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WINROCK INTERNATIONAL

John Ogonowski and Doug Bereuter Farmer-to-Farmer Program
-FTF for Food Security/Bangladesh-

BAN320 Improved Compost Production and Technology

1.0 Background

Bangladesh is an independent nation in southern Asia occupying 144,000 square kilometers (55,598 square miles), and it is divided into 6 administrative divisions: Dhaka, Chittagong, Khulna, Barisal, Rajshai and Sylhet; and, 4 major municipal corporations: Dhaka, Chittagong, Khulna and Rajshahi (**Figure 1**). The territory is slightly greater than the state of New York. The capital city is Dhaka, located in the central part of the country. With a population of ~163.7 million (July 2013 est., CIA World Factbook), or 1,137 people per square kilometer, Bangladesh is ranked as one of the eight most densely populated countries in the world. Bengali is the dominant ethnic group, comprising 98% of the population of whom a majority are Muslim. About 9.8% of the population is Hindu. The official language is Bangla (also known as Bengali).

Bangladesh lies astride the tropic of cancer between 20° 34′ and 26° 38′ north latitudes and 88° 01′ and 92° 41′ east longitudes. It is located at the interface of two different environments: the Bay of Bengal to the south and the Himalayas to the north. India's territories completely envelope the eastern, northern, and western borders of Bangladesh, except for a small area in the southeast with Myanmar (formerly known as Burma). It is divided into three broad physiographic units according to distinct geological ages: Tertiary hills (oldest), Pleistocene terraces, and recent floodplains (youngest). About 80% of Bangladesh is on floodplains, comprising the delta of the two largest rivers on the Indian subcontinent—the Ganges and Jamuna (Brahmaputra). Tertiary hills and Pleistocene terraces occupy the remaining 12% and 8% of the area, respectively. The climate is a humid tropical-subtropical monsoon type with three distinct meteorological seasons: summer (March -June), monsoon (June-October), and winter (October-March). Rainfall ranges from 1,500 mm in the northwest to 5,000 mm in the northeast. Agriculture land use in Bangladesh depends on the distribution of rainfall, mainly related to the duration and uncertainty of the arrival and departure of the monsoon season, as well as the occurrence of drought. Agriculture is the most important sector of the Bangladeshi economy, contributing 19.6% to the national GDP and providing employment for 63% of the population. Rice is the everyday staple food of Bangladeshis, and its culture is an omnipresent feature in the landscape. Rice is produced mainly for domestic markets whereas jute and tea are major export crops. In addition, Bangladeshi farmers produce sugarcane, tobacco, cotton, and various fruits and vegetables (sweet potatoes, bananas, pineapples, etc.) for the domestic market.

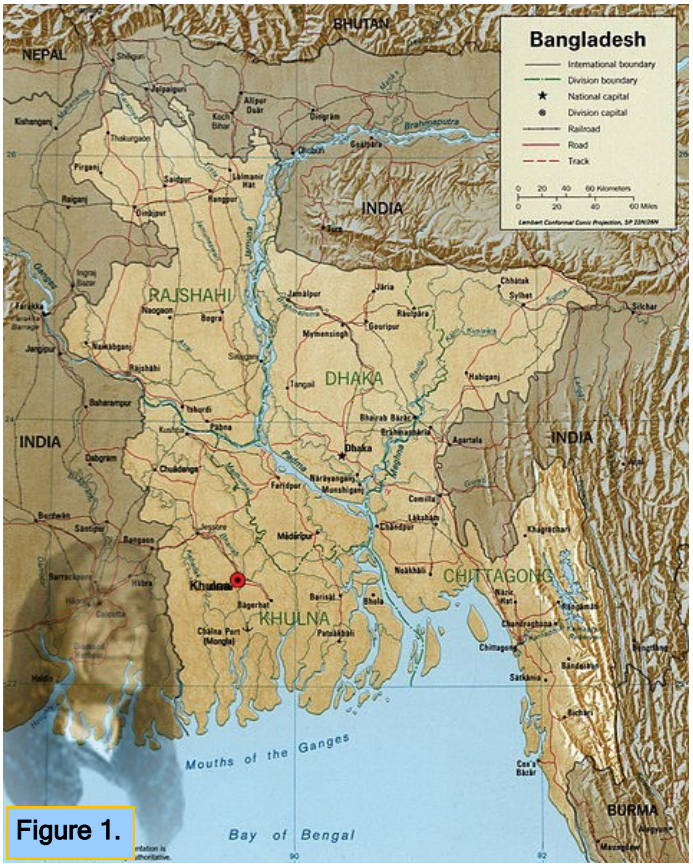

Figure 1.

The Farmer-to-Farmer (FTF) Program provides voluntary technical assistance to farmers, farm groups, and agribusinesses in emerging and transitional countries to promote sustainable improvements in food security and agricultural processing, production, and marketing. FTF assignments generally last from two to four weeks.

The FTF Program was initially authorized by Congress in the 1985 Farm Bill and funded through Title V of Public Law 480. The current FY 2009-2013 phase of the program was authorized by the U.S. Congress in the 2008 Farm Bill, designating it the "John Ogonowski and Doug Bereuter Farmer-to-Farmer Program" in memory of John Ogonowski, agriculture activist and American Airlines pilot who was murdered in the September 11, 2001 attacks on the World Trade Center, and former Congressmen Bereuter, who initially sponsored the program.

The BAN320 assignment took place in, and around, Khulna, the principal city of Khulna district (**Figure 1**). Khulna is the third largest city in Bangladesh after Dhaka and Chittagong. It is located approximately 330 kilometers southeast of Dhaka in southern Bangladesh on the banks

of the Rupsha and Bhairab Rivers. The southern area of Khulna district is covered by extensive tracts of halophytic mangrove forest called sundarbans (literally translated as *Shundor, "beautiful" and bon, "forest"* in the Bengali language). The sundarbans comprise the largest area of tidal mangrove forest in the world, and were inscribed as a UNESCO world heritage site in 1997. It is home to many exotic and endangered fauna including the Bengal tiger.

Oddly, Khulna city has no airport. Traveling there entails two legs: one, by air from Dhaka to Jessore Airport 71 kilometers north of Khulna; and two, by ground transport from Jessore to Khulna. Needless to say, travel fatigue was a prominent feature early in the assignment, especially for someone traveling from his country home one hour from a departing flight at RDU International Airport in North Carolina, with connections in Chicago, Narita (Tokyo), and Bangkok.

BAN320 lasted from 18-31 August 2013. The tentative program schedule, arranged in advance by Dr. Shamsul Kabir, Winrock International Asia FTF Regional Program Director, was: August 18-19: mobilization to Dhaka and travel to Khulna via Jessore by air and ground transport; August 20: follow-up with Environment Friendly Agricultural Development Foundation (EFADF) and advice for further improvement; August 21: follow-up with RUSTIC municipal composting project, and advice for further improvement; training for the primary host, Bismillah Fish and Poultry (BFP) Farm from 22-27 August, with Friday (Sabbath) a day of rest. The BFP training took place at two sites (1) BFP Farm located about 10 km outside of Khulna off Highway 740 (Khulna-Satkhira) and (2) Gazi Medical Teaching Hospital in Khulna. The reason for two training locations is the farm's principal operator, Tania Rahman, and BFP chairman and surgeon Dr. Gazi Mizan, reside at the teaching hospital where both work. Day-to-day management of the BFP farm is delegated to one farm manager, Mr. Sk. Habibur Rahman, and assistant farm hands. During this period some afternoons and/or evenings were also devoted to visiting local research and development sites. Following BFP training, return to Dhaka via Jessore on 28 August and work on end of assignment report on 29 August. Departure from Bangladesh on 30 August, with scheduled return to the USA for 31 August. There were no major changes in the program schedule.

This report is written in journal style from notes and observations recorded by this FTF volunteer. It follows the EOA outline provided by Winrock International inclusive of significant and consolidated recommendations, improvements, future and personal impacts, and host letter. Unlike the submitted EOA, daily activities in this report are embellished with photos to give the flavor of the FTF project. These images were captured by Winrock International's field staff and copied to me.

1.1 Activities and Assistance

20 August 2013 (Figures 2-7)

Visit to Environment Friendly Agricultural Development Foundation, (EFADF). Present company:

- Kbd. G.M. Tayybur Rahman, Executive Chief, EFADF.
- Khan Md. Abrarur Rahman, student, 4th Year 2nd term, Agrotechnology Discipline, Khulna University, Khulna.
- Md. Rakibul Islam, student, 4th Year 2nd term, Agrotechnology Discipline, Khulna University, Khulna.
- Md. Shiduzzaman, student, 1st Year 2nd term, Agrotechnology Discipline, Khulna University, Khulna.
- Milon Kumar Shaha, student, 4th Year 2nd term, Soil Science Discipline, Khulna University, Khulna.
- Kh. Mazhabuddin Pallob, field staff, Winrock International.

Mr. Tayybur Rahman produces and markets two compost products: (1) vermicompost; and (2) vermicompost tea. The vermicompost is prepared from an assortment of feedstock including coconut dust (coir by-product), vegetable ash, cattle dung, water hyacinth, poultry litter, mustard oil cake, and azolla. We visited Mr. Tayybur Rahman's commercial and breeding pit cultures, as well as the farm where he produces vegetable seedlings on vermicompost. The objective was assessing the overall success of his operation and to make recommendations for fine-tuning.

Inspection of commercial and breeding vermiculture pits revealed healthy populations of *Eisenia fetida* (redworm) confirmed anatomically via external clitella (reproductive organs), a detail we shared with the Khulna students.

Figure 2. EFADF commercial vermiculture pit.

Figure 3. Examining *Eisenia fetida* anatomy.

Figure 4. EFADF feedstock processing.

Figure 5. Discussing compost, organic matter, and nitrogen mineralization in soil, EFADF.

Figure 6. Spirited debate about soil organic matter, EFADF.

In addition, Mr. Tayybur Rahman demonstrated some equipment he uses for feedstock preparation, e.g. grinders, coir fiber processors, presses. We discussed compost feedstock pre-processing and the influence of particle size and shape, and chemical composition on decomposition and nutrient release. Mr. Rahman shared his compost test results, which showed a total nitrogen and phosphorus content of 2.5% and 4%, respectively. This volunteer pointed out to Mr. Rahman and Khulna students that the nutrient content of compost is relatively low, limiting its substitution for mineral fertilizers. He then recommended

Figure 4. EFADF seedling production on vermicompost.

that compost compliment mineral fertilizers as the combined effect of humus addition and soluble fertilizer enhances soil fertility better than either one used alone. This volunteer also challenged Mr. Rahman's assertion that mineral fertilizers were "burning out" organic matter in soil. Our group had a spirited discussion about the factors affecting organic matter accumulation the in soil. This volunteer pointed out that natural processes breaking down organic matter in compost via aerobic decomposition also operate in the soil. Cultivating warm, moist soil, and lack of carbon input via compost were suggested as likely reasons for "burning out" of soil humus. We also discussed the role of technology in agricultural development, i.e. "advanced" vs "traditional" methods and what is meant by those terms. Surprisingly, the Khulna students were well acquainted with the concept of minimum and no-tillage farming. We compared surficial decomposition of plant residues with that of composting.

Later, we traveled to Mr. Rahman's farm nursery where he raises vegetable seedlings on blocks of vermicompost. This volunteer noted that vegetable seedling stands were uneven, indicating seedling mortality. We discussed some reasons why the seedlings might have died off, and it was suggested to Mr. Rahman that he might experiment with *Trichoderma* inoculation for control of damping-off and other fungal diseases. Vermicompost inoculated with *Trichoderma* may also improve disease suppression, further enhancing its value. *Trichoderma* is available in Bangladesh.

Recommedations

- Mr. Tayybur Rahman's vermicompost is formulated from a wide array of feedstock of varying chemical composition. It was recommended that he be vigilant about maintaining a constant ratio of feedstock and that, by varying feedstock ratio, the quality of the product is affected. As compost markets in Bangladesh are completely unregulated, farmers using compost as a fertilizer and/or soil conditioner need assurance that the product they purchase is safe and beneficial.
- Mr. Rahman should experiment by creating new products that blend different ratios of feedstock. For example, mustard seed cake is about 35% protein,

and azolla is a nitrogen fixing aquatic plant. Both feedstocks are rich in organic nitrogen. Developing a high nitrogen compost blend would be especially beneficial for leafy green vegetables, whereas a low-nitrogen, high-phosphorus and potash blend would benefit fruiting crops like tomato, pepper, and eggplant. In the USA and Europe, special blends are a popular way for farmers to increase compost sales by "product differentiation". This idea should also work in Bangladesh.

- Mr. Rahman's compost tea should be used as soon after infusion as possible. This is because any nitrate-nitrogen in compost that is dissolved in water rapidly undergoes denitrification, reducing the fertilizer value of the tea.

21 August 2013 (Figures 8-15)

Met with the director of the RUSTIC solid waste management program to discuss efforts directed at composting municipal solid waste in Khulna city. Present company:

- Moral Moor Mohammad, Executive Director, RUSTIC program
- Kh. Mazhabuddin Pallob, field staff, Winrock International

Venue: RUSTIC Project business office, Khulna. Mr. Mohammad and I discussed RUSTIC's solid waste collection and composting process. We also discussed passive aeration systems for compost such as triangular bases and perforated bamboo sticks. This volunteer pointed out that passive aeration of compost from the base of the pile limits its size. To ensure adequate aeration from passive bases pile size should be kept smaller. Later that morning we visited the Khulna municipal solid waste landfill, site of the RUSTIC composting plant. Present company:

- Moral Moor Mohammad, Executive Director, RUSTIC program.
- Khan Md. Abrarur Rahman, student, 4th Year 2nd term, Agrotechnology Discipline, Khulna University, Khulna.
- Md. Rakibul Islam, student, 4th Year 2nd term, Agrotechnology Discipline, Khulna University, Khulna.
- Md. Shiduzzaman, student, 1st Year 2nd term, Agrotechnology Discipline, Khulna University, Khulna.
- Milon Kumar Shaha, student, 4th Year 2nd term, Soil Science Discipline, Khulna University, Khulna.
- Kh. Mazhabuddin Pallob, field staff, Winrock International.

This volunteer lead discussions about the risk of spreading disease and pathogens in compost and the need to monitor pile temperature during active composting to ensure pathogen kill. Visual and tactile examination of the RUSTIC compost indicated that the piles were heating up. I was pleased to see workers separating inert and organic waste wearing oral and dermal personal protective equipment. The group then returned to Mr. Mohammad's office where

Figure 8. Khulna municipal landfill.

Figure 9. RUSTIC women separating municipal waste.

Figure 10. Checking pile temperature.

an oral presentation was delivered by this volunteer distilling information from university and private sector composting bulletins and videos supplied by this volunteer. A question and answer session followed, closing with the following recommendations submitted.

Recommendations:

- Compost pile temperature should be monitored with a long-stem composting thermometer to ensure temperature of 55◦C is realized. This is the critical temperature for pathogen kill. Dial-gauge type

composting thermometers are inexpensive way to ensure safety of the finished product. However, the availability of these thermometers in Bangladesh is unknown.

- The RUSTIC plant has a leaky roof, creating a stream of leachate from the compost piles. The leachate eventually drains into a water way behind the plant. Potentially, this is a point source of water pollution. Effort should be made to collect the leachate and recycle it via addition to the compost piles.

At 15:30 h we departed for Khulna Horticultural Research Center. There, we met Dr. Md. Mizanur Rahman, Director, who conducted a tour of the facility including laboratories where he isolates edible fungi spores. We also inspected autoclaves, and the temperature-controlled growth chamber used to culture fungal mycelium (vegetative stage) on inoculated media ("compost"). This effort is part of a project to introduce mushroom culture in Bangladesh, which is an under-developed but potentially lucrative rural enterprise. This volunteer is a life-long devotee of edible cultured and wild mushrooms so it was gratifying to see research efforts in this realm in Bangladesh. The spent media is also a valuable resource for composting. Outdoors, we inspected experimental plots of an unusual tropical fruit-bearing cacti *Hylocereus* spp. or "dragon fruit", an improved high-protein African variety of moringa tree, and sesbania, a nitrogen fixing legume plant. We then inspected a specimen of grape vine the center is attempting to grow. This Volunteer suggested the scuppernong grape (*Vitis rotundafolia*) native to the southeastern U.S.A., might perform better in Bangladesh, than labrusca or vinifera types.

Figure 11. Discussing waste recycling with Khulna students.

Figure 12. Delivering lecture and video presentation.

Figure 13. Dragon fruit culture on used tires… a Ph.D. dissertation in waiting?

Figure 14. Controlled temperature room with bags of mush-room spawn. Backup generators provide auxy power.

Figure 15. Autoclaves for sterile media production.

22 August 2013

Meeting with Bismillah Fish and Poultry (BFP) representatives at Gazi Medical Teaching Hospital, Khulna. Present company:

- Mrs. Tania Rahman, Managing Director BFP.
- Dr. Gazi Mizan, Chairman, BFP.
- Sk. Habibur Rahman, Farm Manager BFP.
- Md. Ehsanul Kabir, Administrative Officer.
- Kh. Mazhabuddin Pallob, field staff, Winrock International.

This initial meeting with BFP Director and Manager served as an opportunity for this volunteer to assess BFP's present and future composting capacity; BFP operations and facilities for composting; resources available for composting including estimating daily manure production from 20,000 laying hens; and discuss methods of composting suitable for Bangladesh conditions. At once this volunteer dispelled the idea of "pit composting" in Bangladesh due to the anaerobic conditions it would induce. In addition, it was pointed out that composting takes about 90 days, perhaps more depending on temperature, moisture, and nutrient balance and, that "quick methods" are unsuitable for composting a potentially pathogen-bearing, high soluble salt feedstock like chicken manure (these were listed under "Activities to Be Completed" in the BAN320 scope of work). The concept of feedstock carbon to nitrogen (C:N) ratio and bulk density were also explained as scientific methods for determining appropriate mixing ratios and their volumetric equivalents. Process controls involving larger-scale composting facilities were also outlined. Dr. Gazi indicated that as a first step, he wanted me to take the relevant measurements for a land use and composting plant plan, and determine the nutrient content of the Farm's composting feedstock, and equipment that would be needed to manage it. The next two days were occupied in this effort.

23 August 2013 (Figures 16-19)

Sabbath Day. Arranged with Mr. Pallob a trip to the sundarbans. See attached photos.

Figure 16. Edge of the sundarbans.

Figure 17. Nipa palm (*Nypa fruticans*), sundarbans.

Figure 18. Mangrove forest, sundarbans.

Figure 19. Gangplank follies...watch your step!

24 August 2013 (Figures 20-27)

Trip to BFP, about 10 km outside Khulna on the Khulna-Satkhira Highway. Present company:

- Sk. Habibur Rahman, Farm Manager BFP.
- Kh. Mazhabuddin Pallob, field staff, Winrock International.
- Three male farm hands (names unavailable).

Measured bulk density of fresh layer manure (pults and adult birds), cow manure, rice hulls; instructed farm hands in appropriate method for filling bucket with manure and rice hulls, and recording weights using BFP platform scale. The necessary calculations were performed by this volunteer and shared with BFP personnel.

Later that afternoon we visited with Md. Joynal Abedin, PSO in charge, Regional Soil Resource Development Initiative (SRDI), Khulna, to discuss compost nutrient analysis, digital soil maps, and if it was possible to accelerate waste testing by omitting trace mineral and heavy metals from the report.

Figure 20. Layer houses and vegetable gardens, BFP Farm.

Figure 21. Layer house, BFP Farm.

Figure 22. Determining compost feedstock bulk density.

Figure 13. Demonstrating how to level the bucket.

Figure 24. Farm hand weighing bucket + manure.

25 August 2013

Traveled to BFP to collect sample of poultry, cow manure, and rice hulls for nutrient analysis by SRDI. Present company:

- Sk. Habibur Rahman, Farm Manager BFP
- Md. Ehsanul Kabir, Administrative Officer
- Male farm hand (name unavailable)
- Kh. Mazhabuddin Pallob, field staff, Winrock International

For reasons of safety and quarantine, this volunteer was not permitted entry into the poultry houses. Therefore, the waste collection procedure was outlined with the BFP farm manager in advance with Mr. Pallob. Mr. Pallob then accompanied one male farm hand into the poultry houses, delivering instruction on collecting a representative manure sample. Samples of brooder house material were also collected, as well as samples from the Farm's small cow herd. After sub-sampling and mixing the materials were placed in polyethylene bags and delivered to the regional SRDI laboratory in Khulna.

Figure 25. Manure sample collection.

26 August 2013

Delivered multimedia presentation (oral + video) to BFP principals, Gazi Medical Teaching Hospital, Khulna. Present company:

- Mrs. Tania Rahman, Managing Director BFP
- Dr. Gazi Mizan, Chairman BFP
- Sk. Habibur Rahman, Farm Manager BFP
- Md. Ehsanul Kabir, Administrative Officer

Kh. Mazhabuddin Pallob, field staff, Winrock International

The videos featured state-of-the art on-farm composting operations around the U.S.A.; farmer interviews; and different methods of composting.

Later that afternoon we visited the office of Climate Resilient Ecosystems Livelihoods (CREL), a new USAID-Winrock initiative. Present company:

- Md. Touhidur Rahman, Co-coordinator, CREL
- Ms. Ahmad Bipasha, Project Manager and Communication Specialist, Winrock International.

We discussed objectives and scope of the CREL project; potential for cooperation between CREL and Farmer-to-Farmer Program; relevance of composting as a rural enterprise consistent with CREL's objectives.

Visited the USAID-CNFA Agro-Inputs Project (AIP) offices in Khulna. Present company:

- Md. Maksudur Rahman, Senior Agribusiness Advisor
- Md. Mehedi Hasan, Supply Chain Advisor
- Ms. Marzia Lipi, Governance Officer, CREL project
- Ms. Ahmad Bipasha, Project Manager and Communication Specialist, Winrock International.

Figure 26. Manure sample collection.

Figure 27. Subsampling raw manure for analysis.

Discussed objectives and scope of AIP; need for quality control and assurance for agro-inputs; incentives for vendors to comply with QA/QC protocols to ensure mutual farmer-vendor success; compost as an agro-input in Bangladesh and QA/QC concerns.

27 August 2013 (Figure 28)

Final presentation of composting process and proposed composting plant plan to BFP principals, Gazi Medical Teaching Hospital, Khulna. Present company:

- Dr. Gazi Mizan, Chairman BFP
- Sk. Habibur Rahman, Farm Manager BFP
- Md. Ehsanul Kabir, Administrative Officer
- Ms. Ahmad Bipasha, Project Manager and Communication Specialist, Winrock International.

Delivered oral presentation summarizing the composting process from start to finish; process timelines; critical process controls; proposed composting plant plan and three potential feedstock mixing ratios (1:2, 1:3, 1:4) based on information collected on-site at BFP; used computer animation to illustrate how a compost pile is built with BFP layer manure, greenwaste, and rice hulls as feedstock; equipment needed for large-scale composting; compost curing, screening, bagging, marketing. Follow-up with group discussion, question and answer period. A copy of the presentation was copied to Sk. Habibur Rahman and Ehsanul Kabir for future reference. It was agreed to continue collaboration between BFP principals and this volunteer via email, particularly regarding waste test results which will not be available from SRDI for one month.

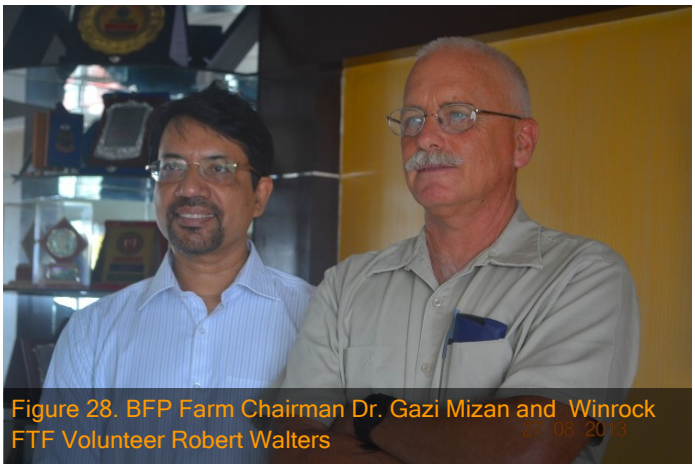

Figure 28. BFP Farm Chairman Dr. Gazi Mizan and Winrock FTF Volunteer Robert Walters

1.2 Significant Recommendations

- Since BFP is totally new to composting, it is recommended that they begin composting on small-scale using available facilities (7- 20.4 m^3 enclosures) to practice pile building, turning, and temperature control. Practice makes perfect.
- A compost mixing ratio of one part poultry manure to three parts rice hulls (1:3) was recommended yielding a 25:1 carbon to nitrogen ratio (C:N ratio) based on average on-farm measured bulk density of 894 kg m^{-3} (pults + adult hen, assuming equal w/w mix) and average published values for carbon 48%, nitrogen 8%, and C:N ratio of 6 for layer manure (subject to modification pending waste analysis by SRDI regional laboratory); and bulk density of 312 kg m^{-3} for on-farm rice hull bedding.
- A large-scale plant is feasible for composting all of BFP's waste products including those obtained off-farm. This plan can only be realized after BFP's farm manager and staff has acquired considerable experience making compost, including a thorough understanding of the relevant science and technology as presented in this training.
- Dial-gauge composting thermometers should be used for temperature control whenever compost might serve as a vector for the spread of harmful organisms. Composting thermometers are inexpensive and should be promoted by relevant government entities to ensure a safe and beneficial product.
- Mature compost should be tested for macro- and micronutrients and heavy metals whenever feedstock of unknown provenance is used (e.g. water hyacinth, off-farm agri-waste).
- Effort aimed at educating farmers about the use of compost is urgently needed. There is general confusion, even among educated Bangladeshis, over whether compost is a fertilizer or soil amendment. Because compost has a low plant-available nutrient content, application rates in the range of 5-10 tons per hectare are needed to completely offset mineral fertilizers. The economic sustainability of this practice is questionable but should not be dismissed without research and testing.
- Easy methods for converting compost mass to volume are needed by producers for field mixing ingredients, and farmers who will be applying the compost to their fields, i.e. measurement in terms of bucket load instead of weight.

1.3 Consolidated Recommendations for Reporting Purposes

- Composting on-farm waste on a scale envisioned by BFP principals should not be undertaken without considerable effort aimed at educating farm managers and staff regarding nutrient balancing; process control; timing; and safety measures for persons involved with hand-turning piles. Composting on a small scale should be practiced and the methods perfected for existing BFP conditions.
- Compost process controls including temperature testing with inexpensive dial-gauge compost thermometers should be promoted by relevant government entities to ensure a safe and beneficial product.
- Mature compost should be tested annually for macro-, micronutrients and heavy metals, or whenever new compost feedstock is introduced.
- Farmer education is urgently needed over the appropriate field use of compost as a fertilizer or soil amendment; easy methods for converting compost mass to volume basis are needed for practical field use.

1.4 Improvements

- BFP farm principals seemed genuinely motivated to learn about all aspects of composting. All are highly educated Bangladeshis. A constant dialog with BFP staff was conducted over five days emphasizing scientific practices and principles associated with advanced composting technology. This volunteer was impressed by some of the difficult questions posed by BFP staff, providing evidence for the successful dissemination of knowledge.

1.5 Future Impacts

- Six months should be enough time for BFP staff to practice making compost piles from scratch and testing the results. A three month production window is predicted; however, local conditions may increase the time to maturity.
- Presently BFP does not have sufficient bin space to compost all of their waste according to the plan proposed by this volunteer. Increasing capacity in future will depend on BFP's ability to acquire the needed equipment as well as build a dedicated facility for composting. A composting facility plant plan was developed specifically for BFP.

1.6 Personal Impacts

BAN320 was this volunteer's first Farmer-to-Farmer assignment. As such, there's always apprehension when facing the unknown. This apprehension melted quickly on the ground with the kindly and patient support of Winrock International's field staff. This volunteer has worked and / or traveled extensively in developing countries but it was his first time in Bangladesh. Communication is an issue particularly where the lingua franca is totally new. Winrock's field staff performed admirably in serving as interpreters, enabling this volunteer to build a rapport across cultural and language barriers that would have been otherwise impossible to bridge. I was also very impressed with the level of farmer innovation happening in and around Khulna district. Generally, there is high awareness of composting as a viable and environmentally sound method of converting agro- and municipal solid waste into useful products. The critical role that humus plays in sustaining soil productivity is also widely appreciated. With this knowledge, Bangladesh agriculture faces a promising future.

Bismillah Fish and Poultry Farm
A 20-21 Mazid Sarani
Sonadango, Khulna

29 August 2013

Dear Sir,
I am pleased to report that the BAN320 Improved Compost Preparation Technology held in Khulna August 22-27, 2013 was deemed successful by all the participants. This volunteer was impressed with the trainee's passion for learning advanced scientific principles for composting. Trainees reported plans to practice making compost using on-farm produced chicken manure, greenwaste, cow manure, and rice hulls. Additionally, post-assignment support via email, Skype, and "cloud" enabled Dropbox was pledged to trainees by the volunteer to facilitate communication and exchange of relevant research materials. Following are recommendations submitted:

- Composting of on-farm waste on a scale envisioned by BFP principles should not be undertaken without considerable effort aimed at educating farm managers and staff regarding nutrient balancing; process control; timing; and safety measures for personnel involved with hand-turning piles. Composting on a small scale should be practiced and the methods perfected for existing BFP conditions.
- Use of compost process controls including temperature testing with inexpensive dial-gauge compost thermometers is encouraged.
- Mature compost should be tested annually for macro-, micronutrients and heavy metals, or whenever new compost feedstock is introduced.
- Producer education is urgently needed over the appropriate field use of compost as a fertilizer or soil amendment; easy methods for converting compost mass to volume basis are needed for practical field use.

It was my esteemed pleasure to serve the people of Bangladesh in the capacity of technical expert, cohort, and emissary of the people of the United States of America.

Respectfully submitted,

Robert D. Walters
Winrock International Volunteer
Agronomy and Soil Science Specialist