3rd International Congress Smallwat 11 25th – 28th April 2011 Seville Spain

HELMINTH EGGS AND PROTOZOA CYSTS IN STABILIZATION PONDS SLUDGE : STUDY IN THE SOUDANO-SAHELIAN CLIMATE OF BURKINA FASO

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Introduction

Major advantage of natural wastewater treatment system in sub-Saharan Africa is its ability to reduce pathogenic organisms for the needs of reuse.

Despite the presence of physical and biological conditions in ponds that can inactivate parasites in sludge, several studies have reported that they can survive for a long period of time in raw sludge.

Objective of the work

Produce useful database on potential parasite accumulation and viability in WSP sludge in the Soudano Sahelian Climate

Study adresses:

- **Occurrence and removal of helminths eggs and protozoan cysts from wastewater in ponds**
- **Accumulation of helminths eggs and protozoan cysts in the sludge**
- **Distribution of protozoa cysts in sludge**
- **Viability and distribution of helminth eggs in sludge.**

Case study description
Burkina Faso

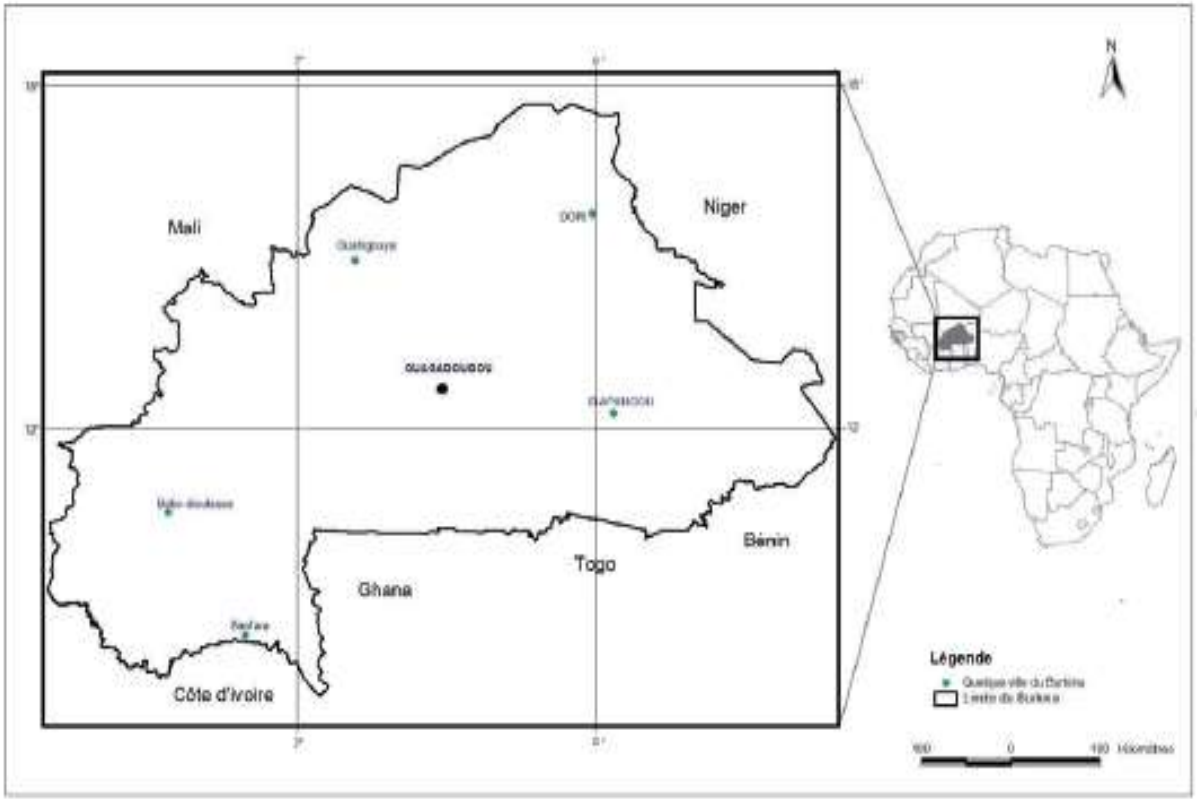
Location: 12°22'N
and 1° 30'W

Soudano sahelian climate:

Dry season : Oct-May

Rainy season June – Sept
600 to 900 mm/year

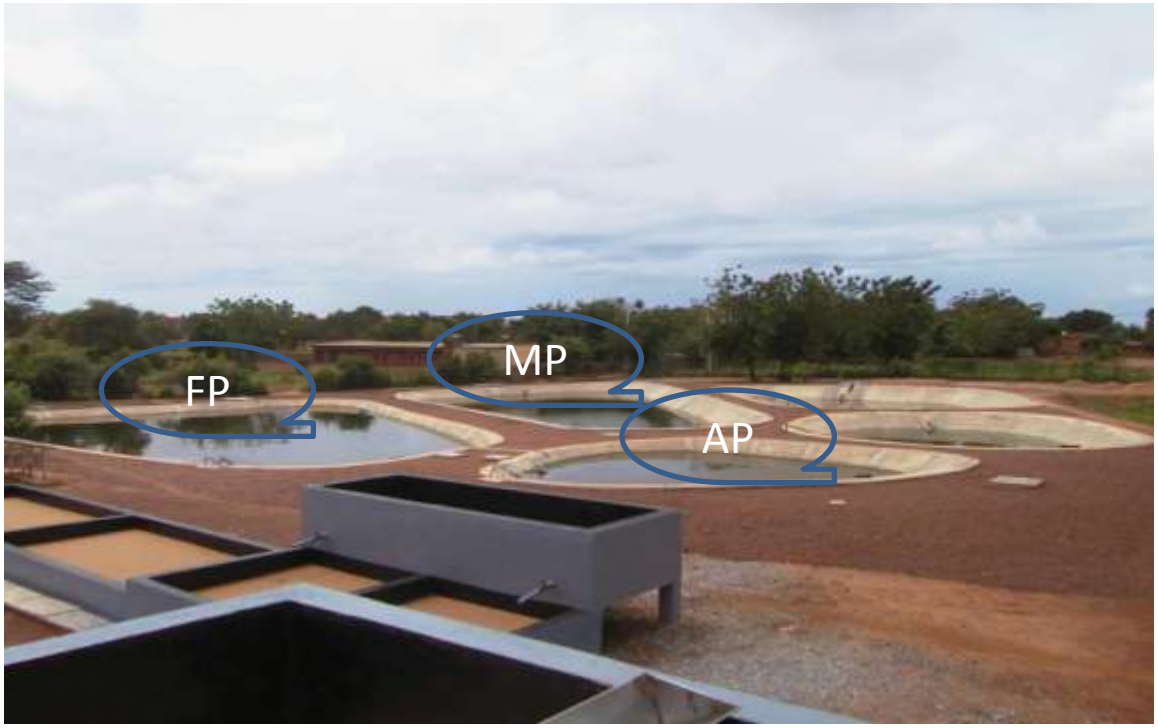
Moderatly favorable belt for
solar energy 2500h/year



Montly average T° of the coldest month: 25 to 26°C
Maximun T°42°C in april
Minimum T° 16°C in january

Pilot Scale Wastewater Stabilization Pond system of 2iE campus:

PONDS	Depth (m)	Volume (m^{-3})	HRT (day)
Anaerobic	2.6	107	3
Facultative	1.4	433	9.5
Maturation	0.9	236	5.5

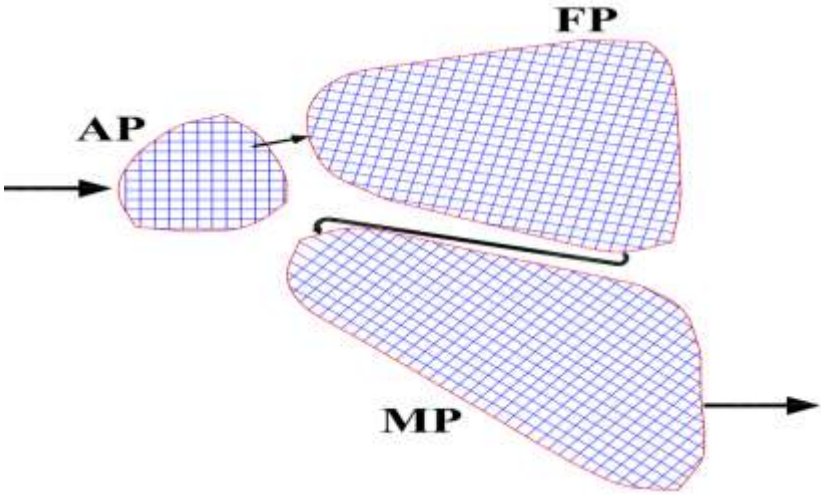


Continuous operation: **6 years**

400 Person-Equivalent (PE)

Effluents reused for the campus garden irrigation

Sampling methods

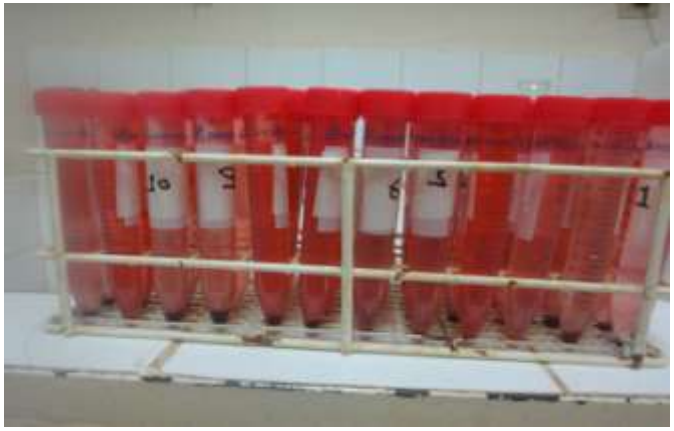


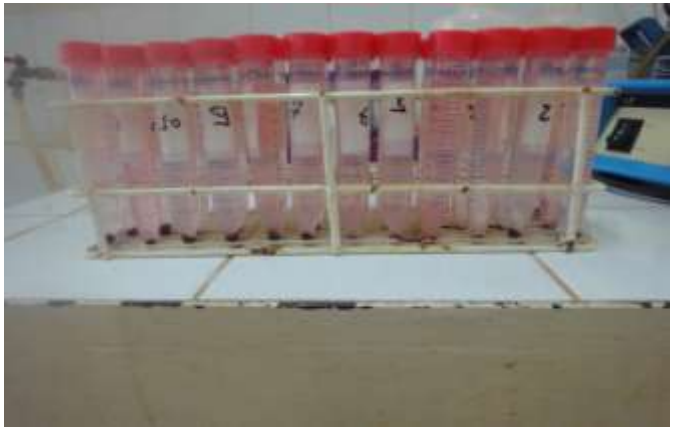
Pre-prepared grid of Ponds for Bathymetric surveys of sludge accumulation

Device of shaft syringe for sludge sampling

Analysis methods

Helminth eggs determined by the US EPA protocol (1999) modified by Schwartzbrod (2003) and **and viability test** using safranine dying method developed by De Victoria and Galvan (2003).





Enumeration of protozoa: Method of Schwatzbrod (1993), with combination of centrifugation and filtration with a solution of sodium acetate formaldehyde as an eluant.

RESULTS

Occurrence and Removal of Protozoa Cysts and Helminth Eggs in influent and effluent waste water

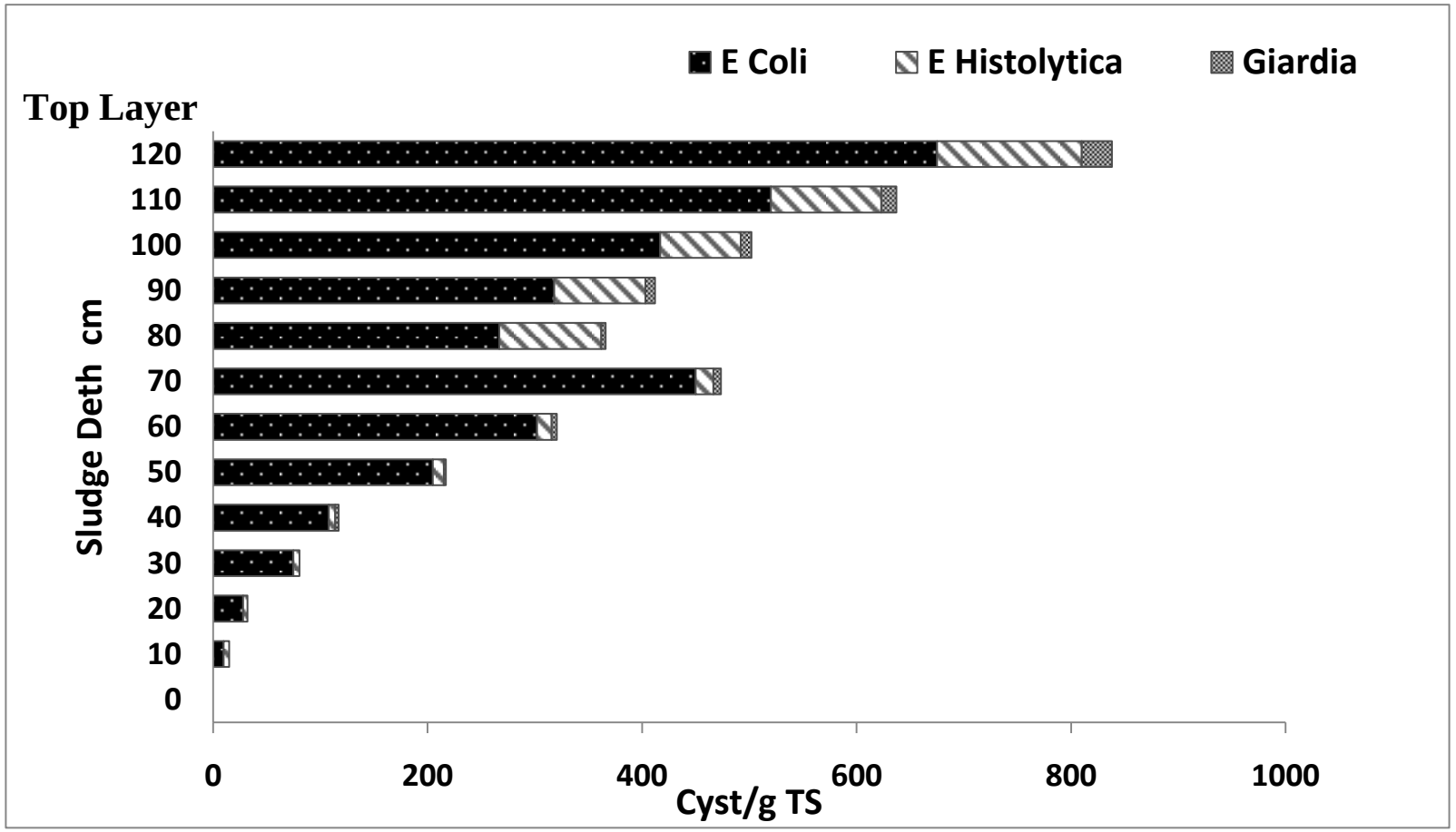
Parameter	Raw Wastewater	Anaerobic Pond	Facultative Pond	Maturation pond	nb
Helminth species	Ascaris Ancylostoma Trichirus Trichostrongilus	Ascaris Ancylostoma	Ascaris Ancylostoma		21
Concentration eggs/l	**15,7** [5 - 36]	**1,5** [0 - 3]	**0,02** [0 - 0,5]	**0**	21
removal rate for each Pond		90,4	98,6	100	21
total removal rate of eggs/ raw wastewater		90,4	99,8	100	21
Protozoa cysts species	Entamoeba Coli Entamoeba Histolytica Girdia lamblia	Entamoeba Coli Entamoeba Histolytica Girdia lamblia	Entamoeba Coli Entamoeba Histolytica Girdia lamblia		21
cysts Concentration /l	**111** [4 - 327]	**13,4** [0-70]	**2** [0- 7]	**0**	21
Removal rate for each pond		87,1	85	100	21
Total removal rate of cyst/raw wastewater		87,1	98,1	100	21

Protozoa in anaerobic pond

Average concentration in sludge :120 cysts/g TS dw

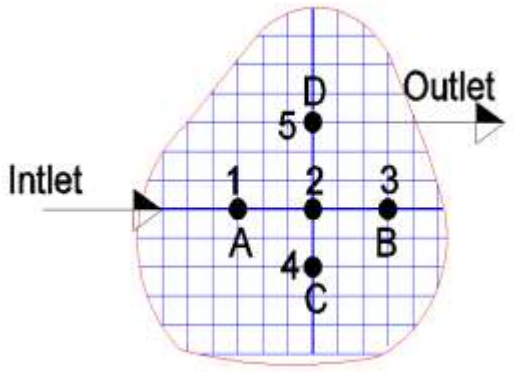
84% of cysts were *E. Coli*, 14% were *E. histolytica*, and 2% were *G. lamblia*

Protozoa cysts in vertical profil sludge in the middle anaerobic pond

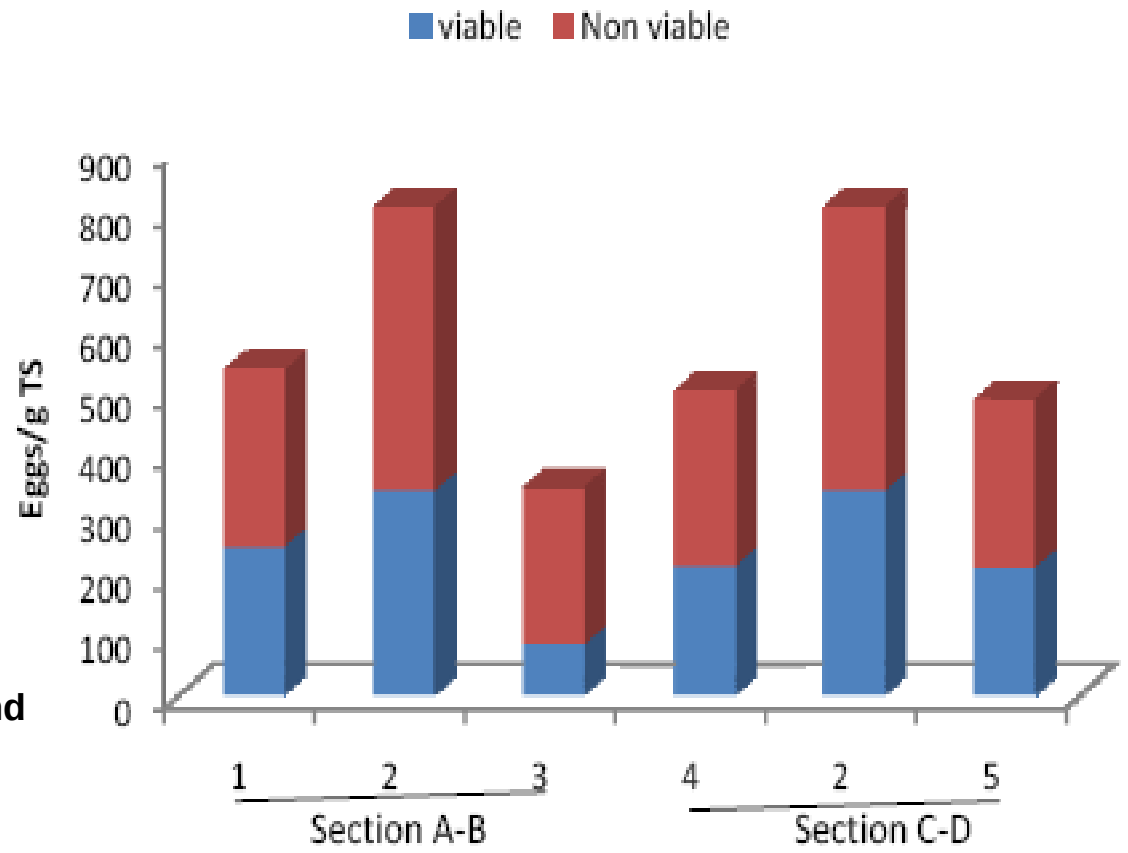


Cyst accumulation versus sludge depth showed that concentrations varied from 0 cysts/g TS at the first ten centimetres in the bottom to 838 cysts/g TS at the top layer of sludge. This difference could demonstrate that significant destruction of cysts had occurred in the deeper sludge.

Helminth eggs distribution in sludge anaerobic pond



Pre-prepared grid of the anaerobic pond



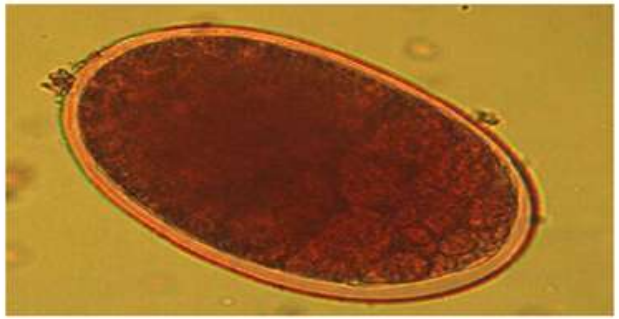
Distribution of helminth eggs in sludge along the length and width of the pond

High value of Total Helminth eggs in the middle.
At the five locations, it is likely the concentration of HE was a function of the height of accumulated sludge

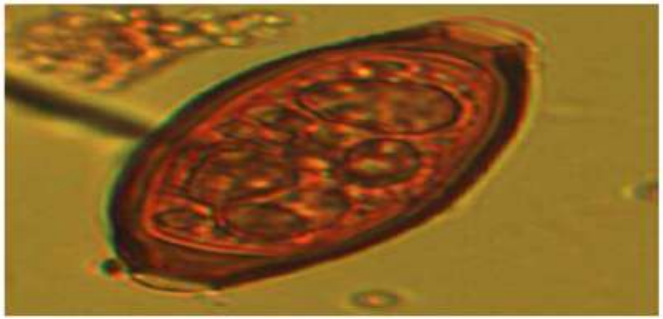
Helminth eggs in sludge anaerobic pond

***Ancylostoma sp* 55.8%,** ***Ascaris lumbricoides* 38.5%**

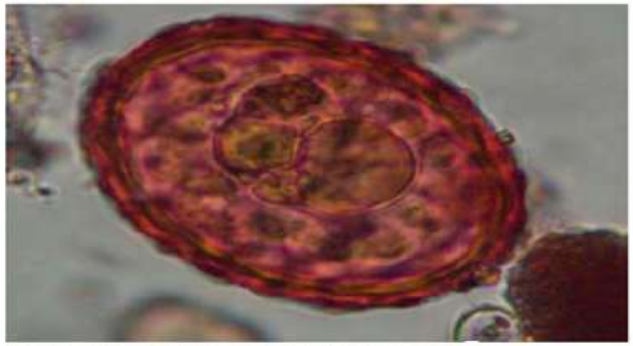
***Trichuris trichiura* 0.5%** ***Trichostrongylus sp* 5.2%.**



Trichostrongylus sp Non viable



Trichuris trichura Non viable



Ascaris Lombricoidesd Non viable

Ancylostoma viable

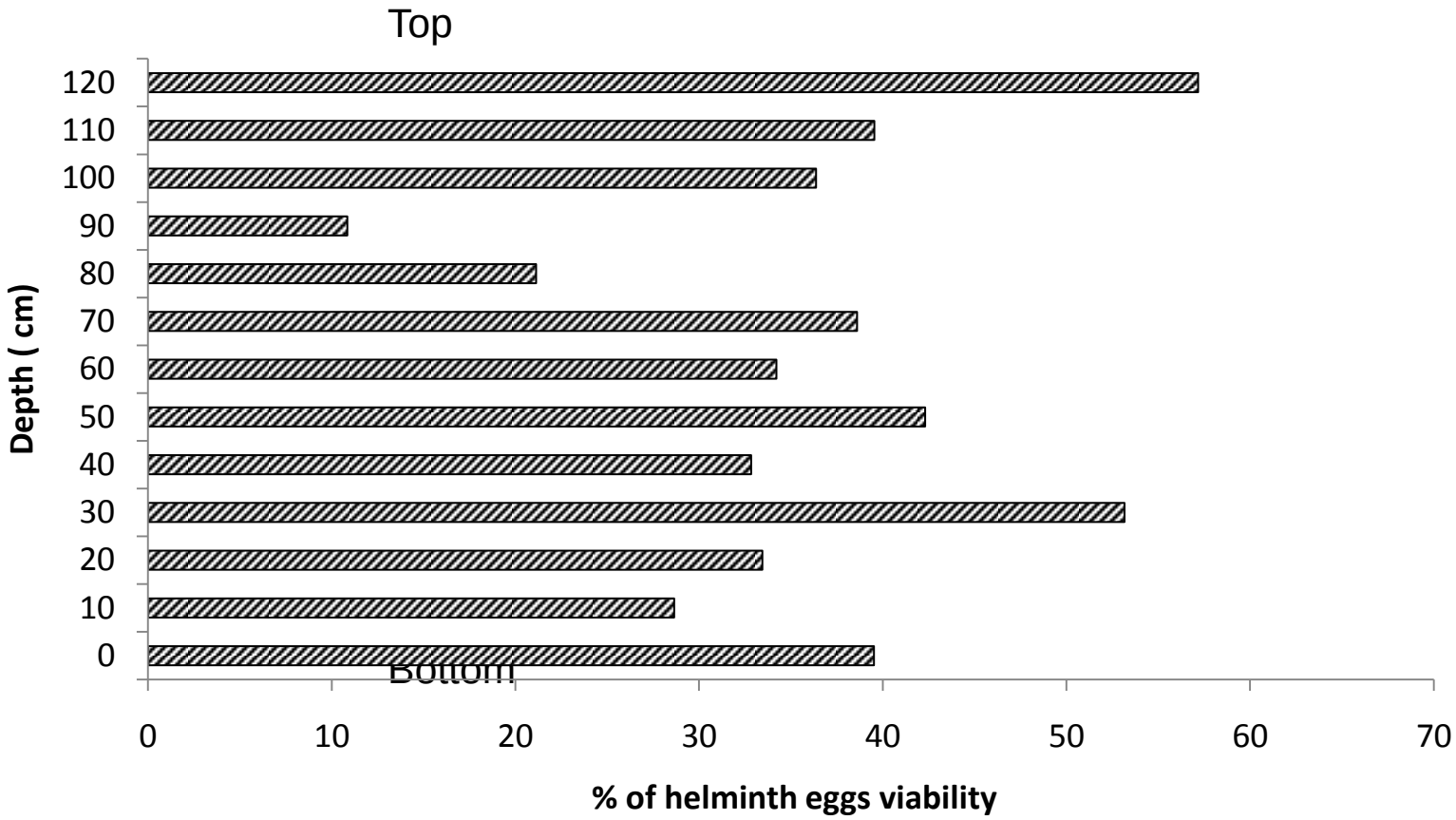
***Ascaris lumbricoides* and *Ancylostoma sp* were the most common eggs present in the sludge after four years of operation.**

Vertical distribution of Helminth eggs at the middle of anaerobic pond

		Ascaris lumbricoides		*Ancylostoma sp*		*Trichuris trichiura*		*Trichostrongylus sp*		**Total count**	
	Depth (cm)	**V**	**NV**	**V**	**NV**	**V**	**NV**	**V**	**NV**	**V**	**NV**
Bottom	0	11	36	90	109	0	4	18	34	119	183
	10	31	114	33	45	0	1	0	0	64	161
	30	95	202	258	157	0	0	67	11	421	371
	50	116	138	29	65	0	0	15	15	160	218
	70	65	158	328	486	0	13	53	53	446	709
	90	19	152	9	222	0	9	19	5	47	388
	100	120	88	133	387	0	0	44	44	297	519
	110	114	31	265	500	1	20	0	31	380	581
Top	120	1327	442	442	885	2	0	0	0	1772	1327

- The 10 cm top layer contains more helminth eggs with a viability ratio of 75% for ascaris and 25% for Ancylostoma
- Viable helminths observed at deeper depths appear randomly distributed
- Average viability 36% (336 viable eggs/g TS dw) in the sediment

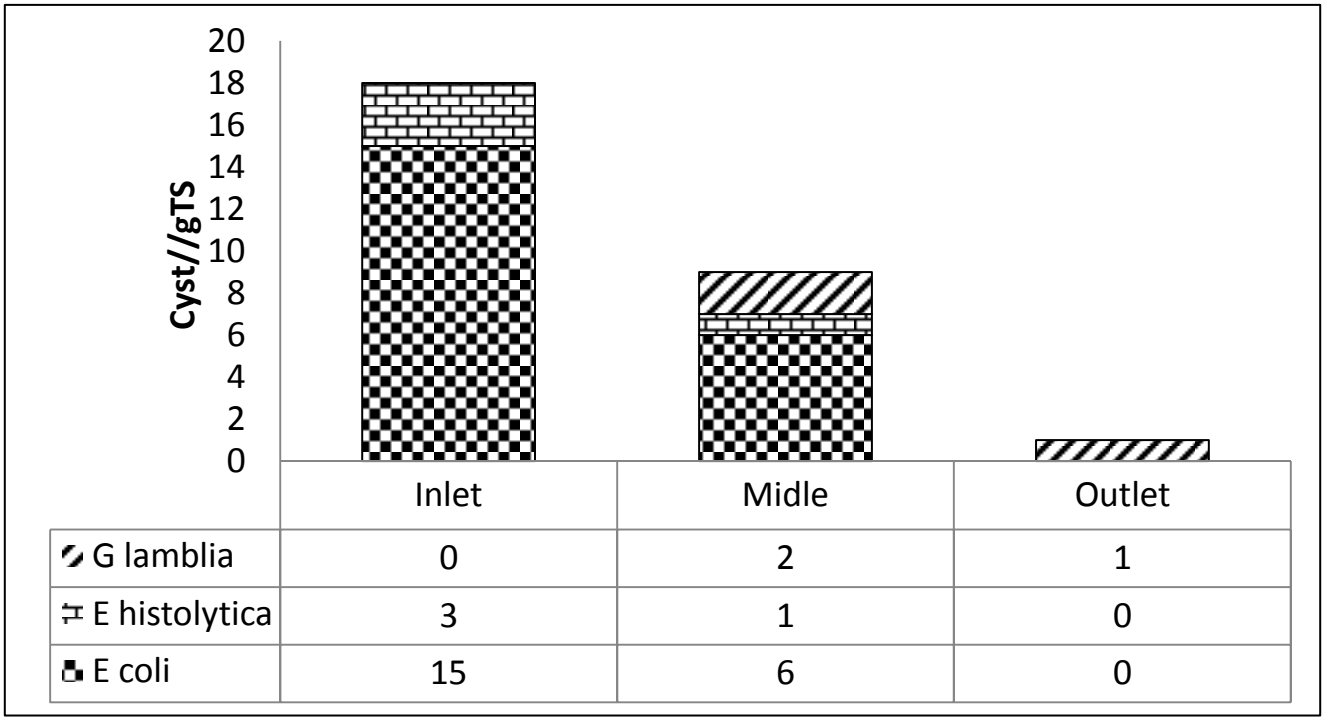
Helminth eggs viability along the depth profile at the middle of anaerobic pond



1772 viable eggs/g TS

measured at the surface

Protozoa cysts in sludge in Facultative Pond



	Inlet	Midle	Outlet
G lamblia	0	2	1
E histolytica	3	1	0
E coli	15	6	0

Concentrations of cysts in the sludge of facultative pond were found to be an average of 10 cysts/g TS.

Helminth eggs in sludge of Facultative Pond

Only two species were detected: *Ascaris lumbricoides (64 %)* and *Ancylostoma sp*. (36%).

Majority of eggs were accumulated in sludge near the inlet (60 eggs/g TS)

Only 16.3 % of detected eggs were viable,

Protozoa cysts and Helminth in sludge of Maturation pond

Enumeration of heliminth eggs and protozoan cysts showed the presence of cysts of *Entamoeba coli* (7 cyst/g TS dw) and eggs of *Ancylostoma sp*.(12 eggs/g TS)

All the *Ancylostoma sp* eggs were found to be non-viable.

CONCLUSION

This study has provided useful data on protozoa cyst and helminth egg viability accumulation in three types of ponds (anaerobic, facultative, maturation), in Burkina Faso.

Experience has showed a total absence of protozoan cysts and helminth eggs in the effluent of waste water treated by a series of three ponds with total HRT of 18 days

However sludge in the 3 ponds contents various level of protozoa cysts and helminth eggs

1. Sludge of anaerobic pond were found to be highly contaminated with viable helminth eggs, (average 336 viable eggs/g TS dw)

Concentration of protozoa cysts was found also high (120 cyst/g TS dw).

2. Eggs of *A. lumbricoides* and *Ancylostoma sp.* were found in the sludge of the facultative pond with a rate of 16.3% viability.

3. Protoza cysts were found and non viable eggs were found in the sludge of the maturation pond.

WHO guidelines suggest a helminth egg content of ≤ 1 helminth eggs/g TS for reuse

After fours years of operation, rather high viability of helminth eggs remains in the sludge demonstrating the need for further treatment before disposal and reuse in agriculture.

Such sludge treatment should be done at low cost, taking into account the financial constraints prevailing in sub-Saharan Africa regions.

Composting and drying bed technology for sludge treatment will be our next investigations for sludge management.


Thanks for your attention