ATTITUDES OF RURAL PEOPLE IN MALI AND NIGERIA TO HUMAN WASTE REUSE IN AGRICULTURE

Mercy Akeredolu
SAFE/IPR/IFRA, University of Mali
obonkus2@yahoo.co.uk, Tel: 002236452372

Ibiyemi Ilesanmi
Institute of Wastewater Management & Water Protection, Hamburg University of Technology (TUHH), Hamburg Germany.

Ralf Otterpohl
Institute of Wastewater Management & Water Protection, Hamburg University of Technology (TUHH), Hamburg Germany.

Abstract

Maintaining the quality of the soil is of paramount importance to food production and an essential component of sustainable agriculture. Farmers through the ages have recognised the importance of fertilisers in improving and maintaining soil fertility. Chemical fertilisers have gradually taken over from natural fertilizers as soil maintenance agents with overall impressive results. However, using chemical fertilizers has its attendant drawbacks which include environmental pollution especially of surface waters that receive runoffs during rainfalls and ironically degradation of the very soil it should improve. This implies chemical fertilisers are not a universal one stop solution to the challenge of improving soil fertility. Human waste due to its basic components, which are largely similar to those of chemical fertilizers, offers a promising alternative as a source of valuable plant nutrients in agriculture. Properly practiced, human waste reuse contributes significantly to issues of food production, poverty reduction, sanitation, environmental and public health protection. The issue of social acceptance is one of the several issues that must be tackled in order to successfully institute the practice of human waste reuse in agriculture. Even if concept and technologies exist, if there is no acceptance there can be no successful practice. This paper looks at and presents the social acceptance of human waste reuse in agriculture in some communities in Mali and Nigeria. Results from both countries in this study revealed knowledge of both manure and human excreta use in farming. However, attitudes to human excreta use are mixed and predominantly influenced by traditional and religious beliefs.

Introduction & Purpose of Study

A third of the world is considered to be food insecure (Esrey, 1997) and one of the greatest global challenges of present times is the production of enough food to meet the needs of an ever increasing population particularly in the developing world, while preserving and enhancing the natural resources.

Throughout history farmers have been in complete agreement as to the need to improve and maintain the fertility of the soil. This is evident when the methods of crop production in the old times are compared with the views now held by many of the leading experiment station workers in various parts of the world.

Fertilizers are used to improve soil fertility because they are materials that contain nutrients essential for plant growth. Fertilizers may be either natural (organic) e.g. manure or mineral (chemical, synthetic, artificial) in nature. Whether chemical or natural, they contribute immensely to human and animal life, as they are important players in the production of foods (human and animal) and natural fibers.

The primary components of fertilizers that are essential to plants are: nitrogen, phosphorus, potassium, sulphur, calcium and magnesium. These are commonly known as the macro-nutrients that aid many important plant-part functions. Other nutrients the "micro-nutrients" or "trace elements", even though needed in smaller amounts are so important to plant function that deficiencies inhibit normal development of plants.

Fertilizers in general: 1) supplement natural soil nutrient; 2) increase yield potential in crops; 3) replenish soil nutrients lost by plant removal, leaching or other natural physical processes; 4) improve and maintain soil conditions for crop production.

As mentioned above fertilizers may be either mineral or organic. Mineral fertilizers supply the same types of nutrients to plants as do organic fertilizers, however the main differences in both stem from the source or origin of each, with organic fertilizers usually originating from bio-sources.

Types of mineral fertilizers and chemical components

Mineral fertilizers depending on type are produced from various synthetic processes, using naturally occurring elements such as nitrogen (N), phosphorus (P), potassium (K) and sulphur (S). From these elements they are formulated in appropriate concentrations and combinations for various crops and growing conditions.

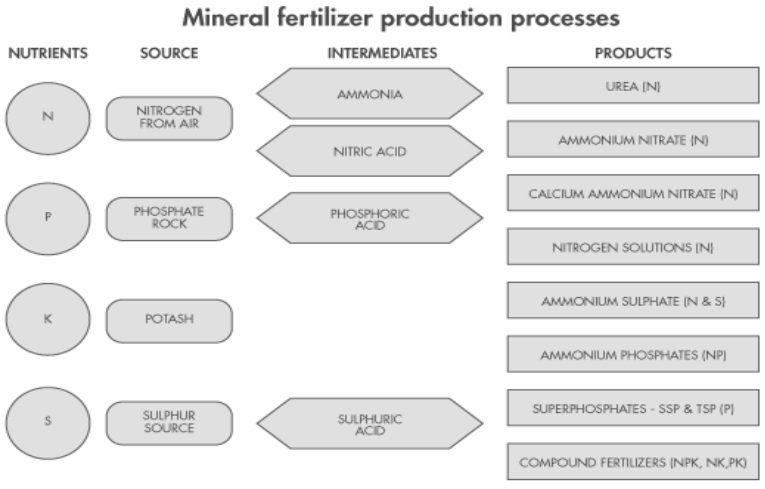

Figure 1: Some fertilizers and their sources

Figure 1 shows types of artificial fertilizers, the nutrients they contain and the source of the elements used in their production. (European Fertilizers Manufacturers Association, EFMA).

Advantages and Disadvantages of using artificial fertilizers

First, all life depend in some way on plants and without nutrients there can be no plants. The most significant benefit of artificial fertilizers is that they are sources of nutrients for plant growth. In addition, they contribute to increased agricultural productivity (crop yields), thus to food supply for both humans and animals, they also compensate for lost soil nutrients.

However the use of artificial fertilizers is not without its drawbacks, most of which have potentially severe environmental and possible human health impact. The extensive use of chemical fertilisers has been known to result in degradation of arable land. Fertilizer production is not only energy intensive but also relies heavily on the extraction of limited fossil resources, many times with attendant environmental problems, which include: soil degradation, surface and

ground water pollution, build up of toxic substances, greenhouse effect and ozone depletion among others.

In addition to the above, use of chemical fertilizers in agricultural production is not particularly sustainable. With the exception of nitrogen, which is obtained from air, most of the components of these fertilizers come from non-renewable sources. Phosphorus for example, exists as phosphate rock and is being mined at an increasing rate to meet the demand for artificial fertilizers. 80 % of phosphates used globally are in chemical fertilizers, while 20 % is divided between detergents, animal feed and other uses such as fire retardants (EcoSanRes). The mining of phosphate not only depletes reserves, it causes extensive damage to the environment, for example it is reported in Nauru, that, phosphate mining – accounting for as much as 99 % of the economic activity on the island - has stripped 80 % of the island's topsoil and vegetation (Switzer, 2001).

Phosphate resources have also been cited as a factor in border conflicts in some regions of the world, e.g. Morocco and Western Sahara (EcoSanRes). Further, chemical fertilizers are expensive and unaffordable by an overwhelming majority of farmers in the developing world.

Theoretical Framework

An alternate source of the same nutrients exist in the form of organic fertilizers e.g. plant and animal manure in various forms, and human excreta.

The practice of human waste reuse for crop production is not new, in fact human excreta have been used in agriculture for hundreds of years in many parts of the world, e.g China, Southeast Asia and parts of Africa, (Strauss, 2000). Raw human waste or wastewater is valued by farmers in parts of the world not only as irrigation water, but also for its fertilizing capacity, which provides them an alternative to expensive chemical fertilizers.

Human waste (excreta) is known to contain all the essential components of chemical fertilisers in similar proportions as in the case of urine (see fig. 2).

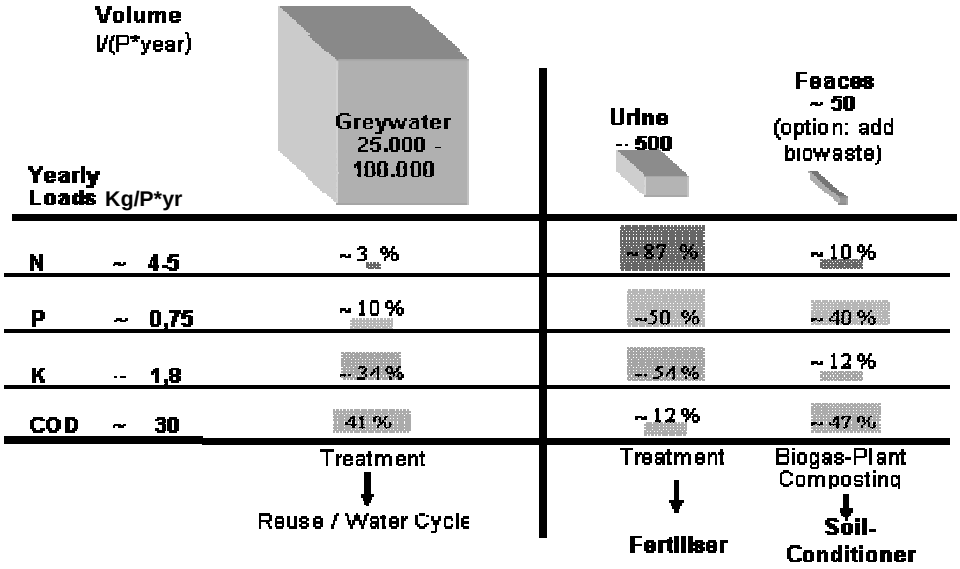

Figure 2: Nutrient components of domestic wastewater (Otterpohl, 2001, TUHH)

Figure 2 shows the percentage contribution of valuable nutrient components of human excrement to domestic wastewater. Other researchers have also given figures similar to those

above for the nutrient content of excreta. Esrey (2000) citing Jönsson (1997) reports 4.56 kg nitrogen, 0.55 kg phosphorous, and 1.28 kg potassium per person per year from faeces and urine. An amount said to be enough to produce wheat and maize for one person every year. Wolgast (1993), reports that humans excrete around 7.5 kg of fertilizer each year, mainly nitrogen, phosphorus and potassium an amount sufficient to grow 230 kg of cereal.

As shown in the figure above, urine and faeces together contains 97 % of the nitrogen, 90 % of the phosphorous, and 66 % of the potassium contained in wastewater. These components represent the essential "macro" nutrients used in chemical fertilizer.

Excreta are not only a valuable source of plant nutrient but extremely useful soil conditioners as well, which is a property that sets them above chemical fertilizers. According to Jönsson (1997), 65–90% of the fertilizing capacity in human excreta is contained in urine, making the fertilizing effect of urine comparable to that of chemical fertilizers. Faeces on the other hand are significantly lower than urine in nutrient content as such function better as soil conditioners.

A new sanitation concept known as ecological sanitation encourages the separate collection, treatment and reuse of human waste in agriculture. This concept promotes sanitation technologies that require little or no water for operation as opposed to the conventional waterborne systems. Ecological sanitation (EcoSan) is based on three principles namely: prevention of pollution and diseases caused by exposure to human excreta; treatment of human excreta as a resource rather than as waste; recovery and recycling of the nutrient content of human excreta. These are the main advantages EcoSan technologies offer over conventional sanitation technologies when properly implemented.

Several important factors influence the use of human excreta in agriculture. The most important of these are the potential human and environmental health risks associated with the practice, which means human excreta should never be applied in agriculture without adequate treatment to render the excreta particularly the faeces safe, in compliance with the established guidelines and standards e.g. the WHO "Guidelines for the safe use of wastewater and excreta in agriculture and aquaculture".

Another important factor is the acceptance by and attitude of users and consumers to the practice of human waste reuse in agriculture, which to a large extent is influenced by existing traditional and religious beliefs or practices.

This paper investigates and documents the attitudes of some communities in Nigeria and Mali to the use of human excreta as organic manure in their agricultural practices. Specifically, the study:

- examined the knowledge of respondents on the use of manure and fertilizers in agriculture;
- examined their knowledge in the use of human excreta for plant production and their acceptability and preferences,
- gives some recommendations for further research.

Methodology

Between January and June 2005, a field study was conducted in the peri urban areas of Abuja, Nigeria on ecological sanitation with a view to proposing some sanitation technologies which were to be ecological in nature requiring little or no water for operation as opposed to the conventional flush and discharge sanitation system. Since the principles of ecological sanitation systems is to view human excreta as a resource rather than waste, therefore collect excreta

separately from other components of wastewater, sanitize the material and reuse the sanitized products in agriculture, it was important that this field research examine the attitudes of the residents of the selected study sites towards human waste reuse in agriculture. A study focusing on traditional agricultural practices and human waste reuse was also carried out in some villages in the Koulikoro region of Mali.

Data collection

The following qualitative methods were used to collect both primary and secondary data: review of existing documents, observation, largely informal key-informant interview and resident survey to obtain the data used in answering the research questions. The specific study settlements and villages were selected after familiarization visits to potential study sites.

Respondents

In Abuja the following sites were purposively selected for various research objectives including their agricultural practices and the practice of open defecation by some of the residents: Chika, Kuchigoro, Mpape, Gwagwa, Karmo, Idu; while in Koulikoro region of Mali, the following sites were purposively selected for the similar reasons; Katibougou, Kati, Touroubougou, Titibougou, Koulikoro and Tande. A total of 420 respondents were involved in this study, with an average of 40 and 30 respondents per settlement in Nigeria and Mali respectively.

Data analysis

Analysis of data collected in this study included frequency counts, percentages, bar and pie charts.

Results

Characteristics of respondents from both countries

Nigeria: These respondents were a mix of indigenous people known as the Gwaris or Gbagyis and migrant settlers. Most of the migrant workers are in the low to middle income bracket and most were literate with minimum formal education up to primary school level. The indigenous people were mostly illiterate and farmers by occupation. This mix of residents implies there is no significantly dominant religion or cultural beliefs among the migrant settlers while the indigenous people mostly held traditional beliefs with a minority being a mix Christians and Muslims. Direct questions regarding religious inclinations were not included in this study due to uneasiness of subjects towards such enquiries.

Mali: The respondents in Mali are mainly Bambaras within the low-income group with very little formal education. There is no significant difference in the educational level of respondents in the two countries. In Mali the respondents were either Muslims or those with traditional beliefs.

Assessing knowledge of fertilizer and manure use in agriculture

In general, with the exception of those who declined to answer among the Abuja respondents, all other respondents in both countries know about the use of fertilizing agents in agriculture (98 %) and claimed that fertilizer increases soil fertility and hence improves their crop yield. Also, 95 % of respondents in Nigeria as well as 98 % in Mali knew about using manure in agriculture. Among these, 91 % had knowledge of animal manure use in Nigeria and 96 % in Mali respectively. It is widely believed that fertilizers increase crop yield, however a

somewhat interesting view especially in Nigeria (from personal discussions), though not directly covered in this study, is that crops grown with chemical fertilizers are not quite as tasty as those grown without.

Assessing knowledge of human waste reuse in agriculture

Respondents from Nigeria: On human waste reuse, 52% answered indicated knowledge of human excreta use in agriculture, 39% did not know about human waste reuse in agriculture while 9% declined to answer.

Respondents from Mali: 58% of the respondents indicated knowledge of human excreta use in agriculture while 42% did not know about human waste reuse in agriculture. This indicates a widespread knowledge of using manure as a fertilizer in agriculture especially that from animal sources; however knowledge of human excreta use was less common.

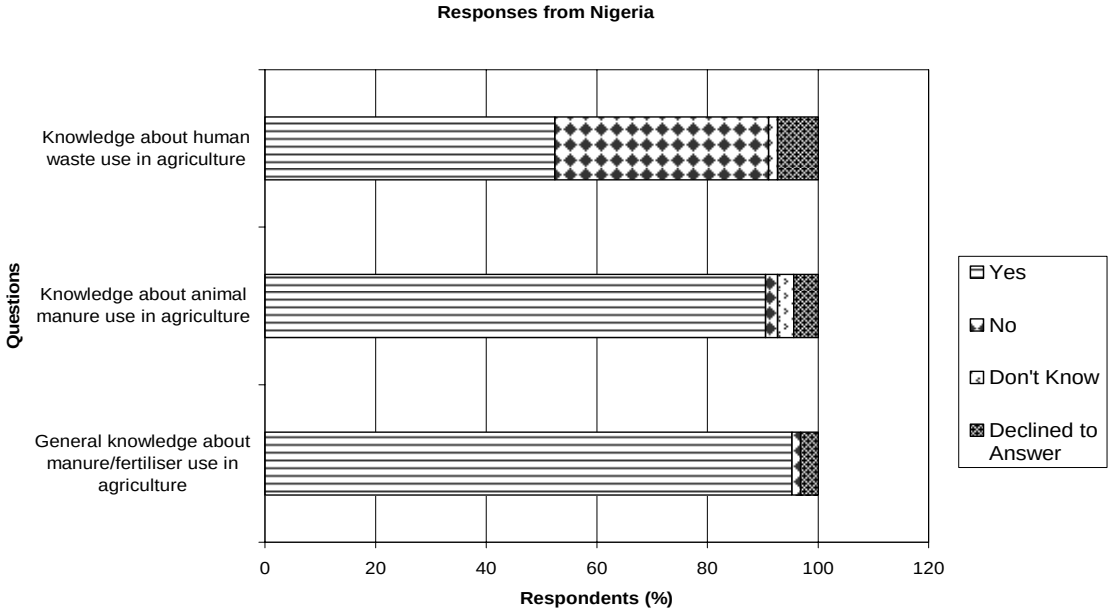

Figure 3: Responses from survey subjects in Nigeria to some of the questions posed.

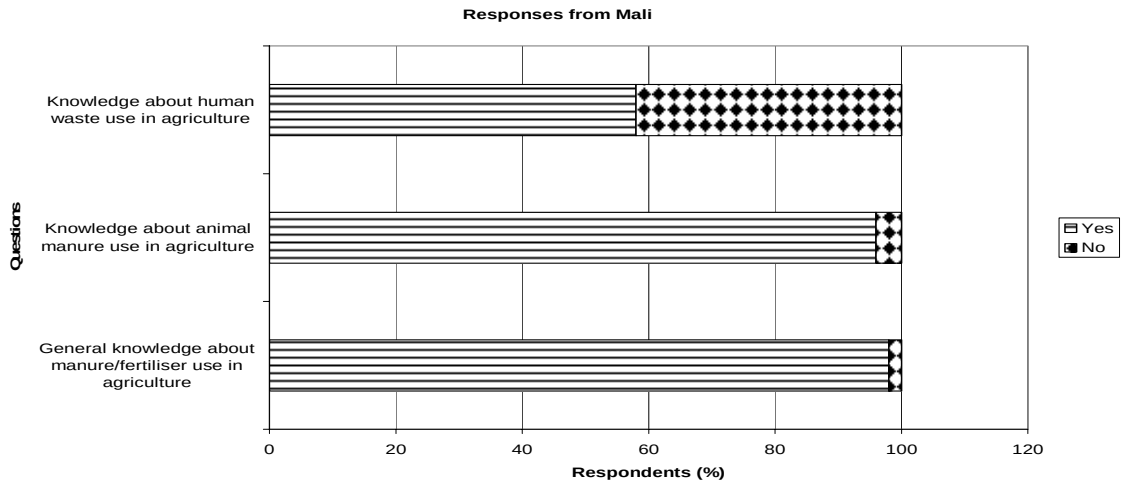

Figure 4. Responses from survey subjects in Mali to some of the questions pose.

Acceptability of Human Excreta Use in Agriculture

42% of respondents from Nigeria thought using human excreta in agriculture was acceptable and 51% thought it was not, 2% did not know and 5% declined to comment. Most of the respondents who thought human waste reuse in agriculture was acceptable were from the indigenous population who were predominantly farmers. The respondents from the settlement of Mpape had the highest percentage of objections, to using human waste in agriculture. It was observed that majority of the residents of Mpape were migrant settlers who were mostly construction site workers, which may explain their response and attitude to human waste reuse in agriculture.

In Mali, 48% of the respondents thought using human excreta in agriculture was acceptable while 40% thought it was not acceptable and 12% did not know.

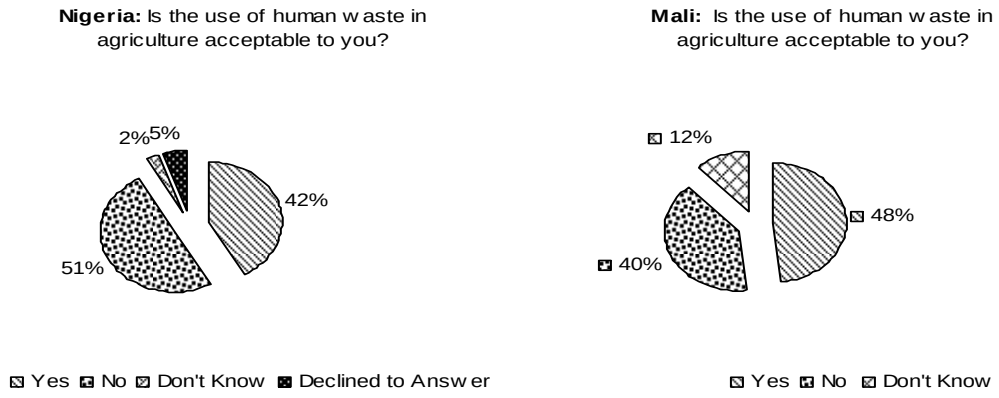

Figure 5. Responses from both countries to the question "is the use of human waste in agriculture acceptable to you?"

Regarding buying and eating food grown using human excreta as manure, in Nigeria, 51% of respondents would buy food grown using human excreta as fertilizer and 41% indicated they would not, 3% did not know and 5% declined to answer. In Mali, 46% of the respondents

said they would buy food grown on human excreta and another 54% indicated that they would not. The Mali results show a slightly higher percentage of negative responses, which may be indicative of the influences of religious beliefs. The Islamic religion has well defined stances on purity (clean, unclean, pure and defiled) especially regarding bodily discharges and places significant restrictions on contact with excreta.

In general, knowledge of the value of excreta as manure is found even among those who object to the direct use of the material in agriculture. In some villages where open defecation is practiced in Nigeria for example, it is common for a particular site to be designated both for defecation and as a solid waste dump. The site is used for some time and abandoned for a new one. Often after a period of rest, edible plants such as vegetables appear on such sites and people acknowledge that crops allowed to grow or sometimes deliberately grown on such abandoned defecation sites grow better, with bigger leaves, etc. and many have no objections to eating such plants even though they will not deliberately apply human excreta. Some farmers on the other hand consider human excreta a source of cheap fertilizing agents as they use septic tank effluent to irrigate their fields more for its nutrient value than for water.

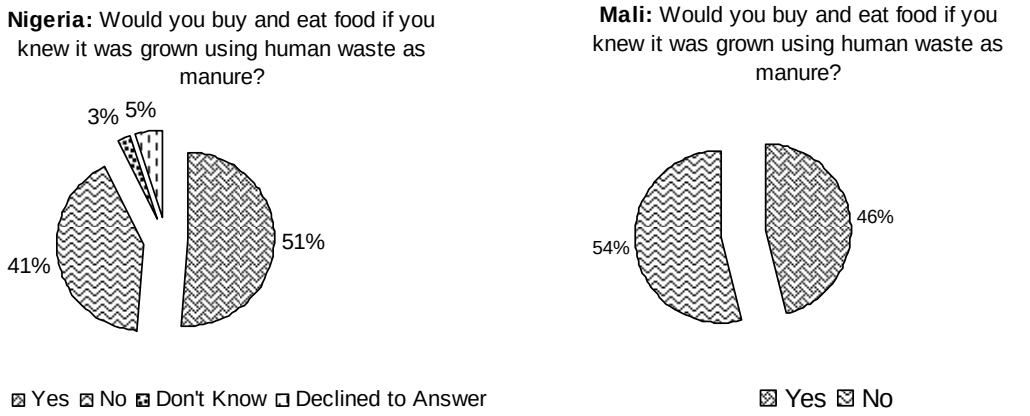

Figure 6. Responses to the question "would you buy and eat food if you knew it was grown using human waste as manure?"

Regarding beliefs about touching or handling human excreta, majority of the respondents in Nigeria 47 % did not have a problem with touching or handling human waste 47 %, while 30 % had positive views of the practice in Mali, (particularly female respondents as women are traditionally responsible for sanitation and hygiene in both cultures). Others said it was not allowed or hygienic, others said it was to them a taboo or that the practice would be harmful. Some respondents from Mali found handling human excreta unacceptable specifically due to their religious beliefs.

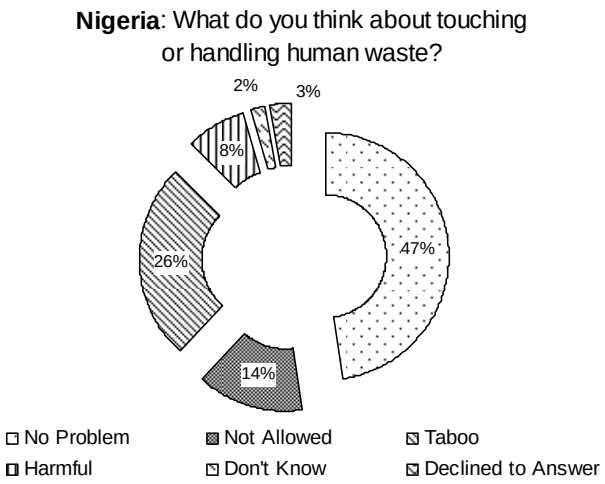

Figure 7. Views about touching or handling human waste from respondents in Nigeria

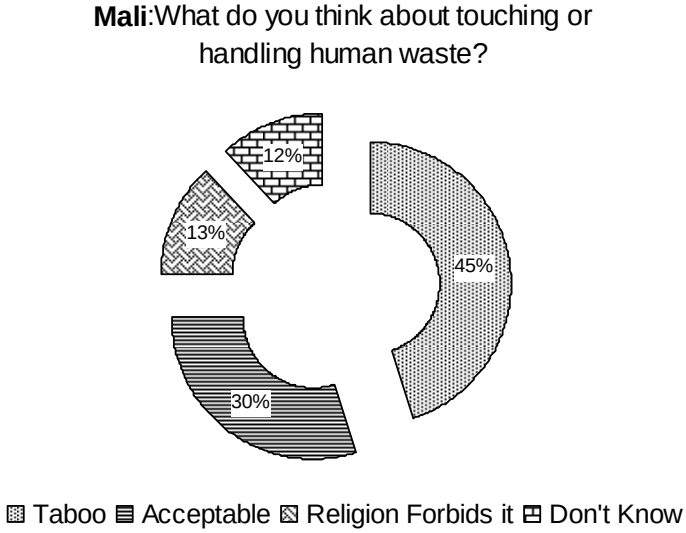

Figure 8. Views about touching or handling human waste from respondents in Mali.

Conclusion

The responses of survey subjects to the various questions are quite mixed as attitudes to excreta use in agriculture are very much influenced by traditional beliefs. It is interesting to note that knowledge of manure use especially that of animals, in farming is widespread and acceptable. Although human waste reuse was not as widespread, it is also not strange. The highest number of people who did not have any problems with handling human waste were those from settlements/villages in the two countries with a high proportion of indigenous people many of whom are traditionally farmers and who are often unable to afford chemical fertilizers, which could be likely reasons for the considerable level of acceptability of handling human excreta and low objections to its use in food crop production and consumption in these locations. Further, a lot of these indigenous people lack access to proper sanitation facilities and as such often practice open defecation and so do not find excreta overly repulsive.

Lessons learned

Human excreta are a potential resource for use in agriculture in general and particularly in the locations of the study. The practice will require some promoting as people with non-religious or cultural objections need to be made aware of the potential benefits of human waste reuse in agriculture, and those who find the practice acceptable need instruction on practicing safe excreta reuse. In general, the practice of human waste reuse needs to be thoroughly regulated in order to ensure that the public's health is not put at risk by a practice that promises immense benefits.

Research needs

In order to develop and advance the use of human excreta in food production for consumption, research into the development of low cost, low tech treatment methods for sanitizing the excreta to render it safe for reuse are needed. Also required is the development or adaptation of existing standards and guidelines to suit the existing conditions in developing countries without compromising human or environmental health. Issues of transportation of the collected excreta from point of production to treatment and use also need to be addressed.

There is also a need for effective marketing of this resource to both farmers and consumers and this is an area where the agriculture extension officers will be invaluable.

Acknowledgements

The support German Ministry of Education and Research (BMBF) in funding the field study in Nigeria and providing scholarship funds for Miss Ilesanmi through its International Office's IPSWat program is gratefully acknowledged.

References

Esrey, S.A.(1997). Food Insecurity - Its Implications for Health (Chapter 6), In: *International Perspectives on Environment, Development, and Health: Toward a Sustainable World* (Shahi, G.S., Levy, B.S., Binger, A., Kjellström, T., and Lawrence, R., Eds.) Springer Publishing Company, New York.

Esrey, S, Gough, J, Rapaport, D, Sawyer, R, Simpson-Hébert, M, Vargas, J and Winblad, U (ed) (1998). *Ecological sanitation*. Sida, Stockholm.

Esrey SA, (2000). Rethinking Sanitation: Panacea or Pandora's Box. (Chorus I., Ringelband U., Schlag G., and Schmoll O., eds.) *Water Sanitation & Health*, London, IWA Publishing, 2000:7-14.

Isherwood, K.F (2000) Fertilizer Use and the Environment. *International Fertilizer Industry Association*, Revised edition. Paris, February 2000.

Jönsson, H.(1997). *Ecological Alternatives in Sanitation: Proceedings from Workshop* (Drangert, J.-O., Bew, J., and Winblad, U., Eds.) Sida, Balingsholm.

Luo Shiming, (2002). The utilization of human excreta in Chinese agriculture and the challenge faced. *EcoSanRes.*

Otterpohl, R., (2001). Design Of Highly Efficient Source Control Sanitation And Practical Experiences. *Dentralised Sanitation and Reuse Concepts, Systems and Implementation* Editor(s): Lens, P., Zeeman, G. and Lettinga, G. IWA Publishing.

Otterpohl, R., Braun, U. and Oldenburg, M. (2003) Innovative technologies for decentralised water-, wastewater and biowaste management in urban and peri-urban areas *Water Science & Technology* Vol 48 No 11 pp 23–32 © IWA Publishing 2003.

Otterpohl, R., Grottker, M., Lange, J. (1997). Sustainable Water and Waste Management in Urban Areas (Part 1). *Water Science and Technology*, 35, No. 9, pp. 121-133.

Strauss, M and Blumenthal, U J (1990). Human waste use in agriculture and aquaculture: utilization practices and health perspectives. *International reference Centre for Waste Disposal*, Duebendorf, Switzerland.

Switzer, J (2001). Armed Conflict and Natural Resources: The Case of the Minerals Sector. A publication by the International Institute for Sustainable Development (IISD) http://www.iied.org/mmsd/mmsd_pdfs/jason_switzer.pdf

Wolgast, M (1993). *Recycling system*. Brochure produced by WM-Ekologen ab, Stockholm, Sweden.

Internet Resources

Closing the Loop on phosphorus; www.ecosanres.org;
http://www.ecosanres.org/PDF%20files/Fact_sheets/ESR4lowres.pdf
http://www.epa.gov/agriculture/tfer.html;
http://www.efma.org/manufacturing/section01.asp
http://www.skwp.de/tce/frame/main/473.htm
http://www.iied.org/mmsd/mmsd_pdfs/jason_switzer.pdf