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RESEARCH PROGRAM ON Water, Land and Ecosystems

Scaling out the Recovery of Nutrients and Organic Matter from Faecal Sludge for Food Production in Ghana: From Waste to Food (WaFo)

Project Brief

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1. **Idea**

In West Africa, human excreta collected as fecal sludge (FS) from on-site sanitation systems are commonly discharged into the environment due to high treatment costs and missing incentives at various stages in the sanitation supply chain to provide safe and sustainable fecal sludge management services. This results in the contamination of urban land, waterways, and food supplies by fecal-borne pathogens. This dangerous waste flow is also rich in nutrients and organic matter which are valuable inputs in agricultural systems. Past studies by the International Water Management Institute (IWMI) resulted in different excreta-based fertilizer formulations (composted FS, composted and blended FS in powder or pellet). These are collectively described here as *Fortifer*©. In particular, the GCE Phase I project resulted in knowledge on pelletizing dried excreta for easier transportation, placement, handling and marketing as well as a preliminary assessment of the market and supporting institutions. This project is to kick-start the Fortifer production and marketing in Ghana through appropriate partnerships and detailed business plan. The project will be for two years.

2. **Overall Goal**

"To commercialize the Fortifier technology for agriculture in a manner that improves the sustainability of the sanitation value chain by generating a positive revenue stream, which measurably improves cities' fecal sludge management."

3. **Strategic Importance and Innovation:**

Faecal Sludge is abundant in urban areas in Ghana and often contributes to environmental pollution due to lack of treatment plants. Its direct (raw) use in farming is also not tolerated by authorities given the health risk induced by the presence of pathogens (Cofie et al 2005, 2010, Adamtey et al. 2009, Razak et al, 2010). Data from our research confirm that FS compost compares favorably well with other sources of nutrients and organic matter for crop production. This project will offer safe FS products tailored for different agricultural uses based on 10 years of research on FS composting/blending/pelletizing/use by IWMI and its partners. It will help to turn a sanitation challenge into recovery of resources and a source of revenue that improves the financial and organizational sustainability of the sanitation value chain**.** The project will move the production of FS fertilizer from a pilot to full scale business, based on a strategic partnership with municipal authorities that are currently responsible for human waste treatment but unable to fully finance FS treatment costs.

This product will generate a revenue stream due to the market demand for soil amendments, especially in the drier parts of Ghana. The demand for FS-based fertilizer was assessed in five out of 10 regions in Ghana, of which the Northern Region has been selected for this project because farmers already use FS for agriculture. Moreover, the Northern Region of Ghana has the largest land area, consumes most of the inorganic fertilizer need in Ghana where alternative sources of fertilizer are minimal.

The institutional landscape in Ghana is favourable for use of treated FS. The National Environmental Sanitation Policy supports 'safe' resource recovery and reuse, and the private sector is very interested in related options. The proposed WaFo project will develop appropriate public-private partnership (PPP) to set a precedent for commercializing a faecal sludge resource recovery project in Ghana. The resulting viable and verified business plan will inform subsequent related initiatives such as the proposed World Bank funded US$150 M project in Accra which will include several FS treatment plants. From its inception, the WaFo project will link up with the proposed World Bank project and other stakeholders to

ensure this example can be used as a model for replication in other urban sanitation treatment projects in Ghana and elsewhere.

4. **Project Plan**

This project will achieve five main target outcomes. Each outcome as well as the related set of activities and outputs are elaborated below. The project team and management structure is described under outcome number 5.

Outcome 1: PPP formed with demonstrated co-funding at 50% of total lifecycle costs

The target outcome 1 requires that a private or public sector production and marketing partner (herein referred to as ProCom (or some form of PPP agreement) commits to operate the Fortifer production facility of 500-1000 tons[1]). Capital investment made by the WaFo Project will be re-invested by the ProCom into the sanitation value chain or used for replicating the project elsewhere. Table 1 presents the activities and expected outputs needed to achieve Outcome 1.

Table 1. Activities, Outputs and Timelines for Outcome 1

Description of activities	Output/Deliverable	Time (Month)	Responsible[2]
1A. Partnership establishment			
1. Includes a review of typology of relevant PPP models	A report, which can be circulated externally, summarizing at least 4 relevant PPP models; at least one case example of each model in practice; recommendations for at least two models that would be particularly relevant for the Fortifier business.	1-2	TREND
2. Revision of financial plan with sensitivity analysis – based on further ground reality checks costs, competition, potential customers and pricing for the selected city	Revised financial plan in excel format; A *narrative* of assumptions and risks of the business. This plan will include estimates for the how a city's treatment costs would be reduced by partnership with IWMI/Fortifier and the potential increase in city's treatment capacity. This analysis will result in a stand-alone brief that	3-5	IWMI

[1] The final capacity of the Fortifer production plant will be confirmed after the selection of the municipality in which the technology will be implemented and following a preliminary baseline study.
[2] Lead institution listed (contributing partners in parenthesis)

	can be circulated externally.		
3. Define criteria for identifying potential partners and shortlist of potential partners	• List of partner selection criteria and partner shortlist (city and private partners) • Process and timeline for vetting and selection of a city and a production partner. • Analysis of partner options and selection recommendations shared with the project advisory board for final approval	1-2	IWMI
4. Partner meetings and negotiations on financing	Partner identified and agreements signed	3-6	TREND
1B. Treatment plant installation and operation			
1. Assessment of production site	Report with the mapping and SWOT analysis of at least two alternative production sites and localization of future investment	1-2	Municipality, (IWMI)
2. Construction bidding and selection of a contractor	Final budget; Constructor selected; Final timeframe for construction of the plant established	3-5	IWMI
3. Development of production site	• 30% achieved by M9 to allow the launching of the production • 100% achieved by the end of this period	6-18	Construction company
4. Fabrication and test–run of equipment of the pelletizing unit	Pelletizing unit installed	3-9	Construction company
5. Launching of Fortifer production unit and field visit	Production of Fortifer initiated	10	ProCom, (TREND, IWMI)
6. Continuous process optimization[3]	Process optimization testing plans are submitted and approved monthly to project management team and are based on trial production records and analysis.	10-24	ProCom with support from IWMI
1C. Business plan development			
1. Post-launch fine tuning of process and marketing strategy based on partner and market	Make a detailed Business plan document with revised financials	12-18	IWMI, ProCom

[3]An optimization master plan will be submitted to the foundation for review and comment by M3. Optimization activities may include trying other FS sanitization and financially viable processing options to increase waste processing rate, optimize value and reduce production costs.

feedback 2. Integration of the logistics with the marketing function, regular monitoring & evaluation of marketing, manufacturing, and operation through training of the sales force, planning of advertising strategy (radio), developing distribution channels and obtaining customer feedback for the launch.			
3. Financial Analysis for Two Models a. Detailed financial analysis for the Business Plan based on operational experience b. Analysis of alternative options for allocating a portion of the Fortifier revenue stream to improve FS collection coverage, to increase amount of sludge treated, and/or to reduce collection costs faced by underserved populations (slums, schools, etc.)	Annual Revised Financial Plan Mirroring Actuals & Financial Plan with social benefit model incorporated Report generated with alternative models for using resource recovery revenues to strengthen the sanitation value chain with recommendation for revenue sharing strategy in Fortifier location.	13-24	IWMI

The Business model will be based on a strong partnership with key actors bridging between sanitation and agriculture and attempt to include the private sector and Government agencies.

Outcome 2: By month 24, the project has secured off-take contracts for 50% of the production of certified Fortifer

This Outcome implies that Fortifer production and commercialization is permitted in Ghana. Fortifer must be certified by the Crops Services Directorate of MoFA as a "fertilizer"; and that the production process as well as the fertilizer are certified for environmental and health safety by Ghana EPA (by Month 18). Off-take contracts with different product buyers (public, private or cooperative) for 50% of production by the end of year 2 is also targeted. Table 2 presents the activities and expected outputs needed to achieve Outcome 2.

Table 2. Activities, outputs and timelines for Outcome 2

Description of activities	Output/deliverable	Time (Month)	Responsible,
2A. Certifications with Ghana EPA and with the Crops Services Directorate (MoFA) // with support of ProCom			
1. Registration of project with EPA, MoFA	Certification process initiated	1	TREND
2. Screening and consultation to determine type of health & environmental assessment needed and type of policy instruments available	Study Protocol	2-4	TREND
3. Scoping and development of TOR for EIA /health/Quality assessment study	ToR	5	TREND
4. EIA and Quality assessment study	Study Report	6-12	TREND
5. Demonstration farm	Demo farm in selected locations across Ghana for choice crops, especially plantation crops	3-24	MoFA (farmers, IWMI)
6. Determination of the optimal application rates for at least two additional crops[4]	Fortifer application rates recommendations summarized in a guidance document for different clients, including retailers, users, government.	1-15	IWMI (MoFA)
7. Review of assessment documents	Recommendation from the advisory team (?)	16-17	IWMI (AT)
8. Follow-up for final approval and issue of permit by relevant governmental authorities	Certification Permit	18	TREND
2B. Market research, marketing plan, securing sales contract			
1. Conduct research on marketing strategy	A report providing an assessment of customer needs, identification of target buyers and end users, and a recommendation on marketing strategy to reach the target customer base	2-12	IWMI, ProCom
2. Review of models for off-take agreements and market commitment mechanisms	A report summarizing models for off-take agreements and for market commitment mechanisms and recommendations for best approaches for composting business	2-18	IWMI

[4] Only maize and cabbage have been tested so far.

3. Awareness creation on the product	• 500 farmers reached based on the recommendations of the marketing strategy report • 50 extension agents and 10 GAIDA distributers trained on appropriate use of Fortifer	13-24	ProCom, IWMI, TREND
4. One workshop organized on the production process and the results of the demonstration activities with users (with field visit)	Media coverage includes, TV, newspapers, radio), 50 GAIDA members, 50 extension agents, government authorities, etc. attend workshop and receive samples and use information.	20	TREND, ProCom
5. Secure sales contract with potential distributors/customers	Formal Commitment from one or more distributors and/or customers to purchase 50% of the production from period 7/2014-7/2015	13-24	ProCom

Outcome 3: Demonstrate that the implementation of the Fortifer plant results in 100% increase in volumes of treated sludge in the city while costs of sludge management are reduced by 25% compared to conventional scenario

Currently, large amounts of FS are not forwarded to the treatment plant in Tamale. Eight trucks (6-8 m^3 of capacity) are being operated in the city. They belong to public institutions such as Tamale Metropolitan Assembly, Tamale Polytechnic, the Ghana Prisons Service, the University for Development Studies and to one private sanitation company (Zoomlion). Each truck can be filled 3-8 times per day (the highest level being observed in the rainy season), but the treated amount is barely 1,500 m^3/month. Based on the production rate of 2003, and taking into account the population increase in the area, the total amount of sludge produced in the city should be around 3,100 m^3/month. It is anticipated that this project will improve the current state by creating incentives for sludge emptiers to discharge their waste at the treatment plant. The activities involved in assessing these benefits are in Table 3.

Table 3. Activities, outputs and timelines for Outcome 3

Description of activities	Output/deliverable	Time (Month)	Responsible
3.1. Baseline study	• Validation of the maximum production capacity of Fortifer plant based on real quantification of sludge availability in Tamale (M4) • Report that establishes baseline conditions (costs of treatment under status quo treatment technology and sanitation model, volumes of each type of FS material being generated and/or	1-12	IWMI (Consultants, Municipality)

	treated) (M12)		
3.2. Assessment of health/environmental and financial impacts of the new model (i.e. with Fortifer production)	Report outlining benefits of Fortifer production in Tamale on the sanitation chain in terms of increased volumes being treated, level of revenue shared back into the sanitation system, benefits of revenue sharing model, spill over incentives to the city to enforce dumping restrictions and properly maintain/operate capital due to revenue generation potential	12-24	IWMI (Consultants, Municipality)

Outcome 4: Proven and replicable business and technology solution established

Once established in Tamale, four Ghanaian cities will be pre-selected and targeted for replication of the Fortifer solution within 4 years. Guidelines for adoption of the technology in other countries will also be provided. The activities to achieve this outcome are in Table 4.

Table 4. Activities, Outputs and Timelines for Outcome 4

Description of activities	Output/deliverable	Time (Month)	Responsible
4A. National market expansion plan for production and distribution of Fortifer			
1. Prefeasibility study for four target cities	Input for market expansion plan/ report providing an assessment of sanitation systems and potential fortifier markets in at least four cities	12-21	IWMI
2. Selection of one or two cities for expansion plan	List of target cities	21	IWMI (AT)
3. Workshop to present results of prefeasibility study to a potential production partner and other relevant stakeholders (including donors)	Informing potential partners	22	TREND (IWMI)
4. Consultation with a potential production partner and industry stakeholders to device an entry strategy to the selected two cities and to develop possible PPP partnership models	Typology of PPP partnership models for 2 cities	22-24	TREND (ProCom, IWMI)
5. Finalization of National market expansion plan jointly with a potential production partner	Market expansion plan report	24	IWMI (ProCom)
4B. Global adoption of the Fortifer solution			
1. Develop metrics for effective adoption of the demonstrated solution	Guidelines for adoption and implementation of the Fortifer Solution in other countries	18-24	IWMI

Outcome 5: Project is effectively managed to deliver on agreed outcomes by end of year 2 (Management and Coordination)

The initial core team is made up of IWMI, a networking organization, a Consulting Firm which will be selected following a competitive and transparent procedure after project start, the Municipal Waste Management Department and the Ministry of Food Agriculture. By the sixth month, the ProCom would have been identified and included in the core team. One representative each from these partners will constitute the Steering Committee with responsibility for project implementation. An advisory Team will be set up to serve as a sounding board. Other stakeholders would be engaged as necessary.

- IWMI, the Lead Institute is responsible for overall project coordination. Moreover, IWMI takes the lead in business and process optimization, Fortifer use guidelines, financial impacts as well as development of expansion plans.
- Training Research and Networking for Development (TREND Group) will be responsible for all activities involving engagement of public authorities and private entities (e.g. PPP facilitation, partner negotiations, certifications, etc.).
- Municipality (Waste Management Department) responsible for FS Management, institutionalization of FS recycling
- Ministry of Food and Agriculture (MoFA) for promotion of Fortifer use through extension services; mainstreaming into fertilizer use policy and training of farmers in Fortifer application
- Fortifer Producer and seller (ProCom) – With Jekora Ventures Ltd. (JVL) pre-selected under some conditions.
- Advisory Team to be constituted and will serve as a sounding board to the project. It will consist of influencers and advisors from public and private sector such as: Representative of Waste Management Dept in Ghana, MoFA, National Development Planning Commission, Financial institution, private waste management companies, EPA and Agro dealers
- Others Stakeholders will include consultants to be contracted by any of the core partners, Research /Training, University for Development Studies (UDS), Water, Engineering and Development Centre (WEDC), Ghana Agro dealers association (GAIDA) etc.

Activities and outputs to achieve outcome 5 are presented in Table 5 while Figure 1 gives a rough illustration of the links between the various project outcomes

Table 5. Activities, Outputs and Timelines

5	Description of activities	Output	Time (Month)
5.1	Project planning workshop and Constitution of the Steering Committee (SC) responsible for project implementation	-Steering Committee established - workshop report	1
2	Constitution of Advisory Team	Advisory Team formed	1
3	Monthly reporting and meeting of the SC	Monthly briefs	
4	Half yearly project reflection meeting	Report	6, 12, 18, 24

5	Half yearly meeting of the Advisory Team	Minutes	
6	Preparation of knowledge materials including information note for including the results of the outputs into funding and programmatic decision making processes at the World Bank and AfDB	Articles, briefing notes, guidelines, Monthly Newsletter	12, 23
7	Two strategic workshops to showcase the Fortifer solution	Market expansion plan report	12, 24

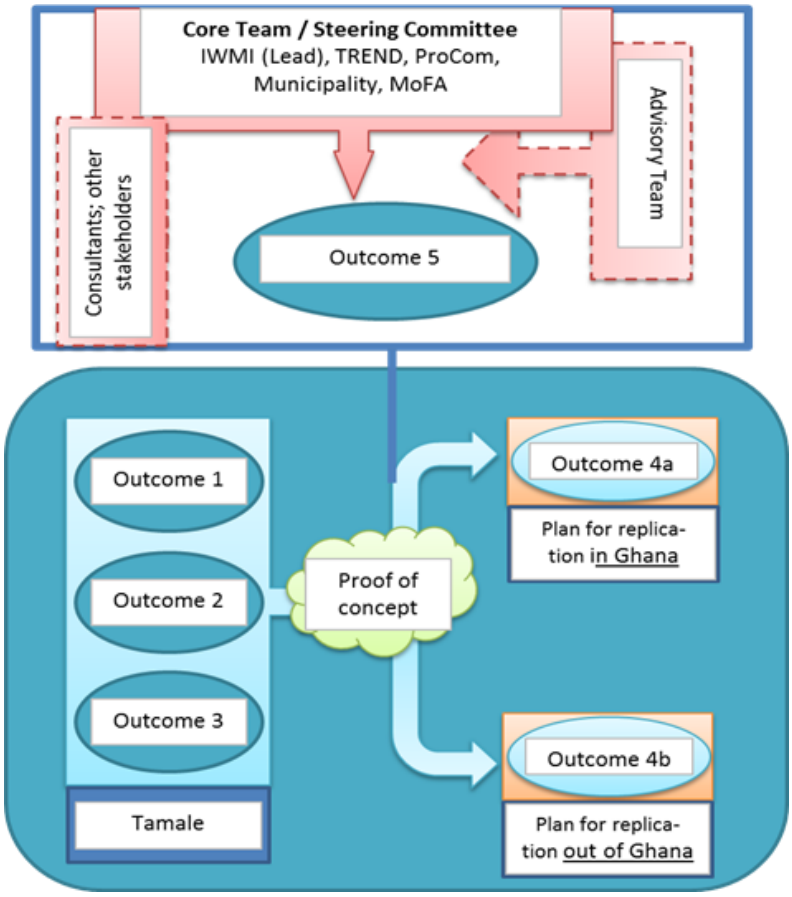

Figure 1: WaFo Project Outcomes and links

Overall, resource recovery will improve the sustainability of the sanitation value chain in Tamale, or the selected project city otherwise. Faecal sludge which so far is used raw, will be available as a safe product on the market and generate a revenue stream and incentive model to that reduces the levels of public land, food, and water contamination. The project will achieve proof-of-concept in Northern Ghana and will generate a thoroughly documented startup process and replicable business model to be used by partners in other parts of Ghana and countries where there is already some interest like: Burkina Faso, Ethiopia, Nigeria, Kenya, India, and Sri Lanka.

Capabilities:

- IWMI's proven capacity to manage multi-partner projects at different scales.

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- IWMI Africa office with financial and administrative capacity is located in Ghana; all suggested partners are well-known.
- Partnership with major private and public sectors partners offers highest probability of success
- Multidisciplinary team include market economist and engineers, and long term experience in excreta management, composting and agricultural reuse
- Business development unit within IWMI research team.
- Strategic partnership network, national and international.

References

Adamtey Noah, Olufunke Cofie, Godfred K. Ofosu-Budu, Seth. K. A. Danso and Dionys Forster (2009). Production and storage of N-enriched co-compost. *Waste Management*: 29 (2009) 2429–2436

Cofie, O.O., Gordana Kranjac-Berisavljevic and P. Drechsel. (2005) The use of human waste for peri-agriculture in northern Ghana. *Renewable Agriculture and Food Systems*: 20(2); 73–80

Cofie O.O, Adeoti, A., Nkansah-Boadu, F. and Awuah E. (2010). Farmers Perception and Benefits of Excreta Use in Southern Ghana. Resources, Conservation and Recycling 55 161–166

Danso, G.P. Drechsel, S. Fialor and M. Giordano. (2005). Estimating the demand for municipal waste compost via farmers_ willingness-to-pay in Ghana

Idrissu S. N. (2012) "Feasibility of incorporating composting into faecal sludge treatment plant and agriculture in the western region of Ghana. An M.Sc. Thesis submitted to the Department of Agricultural Economics and Agribusiness, College of Agriculture and Consumer Sciences, University of Ghana, July 2012.

Nkansah – Boadu, F. Socio-cultural and economic factors influencing faecal sludge use in agriculture in the manya krobo district. (2006) A. M.Sc. Thesis submitted to the Department of Civil Engineering, Kwame Nkrumah University of Science and Technology. July 2006

Razak Seidu (2010). Disentangling the risk factors and health risks associated with faecal sludge and wastewater reuse in Ghana. PhD Thesis. Department of Mathematical Sciences and Technology. Norwegian University of Life Sciences. Norway.

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