development' according to the 'Western' experience

There are two main branches of opinion as to the role of development agencies. The first is that they are potentially a force for beneficial change and that any failure to deliver can be corrected through policy adjustment, (Ferguson, 1990). Many policy

writers buy into this ideological framework of development and regard development agencies as being part of "the great collective effort to fight poverty, raise standards of living, and promote one or another version of progress" (Ferguson, 1990). This perspective conforms to a liberal ideology that conflates 'modernisation' with 'improved standard of living'. Policy advocates focus their criticism of development agencies towards the technical and managerial approach to project planning. "The development apparatus is scrutinised at all levels, but always with an eye to locating what goes 'wrong', why, and how it can be fixed" (Ferguson, 1990).

Many development anthropologists also see the development apparatus as a practical tool for the solution of universal problems. As a branch of applied anthropology, "development anthropology rests in a Western centred system of knowledge and power", in a paradigm of reality where social and political analyses are not the product of neutral frameworks of reference but are instead derived from an accumulation scholarly and political action (Escobar, 1991). As a result many development anthropologists are themselves guilty of subscribing to the same hegemonic principles that regard development agencies as a force for good and advocate criticism aimed at policy reform.

The second approach to conceptualising development institutions is the radical neo-Marxist and Dependency Theory critique which regards development projects as aids to capitalist exploitation, either by incorporating new territories into the world system, or working against radical social change, or bribing national elites, or mystifying the 'real' international relationships, or any number of other mechanisms (Ferguson, 1990). The neo-Marxist movement regards capitalism to be the cause of poverty in the Third World and hence a capitalist run development project is a contradictory endeavour. Furthermore, aid projects cannot be expected to help the poor, since poverty is a consequence of powerlessness and development agencies reinforce the system that is responsible for preventing empowerment and creating poverty in the first place.

Regardless of political allegiance, it is clear from literature that the word 'Development' has two distinct interpretations, one orientated towards structural development the other more humanist in persuasion. On the one hand, 'Development' is taken to mean the process of transformation towards a modern, capitalist, industrial economy, a drive towards 'modernity'. On the other, it refers to the improvement of

'quality of life' and 'standard of living' and the 'amelioration of poverty and material want'(Chambers, 1983; Escobar, 1984; Escobar, 1991; Ferguson, 1990; Gardener and Lewis, 1996; Hobart, 1993; Skalnik, 1989).

Reservations concerning the Liberalistic conflation of these two interpretations, or the dependency orientated views of Marxism which see these views as disparate is a moot point. What is important is to acknowledge the inescapable fact that "development problems are conceptualised in relation to Western 'world-ordered-knowledge" (Gardener and Lewis, 1996). No matter what the 'development concept' might be the 'development industry' is imbued with the discourse of its birthplace. The language used by the West to describe the goals of development and its relationship to developing countries reflects the inequalities that are a result of colonialism, the need for Western States to maintain their position of economic and political dominance and their often limited vision of the global future (Gardener and Lewis, 1996).

Many authors, Arturo Escobar (1984), James Ferguson (1990) and Peter Skalnik (1989) - to name but a few, have in the Boasian tradition, examined some of the characteristics of western society that have shaped the evolution of the discourse which enshrouds development institutions and forms the framework for conceptualising development problems. They, and many others recognise the authenticity of, and reflect upon the question - Why do Third World 'development' strategies cultivated in the 'West', on the whole seem to fail?

Many would suggest the question answers itself - in that the majority of development strategies are Western products and hence have a hegemonic injected into them that destines them to fail from the outset, (see Hobart, 1993). The self-assurance with which Western development agencies know that they are 'doing the right thing' is a product of their systematic, structural and functional knowledge base. However, "as systematic knowledge grows, so does the possibility of ignorance" (Hobart, 1993). Gardener & Lewis (1996) point out that the nature of ignorance is not simply an absence of knowledge, but is instead a state of being which is ascribed by one to another. The nature of systematic knowledge and ignorance might lead Western knowledge bearers to label those who do not ascribe to the Western scientific paradigm of knowledge as ignorant of the true nature of reality and therefore powerless to act for themselves (Escobar, 1984; Escobar, 1988; Escobar, 1991; Ferguson, 1990; Gardener and Lewis, 1996; Skalnik, 1989).

Where else might the origins of this impositional display of superior knowledge be found but in the historical context of our subject matter *i.e.* development institutions? The roots of development discourse according to Escobar are founded in the political reshuffling of the world at the end of World War II. A discourse began to be articulated around the fictitious idea of the underdeveloped or Third World State (particularly with regard to the US relationship with Colombia at the time). The notions of 'Third World' emerged as the defining discourse that allowed Western States to redefine themselves as the global superpowers. It also served to instil a need to bring civilisation in the form of the way of life advocated by industrial capitalism. At this time the industrialised new superpowers also needed to create new markets to sell their goods. Economic development and trade liberalisation under the aegis of institutions such as the World Bank and the IMF became the instruments with which to advance their strategy of creating new foreign markets (Escobar, 1988).

The nature of today's dominant development discourse is summarised by Mark Hobart (1993) who suggests that current development discourse is aimed at the rhetorical appeal of western governments and other donors rather than at the recipients of development. Furthermore "the discourses of development are produced by those in power and often result in reproducing power relations between areas of the world and between people", (Gardener and Lewis, 1996). At the risk of sounding Marxist in orientation, these relations serve to maintain the status quo whereby overall wealth maintains itself at the expense of the poor, voiceless and powerless who remain unable to change their situation.

Applying anthropological principles to the development industry Gardner and Lewis (1996) identify a number of qualities that are a consequence of this dominant development discourse and which limit the development institution's ability to be effective. These qualities raise questions concerning the top-down approach to development encouraged by the institutionalisation, professionalisation and legitimacy of 'expert' advice in a grassroots context. It also raises questions regarding the level of participation of local people in the project planning and implementation process. Paul Sillitoe points out that many of these 'expert' qualities are in opposition to the multiplicity of indigenous knowledge systems and that the top-down approach to development advocated by many agencies was partly to blame for development failures (Sillitoe, 2000).

Sillitoe (1998) has also suggested "that within the broad context of development there is a growing acknowledgement that effective development assistance benefits from some understanding of local knowledge and practices". That, due to the top-down bias and the assumptions of experts, "ignorance of the needs and aspirations of the poor, did great damage. Agencies now accept that they need to consult more closely with their 'target beneficiaries', that is, involve the poor themselves in problem identification and decision-making processes, rather than trying to impose outsider devised interventions on them" (Sillitoe, 2000).

There is an ever-increasing body of literature that addresses the question of the place of local knowledge in development policy planning and implementation. The anthropologist's view is that "research in local knowledge relates to development issues and problems. Its objective is to introduce a locally informed perspective into development, to promote an appreciation of indigenous power structures and know-how" (Sillitoe, 1998). Sillitoe (1998) is careful to point out however, that there are those who argue "that conflation of others knowledge traditions into a single meta-category distinct from the western scientific one is unsupportable", and that the arrogance displayed by supporters of the western paradigm of thought cannot be ignored in that "distinguishing between others' knowledge traditions and ours privileges the scientific perspective".

5.2 The role of participation in development

Participatory approaches to development struck at the heart of the top-down modernisation paradigm by suggesting that development should instead come from the bottom-up (Chambers, 1983; Gardener and Lewis, 1996; Hobart, 1993). This shift in development thought has its roots in the concept of empowerment as a form of developmental change brought about by local problem-solving efforts and techniques. Proponents of this approach argued that only when the supposed beneficiaries of development interventions participate in the planning and implementation of the projects intended for their benefit will they have any real interest in making them succeed. Participation they argued, is a key prerequisite for sustainability (Bond and Hulme, 1999; Chambers, 1983; Ferguson, 1990; Sillitoe, 1998; Sillitoe, 2000).

5.2.1 The Process Approach

Participation is not the only major consideration to the success of development projects that aim to empower. Experimentation, learning by all parties, adaptation,

flexibility, building local capacity and organic expansion of projects are all part of the contrasting approach to the rigidity of top-down blueprint development. Project frameworks containing these characteristics ascribe to a paradigm of development practice known as the process approach (Bond and Hulme, 1999). The process approach accepts that many things are unknown at the start of a project and that the capacity of institutions to solve problems and improve performance is built up over time and not simply imported. Error is to be embraced and project beneficiaries are actors in their own right. Projects are not fixed to a time scale but are instead allowed to develop at their own rate depending upon both achievements and setbacks (Bond and Hulme, 1999; Ely *et al.*, 1991).

This discussion has pointed towards the dangers of implementing development projects planned using a top-down approach. Hobart (1993) and Gardner and Lewis (1996) argue that the nature of the Western mode of thought encourages its experts to see local knowledge bearers as powerless to act for themselves. Sillitoe (1998; 2000) and Bond and Hulme (1999) further point out that effective development initiatives benefit from local knowledge. However, as exemplified by the army's intervention in Evatraha local knowledge may not always embody wisdom simply because it is local knowledge. Soldiers and officers in the Malagasy Army must possess at least some level of local knowledge by default as must the President of Evatraha who instigated the intervention. However, their clean up and sanitation intervention was a resounding failure which may have even resulted in increasing resident's resistant to the improved sanitation.

The responsibility of the development practitioner therefore is not to dismiss their own knowledge base as inappropriate but to listen to local knowledge bearers, attempt to understand and appreciate the nuances of local culture and context, and plan development interventions as informed collaborations between local and outsider systems of knowledge from the ground up. It is in the spirit of recognising the importance of, and collaborating with, local knowledge bearers and practitioners that Steve Williams (1999) undertook to discover why latrines were so unpopular with the people of Evatraha and other villages surrounding Fort Dauphin.

5.3 The Beliefs and Attitudes Associated with Sanitation in south-east Madagascar

For all the ethnic difference that arises in present day Malagasy culture there is at least one underlying common element between them. The notion of and belief in the power of the ancestors or *Razana*. There are many reasons for the development of open defecation practices in Madagascar that are not appropriate to expand upon here. Suffice to say that the concepts of taboo or *fady* relating to *Razana* and *Vazimba* play an important role in constructing Malagasy social behaviour regarding sanitary practices.

The *Vazimba* are the previous occupiers of Madagascar before the *Razana*. *Vazimba* are worshiped as nature spirits who inhabit the earth and are able to influence aspects of its fertility. They are representative of vitality, sexuality, and femininity, all of which are symbolised in Malagasy law by water (Mack, 1986; Williams, 1999). The *Razana* on the other hand have abandoned this life, its pleasures, its softness and wetness for a higher moral purity. *Razana*, the ancestors of living Malagasy, are *anti-Vazimba* and transcend human experience and action (Bloch, 1971b). They are considered to be the guardians of the living and dictate appropriate and moral behaviour. The more strictly their wishes are adhered to the greater is their ability to look after the needs of the living. In order to become *Razana* it is traditionally required that the corpse undergo an exhumation, ritual cleansing and reburial cycle to dispose of the deceased individuals personal belongings, the most important of which is their moist flesh. The purpose of the cleansing ritual is to separate the 'wet' from the 'dry'. The wet being symbolic of the *vazimba* and the dry the higher power of *Vazimba*-free *Razana*. Those who dress the corpse are also obliged to purify themselves of the polluting effect (known as *boty*)[8] of both the touch *(tohina)* of the decomposing material and its smell *(fofona)*.

5.3.1 *Fady, Boty* and their Implications for Latrine Design

The customs and *fady's* relating to decomposition do not just apply to flesh but to other kinds of decomposing material such as faeces. Human faeces is however,

[8] For more information regarding both *Boty* and the associated concept of *Teeva* see Williams (1999).

regarded as deserving of extra care and attention which has led in part, to the prevailing sanitary practice of open defecation on traditionally designated and regularly used defecation sites in both urban and rural south-east Madagascar, and indeed across the majority of the island. People do not live on or next to these defecation areas and only visit them for their one intended purpose. *Boty* dictates that no material may be removed from a defecation site. Spiritual belief however, is unlikely to be the only factor that defines Malagasy defecation habits. Simple resource deficiency in a context of widespread poverty is likely to be a contributing factor governing social behaviour in this regard.

It may have occurred to the reader that to become polluted by the touch or smell of faeces would be more likely when using a defecation site than when using a latrine. However, for the Malagasy the idea of using a pit latrine with nothing but wooden boards between the user and a pit full of human excrement is a horrifying thought. To step carefully through a defecation site to a likely spot is a much less risky venture. Furthermore, unless properly constructed and ventilated the smell emanating from a pit latrine is vastly more overpowering than from a defecation site.

The consequences of the polluting effect of decomposing faeces for latrine design were identified by Williams (1999) and resulted in three latrine design recommendations.

a) Ventilation of the pit to encourage aerobic, high temperature decomposition which reduces the emission of bad smells and speeds up destruction of pathogenic organisms (Grant et al., 1996). Reduction of smell is especially important since it has been confirmed by Williams that the Malagasy assume smell to be a transmitter of 'pollution'. The word *boty* describes anything that is polluting and has association with human faeces. Anyone or anything can become *boty* through direct and indirect association with faeces. Pollution through *fofona* or smell is a form of *boty* contamination and as such a foul smelling latrine is unlikely to be used.

b) The squat slab or sanitation platform (sanplat) should be made of easy to clean material and have foot plates which provide an appropriate squatting position even at night (Franceys *et al.*, 1992; Mann and Wilson, 1982). This helps to avoid fouling the slab, especially important since a latrine that looks unhygienic and presents the user with the increased likelihood of coming into

contact with faeces is unlikely to be used. Furthermore, a fouled or otherwise dirty slab is likely to produce undesirable smells, discourage use of the latrine and become a source of infectious disease.

c) A much more serious form of *boty* is *teeva*, (Williams, 1999) a definition reserved for when an individual has come into direct contact *(tohina)* with human faeces. Those who become *teeva* are obliged to purify themselves (Mack, 1986) which requires considerable financial and social investment in the form of cleansing rituals and reference to the *Razana* (Williams, 1999). In case of the risk of becoming *teeva* a dirty latrine, especially one whose sanplat looks structurally unsound, is highly unlikely to be used due to the perceived increase in the risk of contact with excrement.

The ongoing Evatraha Health and Sanitation Latrines Project has shown that with these considerations for Malagasy belief born in mind, rural Malagasy people are enthusiastic about incorporating the use of pit latrines into their sanitary practices.

5.4 Lessons learned from a participatory process approach to development in Evatraha

The Health and Sanitation initiatives implemented by Azafady NGO in 2000/1 used a process approach to development. Azafady takes the middle ground between the purist viewpoints of Chambers (1983) and Korten (1980) who advocate local institutional development where the role of external agents are minimised and the more managerial viewpoint of Brinkerhoff (1992) who suggests that external management systems can play a useful role.

However, a number of assumptions were made against the spirit of processual development during the implementation of the Evatraha Health and Sanitation Project. One of the foremost assumptions was that people would prefer to have latrines built close to their homes (also preferable for encouraging people to use them at night). Neighbours close to households who wanted latrines next to their homes strongly objected to the idea, as did many of the other villagers. A second mistake was to assume that each household should have access to a latrine of their own. Many families were spread over several houses and objected to the notion of buying latrines for each homestead. It was decided that choices regarding both the number of latrines

per household and their position should be collectively left to their prospective owners to decide.

Over time the majority of the decision making regarding incorporating latrines into daily routine such as their position in the village relative to living areas, security and methods of access, privacy, the choice of the type/source and method of gathering/transporting locally available materials, the sequence in which client orders were fulfilled etc became the participant's responsibility. Under circumstances where there is a high degree of community involvement and a large number of people are making decisions regarding project management it is to be expected that the process takes longer and the course of the unfolding chain of events is often unclear. Goals become difficult to tie to a time scale and just one of a host of random events can seemingly prevent progress for hours, days and even weeks at a time. This however, is the essence of empowerment and process. The role of the outsider in the process is a multiple one – asking questions, relaying information, fetching, carrying, buying, building, digging, cleaning, maintaining equipment, encouraging the implementation of community decisions, building and maintaining relationships. Summed up in a single word, 'facilitation'.

Although community involvement is the quintessential aspect of Azafady's sanitation project the advantages of external management structures became apparent when dealing with day-to-day logistical issues such as keeping vehicles running, ensuring supplies of fuel, and other non-locally available materials, providing access to expensive equipment, offering credit facilities and passing on knowledge of key aspects of safe latrine construction and installation. A badly built latrine is more of a health hazard than no latrine at all (see Hall, 1991; Smet, 1993). It is vital to the success of any project that 'expert' knowledge is passed on to as many project participants as possible and that people experiment with their own variations of it and learn from their mistakes in order that they make the knowledge their own.

5.4.1 The advantage of research in development

It has been shown that a process approach to development works successfully in the rural villages surrounding Fort Dauphin where there are now more than 50 latrines built and owned by local people. The initial direction of the project was based on Steve Williams' recommendations. Without this insight into the Malagasy requirements of sanitation facilities and suggestions as to how they may be met

through latrine design the Evatraha Health and Sanitation project is likely to have been added to the list of regional development failures. In order that the project in urban Fort Dauphin is designed and implemented with the maximum success, lessons regarding the value of preliminary research are being adhered to. Hence, the Fort Dauphin Sanitation Survey was designed and administered with the co-operation of 1000 household representatives to answer a number of important questions determined by a year of participant observation in Evatraha, (see appendix 2 – the survey questionnaire).

Issues regarding suitability of the rural VIP latrine design and construction methods to the urban setting are not the focus of this study. However, it is already known that the VIP latrine design used in Evatraha is unsuitable for many of the residents of Fort Dauphin because of soil instability and space restrictions in some of the urban neighbourhoods. Further research is required to identify the most appropriate latrine design for these neighbourhoods (for latrine design manuals see especially Bester, 2000; Mann, 1973; Mara, 1984; Pickford, 1995; Reed, 1995; Van-Nostrand, 1983a; Van-Nostrand, 1983b).

It is hoped that in answering the research questions in 2.2.1 this study will move urban sanitation project design and implementation in a more informed direction and provide future researchers with a platform of baseline data from which to launch additional enquiries.

6 Research Methodology

6.1 The sampling method

This study is not *experimental* or *quasi-experimental* in nature but is simply an *exploratory* or *descriptive* first step towards gathering the data needed to implement a sanitation initiative in Fort Dauphin (see Blaikie, 2000). It is meant only to 'flesh out' the current picture and establish certain population parameters regarding the current level of sanitation infrastructure, hygiene behaviour and neighbourhood enthusiasm and support for sanitation in Fort Dauphin. The research questions defined in chapter 2.2.1 require 'what' and 'how much' type information. Sample surveys are generally unable to ascertain the 'how' and 'why' of a problem but are more able to address the 'what' and 'how much' which simply lead to a fairly general understanding of the problem area (Blaikie, 2000; Bulmer and Warwick, 2000; Czaja and Blair, 1996; De-Vaus, 1993).

The strategies useful to descriptive research of this nature are *inductive* and *abductive* strategies, (Blaikie, 2000). Of the two *inductive* research is the most useful strategy here and requires that the researcher be a detached observer and avoid allowing personal values or political commentary to contaminate the research. The research strategy most commonly associated with *inductive* research is the social survey (Blaikie, 2000; Moser and Kalton, 1971). In its capacity to establish a baseline description of sanitary infrastructure and patterns of use in Fort Dauphin the research was designed to gather statistically representative results using *quantitative cross-sectional* data. The two most common methods of gathering this type of data are through *questionnaire* and *structured observation surveys*, both of which were employed during this research (Blaikie, 2000).

6.1.1 The accuracy, precision and size of a population sample

Simple random sampling was used to gather a representative population sample using the household questionnaire in appendix 2.

The accuracy of a sample refers to the difference that occurs between the mean value of a sample variable ($\bar{x}$) and that of the true population mean (μ) for the same variable. The greater the difference, the less accurate the sample's representivity. This difference is often referred to as the confidence interval (E) and is related to the

precision of data as measured by the standard deviation (σ), (Blaikie, 2000; Moser and Kalton, 1971)

The accuracy of a data set cannot usually be assessed since the actual population mean (μ) for a given variable is unknown and unquantifiable – otherwise it would not be necessary to draw a population sample. However, instead of the accuracy of data, its probable accuracy or precision can be measured. If an infinite number of samples were taken from a given population, each sample would have a different average value for any given variable, ($\bar{x}_1$), ($\bar{x}_2$), ($\bar{x}_3$)...($\bar{x}_n$) etc. This phenomenon is known as the sampling distribution. The spread of the sampling distribution is measured by its standard deviation and is known as the standard error of the mean (S.E.$_{(\bar{x})}$). The standard error of the mean can be calculated from a single data set thus providing a measure of the precision of the sample for a given variable (Blaikie, 2000; De-Vaus, 1993; Moser and Kalton, 1971).

It is a common misunderstanding that a survey sample must be a fixed proportion of the population. However, there are two important considerations when determining sample size. Firstly, there is the degree of accuracy and precision with which one requires the sample to represent the population parameters in question. Secondly, sample size must account for the extent of the heterogeneity or variation in the population with regard to the key characteristics of the study (Blaikie, 2000; Bulmer and Warwick, 2000; Czaja and Blair, 1996; De-Vaus, 1993; Moser and Kalton, 1971).

If all the planned statistical tests were to be run on the sample as a whole the sample size *(n)* would depend entirely on the level of precision with which the sample needs to reflect the true population value and the expected variation of the key population characteristic. However, many tests do not involve the entire sample but instead use sample sub-groups which may be dependent on for example, ethnicity, gender, employment, household means, residential neighbourhood etc. Tests can only be run on these sample sub-groups if they are of sufficient size (n_x) to allow the confidence interval to remain within acceptable limits given the expected variance $p(100 - p)$ in the key sample characteristic. In order to make inferential statements into a population from a population sample, the sample size must also account for the desired confidence level with which inferential statements are made (for further discussion of survey sample size and its implications for inferential statistics see Blaikie, 2000; Czaja and Blair, 1996; De-Vaus, 1993; Moser and Kalton, 1971).

Finite Population Correction (f.p.c.)
Used when sample size ≥≈ 5% population size

$$\text{Sample size } n = \left(1 - \frac{n}{N}\right) \frac{p(100-p)Z}{E^2}$$

Where p is the expected percentage of a given variable
Z is the t-value for the chosen confidence level
E is the maximum allowed confidence interval
n is the sample size
N is the population size

Adapted from (Blaikie, 2000)

For this research a 5% confidence interval at a 95% confidence level was chosen in order to make inferred statements from the sample set about the population of Fort Dauphin as a whole. In practice a 5% confidence interval means that differences in results of less than 5% between sample sub-groups are not large enough to be attributable to the precision of the sample alone and must be rejected as being reflective of true differences in population characteristics. However, differences between compared sub-groups of greater than 5% fall outside the bounds of sample precision alone and can be said with 95% confidence to be reflective of true population characteristics. For example, if a 34% of a sub-group indicate that they own a latrine and 38% of a second sub-group indicate that they did not the difference of 4%, when n_x is determined by a confidence interval of 5% cannot be said to be representative of a difference in the population since it can be accounted for by the precision of the sample alone.

To calculate an adequate sample size for a homogenous (low variance) population where sub-group size is not accounted for and the key population characteristic (p), *i.e.* latrine ownership is estimated at 40%, the sample size *(n)* ≈ 369.

$$\text{Sample size } n = \frac{40(100-40)1.96^2}{5^2} = 368.79$$

However, observation showed that Fort Dauphin's population displayed quite a high heterogeneity that was likely to result in tests between sample sub-groups. When other variables remain constant, as the size of a sample reduces its confidence interval increases. Using the equation above as an example, if sample size *(n)* is reduced to n_x = 256 the confidence interval of the sample increases to 6% and differences in a

population characteristic of ≤6% between two sub-groups cannot be detected. Therefore, assuming that the key population characteristic *i.e.* latrine ownership is equal to 40% (p = 40%) we can see from the equation that to maintain a confidence interval of 5% with a 95% confidence level sample sub-groups can be no less than 369 cases. In order to try to maintain a 5% confidence interval at a 95% confidence level and account for unknown sample sub-group size a survey sample of 1000 households was considered adequate. Although it was also noted that a larger sample does not guarantee the accuracy of the data since it does not reduce bias inherent in the sample selection procedure (Moser and Kalton, 1971).

6.1.2 Survey data bias

The bias in a survey sample is indicated by the difference in the arithmetic mean of a sampled population parameter for a series of samples ($\bar{x}_1$), ($\bar{x}_2$), ($\bar{x}_3$)...($\bar{x}_n$). This value is known as the expected value of the estimator (m). If for a given sampling method or sample design, m is equal to the actual population parameter the data is said to be unbiased. If however, m is not equal to the population parameter the sample design or method is said to have introduced a bias into the sample (Moser and Kalton, 1971). These errors can affect the capacity of the sampling design or method to estimate population parameters (Blaikie, 2000).

Without careful appraisal, survey design it is likely to embody the concepts and categories important to the researcher rather than those important to the local context (Chambers, 1983; De-Vaus, 1993; Stern, 1980; Strauss and Corbin, 1991). To counter outsider bias questions for households were chosen after almost 12 months of participant observation in Fort Dauphin, working on health and sanitation projects in the locale and developing a – 'learned in the field' – working grasp of the Malagasy language. The author's familiarity with local concepts surrounding the subject area at least reduce the impact of outsider naivety and hopefully introduce empathy with local concerns. Also, in the spirit of a more participatory approach to research, many of the multiple choice answers that feature in the household questionnaire were based on information gathered during focus group interviews. The questionnaire was also designed in close co-operation with Azafady NGO staff, without whom the writing and especially translation of the questionnaire into the Antanosy dialect would not have been possible.

In order to reduce insider bias the household questionnaire included instructions and visual research tools with a number of the questions. The tools (see appendix 3) were used in order to stimulate productive dialogue and create a more enjoyable experience for both the field worker and the respondent. An element of humour was designed into the drawings in an attempt to ease the likely embarrassment of answering questions relating to a number of personal habits. In selecting their respondents field workers were directed to seek out any permanent household member able to answer the questions about their household. The respondent could be male or female, old or young. Field workers were however, directed to find respondents who looked more than 16 years old as younger children might have had more difficulty than adults with the nature of some of the personal questions. The number of male and female respondents were monitored as the research progressed in order to maintain an approximately even split in the gender of respondents.

The questionnaire was written in a local Malagasy dialect, piloted, commented upon and fielded by the same group of field workers who underwent training in the use of the questionnaire and its associated tools. All five of the field workers were born in Fort Dauphin, of Malagasy nationality, and varying ethnic origin with a full grasp of the necessary local dialects. The more experienced field workers mentored those with less experience during the first few days of data gathering. The completed questionnaires were gathered at the end of each day and a random sample from each field worker checked for errors. The field workers also met briefly at the end of each working day to discuss both positive and negative issues pertaining to their work. However, the personal values, opinions, level of experience as a field worker and potential lack of knowledge regarding research methodology are all a source of insider bias to an unknown and unquantifiable degree (Blaikie, 2000; Yin, 1984). The mapping exercise was also conducted by a local artist and as such may have been influenced by him to an unknown degree.

Researcher bias can also influence the results during data capture, reduction, and analysis phases (Blaikie, 2000; De-Vaus, 1993; Strauss and Corbin, 1991). Close attention was paid during the data capture phase to be accurate and consistent with identification and classification of the data. For open-ended answers, coding categories were established and answers grouped at the author's discretion (see Appendix 5 – coding categories) accepting the obvious loss of data quality.

It is acknowledged that survey research methods generally fail to facilitate any meaningful participation in the study by people in the group or community where the research is being conducted (Chambers, 1983). On a positive note, in terms of local capacity building the exercise was a beneficial learning experience for all involved in the survey design process and could not have been implemented without their valuable and informative input.

Shortly after budgets had been allocated to cater for 1000 survey questionnaires preparations began for mayoral elections. The elections provided an opportunity for access to an accurate and up to date adult population count in each of the 11 fokontanies. Participation in terms of permission to conduct the research was sought from the 11 fokontany presidents, all of whom were pleased to offer their assistance (see appendix 6).

The 1,000 household questionnaires were printed and allocated between the fokontanies in proportion to the number of registered voters on each electoral register as detailed in Table 4. During data capture 1 of the questionnaires was found to be unfit for use because it had not been filled out correctly therefore a total of 999 questionnaires comprise the data set.

Table 4. The number and proportion of questionnairs allocated to each of the fokontanies

Fokontany	# of Registered Voters	Questionnaire Count	Sample % of Population	Weight
Ambinanibe	595	39	6.55	15.26
Ambinanikely	2367	166	7.01	14.26
Amboanato	2271	171	7.53	13.28
Ampamkiambato	895	58	6.48	15.43
Amparihy	1694	120	7.08	14.12
Ampasikabo	Inc. Esokaka	56	7.47	13.39
Ampotatra	962	69	7.17	13.94
Bazaribe	775	55	7.10	14.09
Bazarikely	1179	84	7.12	14.03
Esokaka	1500	51	6.80	14.7
Tanambao	1819	130	7.15	13.99

7 Results

The 999 valid household questionnaires and 10 structured observation schedules were captured using Microsoft Excel 2000 and imported into Statsoft Statistica 5.5 for the following analysis. Map data presented in appendix 1 is discussed in 7.1.

At all times during the analysis the weighting shown in Table 4 is used to account for the small differences in proportional sample size across the fokontanies. Therefore, frequency distributions presented in the following tables have been multiplied up to the population size (N) rather than the sample size (*n*).

In answer to a number of the research questions frequency and percentage distribution tables of dichotomous multiple response data are cited as evidence, in which case there are three important columns to note. Firstly, there is the *count*, secondly the percentage of *responses* and thirdly the percentage of *respondents*, the interpretation of which are best explained by using the example in Table 5.

Each column (or variable) represents a single multiple response option and each row a person (or respondent) who answered the multiple response question. If a question were composed of 7 multiple response options and answered by 20 people there would be 7 columns of data and 20 rows. Dichotomous refers to the fact that the data can be one of two values, a'0' or a '1'. A '0' or no, indicates the respondent did not mark a particular choice and a '1' or yes, that they did.

The count column is simply a measure of the number of positive *responses* for each multiple response choice. The count column total can often exceed the population figure (N) because many of the respondents will have answered positively to more than one multiple choice.

In the table below there are a total of 12 yes' and 13 no's across the five columns. The total number of *responses* therefore is 12. Variable 1 represents 25% of all the responses, variable 2 represents 8.3% etc. When the percentage of responses is cited it always conforms to convention and represents a proportion of 100%.

When interpreting the percentage of *respondents* column it is important to remember that a respondent can answer yes to more than one multiple choice. Therefore, a sum of the percentage of respondents column is not meaningful in that it is highly likely to

produce a figure of greater than 100%. There are 5 respondents in Table 5, 60% of them chose multiple choice option 4 and 40% option 3. Notice that having accounted for only two of the respondents the sum of their proportions is already 100%. The percentage of respondents column is therefore never from a total of 100% and each proportion should be treated as a discrete figure.

Table 5. Interpreting dichotomous multiple response data

	Variable 1	Variable 2	Variable 3	Variable 4	Variable 5
Respondent 1	1	0	0	1	0
Respondent 2	1	0	1	0	1
Respondent 3	0	1	0	0	1
Respondent 4	0	0	1	1	1
Respondent 5	1	0	0	1	0

7.1 The geography of defecation in Fort Dauphin

Two research strategies contributed to the investigation of Fort Dauphin's defecation geography. First, two maps comprising all 11 fokontanies were drawn. They included hospitals, clinics, schools, churches, water stand pipes, crop growing areas, rubbish areas, defecation sites, slopes and large bodies of water (see appendix 1). Second, a structured observation survey was conducted in 10 of the 11 fokontanies (see appendix 4).

The maps indicate 75 stand pipes across the fokontanies and at least 60 individual defecation sites which in partial answer the first research question clearly demonstrates a need for improved sanitation in Fort Dauphin. Furthermore, 6 schools 12 of the stand pipes, the hospital in Amboanato, two clinics in Bazaribe and some of the crop growing areas are close enough to defecation sites to present an immediate threat to the health of people using these facilities. Furthermore, considering the staple Malagasy food crop is rice grown in a flooded rice paddy and many of the more virulent faecal-oral diseases are water borne, the large deposits of unprotected human excreta close to these bodies of water simply compounds the risk of an infectious disease outbreak.

However, defecation sites do not need to be close to water in order to have an impact on the health of Fort Dauphin's residents. It has already been noted that Genthe *et al.* (1996) detected poorer water quality in communal taps which resulted in a comparatively higher incidence of diarrhoea among the children who used them. It was also noted that water was significantly more contaminated at the point of use than at the source indicating contamination during collection and storage. Furthermore,

researchers in Thailand have used the incidence of diarrhoeal disease in a village as a proxy indicator of the level of neighbourhood contamination (Lewis *et al.*, 1997). That diarrhoea is the second largest cause of infant and child death in the south-east of Madagascar after Malaria (Action Sante Organisation Secoures (ASOS), 1997) is no surprise considering the extent of environmental faecal contamination and the reliance by many people on communal water supplies.

In addition to the defecation sites, the structured observation schedules revealed the presence of human faeces along roads and pathways in almost all of the fokontanies. It also showed the presence of faeces near to water sources and crop growing areas in Bazarikely, Ampotatra and Tanambao. There was faeces present in family compounds in Bazarikely, Ampotatra, Amboanato and Amparihy, but not inside houses. Adults and/or children were seen by field workers defecating in public places in all of the fokontanies except Bazaribe and Ampamkiambato. This is surprising behaviour considering the polluting effects of *boty*, *teeva*, *tohina* and *fofona* associated with human faeces (see section 5.3). It may be that defecation practices born of the rural environment are transforming in urban Fort Dauphin. That culture is not static but in a permanent state of flux is well documented. As people migrate from one environment to another the shifting pressures of a changing environment cause transformations in cultural practices. The metamorphosis in defecation habits between rural and urban south-east Madagascar is likely to be the product of a diverse and dynamic environment and is a topic for further research. For further discussion of the dynamic nature of cultural practices see Thornton (1988).

7.2 The geography of latrines in Fort Dauphin

7.2.1 The number and location of existing latrines

In answer to the second part of research question 1, the following discussion establishes the basic geography of latrines in Fort Dauphin. It discusses the number of latrines, where they are, which sub-groups of the population – if any – are likely to own a latrine, and what condition the latrines are in. Table 6 reveals that 65% of the population of Fort Dauphin were latrine owners.

Table 6. Number and percentage of latrines in Fort Dauphin

	Count	Percent
No	4934	35
Yes	9067	65
Missing	0	0
Total	14001	100

The most basic relationship that describes where the latrines were is the bivariate relationship between latrines and fokontanies. Fokontany residents have been grouped by the variable Latrine in Table 7 to indicate the prevalence of latrines across each fokontany.

Table 7. Percentage distribution of Fokontany grouped by Latrine

Rank Order Fokontanies	Latrine - No		Latrine - Yes	
	Count	Percent	Count	Percent
Ambinanibe	555	95	30	5
Ambinanikely	560	25	1876	75
Amboanato	650	27	1638	73
Ampamkiambato	465	55	315	45
Amparihy	812	50	798	50
Ampasikabo	13	2	702	98
Ampotatra	518	54	434	46
Bazaribe	14	2	686	98
Bazarikely	56	6	1092	94
Esokaka	330	35	630	65
Tanambao	961	55	866	45
Total	4934	35	9067	65
	Chi-square	df	P	
M-L Chi-square	3555.133	df=13	p=0.0000	
Cramér's V	0.469			

The number of latrines and their whereabouts has been established. In doing so, the question regarding who is likely to own a latrine is also partially answered. Table 7 tells us that residents of Bazaribe, Ampasikabo and Bazarikely seem the most likely sub-groups to own a latrine.

Cramér's V correlation coefficient in Table 7 establishes the strength and direction of the relationship between Fokontany and Latrine which was positive and moderately strong (0.465). However, that these two variables are positively correlated does not mean that one is the cause of the other, *i.e.* fokontanies do not cause latrine ownership nor vice versa. The question therefore regarding who is most likely to own a latrine is not yet fully answered. In order to do so the mechanism that establishes the Fokontany/Latrine relationship was explored a little further.

7.2.2 Detecting population sub-group patterns in latrine ownership

When variables are related but not causally so, the relationship is known as spurious (De-Vaus, 1993). Variables that might contribute to establishing a spurious relationship can be controlled for and their effect on the strength of the zero order relationship noted. When the effect of a control variable has been removed from the zero order relationship the new relationship becomes known as a first order conditional relationship. Removing the effect of two control variables produces second order conditional relationship, three a third order relationship and so forth (De-Vaus, 1993).

7.2.2.1 Establishing control variables

Likely control variables are those that display an independence of association in their frequency distribution when grouped by the same grouping variable as that used in the zero order relationship – in this case the variable Latrine. The Chi-Square statistic is the categorical test used here to test for independence of association. A p-value <0.05 indicates that the alternative hypothesis should be accepted with 95% confidence (De-Vaus, 1993; Wegner, 2000).

The null and alternative hypotheses for the Chi-Square tests are;

H_0: There is no independence of association in the frequency distribution of the test variable when grouped by 'Latrine'.

H_1: There is an independence of association in the frequency distribution of the test variable when grouped by 'Latrine'.

Once independence of association has been established the strength of the relationship between the test variable and the grouping variable is noted by the value of Phi (for 2x2 tables) or Cramér's V correlation coefficient. The correlation coefficient standardises the Chi-Square calculation by converting it to an index between 0 and 1. The stronger the relationship between the test variable and the grouping variable the closer to 1 the correlation coefficient becomes, 1.0 being perfect association. The stronger the relationship is between the test variable and the zero order grouping variable the more likely the test variable is to play a role in establishing the zero order relationship.

Only the variable Assets was tested for its eligibility as a control variable. Assets is an ordinal level variable generated from the questionnaire means test – questions 43 to

48. It was designed to establish a collective 'household means' level independent of the respondent's income or employment status. Since there was no focus to seek out the head of household during the fieldwork the data consists of a random sample of household members. As such it is important that the control variables are representative of the household and independent of individuals.

Assets was derived independently of individuals income or employment by combining two ordinal level variables which consisted of four categories each. The first variable is an indicator of the condition of a respondents home as measured by three factors, the number of rooms in the house, the predominant roofing material and the predominant wall material. The second is a measure of household access to services and ownership of home appliances. The author's knowledge and impressions of living conditions in Fort Dauphin informed the choices regarding rank order relationships in the data.

The relationship between the ranking variable Assets and latrine ownership shown in Table 8 is moderately strong (when $p<0.05$ and the confidence interval = 3.11). The table indicates that Assets displays a positive correlation with latrine ownership where ≈94% of top rank respondents own a latrine as opposed to only 37% of the lowest ranked respondents owning a latrine. The p value of the Chi Square test indicates an independence of association in the frequency distribution of Assets grouped by Latrine and the moderately strong correlation coefficient shows that Assets is likely to play a significant role in establishing the zero order relationship.

Table 8. Percentage distribution of Assets grouped by Latrine

Assets Rank	Latrine - No		Latrine - Yes		Proportion of *n*
	Count	Percent	Count	Percent	
1	214	6	3397	94	26
2	748	21	2721	79	25
3	987	46	1152	54	16
4	2943	63	1755	37	33
Totals	4892	35	9025	65	100
	Chi-square		df		p
M-L Chi-square	3305.113		df=3		p=0.0000
Cramér's V	0.4873268				

7.2.2.2 Using Assets as a control variable

A spurious relationship is detected by comparing the strength of association of the zero order relationship with that of the first order conditional relationship. If the conditional correlation co-efficient is substantially lower, at least by the order of 0.1,

than the zero order correlation coefficient when all but a single sub-group of the control variable is removed from the calculation it may mean that a spurious relationship has been detected (De-Vaus, 1993).

Having established that Assets is a good candidate as a control variable each of the four ranks is treated as an independent sub-group of respondents. The zero order correlation coefficient was recalculated for each sub-group and summarised in Table 9. Controlling for group 1 significantly weakens the first order correlation coefficient confirming that latrine ownership across the 11 fokontanies is at least partly spurious and dependent on household Assets.

Table 9. First order conditional correlation coeficient matrix controlling for Assets

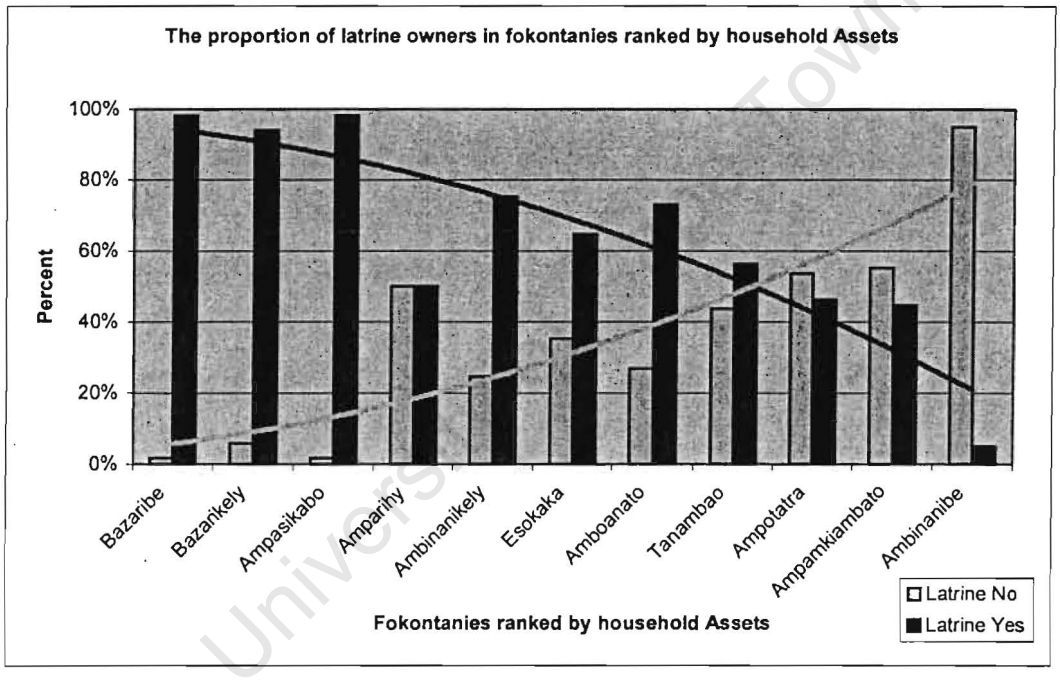
	Chi-square	df	p
Include Assets rank = 1			
M-L Chi-square	361.725	df=12	p=0.0000
Cramér's V	0.351567		
Include Assets rank = 2			
M-L Chi-square	837.2124	df=12	p=0.0000
Cramér's V	0.465887		
Include Assets rank = 3			
M-L Chi-square	579.7663	df=13	p=0.0000
Cramér's V	0.489422		
Include Assets rank = 4			
M-L Chi-square	1000.674	df=13	p=0.0000
Cramér's V	.4409059		

The obvious hypothesis knowing that Assets plays a role in latrine ownership is that household groups with greater assets are more likely to own a latrine than those with fewer Assets. To test the hypothesis fokontanies were ranked by household Assets (seeTable 10) along the x-axis of Figure 8 and grouped by latrine ownership. The graph displays a distinct relationship between fokontanies ranked by Assets and latrine ownership.

Table 10. Ranked percentage distribution of Assets across each of the fokontanies

Rank order	Fokontany	Assets Rank				Proportion of *n* (%)
		First (%)	Second (%)	Third (%)	Fourth (%)	
1	Bazaribe	67	16	11	5	6
2	Bazarikely	48	42	7	2	8
3	Ampasikabo	43	34	5	18	5
4	Amparihy	31	25	16	28	12
5	Ambinanikely	32	22	13	33	17
6	Esokaka	12	39	24	25	6
7	Amboanato	15	26	20	40	16
8	Tanambao	15	24	15	45	14
9	Ampotatra	10	22	28	41	7
10	Ampamkiambato	21	5	21	53	6
11	Ambinanibe	0	0	15	85	4

Figure 8. The distribution of latrines across the fokontanies ranked by Assets



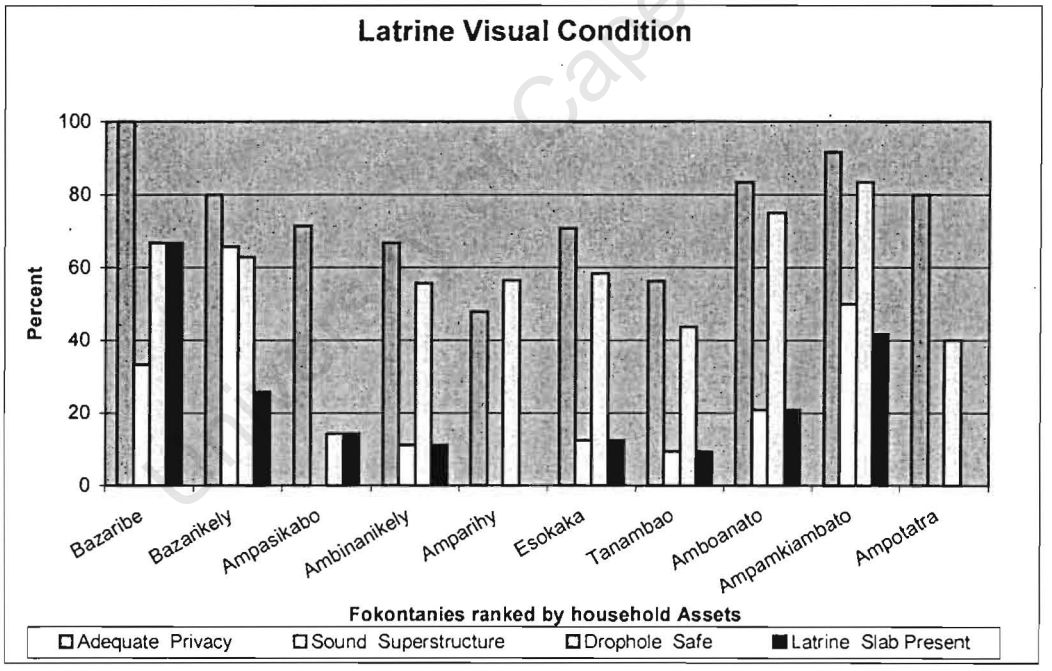
The investigation of the geography of latrines in Fort Dauphin showed that 65% of households owned a latrine. The test also indicates that latrines are most likely to be found in the higher household Assets ranked fokontanies such as Bazaribe, Bazarikely and Ampasikabo. However, the relationship between Fokontany and Latrine has been shown to be at least partly spurious. The population group most likely to own a latrine therefore, is not dependent on which fokontany respondents live in but on the level of household Assets. Those with greater Assets are more likely to own a latrine.

7.2.3 The Observed Condition of Latrines

The physical condition of existing latrines is an important aspect of research question 1 not yet discussed. A poorly built latrine can be more of a hazard to public health than no latrine at all. Improperly managed concentrations of human faeces are a potential health hazard and guaranteed source of faecal oral disease (Hall, 1991; Smet, 1993). Furthermore, improperly constructed latrines will only serve to reinforce the prevalent Malagasy perception that latrines are bad.

The structured observation schedule (see appendix 4) was used to assess the basic condition of latrines in ten of the fokontanies. The few latrines in Ambinagnibe did not warrant an observational survey. The data in Figure 9 illustrates the condition of as many latrines as could be reasonably accessed and observed without causing offence to owners.

Figure 9. Visual indicators regarding the physical condition of latrines across the fokontanies ranked by Assets



Question 5 on the structured observation schedule (appendix 4) was designed to provide information in complimentary pairs. It consisted of four parts and asked the researcher to observe and record the physical condition of latrines. The question concerning adequate privacy was offset by the question concerning soundness of the superstructure, which referres to the condition of the four walls and roof. If the superstructure is not sound then it is argued that adequate privacy is not available. It is interesting to note in Figure 9 that many of the latrines were judged to be adequately

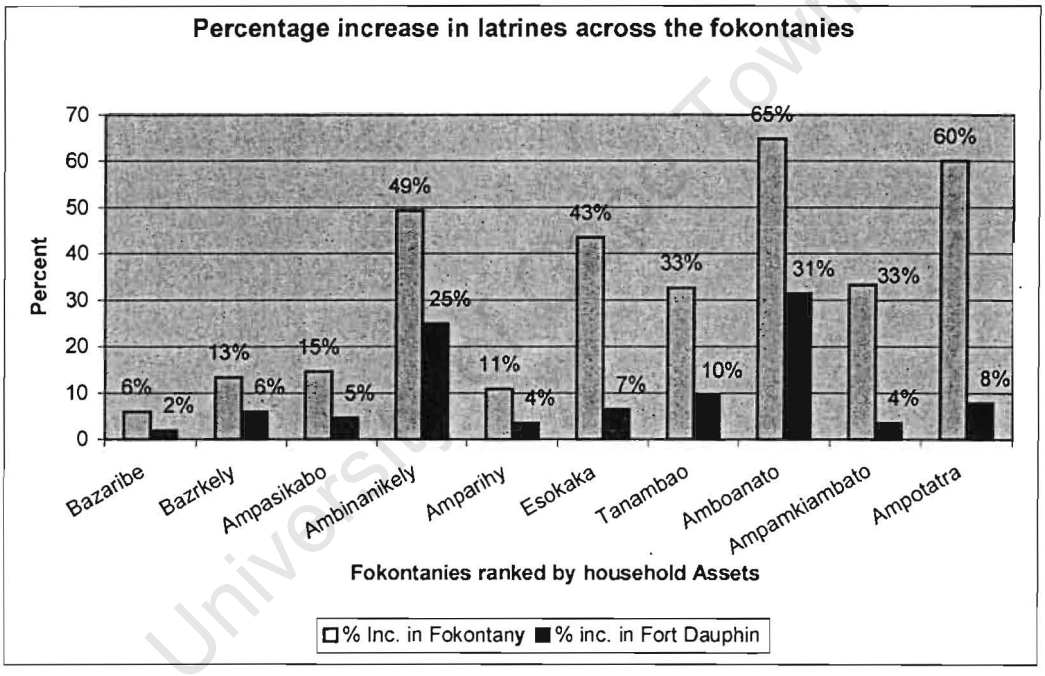
private yet their superstructure was poor to non-existent! Only in Bazarikely where a greater number of residents may be more able to afford quality building materials was the proportion of latrines with a sound superstructure close to those that were deemed adequately private. Observations in Evatraha showed that adequate superstructure and privacy dramatically increased the likelihood that people would use a latrine. Comfort is important. It is argued here that although the field workers regarded privacy to be adequate people's experience of using a latrine and their willingness to continue its use would be improved if the superstructure were more sound and privacy increased.

It appears from Figure 9 that few of the latrines built in Bazaribe, Ampasikabo, Ambinanikely, Amparihy, Esokaka, Tanambao, Amboanato and Ampotatra were well constructed. It is especially important that a latrine pit is adequately protected from the elements by it's superstructure. The presence of water in the latrine pit reduces the rate of faecal decomposition and produces an anerobic environment which increases the production of foul smelling gas (Bester, 2000; Franceys *et al.*, 1992; Mara, 1984; Smet, 1993; Van-Nostrand, 1983a). Water in the latrine pit also increases the rate at which the pit fills, reduces the lifetime of the latrine and increases the risk of flooding, overflow and subsidence.

Flies are highly mobile carriers of excreta related disease and a latrine pit is a safe, warm and nutriotious breeding ground for their larvae. A combination of solid latrine superstructure and a mesh over the top of the latrine vent pipe play an essential role in preventing fly infestations in the pit. If the superstructure is solid enough to keep the inside of the latrine fairly dark flies are attracted to the light at the top of the vent pipe rather than through the drop hole. The mesh over the top of the pipe prevents the flies from escaping the pit and becoming mobile disease carriers. It also prevents flies attracted by the smell of excreta from entering the pit via the vent pipe. The flies trapped at the top of the pipe rarely find their way back into the pit since they are attracted to the light rather than the dark at the bottom of the pipe and eventually die. If the latrine superstructure is not solid, even if there is a mesh over the vent pipe, flies will be guided out of the latrine pit through the drop hole via the light coming through the superstructure walls. An unchecked, fly infested pit latrine is not only a neusance to all living close by, it is a deadly public health risk. For these reasons alone poorly constructed latrines are extremely undesirable, especially in a highly populated urban environment.

The superstructure is a particularly degradable part of a latrine. A quick investigation of the increase in the number of latrines in 2000 before and after the principal construction months of February to May shows the location of the newest latrines in Figure 10. Few have been recently built in Bazaribe, poor superstructure is therefore likely due to old age. However many new latrines were built in 2000 in Ambinanikely, Esokaka, Tanambao, Amboanato, Ampamkiambato and Ampotatra. The majority of latrines in these fokontanies had poor superstructures which indicates rushed or less than ideal workmanship during their construction possibly creating a serious hazard to public health.

Figure 10. Histogram of the percentage increase in latrines both in and across the fokontanies before 2000 and in June 2000



Similarly to superstructure and privacy, drophole safety can be cross-referenced with the presence of a sanitation platform (sanplat). It is the assertion of this thesis that without a sanplat the drophole cannot be considered safe in the long term (Franceys *et al.*, 1992; Van-Nostrand, 1983a; Williams, 1999). Although Figure 9 indicates that many of the latrines were considered to have a safe drophole there appears to be few latrines in Fort Daupin that have been constructed with a sanplat, especially in Ambinanikely, Esokaka, Tanambao, Amboanato, Ampotatra and to a lesser extent Ampamkiambato. Again these are the fokontanies that have experienced the most latrine building activity in 2000 which reinforces the notion that the pace with which

latrines are being built in this resource constrained environment may be causing them to be poorly and possibly dangerously constructed.

The exception in this case is Bazaribe which has more than two thirds of visible latrines built with a concrete sanplat. Bazaribe was a favorite residential area for French colonials and a number of the latrines in the observation survey are more than likely relics of the past.

Overall, the lack of sound superstructure or proper sanitation platforms in many recently but speedily and poorly constructed latrines lends further credence to the idea that there is a need for improved sanitation in Fort Dauphin. Many of these latrines are likely to be a hazard to public health and provide poor working examples of the benefit and convenience of improved sanitation.

7.3 Patterns of latrine use

7.3.1 Latrine sharing in Fort Dauphin

One aspect of Steve Williams' (1999) discussion and additional participant observation in Evatraha concerned peoples' preference for not sharing latrines amongst large groups. To assess the possibility that public latrines might be a viable part of a sanitation intervention in Fort Dauphin, research question 2.1 asks 'do latrine owners share their facility with others, if so, how many people regularly use the latrine and who are they?' The number and identity of people using a latrine was informed by the known number of male and female adults and children cited by the respondent as using the latrine on the day before the interview.

Table 11. Frequency distribution of the categorised number of individuals regularly sharing a single latrine [9]

Category #	Categorised # of Individuals	Count	Percent
1	1-3 INDS	1016	11
2	4-6 INDS	2147	24
3	7-9 INDS	2192	24
4	10-12INDS	1570	17
5	13-15INDS	648	7
6	16-18INDS	415	5
7	19-21INDS	278	3
8	22-24INDS	28	0
9	25-27INDS	42	0
10	28-30INDS	13	0
11	31-33INDS	41	0
	Missing	677	7
	Total	9067	100

Table 12. Descriptive statistics of INDS_CAT showing median, quartile range and skewness[10]

Variable	Valid N	Median	Quartile Range	Skewness
Categorised Number of Individuals Using a Family Latrine	8390	3	2	1.204959

The data in Table 11 is shown in Table 12 to be positively skewed indicating that the majority of the survey sample has indicated their family latrine is used by fewer

[9]Although categories 8 to 11 do not actually represent 0% of the frequency distribution the results have been presented in a standard format throughout, where all percentages are rounded to the nearest whole number.

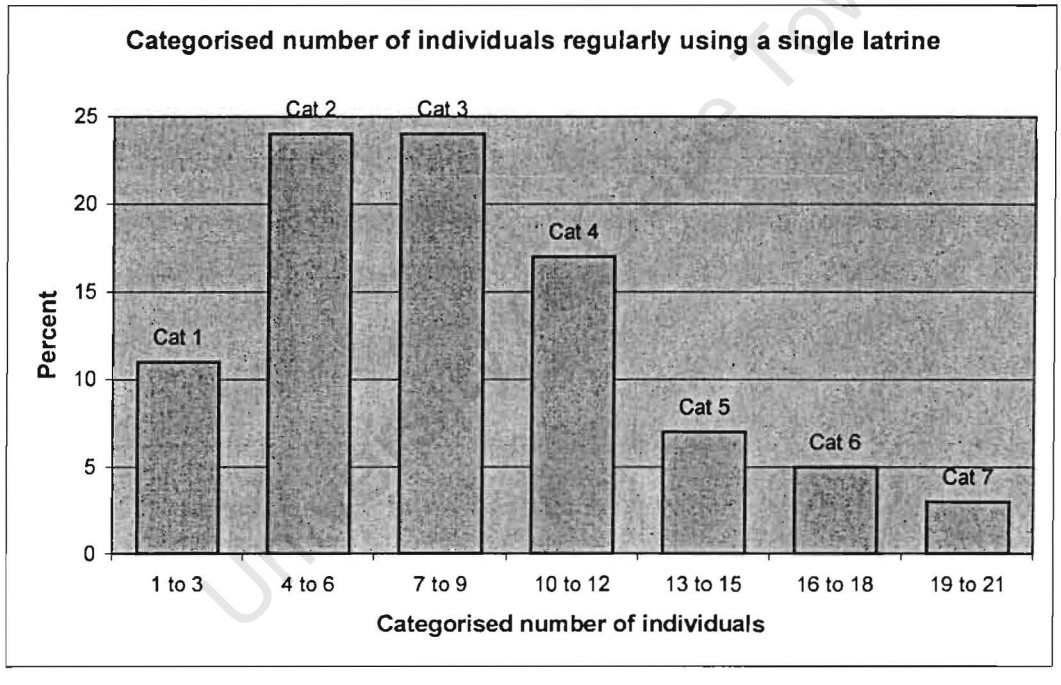
[10] There is much debate as to whether categorised ratio scale data such as respondent's age or the number of respondents using a latrine is demoted to interval or ordinal level data. This topic is discussed briefly by two authors who provide us with opposing views as to the outcome of categorising ratio data. Wegner (2000) regards the outcome of categorising ratio scale data as a demotion to ordinal scale in that, "there is an applied ranking between response categories. Each category possesses either more or less of a given characteristic. The implied ranking between consecutive categories could apply to, for example, increasing or decreasing age".

De Vaus (1993) on the other hand sites that, "an interval/ratio variable is one in which the categories have a natural ranking and it is possible to quantify precisely the differences between the categories". By this logic the number of individuals is an interval level variable because as well as ranking according to numeric order, the precise difference between the categories can be quantified.

people.[11] Removing all the outlying categories above 5 in order to produce a more normal distribution does not remove the statistical significance of the skewness.

Table 12 shows that the central location of the data in Table 11 is within category 3 (also see Figure 11). The measure of the spread of data in Table 12 shows 50% of valid responses fall within a range beginning in category 2 and ending in category 4. The median and quartile range limits however, give no indication of their position within interval categories. Table 11 indicates that slightly more than a third of valid responses have no more than 6 individuals using the same latrine and almost two thirds share with no more than 8 other individuals. These figures are indicative of a willingness to share a latrine, but with whom?

Figure 11. Histogram of the categorised number of individuals regularly using a single latrine



Williams (1999) noted that the sharing preference amongst respondents was reserved to close family members. Many families in Fort Dauphin live in small fenced compounds of two or three houses and up to three generations of family. Families live

[11] If the value of Pearson's skewness coefficient is greater than ±1 then significant skewness occurs in the data. The mean and standard deviation are valid only when the frequency distribution is essentially symmetrical. When the frequency distribution data are skewed, then the quartile deviation (QD = quartile range/2=1) is the appropriate measure of spread to quote, alongside the median (Wegner, 2000)

in close proximity to upwards of 10 immediate members. In this context, it possibly becomes more important to examine whom latrines are most often shared between rather than how many people use them. Since approximately 75% of respondents say that they share a latrine with no more than 11 other individuals it may be that the majority of people are only willing to share a latrine with other members of their immediate kin.

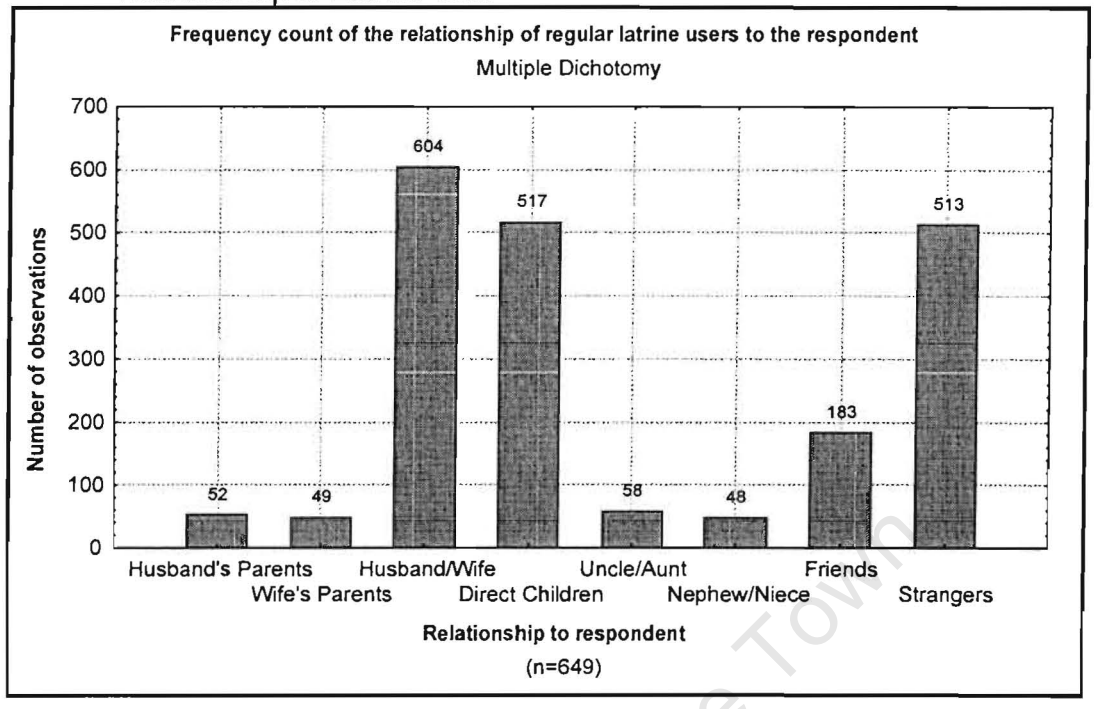
The data does not provide information concerning the total sample population's relationship to those people with whom they would be willing to share a latrine. The questionnaire was designed in such a way that only latrine owning families were asked for a response to this question, (see appendix 2, question 6). Table 13 summarises the relationship between latrine owning respondent and the other people with whom they regularly share the same latrine. Proportions are based on the total number of latrine owners.

Table 13 shows that 30% of all the positive responses and 97% of respondents indicated that they shared a latrine with their husband/wife. 26% of responses and 83% of respondents say that they regularly share with direct children. Table 13 and Figure 12 certainly add credence to the notion that the most common latrine sharing is between family members and that gender is not an issue with regard to latrine sharing. However, a further 25% of positive responses and 82% of respondents indicate that they are willing to share a latrine with strangers.

Table 13. Frequency and percentage distribution of latrine co-users relationship to the respondent

Relationship to Respondent	Count	% of Responses	% of Respondents
Husband's Parents	52	3	8
Wife's Parents	49	2	8
Husband/Wife	604	30	97
Direct Children	517	26	83
Uncle/Aunt	58	3	9
Nephew/Niece	48	2	8
Friends	183	9	29
Strangers	513	25	82
Total	2024	100	

Figure 12. Bar graph of the frequency count of multiple response variable – Relationship to Latrine User



In answer to research question 2.1, latrine owners appear willing to share their facilities with others and appear to be non-gender discriminatory. Two thirds of respondents were willing to share a latrine with up to 8 other users, the majority of whom were family members. However, the latrine sharing data presented here is inconclusive with regard to indications that public latrines might be a successful initiative unless however, people's willingness to share with both immediate family and with strangers is a true reflection of their attitude.

7.3.2 Latrine owners use of defecation sites

Research question 2.2 asks if latrines are the exclusive form of excreta management amongst owners or do these owners continue to contribute to the pool of open defecation practitioners? Questions 7, 8 and 9 of the household questionnaire were designed to assess whether owning a latrine at home predisposes latrine owners to not defecate elsewhere.

Table 14. Summary of the distribution of latrine owners defecation habits away from home

Latrine Owners	Q7: Defecate away from home?			Q8: Use family latrine?			Q9: Use friend's latrine?		
	No	Yes	Missing	No	Yes	Missing	No	Yes	Missing
Count	1910	7115	0	5367	3658	3	5894	3131	3
Percent	21	79	0	59	41	0	65	35	0

Table 15. Cross-referenced frequency response from Q7, Q8 & Q9 in Table 14

Response Combination	Count		Percent
Defecate away from home - **yes**, Use a family latrine - **no**, use a friend's latrine - **no**	3139		45
Defecate away from home - **yes**, Use a family latrine - **yes**, use a friend's latrine - **yes**	2385	3976	33
Defecate away from home - **yes**, Use a family latrine - **yes**, use a friend's latrine - **no**	943		13
Defecate away from home - **yes**, Use a family latrine - **no**, use a friend's latrine - **yes**	648		9
Column Totals	7115		100

Table 14 Q7 shows that of the respondents who own a latrine ≈80% of them still defecate elsewhere. In Table 15, 45% of the latrine owners who still defecate away from home are shown not use either family or friend's latrines. The data suggests that almost half of Fort Dauphin's current latrine owners still use open defecation in addition to their facilities at home.

It may be that these latrine owners do not have access to a latrine other than their own. However, ≈65% of household representatives said they owned a latrine, which casts doubt on the idea that none of the 45% of latrine owners who defecate elsewhere have neither family nor friends whose latrine they might use. It should also be pointed out that there is no evidence here to suggest that the inferred 3976 latrine owners who say they use family and/or friend's latrines when they are away from home do so exclusively. It may be that these latrine owners also contribute to the pool of open defecation practitioners.

Considering the discussion in 7.2.3 regarding the observed condition of latrines, it is possible that the continued use of defecation sites is motivated by poor quality facilities at home. If further research were to prove this true, the notion that improved sanitation is a necessity in Fort Dauphin would only be strengthened. These findings also have implications for public latrines. If a large proportion of latrine owners are more keen to use a defecation site than family or friend's latrines how enthusiastic might these same individuals be about using public latrines? Possibly a question for further research. It is however, encouraging for sanitation proponents that 55% of the current latrine owning population said they were willing to use latrines other than their own.

It is a limitation of this research that questions regarding the quality and availability of sanitation facilities and sanitary habits of people at work were not addressed? Hygiene practices and provision of daytime sanitation facilities at work are a vital aspect of lifestyle that any intervention aiming to reduce the incidence of sanitary related illness in Fort Dauphin must address.

7.4 Other sources of faecal-oral disease

7.4.1 Disposing of children's faeces

Children's faeces is more harmful than adult faeces from the point of view of faecal-oral disease risk since children are more likely than adults to be disease carriers, (Esrey, 1996; Sanders, 1985). On that bases research question 3.1 asks what methods adults use to dispose of their children's faeces. Questionnaire respondents were asked how they help their children to defecate and as a part of that question, what do they do with the faeces? The picture card in appendix 3 - figure 1 was used by the field workers to note a three digit code corresponding to respondent's principal method of assisting their child to defecate. The capital letter at the beginning of the code corresponds with the left hand column options of figure 1 – appendix 3, the small letter with the middle column options and the number with the right hand column options. There were 33 defecation codes specified by respondents, the confidence interval of the frequency distribution was ≈3.1. All defecation codes that represented more than 3.1% of the sample were included in Table 16.

A number of parents indicated that they had more than one child. In these cases defecation codes were recorded for each child. The analysis of defecation practices among children is therefore child centred. Table 16 represents the frequency distribution for 88% of the children helped by parents. The defecation codes of the remaining 12% all represented less than 3.1% of the sample set and as such were below the confidence interval threshold. The table shows children in families who both do and do not own a latrine. A '1' in the defecation code indicates that families dispose of faeces in a latrine, '2' indicates disposal on a rubbish heap, and '3' disposal in a hole. Although disposal of children's faeces on rubbish heaps is a practice that was detected it is not common enough to be included in Table 16. The distribution in the table shows that children living in families with a latrine most often have their faeces disposed of in a latrine and children in families without a latrine most often have their faeces buried. The most popular overall method used to dispose of children's faeces is for a parent to help their child squat and defecate on the ground, pick the faeces up with a shovel, put in a hole and bury it (Bd3)[12].

[12] For a full pictorial explanation of all the defecation codes used in Table 16 refer to figure 1 – appendix 3.

Table 16. Frequency distribution of how parents help their children to defecate

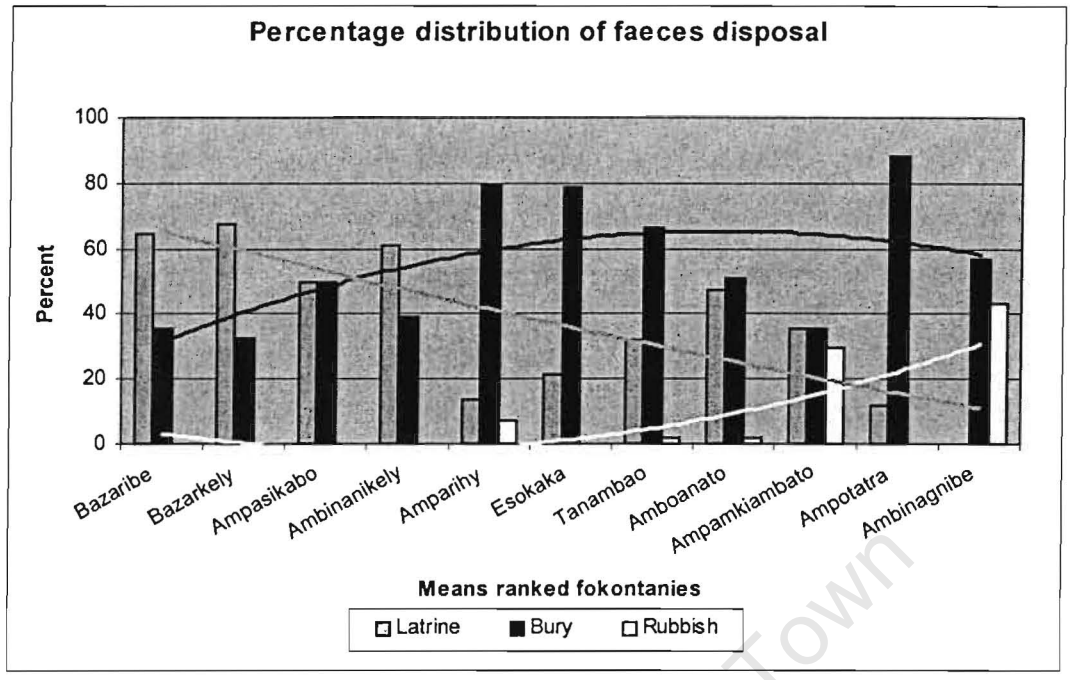
Disposal method	Defecation Code	Latrine - No		Latrine - Yes		% of *n*	Row Totals	Row %
		Count	Percent	Count	Percent			
Dispose of faeces in a latrine	Help child squat, pick faeces up with a shovel (Ad1)	0	0	378	100	5	378	100
	Help child squat, pick faeces up with a shovel (Bd1)	14	3	489	97	7	503	100
	Help child squat over potty, potty used to pick up faeces (Ce1)	0	0	750	100	10	750	100
	Child helped squat in a latrine (D1)	43	6	731	94	10	774	100
Bury faeces	Help child squat, pick faeces up with a shovel (Ad3)	598	63	357	37	13	955	100
	Help child squat directly over a hole (B3)	226	50	224	50	6	450	100
	Help child squat, pick faeces up with a shovel (Bd3)	1414	61	895	39	31	2309	100
	Help child squat over potty, potty used to pick up faeces (Ce3)	329	86	54	14	5	383	100
	Column Totals	2624		3878		87	6502	100

An analysis of the complete data set of children's defecation codes shows that 38% of children in latrine owning families have their faeces buried and 62% have their faeces disposed of in a latrine. Conversely, 84% of children in families without a latrine have their faeces buried. A further 14% have their faeces disposed of on a rubbish heap and only 2% in a latrine.

Faecal disposal practices do represent an alternative source of faecal-oral disease. Disposal methods among families who own a latrine are not ideal but represent less of a threat to public health than practices among non-latrine owning families. An increase in the number of latrines in Fort Dauphin would therefore be likely to ease the threat to public health presented by the unhygienic disposal of children's faeces.

It is interesting to note that of the ≈14% of non-latrine owning respondents who dispose of their children's faeces on rubbish heaps the majority live in the lower Assets ranked fokontanies. Conversely, in the four top Assets ranked fokontanies the most popular method of faeces disposal is in a latrine (see Figure 13). The author is not suggesting a causal link between household assets and how parents dispose of their children's faeces. There is currently no evidence available to ascertain the cause of this phenomenon and further research is required.

Figure 13. The change in child faecal disposal methods across the fokontanies



Regarding latrine owners alone, it is very interesting to note that of the 38% of latrine owners who bury their children's faeces, Table 17 shows that 95% of them are men – 2901 of 3043 cases. Men overwhelmingly prefer to bury their children's faeces! Table 17 also shows that the trend continues amongst those without a latrine, again ≈95% of respondents who bury a child's faeces are men.

Table 17. Frequency distribution of the gender split amongst people who bury their children's faeces[13]

Males and Females				Males Only			
Defecation Code	Latrine		Row Totals	Defecation Code	Latrine		Row Totals
	Yes	No			Yes	No	
Ad3	341	540	881	Ad3	341	540	881
B3	57	142	199	B3	14	43	57
Bd3	626	924	1550	Bd3	626	924	1550
Ce3	171	242	413	Ce3	171	242	413
Totals	1195	1848	3043	Totals	1152	1749	2901

These findings beg the question – what of the gender preference amongst respondents who dispose of their child's faeces in a latrine?

[13] For a full pictorial explanation of all the defecation codes used in Table 17 and Table 18 refer to figure 1 – appendix 3.

Table 18. Frequency distribution of the gender split amongst people who dispose of their children's faeces in a latrine[14]

Males and females				Males Only			
Defecation Code	Latrine		Row Totals	Defecation Code	Latrine		Row Totals
	Yes	No			Yes	No	
Ad1	313		313	Ad1	14		14
D1	384		384	D1	28		28
Ce1	683		683	Ce1	156		156
Bd1	412	14	426	Bd1	57		57
Total	1792	14	1806	Total	256	0	256

Table 18 shows that of the 1792 cases of faecal disposal in a latrine, women are responsible for 85% of them. The evidence in Table 17 & Table 18 certainly suggests a distinct gender dependent difference in the manner in which parent's choose to dispose of their children's faeces. Men favour burial and women prefer disposal in a latrine. Why this should be so is inexplicable in the light of the data available and is therefore an issue for further research that is likely to have important consequences for future sanitation interventions in Fort Dauphin, especially with regard to hygiene education.

7.4.2 Children's hand-washing practices

As a second aspect of research question 3.1 respondents were asked about their children's hand-washing practices. It is assumed here that a parent's view of their children's behaviour in this regard is at least a reflection of the parent's hand-washing practices or what parent's believe their hand-washing practices should be. This discussion therefore also provides an idea as to the level of parent's basic hygiene knowledge.

The data in Table 19 indicates that more than half the children in families with and families without a latrine wash their hands after defecating. In families with a latrine the prevalence of hand-washing amongst children is much higher than in non-latrine owning families. The reason for this is a topic for further research.

Table 19. Hand-washing practices in families with and without a latrine

	Latrine - No		Latrine - Yes	
	Count	Percent	Count	Percent
No	1948	39	1536	17
Yes	2730	55	7394	80
Missing	284	6	298	3
Total	4962	100	9228	100

Table 20 shows the distribution of where families with and without a latrine keep their hand-washing water. Families who own a latrine prefer to keep their hand-washing facilities inside the latrine building whereas those without a latrine prefer to keep their hand-washing facilities outside their home. Lewis *et al.* (1997) found that water contamination was worse when the water source was outside the home. Water storage methods therefore, can also be an alternative source of faecal-oral disease that a hygiene education programme should discuss.

Table 20. Q16a,b, Q30a,b: Where is the hand-washing facility?

Multiple choice response	Latrine - No		Latrine - Yes	
	Count	%	Count	%
Hand-washing facility inside the House/Latrine?	910	33	4678	63
Hand-washing facility outside the House/Latrine?	1777	65	1976	27
Missing data	43	2	739	10
Totals	2730	100	7393	100

Questions 17 and 31 in Table 21 refer to how respondents use their water container to wash their hands. Figure 2 in appendix 3 clarifies the focus of these two questions. It is important when washing hands that one does not use contaminated water or contaminate the water for other users. Results regarding the hand-washing method amongst both latrine and non-latrine owners are positive in that the majority of respondents say their children wash their hands outside the water container thereby avoiding contamination of themselves or others. The way people use hand-washing water does not appear to be an alternative source of faecal-oral disease.

Table 21. Q17, Q31: How do the children wash their hands?

Multiple choice response	Latrine - No		Latrine - Yes	
	Count	%	Count	%
Wash hands inside the bucket?	213	8	753	10
Wash hands outside the bucket?	2460	90	6385	87
Missing data	57	2	255	3
Totals	2730	100	7393	100

Furthermore, the use of soap is quite common among latrine-owning families. This may be due to the link between assets and latrine ownership in that households that have a latrine are more likely to be able to afford the soap.

Table 22. Q18, Q32: Do the children use soap to wash their hands?

Multiple choice response	Latrine - Yes		Description	
	Count	%	Count	%
Yes	5348	59	1368	28
No	3719	41	3566	72
Totals	9067	100	4934	100

Questions 19 and 33 in Table 23 indicate behaviour regarding other uses for the hand-washing water. Field workers used Figure 3 in appendix 3 to ensure consistency in respondent's answers. Since the vast majority of respondents prefer to wash their hands outside the bucket there is little else that can be done with the contaminated water after it has been used. More than 90% of families who own and do not own a latrine reported that hand-washing water was reserved for that one purpose only.

Table 23. Q19, Q33: Does the hand-washing water have other uses?

Multiple choice response	Latrine - No			Latrine - Yes		
	Count	% Responses	% Respondents	Count	% Responses	% Respondents
A: Hand-washing water has no other use?	16	1	1	86	1	1
B: Water used for hand-wash at other times?	2322	92	92	6294	90	94
C: Hand-washing water used on flowerbeds?	181	6	6	421	6	6
D: Hand-washing water use to wash Veg?	0	0	0	0	0	0
E: Hand-washing water used to wash dishes etc?	0	0	0	0	0	0
F: Other	15	1	1	179	3	3
Totals	2534	100		6980	100	

Table 19 shows that ≈80% of latrine owning families say their children wash their hands after defecating but Table 24 shows that only 9% of those families had hand-washing facilities that were actually ready to use at the time of the interview. The information provided by parents regarding their children's hand-washing habits may simply have been a reflection of what parent's believe their children's hand-washing habits should be. Many studies have shown the positive relationship between access to water supply and level of personal and domestic hygiene. Esrey *et al* (1991) report that from 15 studies reviewed, the health benefits were greater for children in families who used more water than in families who used less. The result in Table 24 may reflect the true hygiene behaviour of families with poor access to water supply in that although a hygiene facility is often available there is not enough water for it to be effective. The number of ready to use facilities was a little better amongst families

who do not own a latrine (≈16%) but are still far short of ideal. Better access to clean water supply and a hygiene education programme may to improve this circumstance.

Table 24. Q16c, Q30c: Can the hand-washing facility be used now?

	Latrine - No		Latrine - Yes	
	Count	%	Count	%
Yes	774	16	800	9
No	4160	84	8267	91
Totals	4934	100	9067	100

Although many parents gave positive signs that there were good hand-washing practices in their household the lack of ready to use hand-washing facilities suggests that current hygiene practice is a potential source of faecal-oral disease. Any hygiene education programme should include best practice water storage and hand-washing in its curriculum.

7.4.3 Anal cleansing

Lewis *et al.* (1997) report that a study in Thailand indicated a number of factors including what village a person is from impacts on the incidence of disease and that the level of disease incidence could be seen as a proxy for the level of neighbourhood contamination among other causes. Using this as a basis, research question 3.2 posed the question – are the commonly used anal cleansing materials likely to increase the infectious disease burden as a source of faecal-oral disease? It certainly makes good common sense that discarded used anal cleansing materials are a source of contamination other than faeces itself. The survey questionnaire incorporated a section designed to gather data regarding the variety of anal cleansing methods people commonly use. Figure 4 in appendix 3 was used to illustrate the focus of the question and to bring an element of humour to such a personal topic. It was hypothesised that the wider the range of materials and methods the greater the potential for environmental contamination. However, the research is limited in that no information was gathered regarding disposal of these materials.

Table 25 shows a greater variation in the anal cleansing materials used by residents who do not own a latrine than by those who do. However all respondents (85% of non-latrine owners and 99% of latrine owners) overwhelmingly favour the use of paper. It is interesting to note that almost a third of the non-latrine owning respondents regularly use stones or leaves as opposed to almost none of the latrine owning respondents. That non-latrine owners use a wider variety of anal cleansing

materials than latrine owners do suggests that these materials are an additional source of excreta related disease that could potentially be curbed with improved sanitation. Further research is needed concerning how these materials are disposed of, as there may be other options for reducing their role as environmental contaminants.

Table 25. Q20, Q34: What is the respondent's preferred anal cleansing method?

Multiple choice response	Latrine – No			Latrine - Yes		
	Count	% Responses	% Respondents	Count	% Responses	% Respondents
Paper	3982	53	85	9115	85	99
Corn Cob	327	4	7	0	0	0
Stick	15	0	0	14	0	0
Stone	1123	15	24	57	1	1
Leaves	1066	14	23	43	0	0
Grass	14	0	0	0	0	0
Heel	370	5	8	1109	10	12
Other	554	7	12	384	4	4
Total responses	7451	100		10722	100	

7.5 Resident's views on improving sanitation in their fokontany

Questions 35 to 41 of the household questionnaire are regarding resident's opinions of the appropriate methods and likely consequences of improving sanitary conditions in their fokontany. The closed ended multiple choice answers were based on almost a year of participant observation in Evatraha village, a focus group and conversations with the fokontany presidents. Field workers were aware of the importance of allowing respondents the right to exercise their choice of using an open-ended answer to any questions they wished. Less than 10% and as few as 2% of respondents chose to give an open-ended answer to any of the multiple-choice questions.

7.5.1 Improving sanitary conditions

Research question 4.1 asked what form of intervention residents felt was most likely to improve sanitary conditions in their fokontany? Table 26 shows that an overwhelming 85% of people across the 11 fokontanies agreed that latrines were an appropriate solution. The result indicates that not only is improved sanitation necessary in Fort Dauphin but that it is an acceptable option according to residents. Almost half of the respondents also agreed that hygiene education would be appropriate and a third agreed that cleaning committees were a good idea.

Table 26. Q35: What would the respondent do to improve sanitary conditions in their fokontany?

Multiple choice response	Count	% of Responses	% of Respondents
A: Hygiene education	6273	26	43
B: Cleaning committee	4314	18	30
C: Latrine building	12375	51	85
D: Other	1203	5	8
Total responses	24165	100	

7.5.2 Resident's perception of the benefits and inconveniences caused by latrine building in their fokontany

When asked what benefit or inconvenience latrines would bring to the fokontany (research question 4.2) residents had both positive and negative opinions that are summarised in Table 27. Almost 70% of people said that latrines would reduce the risk of disease and almost 60% thought that latrines would improve public health, both opinions of course, are correct. A further 42% said that latrines would be more convenient to use at night and more than a third said that they would reduce open defecation. All are further positive signs that a sanitation intervention would be well received. It is interesting to note however, that more respondents did not think latrines would reduce open defecation, especially considering the results in section 7.3.2 where 45% of latrine owners appear to still defecate without using a latrine. The impact of improved sanitation on the prevalence of faecal-oral disease would be reduced if environmental contamination levels remained high through the continued use open defecation.

Approximately 65% of respondents said they thought the presence of latrines would increase bad smells in their fokontany. This is of great concern to a prospective latrine-building project considering the beliefs regarding *boty* and *fofona* discussed in section 5.3.1. Experiences in Evatraha showed that there are few more effective ways to counter such belief than to practically demonstrate its falsehood by building, using and maintaining a working latrine.

Slightly more than 50% of respondents indicated their concern for the possibility of latrines subsiding in Fort Dauphin's sandy soil. This is a very real risk when any superstructure built on sand relies on a deep liquid filled pit as its foundation. Due to the risk of subsidence the use of ventilated improved pit latrines should be carefully assessed in some parts of Fort Dauphin.

Table 27. Q36: What benefits or inconveniences would latrines bring to the respondent's fokontany?

Multiple choice response	Count	% of Responses	% of Respondents
A: Reduce open defecation	5236	11	36
B: More convenient at night	6146	12	42
C: Reduce disease risk	10107	20	69
D: Increase disease risk	1699	3	12
E: Improve public health	8674	17	59
F: Increase bad smells	9557	19	65
G: Risk of subsidence	7403	15	51
H: Don't know	565	1	4
I: Other	360	1	2
Total responses	49747	100	

When the same respondents were asked what other problems they thought latrine building would bring the overwhelming response (almost 85% in Table 28) was that it would cause fighting amongst neighbours. Observations in Evatraha village bear out this finding where the bulk of the controversy among neighbours revolved around how close latrines should be built to the owner's house. Some of the first people to build a latrine in Evatraha wanted them in their family compounds next to their houses. This approach met with considerable opposition that resulted in a long delay in the progress of the project. Also note that bad smells features again but less so than previously. As a final point it is encouraging to note that as few as 5% of respondents thought latrines might increase the incidence of disease.

Table 28. Q41: What problems might latrine building cause?

Multiple choice response	Count	% of Responses	% of Respondents
A: Fights between neighbours	12184	52	84
B: Bad smells	5634	24	39
C: Fly problems	1597	7	11
D: Pollution in the fokontany	1827	8	13
E: Increased disease	743	3	5
F: Other	1440	6	10
Total responses	23425	100	

7.5.3 Neighbours and latrines

In relation to research question 4.3 respondents were asked how they would feel if their neighbour built a latrine? In contrast to Table 28, Table 29 shows that the overwhelming majority said they would be pleased. It can only be interpreted that residents would not, in principal, fight their neighbour over building a latrine unless there was disagreement over its position. Respondents also indicated that not wish to

use their neighbours latrine (see Table 31). Neither would their neighbour be likely to let them share their latrine (see Table 30).

Patterns in prospective latrine sharing indicated in Table 30 and Table 31 are in accordance with previous findings regarding latrine-sharing preferences. However, as discussed previously the findings do not bode well for the future of public latrines. However, that so many of the respondents would be pleased in principal to see their neighbour building a latrine is a positive sign for improving sanitation in Fort Dauphin. Most residents already appear to accept the idea of using latrines even if they do not own one.

Table 29. Q37: How would the respondent feel if their neighbour built a latrine?

	Count	Percent
A: Pleased	12359	88
B: Displeased	610	4
C: Indifferent	318	2
Missing	714	6
Total	14001	100

Table 30. Q38: Does the respondent think their neighbour would share their latrine?

	Count	Percent
No	11061	79
Yes	2830	20
Missing	110	1
Total	14001	100

Table 31. Q39: Would the respondent want to share their neighbour's latrine?

	Count	Percent
No	12370	88
Yes	1337	10
Missing	294	2
Total	14001	100

7.5.4 Where to build latrines

Finally, as an indicator of resident's immediate awareness regarding the likely problems building a latrine too close to a neighbour's residence might cause the field workers asked respondents if they would prefer to build a latrine inside or outside their family compound? Respondents in Fort Dauphin voiced the same preference that caused so much consternation in Evatraha. They overwhelmingly agreed in Table 32 that it was preferable to build inside their compounds.

Table 32. Q40: Where would respondents prefer to build their latrine?

	Count	Percent
Inside the Family Compound	11891	85
Outside the Family Compound	1591	11
Missing	519	4
Total	14001	100

The agreement that allowed the project to proceed in Evatraha was to build latrines on existing defecation sites but as close to people's homes as possible. This solution is not appropriate for Fort Dauphin where the urban nature of the environment vastly increases the likelihood of the theft or vandalism of latrine materials if they are not secure. Furthermore, ownership of the defecation sites in Evatraha was clear, in Fort Dauphin the situation regarding land ownership is likely to be much less straightforward. The placement of latrines in or around small family compounds will be one of the key issues that must be resolved before a successful sanitation intervention can begin in Fort Dauphin.

8 Conclusion

Due to both historical and current national and international politico-economic circumstances poverty and inequality are rife in south-eastern Madagascar. There has been long-term exploitation of both the people and resources exacerbated by the introduction of neo-liberal macro-economic policies promulgated by international money lenders in the form of structural adjustment programmes. SAP's were responsible for the destabilisation of Madagascar's food supply, especially in the South and provided an opportunity for the wealthy elite to consolidate their power base. Fiscal austerity, as part of structural adjustment policy also led to the degradation of Madagascar's primary health care services. Drug supply, the provision and quality of healthcare equipment and cash incentives for healthcare professionals were all discontinued.

Water supply and sanitation as one of the cornerstones of preventative health care are known to be controlling factors in preventing communicable disease outbreaks of bacterial and protozoic illnesses, and helminthic infections. Diarrhoea is currently the most significant global public health problem affected by water and sanitation and the second most common cause of illness in Southern Madagascar. Sanitation facilities interrupt the transmission of many faecal–oral diseases at their source. From epidemiological evidence Esray (1996) suggests that sanitation "appears overwhelmingly to confer broader and larger benefits to health than improved water supply". He further concludes that benefits from sanitation are larger in urban areas than rural and that benefits from improved water supply were only found when optimal water services and improved sanitation were present.

Anosy's one water treatment plant currently meets the needs of only ≈6,000 people. Sanitation provision is even more scarce, where approximately 97% of the population of Southern Madagascar practice open defecation. In Fort Dauphin alone it is estimated that 6000 people daily use the beaches for latrines.

A mapping strategy was used to assess the current defecation geography of Fort Dauphin (shown in appendix 1). The maps showed that people do not only use the beaches to defecate. There are a large number of defecation sites inside the residential areas of town. The map reveals that a number of the defecation sites are close to a variety of public gathering places such as schools, clinics, the Philbert Tsiranana

Hospital and communal fresh water stand pipes. Children, clinic patients and hospital patients are three groups of people whose immune systems are likely to be weaker than that of a healthy adult. The risk of these people contracting a number of infectious diseases not confined solely to faecal-oral diseases is extremely high. Furthermore, Genthe *et al.* (1996) reported water collected at communal stand pipes and transported for storage in the home was significantly more contaminated at the point of use than at the source. In addition Lewis *et al.* (1997) established a connection between diarrhoea incidence and the level of environmental contamination. In light of this, the type of water provision in Fort Dauphin coupled with open defecation practices are highly likely to be one of the primary causal factors in increasing the incidence of illness and death from sanitary related diseases for the whole population of Fort Dauphin, but especially amongst infants and children.

The fact that there are so many defecation sites in Fort Dauphin is justification enough for a well researched, planned and implemented improved sanitation initiative. That a number of the defecation sites are close to schools, medical facilities and communal water supplies simply calls for more urgent action.

In order to provide evidence to inform a meaningful sanitation intervention a household questionnaire survey was conducted to assess Fort Dauphin's current sanitation infrastructure. The results of the survey indicated that 65% of households across the 11 fokontanies own a latrine. However, the distribution, condition and likely benefit to health from those latrines is highly variable. In order to establish the geography of existing latrines the 11 fokontanies were ranked according to household assets and the proportion of latrine owning residents in each fokontany represented in a histogram in Figure 8. The graph clearly shows the relationship between assets and latrine ownership, *i.e.* households with fewer assets are less likely to own a latrine.

When ranked by Assets Bazaribe, Bazarikely and Ampasikabo are the wealthiest fokontanies and Ampamkiambato, Ampotatra and Ambinagnibe the poorest. Therefore residents of Bazaribe, Bazarikely and Ampasikabo are the most likely to own a latrine and residents of Ampamkiambato, Ampotatra and Ambinanibe the least likely (see chapter 7.2). An assessment of the age of latrines revealed a dramatic increase in their number across all of the fokontanies in 2000 except for Bazaribe, Bazarikely, Ampasikabo and Amparihy. A structured observation of the condition of latrines across the fokontanies indicated that few of them were in good condition. For

the most part latrines appear to have been built quickly and poorly and as such may be more of a hazard to public health than if there were no latrines at all.

In order to determine if the latrines currently in use are effective in preventing people from continuing to use open defecation practices latrine owners were asked if they defecate away from home and whether they use friends or family's latrines. Almost 80% said that they did still defecate away from home and 45% said they did not use another's latrine. This suggests that almost half of the current latrine owners are still contributing to the pool of open defecation users but that latrines have begun to reduce their number. Based on this evidence, a well designed and executed improved sanitation intervention is likely to considerably reduce the number of people using open defecation. That many latrines are currently in such poor condition may contribute to latrine owners continued motivation to use open defecation when away from home.

Understanding latrine sharing preferences was an aspect of the survey designed to assess the viability of public latrines. The findings were inconclusive but erred on the side of caution with regard to the appropriateness of public latrines. Evidence concurred with that of Williams (1999) in that residents would share a latrine with up to 10 other people but preferred that co-users be immediate family members. There was also evidence that latrine owners would share with strangers but the reason for this requires further research and corroboration. Findings from other aspects of the survey indicated that respondents would overwhelmingly preferred not to share a latrine with their neighbour. Neither did they think their neighbour would be willing to share their own latrine.

Children's faeces are a more potent source of faecal-oral disease than adult faeces. In recognition of this, parents were asked how they disposed of their children's faeces. Three disposal methods were cited – in a latrine, burial or on a rubbish heap. Results indicated that the preferred disposal method is associated with household latrine ownership. In the high asset ranked fokontanies where latrine ownership is more likely parents more often disposed of their children's faeces in a latrine or buried it. The choice between these two disposal methods appeared to depend largely upon gender. Men preferred to bury their children's faeces and women to dispose of it in a latrine. As latrine ownership became less likely in a fokontany so did the practice of disposing of children's faeces in a latrine. Burial became the more commonly used

option in the mid Assests ranked fokontanies and disposal on a rubbish heap in the lowest ranked fokontanies. The evidence suggests that owning a latrine promotes the safest form of disposing of children's faeces and adds credence to the already well justified notion that an improved sanitation intervention would greatly reduce the burden of infectious disease on the population of Fort Dauphin.

As pointed out by a number of authors, hand-washing is an essential element of hygiene education and that for improved sanitation to be effective good hygiene behaviour must be practiced. Okun (1988) reported that the act of washing ones hands with soap and water can reduce the incidence of diarrhoeal disease by up to one third. Parents indicated that regardless of latrine ownership more than half said their children washed their hands after defecating. A third more families with a latrine said their children used soap to wash their hands than families without a latrine. The overwhelming majority of respondents reported that they did not use the hand-washing water for other purposes. However, when asked to see the hand-washing facility only ≈16% of households without a latrine and only ≈9% of households with a latrine had a hand-washing facility that was ready to use. Although many parents gave positive signs that there were good hand-washing practices in their household the lack of ready to use hand-washing facilities suggests that current hygiene practice is a potential source of faecal-oral disease. Any hygiene education programme should include best practice water storage and hand-washing as parts of its curriculum.

Lewis *et al.*(1997) reports from a study in Thailand that the incidence of diarrhoea is associated with the level of environmental contamination. One of the many sources of faecal environmental contamination in Fort Dauphin are the anal cleansing materials used post defecation. The survey found that non-latrine owning respondents used a wider variety of anal cleaning materials than latrine owners. It is a limitation of the research that information regarding disposal of anal cleansing materials was not gathered. However, that latrines reduce the variety of anal cleansing materials used is a positive indicator that they will help reduce faecal contamination of the environment in this regard.

There is overwhelming evidence of both the need and benefits of improving sanitation in Fort Dauphin. However, lessons learned in Evatraha indicate that such an intervention would have to be implemented in a participatory spirit of development. The consent, support and co-operation of residents would be essential if such a project

were to succeed. With this in mind, respondents were asked, using a multiple choice question format, what they thought would improve sanitary conditions in their fokontany. Approximately 85% of residents regarded latrines as an appropriate solution, almost 45% indicated hygiene education as a solution and ≈30% cited cleaning committees as important. As many as ≈70% of people thought that latrines would reduce the incidence of disease and almost 60% said latrines would be an improvement to public health. However, only slightly more than a third of respondents said that latrines would reduce open defecation. It has been shown that latrines currently in use in Fort Dauphin do reduce open defecation but also that many latrine owners still practice this form of excreta management. It is a matter for further research to determine whether well built, properly installed public latrines would discourage the use of open defecation considerably more than the present latrine stock.

Of great concern to a future sanitation initiative is that ≈65% of respondents thought latrines would smell bad. Sanitation proponents must treat this opinion sincerely in light of beliefs regarding *boty* and *fofona*. Experience in Evatraha showed that the most effective way to demonstrate that improved latrines do not smell bad is by building, using and maintaining a working demonstration model.

Slightly more than 50% of respondents said that there is a risk of subsidence when building latrines. This is certainly true and is another of the resident's recommendations to be taken seriously. Much of Fort Dauphin is built on sand dunes. Residents who have built houses on such terrain know well the difficulty of building and maintaining solid structures. There are many risks to building on sand that are compounded when an essential design aspect of a structure is a deep pit underneath the superstructure. For this reason alone the use of a ventilated improved pit latrine should be reassessed in some parts of Fort Dauphin. Residents may have a number of affordable locally appropriate solutions to this issue.

Respondents also suggested that building latrines might cause neighbours to fight. When asked if they would object to their neighbour building a latrine, 88% said they would be pleased to see their neighbour engaged in such activity. Why then should people think that latrines would cause fighting between neighbours? The most common source of consternation caused by latrine building in Evatraha was that

neighbours disagreed over where they should be built. There was great concern that latrines built to close to another person's house would pollute the air for example. When respondents in Fort Dauphin were asked where they would most like to build a latrine 85% of them said they would build inside their family compound. It is this inclination that is likely to be the greatest cause of anxiety between neighbours and warrants considerable consideration when planning a sanitation intervention in Fort Dauphin.

In brief, there is considerable and urgent need for an extensive improved sanitation programme in Fort Dauphin. However, the data regarding the success of a public latrines based intervention are inconclusive. The current stock of latrines in Fort Dauphin do reduce the level of faecal environmental contamination but not to a significant degree. The impact that improved sanitation would have on the level of environmental contamination is a matter for further research. Only a few parents currently use hygiene practices that are an essential part of any improved sanitation initiative. An extensive hygiene education campaign would be a fundamental core requirement of an improved sanitation initiative in Fort Dauphin. The research highlights the importance of resident's consent, support and co-operation if a sanitation intervention is to succeed. The evidence suggests that residents support the idea of improving sanitation infrastructure in their fokontanies but that they had reservations concerning the impact of latrine building on neighbourly relationships, that latrines might increase bad smells and that there was a risk of pit latrines subsiding in Fort Dauphin's sandy soil.

The next step in planning a meaningful sanitation intervention in Fort Dauphin is to establish a more solid understanding of latrine sharing preferences and to establish a pilot latrine building project in conjunction with an extensive hygiene education programme. The pilot project would assess latrine's impact on reducing the incidence of faecal-oral disease and environmental contamination from open defecation practices and the use of various anal cleansing materials. The pilot project would also test solutions to the possibility of subsidence and demonstrate that latrines do not have to cause fights or create bas smells.

9 Appendices

Appendix 1 – Maps of Fort Dauphin

Appendix 2 – English and Malagasy household questionnaires.

Appendix 3 – Picture cards accompanying the household questionnaire.

- Figure 1 accompanies questions 11 or 25
- Figure 2 accompanies questions 17 or 31
- Figure 3 accompanies questions 19 or 33
- Figure 4 accompanies questions 20 or 34

Appendix 4 – English and Malagasy structured observation schedules.

Appendix 5 – Statsoft Statistica 5.5 data codes.

Appendix 6 – Permissions from the fokontany presidents.

Appendix 2 – Household questionnaire survey

ONG Azafady

Household Sanitation Questionnaire

The interviewee is Male ☐ **Female** ☐ **Age** ☐

Surveyor: ..... Fokontany: ..... Date: .....

FAMILIES WITH A LATRINE

1. How long have you lived in Fort Dauphin? ☐
2. What is your religious affiliation? ☐
3. Do you have a latrine? Yes ☐ No ☐
   - ➢ **IF NO GO TO QUESTION 21**
4. When was it built? ☐☐ Month Year

Latrine sharing in families with a latrine

5. How many people use your latrine regularly?

Adults		Children < 5	
M	F	M	F

6. Who is allowed to use your latrine?
   Specify_____
   _____
   _____
   _____

   a) Husbands Parents ☐
   b) Wife's Parents ☐
   c) Husband and Wife ☐
   d) Direct Children ☐
   e) Uncles and Aunts ☐
   f) Nephews and Nieces ☐
   g) Friends ☐
   h) Strangers ☐
   i) Other (please specify) ☐

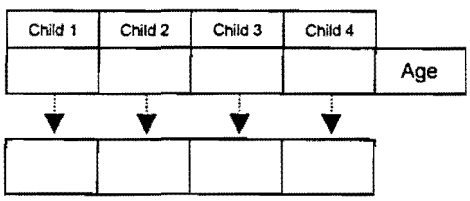
7. Do you defecate when you are away from home? Yes ☐ No ☐
8. Do you ever use other family latrines? Yes ☐ No ☐
9. Do you ever use friend's latrines? Yes ☐ No ☐

Appendix 2

Children's defecation habits in families with a latrine

10. Do you help your children to defecate? Yes ☐ No ☐
    - ➢ **IF NO GO TO QUESTION 13**

11. How old are the children you help?
    (Indicate ages in the boxes provided)



12. What is the defecation fomba you use?
    (Enter option from illustrated examples)
    Specify_____
    (Fill in the boxes above with the appropriate letter from the example drawings supplied, use 'o' for other and specify)

13. Why do you not help your children to defecate?
    a) Too old ☐
    b) Young enough but do not think it is necessary ☐

14. Where do your children defecate?
    Specify_____
    a) In your latrine ☐
    b) Inside family compound ☐
    c) Local defecation site ☐
    d) Do not know ☐
    e) Other (please specify) ☐

Hand-washing in families with a latrine

15. Do the children wash their hands after using the latrine?
    - ➢ **IF NO GO TO QUESTION 20**

    a) Yes ☐
    b) No ☐
    c) Sometimes ☐

16. Ask to see the hand-washing facility.
    a) Is it inside / close to the latrine? ☐
    b) Is it inside the house? ☐
    c) Can it be used now? ☐

17. What is the fomba for your children to wash their hands?
    a) In the bucket ☐
    b) Outside the bucket ☐

18. Do your children use soap to wash their hands? Yes ☐ No ☐

19. Does the hand-washing water have other uses?
    Specify_____
    a) No ☐
    b) Hand-washing at other times ☐
    c) Watering flowers ☐
    d) Watering / washing vegetables ☐
    e) Washing buckets, dishes, etc ☐
    f) Other (please specify) ☐

Appendix 2

Anal cleansing in families with a latrine

20. What is your family's preferred cleansing fomba?
    Specify_____
    _____
    _____
    _____

➢ **Go to Question 35**

a) Paper
b) Corn cobs
c) Sticks
d) Stones
e) Leaves
f) Grass
g) Heel
h) Other (please specify)

FAMILIES WITHOUT A LATRINE

IF THE ANSWER TO QUESTION 3 IS NO THEN BEGIN HERE

21. How many minutes walk is it to your most regularly used defecation site? ____ Minutes

---

Latrine sharing in families without a latrine

22. Do you ever use other family latrines? Yes ____ No ____

23. Do you ever use friend's latrines? Yes ____ No ____

Children's defecation habits in families without a latrine

24. Do you help your children to defecate? Yes ____ No ____
    ➢ **IF NO GO TO QUESTION 27**

25. How old are the children you help?
    (Indicate ages in the boxes provided)

Child 1	Child 2	Child 3	Child 4	Age

26. What is the defecation fomba you use?
    (Enter option from illustrated examples)
    Specify_____
    _____
    _____
    _____

(Fill in the boxes above with the appropriate letter from the example drawings supplied, use 'o' for other and specify)

27. Why do you not help your children to defecate?

a) Too old
b) Young enough but think it is unnecessary

Appendix 2

28. Where do your children defecate?
    Specify_____
    _____
    _____
    _____

a) Neighbour's latrine
b) Inside family compound
c) Local defecation site
d) Do not know
e) Other (please specify)

Hand-washing in families without a latrine

29. Do the children wash their hands after defecating?
    ➢ **IF NO GO TO QUESTION 34**

a) Yes
b) No
c) Sometimes

30. Ask to see the hand-washing facility.

a) Is it outside the house?
b) Is it inside the house?
c) Can it be used now?

31. What is your children's hand-washing fomba?

a) In the bucket
b) Outside the bucket

32. Do your children use soap to wash their hands?

Yes ☐ No ☐

33. Does the hand-washing water have other uses?
    Specify_____
    _____
    _____
    _____

a) No
b) Hand-washing at other times
c) Watering flowers
d) Watering / washing vegetables
e) Washing buckets, dishes, etc
f) Other (please specify)

Anal cleansing in families without a latrine

34. What is your children's preferred cleansing fomba?
    Specify_____
    _____
    _____
    _____

a) Paper
b) Corn cobs
c) Sticks
d) Stones
e) Leaves
f) Grass
g) Heel
h) Other (please specify)

Appendix 2

Thoughts on improving sanitary conditions within the fokontany

35. What would you do to improve sanitary conditions in your fokontany?
Specify _____

a) Hygiene education ☐
b) Cleaning committee ☐
c) Latrine building ☐
d) Other (please specify) ☐

36. What benefit or inconvenience would latrines be in your community?
Specify _____

a) Reduce open defecation ☐
b) More convenient at night ☐
c) Reduce disease risk ☐
d) Increase disease risk ☐
e) Improved public health ☐
f) Increase bad smells ☐
g) Risk of subsidence ☐
h) Do not know ☐
i) Other (please specify) ☐

37. How would you feel if your neighbours built a latrine in their family compound?
Specify _____

a) Pleased ☐
b) Displeased ☐
c) Indifferent ☐
d) Other (please specify) ☐

38. If your neighbours built a latrine do you think they would share it with anyone?

Yes ☐ No ☐

39. Would you want to use your neighbour's latrine?

Yes ☐ No ☐

40. If you had any interest in building a latrine would you prefer to build it inside or outside your family compound?
Specify _____

a) Inside the family compound ☐
b) Outside the family compound ☐
c) Other (Please specify) ☐

41. What problems do you think building latrines in your fokontany may cause?
Specify _____

a) Fights between neighbours ☐
b) Bad smells ☐
c) Fly problems ☐
d) Pollution in the fokontany ☐
e) Increased disease ☐
f) Other (Please specify) ☐

Appendix 2

Means Test

42. What is your profession?

Specify _____

_____

_____

_____

a) Government Employee ☐
b) Market Trader ☐
c) Fisherman ☐
d) Farmer ☐
e) Shop Owner ☐
f) Other (please specify) ☐

43. How many rooms are in your house? ☐ Rooms

44. Do you have a piped water system? Yes ☐ No ☐

45. Do you have an electricity supply? Yes ☐ No ☐
   - **IF NO GO TO QUESTION 47**

46. Do you have a:

a) Telephone ☐
b) Radio ☐
c) Television ☐

47. Is the roof of your house made from:

a) Metal ☐
b) Wood ☐
c) Raty ☐
d) Other (please specify) ☐

48. Are the walls of your house made from:

a) Brick ☐
b) Stone ☐
c) Wood ☐
d) Falafa ☐
e) Other (please specify) ☐

Appendix 2 – Household questionnaire survey

ONG Azafady
Fanadihadiana Momba ny Fahasalamana an - Tokatrano

Lehilahy no Anuntaniana ☐ **Vehivavy** ☐ **Taona** ☐

Mpanao fanadihaoiana ..... Fokontany: ..... Daty: .....

NY FIANAKAVIANA SY NY KABONE

1. Efa ela nareo nipetraky eto Fort Dauphin? ☐

2. Ino gn'antokom-pinoa misy anao? ☐

3. Misy kabone aminareo ato? Eny ☐ Tsia ☐
   ➢ **RAHA TSIA JEREO QUESTION 21**

4. Vita tamin'ny ombia? ☐☐
   Volana Taona

Fomba fampiasan'ny fianakaviana ny Kabone

5. Firy gny isan'ny olo mampiasa io kabone io isan'andro?

Olombe		Zaza < 5	
L	V	L	V

6. Iza gn'olo afaky mampiasa gny kabonenareo?
   Hazavao tsara

   _____
   _____
   _____
   _____

   a) Ray amandrenin'ny dada ☐
   b) Ray amandrenin'ny neny ☐
   c) Dada sy neny ☐
   d) Zanaka natereny ☐
   e) Dadatoa sy nenifou ☐
   f) Zanaka naterany ☐
   g) Namana ☐
   h) Vahiny ☐
   i) Na zavatra hafa ☐

7. Mangery avao koa hanao raha ambadiky lavatsy gny misy anao? Eny ☐ Tsia ☐

8. Mampiasa gny kabonen'ny fianakavianao hanao? Eny ☐ Tsia ☐

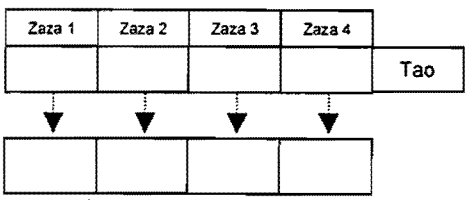
9. Mampiasa gny kabonen'ny gny namanao hanao? Eny ☐ Tsia ☐

Appendix 2 – Household questionnaire survey

Fomba fikabonezana mahazatra ny an-kizy ao @ fianakaviana manana kabone

10. Manampy ny zaza hanao no fa mangery izy? Eny ☐ Tsia ☐
    - ➢ **RAHA TSIA JEREO QUESTION 13**

11. Firy tao io zaza ampianao io?
    (Mariho ao anaty tabilao ny taonany)



(Fenoy ny tabilao eo ambony izay mifanaraka @ litera izay ohatra hita eo @ sary, asio 'O' raha misy fanao hafa hazavao tsara)

12. Ino aby ny fomba atao no fa mangery ny zaza?
    (Mila tao mazava tsara)
    Hazavao tsara _____

13. Fa manino tsy manampy ny zaza no fa mangery izy?
    a) Efa be ☐
    b) Tsy ilaina na tsy mila ☐

14. Eza mangery zananao?
    Hazavao tsara _____
    a) Anaty kabone ☐
    b) An tokotany ☐
    c) Fomba makazatsy ☐
    d) Tsy hay ☐
    e) Na zavatra hafa ☐

Fomba fanasana fanana ao @ fianakaviana manana kabone

15. Manasa tana ny zaza no fa avy mangery? Eny ☐ Tsia ☐
    - ➢ **RAHA TSIA JEREO QUESTION 20**

16. Manontany raha afaky mahita ny toera fanasa - tana.
    d) Agnatiny ao/akaiky kabone? ☐
    e) Anaty ny trano? ☐
    f) Azo ampiasana @'izao? ☐

17. Manao akory ny fomba fanasan'ny zaza tana?
    a) Anaty sikoa ☐
    b) Ivelany na ambadiky ☐

18. Mampiasa savony no fa manasa tana? Eny ☐ Tsia ☐

19. Manao ino miaraky ny rano eto no fa avy nanasana tana?
    Hazavao tsara _____
    a) Tsy misy atao ☐
    b) Manasa tana a fotoa hafa ☐
    c) Anondraka vonikazo ☐
    d) Manondraka/anasana legioma ☐
    e) Anasana sihoa, lasety, etc ☐
    f) Na zavatra hafa ☐

Appendix 2 – Household questionnaire survey

Fomba fifirana ho an'ny fianakaviana manana kabone

20. Ino ny raha tena ampiasainareo no fa mifitsy?
    Hazavao tsara _____
    _____
    _____
    _____

➢ **JEREO QUESTION 35**

Taratasy
a) Taho tsaka ☐
b) Hazo ☐
c) Voan Traha ☐
d) Ravy ☐
e) Atata ☐
f) Holro na ☐
g) Na zavatra hafa ☐

FIANAKAVIANA TSY MISY KABONE

➢ **RAHA VALINY NY FANONTANIANA FAHA 3 DIA MANOMBOKY ETO**

21. Aiza ho aiza ny halavitry ny toerna fangarianareo? ☐ Minutes

---

Fomba fahazoany mampiasa kabone as @ fianakaviana tsy misy kabone

22. Mampiasa gny kabonen'ny fianakavianao hanao? Eny ☐ Tsia ☐

23. Mampiasa gny kabonen'ny gny namanao hanao? Eny ☐ Tsia ☐

Fomba fikabonezana mahazatra ny ankizy ao @ fianakaviana tsy misy kabone

24. Manampy ny zaza hanao no fa mangery izy? Eny ☐ Tsia ☐
    ➢ **RAHA TSIA JEREO QUESTION 27**

25. Firy tao io zaza ampianao io?
    (Mariho ao anaty tabilao ny taonany)

Zaza 1	Zaza 2	Zaza 3	Zaza 4	
				Tao

(Fenoy ny tabilao eo ambony izay mifanaraka @ litera izay ohatra hita eo @ sary, asio 'O' raha misy fanao hafa hazavao tsara)

26. Ino aby ny fomba atao no fa mangery ny zaza?
    (Mila tao mazava tsara)
    Hazavao tsara _____
    _____
    _____
    _____

27. Fa manino tsy manampy ny zaza no fa mangery izy?
    a) Efa be ☐
    b) Tsy ilaina na tsy mila ☐

Appendix 2 – Household questionnaire survey

28. Eza mangery zananao?
    Hazavao tsara _____
    _____
    _____
    _____

a) Anaty kabone
An tokotany
b) Fomba makazatsy
c) Tsy hay
d) Na zavatra hafa

Fomba Fanasana tanana as @ fianakaviana tsy misy kabone

29. Manasa tana ny zaza no fa avy mangery?
    ➢ **RAHA TSIA JEREO QUESTION 34**

Eny ☐ Tsia ☐

30. Manontany raha afaky mahita ny toera fanasa - tana.

g) Agnatiny ao/akaiky kabone?
h) Anaty ny trano?
i) Azo ampiasana @'izao?

31. Manao akory ny fomba fanasan'ny zaza tana?

a) Anaty sikoa
b) Ivelany na ambadiky

32. Mampiasa savony no fa manasa tana?

Eny ☐ Tsia ☐

33. Manao ino miaraky ny rano eto no fa avy nanasana tana?
    Hazavao tsara _____
    _____
    _____
    _____

c) Tsy misy atao
d) Manasa tana a fotoa hafa
g) Anondraka vonikazo
h) Manondraka/anasana legioma
i) Anasana sihoa, lasety, etc
j) Na zavatra hafa

Fomba fifirana ao @ fianakaviana tsy misy kabone

34. Ino ny raha tena ampiasainareo no fa mifitsy?
    Hazavao tsara _____
    _____
    _____
    _____

a) Taratasy
b) Taho tsato
c) Hazo
d) Voan Traha
e) Ravy
f) Atata
g) Holro na
h) Na zavatra hafa

Appendix 2 – Household questionnaire survey

Hevitra hanatsarana ny fahasalamana ao @ fokontany

35. Ino ny fomba tokony hataonareo mba hitsinfovana ny fahadiovana sy ny fahasalamana eto amin'ny tanananareo?
    Hazavao Tsara _____
    _____
    _____
    _____

a) Fampianara fahadiovana ☐
b) Fahadiovany fikanbana ☐
c) Manamboasy Kabone ☐
d) Na zavatra hafa ☐

36. Misy kabone maromaro eto amin'ny fokontany ino ny lafitsara sy ny lafiratsiny amin'areo
    Hazavao Tsara _____
    _____
    _____
    _____

a) Firenany mangeringery ☐
b) Tombotsoa amin'ny hariva ☐
c) Fihenan'ny aretina ☐
d) Fitombo ny aretina ☐
e) Mahasalama ny fokonolo ☐
f) Mitombo ny fofona ratsy 'na mihena ☐
g) Tsy hay ☐
h) Na zavatra hafa ☐

37. Ino eritserisinao raha ny olo ambadikinareo mamboasy kabone?
    Hazavao Tsara _____
    _____
    _____
    _____

a) Afa - po ☐
b) Tsy afa - po ☐
c) Tsy miraharaha ☐
d) Na zavatra hafa ☐

38. Raha hamboasy kabone hanao afaka ampiasa ianao miaraka amini olona hafa ve?

Eny ☐ Tsia ☐

39. Raha ny olo ambadiky mana kabone afaky miharo kabone amin'azy nareo?

Eny ☐ Tsia ☐

40. Raha ohasy hamboasy kabone nareo hamboasy anaty tokontany sa ivelany?
    Hazavao Tsara _____
    _____
    _____
    _____

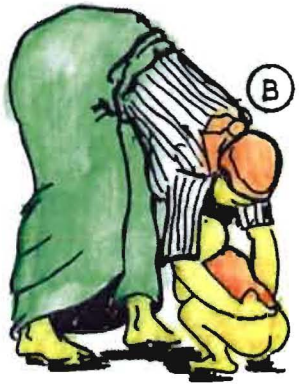
a) Anaty ☐
b) Ivelany ☐
c) Na zavatra hafa ☐

41. Inona ny olana mety hiteraka raha toaka mamboatra kabone ato anaty'ny tokontan'ny ny olona na fianakaviana iray?
    Hazavao Tsara _____
    _____
    _____
    _____

a) Nampiady ☐
b) Membo ☐
c) Be lalisy ☐
d) Mampaloto ☐
e) Mitombo ny aretina ☐
f) Na zavatra hafa ☐

Fig 1

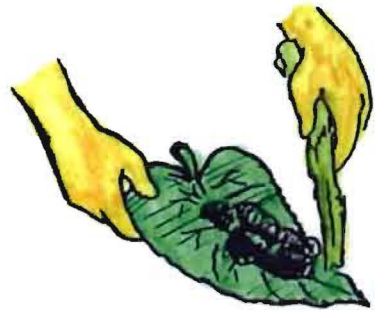
A



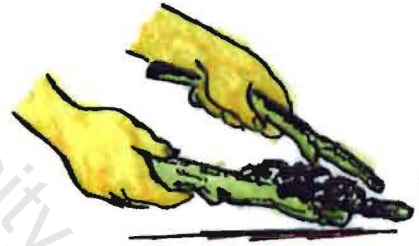
B

D

C



a



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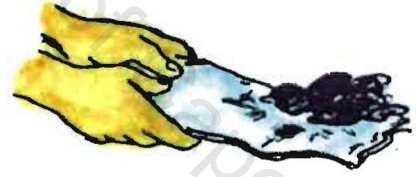
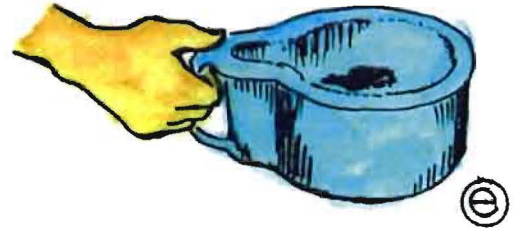


c

d



e

1

2

3

Fig 2

Fig 3

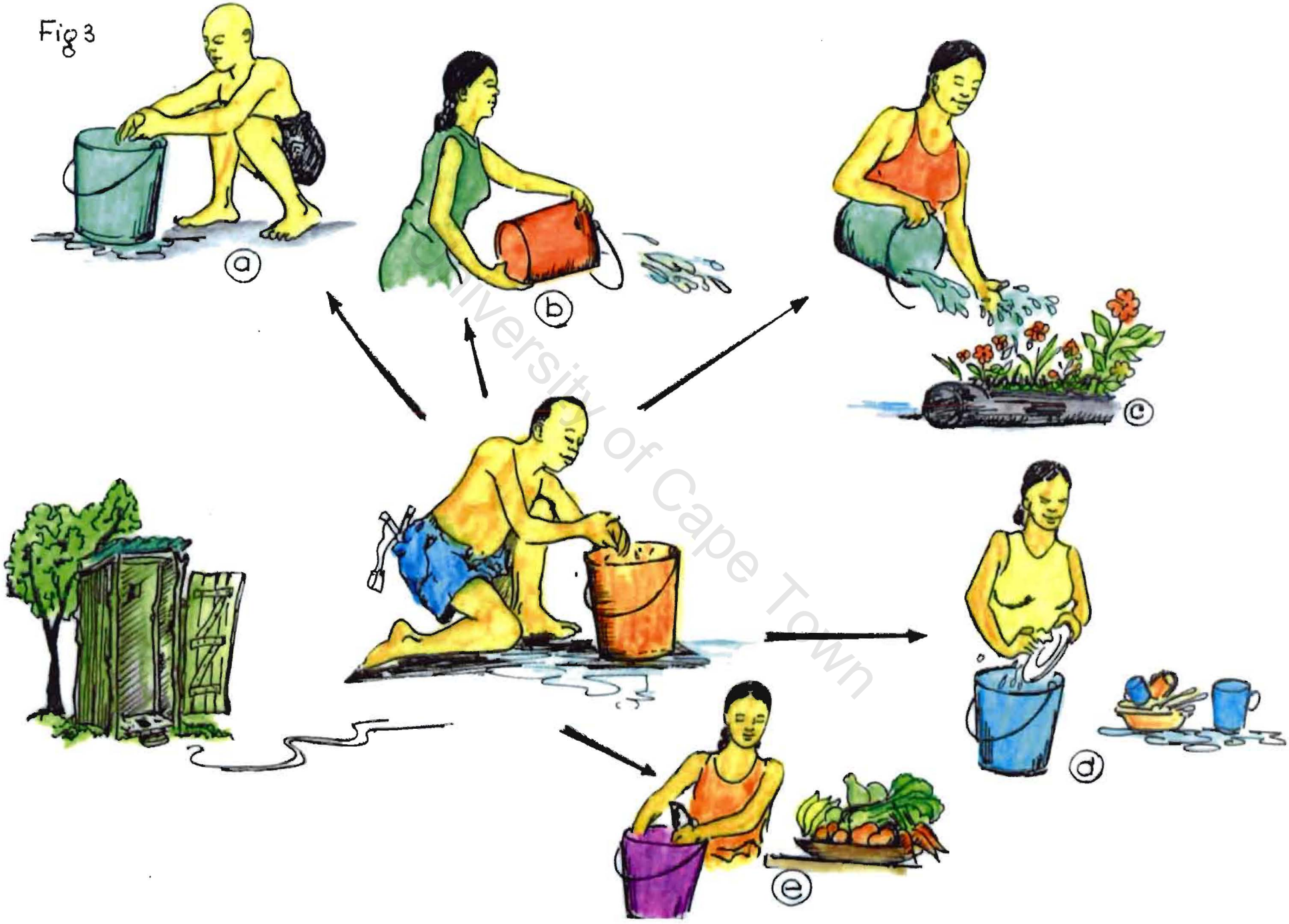
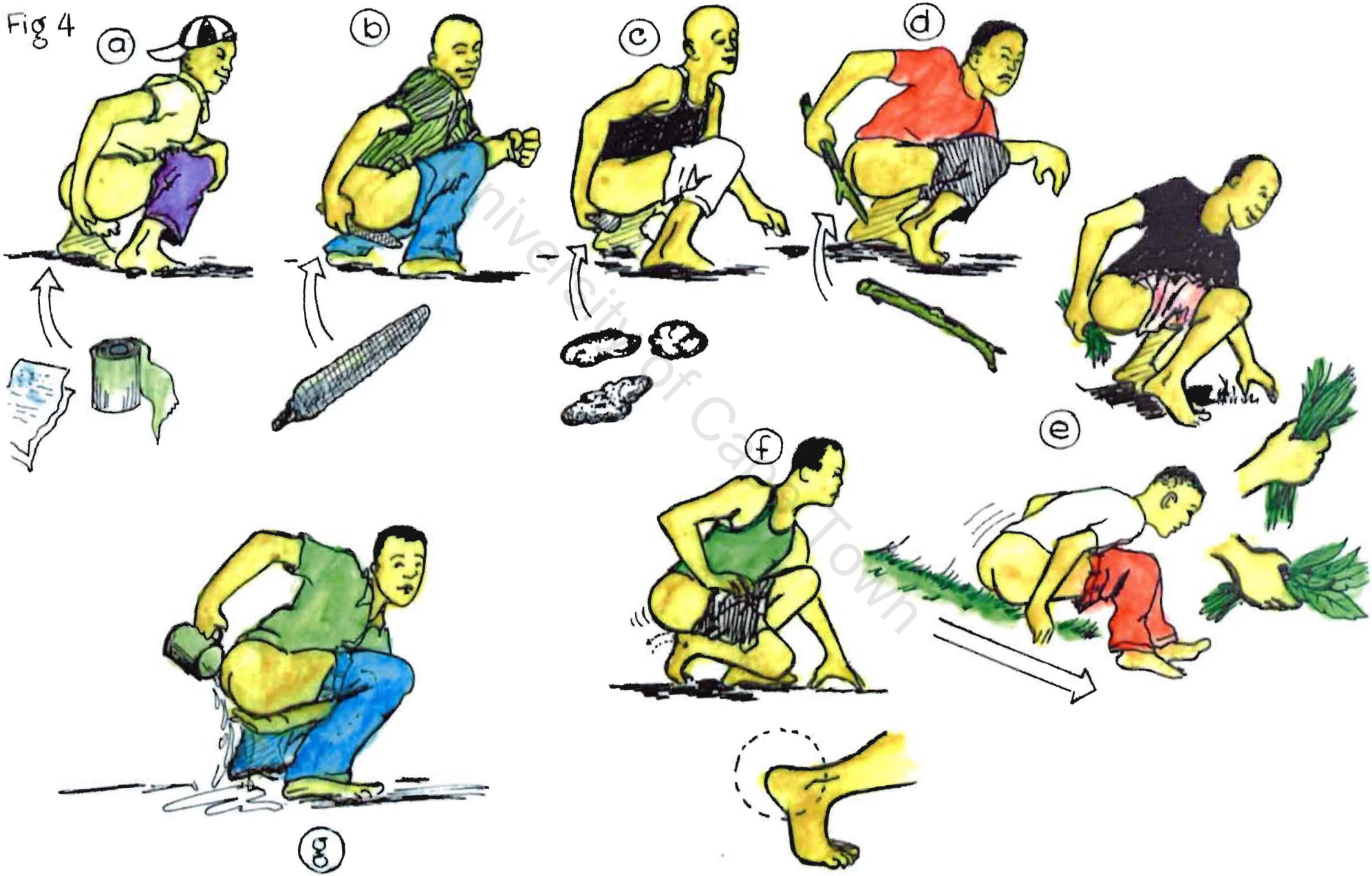


Fig 4



Appendix 4 – Structured observation schedule

ONG Azafady

Structured Observation Schedule

Surveyor: ..... Fokontany: ..... Date: .....

1. Is there evidence of faecal contamination?
   - Along roadsides ☐
   - Along footpaths ☐
   - Near water sources ☐
   - In/near the fields ☐
   - Inside family compounds ☐
   - Inside family houses ☐
   - On the beach ☐

2. What faecal contamination was observed?
   - Infant faeces ☐
   - Adult faeces ☐
   - Diarrhoeal faeces ☐
   - Animal faeces - breeding places for flies ☐
   - Other ☐

3. Anyone observed defecating during this observation?
   - Infant ☐
   - Adult ☐
   - ➢ Where: _____

4. How many houses are observed with a latrine / where are they located?
   - Number of houses with a latrine INSIDE the compound ☐
   - Number of houses with a latrine OUTSIDE the compound ☐

5. Observe the latrine; check the appropriate boxes in the table below.

Toilet number	1	2	3	4	5	6	7	8	9	10	11	12
Is the superstructure sound?												
Is the ground safe to stand on?												
Does it have a latrine slab?												
Is the drophole small enough to be safe for children?												
Is there adequate privacy?												
Is the latrine pit vented?												

- Are there any other interesting observations, give latrine number and description.

Comments: _____

Appendix 4 – Structured observation schedule

6. Are there signs to show the latrine is in use?

Toilet number	1	2	3	4	5	6	7	8	9	10	11	12
Is the path leading to it clear?												
Is the toilet clean?												
Is it reasonably free of smells?												
Hygiene/cleansing materials present?												
Is there water in the vicinity?												
Is there ash in the vicinity?												

- Any other evidence of use, give latrine number and description.

Comments: _____

_____

_____

_____

_____

_____

_____

_____

_____

7. How close are the hand-washing facilities (water and ash or soap) to the latrine?

Toilet number	1	2	3	4	5	6	7	8	9	10	11	12
Next to the latrine												
Within walking distance												
Inside the users house												
No evidence												

Comments: _____

_____

_____

_____

_____

_____

_____

_____

_____

Appendix 4 – Structured observation schedule

ONG Azafady

Structured Observation Schedule

Mpanao fanadihadiana: ..... Fokontany: ..... Daty: .....

8. Misy toerana fikabonezana voaloto?
   - Amin'ny sisindalana ☐
   - Lalana kely ☐
   - Akaiky fatsakan - drano ☐
   - Anaty / akaiky tavy ☐
   - Ao'an tokontanyny fianakaviana ☐
   - Ao anaty trano ☐
   - Amoron driaky ☐

9. Inona no toerana fanaovana maloto fena jerena?
   - Tain juza ☐
   - Tain olombe ☐
   - Tay mivalana misy otrikaretina ☐
   - Toim biby amin'ny toeram - piompiana misy lalitra ☐
   - (Na hafa) sns ☐

10. Mandritry ny fanadihadiana hisy hahatsapo ny fahaiotoana?
    - Zaza ☐
    - Olombe ☐
    - ➢ Aiza? _____

11. Firy ny trano nanaovana fanadihadiana momba ny kabone / aiza no misy azy ireo?
    - Isan'ny kabone AV AN tokotany ☐
    - Isan'ny kabone IVELAN'NY tokotany ☐

12. Diniho ny kabone; ampifanaraho av onatin'ity tabilao ambany ity.

Isan'ny kabone	1	2	3	4	5	6	7	8	9	10	11	12
Rindrim bato sy mitafo ve?												
Mahazaka tsara ny grodona raha itaingenana?												
Manana kabone vita amin'ny simenitra?												
Tsy misy atohorana @zazakely ny lavakin'ny kabone ?												
Misy tafo sy rindriny?												
Azon drivotra ve ny lavaka?												

- Misy fomba fanadihadiana tsara hafa koa, manomeza ny isan'ny kabone sy ny mombamomba azy.

Fanazavan: _____

Appendix 4 – Structured observation schedule

13. Misy fomantarana miseho fa miasa ny kabone?

Isan'ny kabone	1	2	3	4	5	6	7	8	9	10	11	12
Mazava tsara ve ny ialana makany @ kabone?												
Madio ve ny kabone?												
Tena mamofona be ve sa antonony?												
Misy fitaovana fidiovana ve anatiny?												
Misy rano eo akaikiny (tsy lavi-drano)?												
Misy lavenona akaiky eny @ manodidina?												

- Misy fomba hafa fampiasa, omeo ny fombafomba sy ny isan'ny lava piringa - (kabone).

Fanazavan:_____

_____

_____

_____

_____

_____

_____

_____

_____

14. Ohatrin'ny aiza ny hakakaikin'ny fanasan-tanana (miaraka amin'ny savony lavenona) oorian'ny kabony?

Isan'ny kabone	1	2	3	4	5	6	7	8	9	10	11	12
Akaikin'ny kabone												
Lavidavitra												
Anaty trano												
Tsy misy famantarana												

Fanazavan:_____

_____

_____

_____

_____

_____

_____

_____

Appendix 5 – Data codes

Gender Data Codes	
Male	1
Female	2

Tribal Membership Data Codes	
Antakarama	1
Antandroy	2
Antanimoro	3
Antanosy	4
Antefasy	5
Antesaka	6
Bara	7
Betsileo	8
Betsimisaraka	9
Karana	10
Komorianina	11
Mahafaly	12
Masihanaka	13
Merina	14
Metise Sinoa	15
Sakalava	16
Tabnihazo	17
Taisaka	18
Tantsimo	19
Tavaratra	20
Vezo	21

Surveyor Data Codes	
Christian	1
Daniela	2
Edson	3
Flavien	4
Rowland	5

Fokontany Data Codes	
Ambinanibe	1
Ambinanikely	2
Amboanato	3
Ampamkiambato	4
Amparihy	5
Apasikabo	6
Ampotatra	7
Bazaribe	8
Bazarikely	9
Esokaka	10
Tanambao 1	11
Tanambao 2	12
Tanambao 3	13
Tanambao 4	14

Survey Date Data Codes	
6th June 2000	1
7th June 2000	2
8th June 2000	3
9th June 2000	4
10th June 2000	5
11th June 2000	6
12th June 2000	7
13th June 2000	8
14th June 2000	9
15th June 2000	10
16th June 2000	11
17th June 2000	12
18th June 2000	13

Religion Data Codes	
Adventist	1
Assembly of God	2
Aza-pilazantsara	3
Catholic	4
FJKM	5
Jesosy Mamonjy	6
Jetilisa	7
Jsimiahina	8
Lutheran	9
Muslim	10
None	11
Protestant	12
Remah	13
Secte	14
Tsimiankina	15

Q13 Data Codes	
Child is too Old to Help	1
Young Enough but Help is not Necessary	2

Q14Other Data Codes	
No Children	1
Wherever Happy	2

Q16 Data Codes	
In the Latrine	1
Inside the House	2
Can be used now!	3

Appendix 5 – Data codes

Q17 Data Codes	
In the Bucket	1
Outside the Bucket	2

Q19Other Data Codes	
Uses Tap Water	1
Washing Veg. if there is no soap in the water	2

Q20Other Data Codes	
Lamba	1
Piece of Cloth	2

Q27 Data Codes	
Child is too Old to Help	1
Young Enough but Help is not Necessary	2

Q28Other Data Codes	
No Children	1
Wherever Happy	2
Road	3
Forest	4
Beach	5

Q30 Data Codes	
Outside the House	1
Inside the House	2
Can be used now!	3

Q31 Data Codes	
In the Bucket	1
Outside the Bucket	2

Q34Other Data Codes	
Clean	1
Lamba	2
Paiuba	3
Piece of Cloth	4
Wood Bark	5

Q35Other Data Codes	
Build Latrines	1
Clean up the Ground/Beach	2
Clean up the Ground and Return to DDT Spraying	3
Clean up the Markets and Communal Selling Areas	4
Clean Water	5
Clean Water and Hospital	6
Dig Rubbish Holes	7
Family Compounds are too Small	8
Food Hygiene Education	9
Health/Education Committee	10
Hospital	11
Improve Health of the Population	12
Medicine	13
Nothing	14
Pharmacy Provision	15
Pharmacy and Clean Water Provision	16
Pharmacy and Public Toilet Provision	17
Return to DDT Spraying	18
Rubbish Collection	19
Rubbish Holes in Family Compounds	20
Rubbish Holes, Cook and Dispose of Food Properly	21
Wells Built from Stone	22
Clean up around Market and Houses	23
Stop Defecation along the Road	24
Rubbish Bins in Dirty Areas	25
At Bus Stop, Table for Sellers, Cover Food, Clean up	26
Sandy Therefore Often Frequent Rebuilds are Necessary	27
Properly Dispose of Anal Cleansing Material (sticks, grass)	28

Appendix 5 – Data codes

Q36Other Data Codes	
Latrines are Bad for Health	1
Latrines make a Cleaner District	2
Good Latrines are Needed	3
Latrines Make the Wind Smell Bad	4
No Latrines needed, there is a Forest	5
No Problem if there are Many Latrines	6
State Supervision is Necessary	7
Latrines Must be Far From the House and Isolated	8

Q37 Data Codes	
Pleased if neighbour built a latrine	1
Displeased if neighbour built a latrine	2
Indifferent if neighbour built a latrine	3

Q37Other Data Codes	
Bring Bad Air/Smells	1
Family Compound too Small	2
Ground is Soft	3
Ground May go Bad	4
Happy if Area Kept Clean	5
Happy if Well Built	6
No Problem	7
Not Close to House	8
Not Close to Road	9
Not if Always Used	10
Slow Wind, Bad Smell	11
State Intervention	12
There is a Forest!	13
Unsure	14
Happy Because Roadside will be Clean	15

Q40 Data Codes	
Inside Family Compound	1
Outside Family Compound	2

Q40Other Data Codes	
Already has a Latrine	1
Does not Want a Latrine	2
Family Compound is too Small	3
Government Intervention is Necessary	4
Ground is Soft	5
Must Consult the Neighbours	6
There are Pathways, Latrines Should be Capped with Wood	7
Unsure	8
Land Owner Will Not Agree	9

Q41Other Data Codes	
Bring Dirty Air	1
Bring Uncleanliness	2
Disease Problem is Different	3
No Family Compound	4
Family Compound Too Small	5
Family Unhappy	6
There is Contagious Disease	7
Need Barrels. Small Latrine is Bad	8
Need Community Effort	9
Need Community Effort for Cleanliness	10
Need Education	11
No Problems	12
No Problems (But No Money)	13
No Problems (Already Many Latrines)	14
Pharmacy and Public Latrine Needed	15
Provoke Disease Contamination	16
We will probably negotiate	17
Latrine quickly Full	18
Can't Afford Barrels Therefore We Will Have Bad Latrines	19

Q42Other Data Codes	
Baker	1
Basket Weaver	2
Beggar	3
Brick Maker	4
Butcher	5
Carpenter	6
Cattle Herder	7
Charcoal Maker	8
Chef	9
Child Minder	10

Appendix 5 – Data codes

Child Minder (Family)	11
Domestic Worker	12
Driver	13
Electrician	14
Embroiderer	15
Employee (Air Madagascar)	16
Employee (Bank)	17
Employee (de Holme)	18
Employee (ESCAR)	19
Employee (Enterprise)	20
Employee (FIDA)	21
Employee (Hotel)	22
Employee (JIRAMA)	23
Employee (Karana)	24
Employee (MADPECHE)	25
Employee (Martin Pecheur)	26
Employee (QMM)	27
Employee (SIFOR)	28
Employee (WWF)	29
Engineer	30
Estate Agent	31
Financier	32
Fisherman	33
Fisherman (Lobster)	34
Gardener	35
Guardian	36
Gravel Worker	37
Ground Worker	38
Guide	39
Haulier	40
House Builder	41
House Wife	42
Judge	43
Launderer	44
Madam	45
Makes Vakaky	46
Manager	47
Mechanic	48
Milking Person	49
Worker	50
Pastor	51
Police	52
Rafia Weaver	53
Builder	54
Retired	55
Seamstress	56
Secretary	57
Security	58
Security (Batelage)	59
Security (de Holme)	60
Security (Hotel Gina)	61
Security (JIRAMA)	62
Security (SIFOR)	63
Spouse (Driver)	64
Spouse (Guide)	65
Spouse (Partnership)	66
Spouse (Teacher)	67
Student	68
Teacher	69
Teacher (Private School)	70
Teacher (Professor)	71
Unemployed	72
Volunteer (Church)	73
Welder	74
Wood Collector (Fuel)	75
Wood Seller	76
Work in the forest	77
Works with Hands	78
Writes on Wood	79
Street Vendor	80

Q48Other Data Codes	
Bed	1
Cardboard	2
Mat	3
Sheet Metal	4
Stone	5
Turf	6
Vakaky	7

Statistica Ordinal Data Codes

Q43 Ranking Codes (rms_rank)	
1 to 2 rooms in the house	1
3 to 4 rooms in the house	2
5+ rooms in the house	3

Q44-45 Ranking Codes (utl_rank)	
Water and electricity in the house	1
Either water or electricity in the house	2
Neither water nor electricity in the house	3

Q46 Ranking Codes (apl_rank)	
2 or 3 appliances in the house	1
1 appliance in the house	2
0 appliances in the house	3

Appendix 5 – Data codes

Q47 Ranking Codes (rf_rank)	
Stone, metal or concrete roof	1
Wood or falafa roof	2

Q48 Ranking Codes (wal_rank)	
Stone, brick walls	1
Hardwood, good metal walls	2
Falafa, cardboard, turf, mat, poor metal, Vakaky walls	3

hse_rank	
3+1+2, 3+1+1	1
2+1+1, 3+1+3	2
2+1+2, 1+1+1, 3+1+3, 2+1+3	3
1+2+3, 1+2+2, 2+2+3	4

Each figure in the three digit ranking code reads from left to right, rms_rank + rf_rank + wal_rank.

mns_rank	
1+1	1
1+2, 2+1	2
2+2, 3+1, 1+3	3
3+2, 2+3, 3+3	4

Each figure in the two digit ranking code reads from left to right, utl_rank + apl_rank.

means	
1+1, 1+2, 2+1	1
2+2, 2+3, 3+2, 3+1, 1+3	2
3+3, 3+4, 4+3, 4+1	3
4+4, 4+2, 2+4	4

Each figure in the two digit ranking code reads from left to right, mns_rank + hse_rank.

Appendix 6 - Permissions

Fahazoan - Dalana Hanao Fanadihadiama Momba Ny LavaPiringa (Kabone) Eran'ny Fokontany (11) Eto Tolagnaro

Surveyor: Ross Chamberlain
Mr Lahery

① Fokontany: ~~ANDOHATO~~ President: ~~TSILOKANA~~ Apollinaire
Adiresy: ~~SONIA BP 43 Tél - 92-214 41 TOLAGNARO 614~~
Isan'ny Mpiray Monina: 2.271 (electeurs) Daty: 15/11/99 Sonia:

② Fokontany: BAZARIBE President: RANDRIANASOLO RAKOTOMANGA Emmanuël
Adiresy: B P 60 Service des Domaines
Isan'ny Mpiray Monina: 775 Daty: 16/11/99 Sonia:
(Electeurs + 18 ans)

③ Fokontany: ESOKAKA President: Remandahatra Raulsn
Adiresy: B.P 250 tél 211 69 Service Contributions Directes
Isan'ny Mpiray Monina: 1500 Daty: 16/11/99 Sonia:
(Electeurs + 18ans)

④ Fokontany: Comptoirs President:
Adiresy:
Isan'ny Mpiray Monina: 962 Daty: 16-11-99 Sonia:

⑤ Fokontany: Bazaribody President: Rakotò Joseph
Adiresy: Rakotò Joseph Secteur des Douanes
Isan'ny Mpiray Monina: 1179 Daty: 16/11/99 Sonia:

⑥ Fokontany: Canambao President: Samy Jean Marie
Adiresy: BP 286
Isan'ny Mpiray Monina: 1819 Daty: 16/11/99 Sonia:

Appendix 6 - Permissions

⑦ Fokontany: ANDRANANDIBE President: Jules Ramisa (vice)

Adiresy: Ambinanibe Lohalaoka

Isan'ny Mpiray Monina: 559 Daty: 17/11/99 Sonia:

⑧ Fokontany: ANDRIMY President: LAMBO Julien

Adiresy: Comptable au Service des Eaux et Forêts

Isan'ny Mpiray Monina: 1694 Daty: 17-11-99 Sonia:

⑨ Fokontany: Imporonkiambato President: Mia Monsieur

Adiresy:

Isan'ny Mpiray Monina: 895 Daty: 17-11-99 Sonia:

⑩ Fokontany: AMBINANIKELY President:

Adiresy: B.P 202

Isan'ny Mpiray Monina: 2367 Daty: 13/11/99 Sonia:

⑪ Fokontany: Ampasikalo President: Matsolombo Ferdinand

Adiresy: Ampasikalo - Fort-Dauphin

Isan'ny Mpiray Monina: (voir Isokaka) Daty: 22/11/99 Sonia:

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