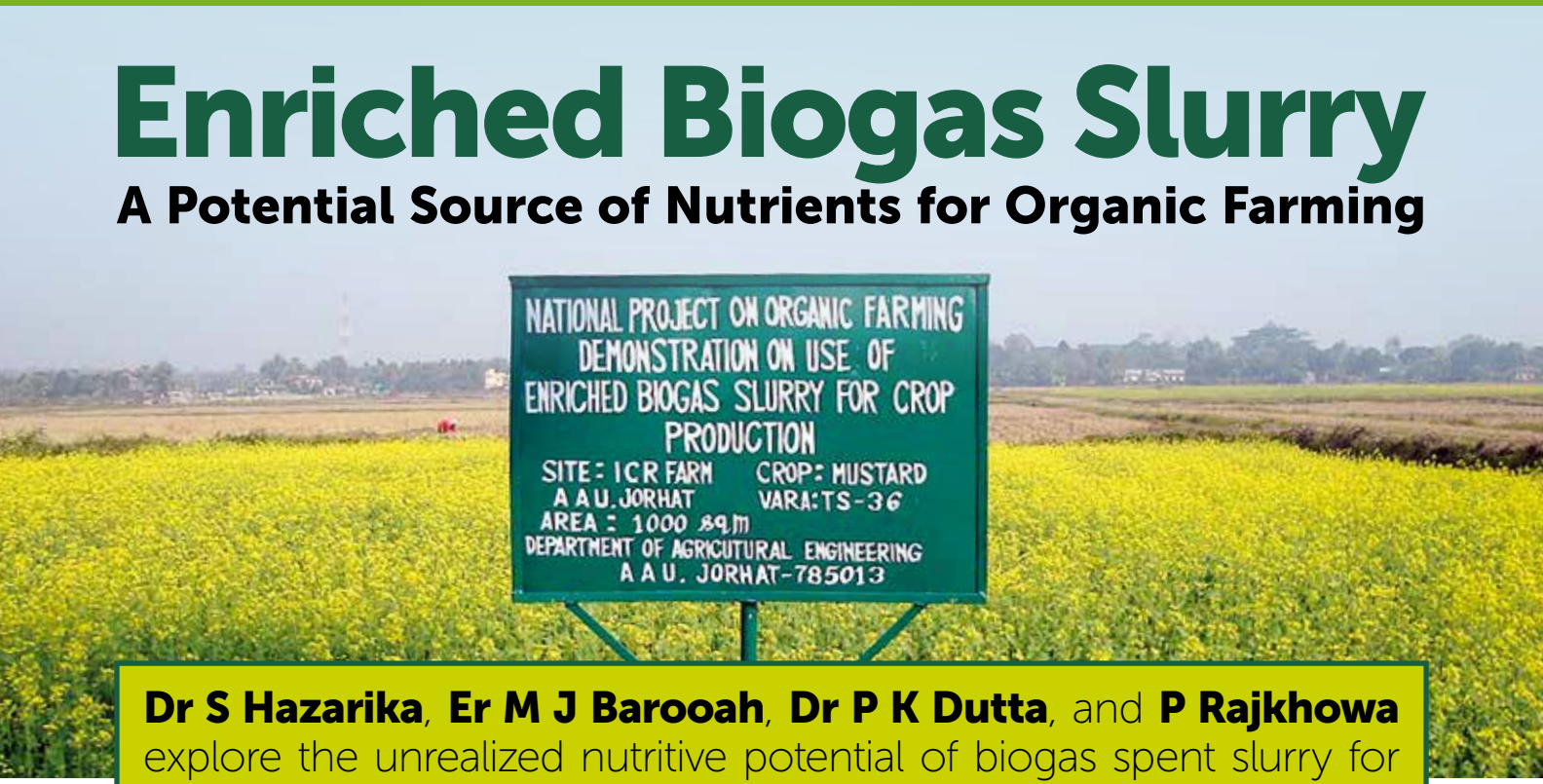
Enriched Biogas Slurry

A Potential Source of Nutrients for Organic Farming



Dr S Hazarika, **Er M J Barooah**, **Dr P K Dutta**, and **P Rajkhowa** explore the unrealized nutritive potential of biogas spent slurry for organic farming. Through case studies conducted in Assam, they describe the usefulness and significance of developing this resource.

The slurry emanating from the biogas plant is referred to as biogas plant spent slurry (BSS). It is rich in nitrogen (N), phosphorous (P), potassium (K), and several micronutrients. The content of these plant nutrients varies, depending on the type and nature of feedstocks used for production of biogas. The average nutrient and organic matter content of BSS is given in Table 1. The digested slurry discharged from the conventional biogas plants normally contains 92–94 per cent moisture whereas in the case of solid state biogas plants, the moisture content varies between 88–90 per cent. BSS is one of the potential sources of nutrients for organic farming but it is practically difficult to supply the entire nutrient demand of crops with BSS because of its bulky nature. To reduce bulkiness, enrichment of BSS with nutrients using organic (e.g., biofertilizers) and mineral sources (e.g., rock phosphate) is an attractive option for its use in organic farming practices.

Table 1: Average nutrient content of biogas plant spent slurry (BSS)

Nutrient	Average Content
N	1.8%
P_2O_5	1.0%
K_2O	0.90%
Mn	188 ppm
Zn	144 ppm
Fe	3,550 ppm
Cu	28 ppm
C/N ratio	10–15
Organic matter	65%

Organic farming has emerged as a major thrust area in agriculture over the years. Assam and the North-East are mostly organic by default and out of 85,346 ha under organic cultivation in the North-East, Assam has an area of 2,828 ha. The Government of India through Ministry of Development of North Eastern Region (DoNER) has launched a 'Scheme for Organic Farming in the North Eastern Region' with an initial outlay of ₹100 crore for the year 2014–15. Conscious organic farming has suddenly picked up across the state of Assam, especially among those cultivating ginger, turmeric, oranges, black pepper, and pineapples. On an experimental basis, the Sate Department of Agriculture, Assam, has taken up organic cultivation of scented rice (var. Joha, Keteki Joha, etc.) across 92 ha in three districts, involving 162 farmers. Moreover, the Agricultural and Processed Food Products Export Development Authority (APEDA) has plans to export indigenous varieties of rice, produced with organic farming methods in the Northeastern region of the country to the foreign markets. As per the

statistics provided by National Biogas and Manure Management Programme (NBMMP), more than 85,000 numbers of family type biogas plants have so far been installed in Assam and there is ample scope to involve these biogas plant owners in organic farming practices in the years to come. Realizing the importance of enriched BSS as a source of nutrients for organic farming, packages have been developed for rice and mustard crops and tested in the farmers' fields. To create awareness and popularize the technology among the farmers, a field day was organized at the demonstration site.

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Nutrient Package

Nutrient packages were developed in the Department of Agricultural Engineering, Assam Agricultural University using enriched biogas slurry as a source of nutrients for cultivation of rice and mustard crops using organic farming practices. Under this package, 50 per cent of the recommended dose (RD) of nitrogen (N) for rice and mustard crops is replaced by BSS nitrogen and remaining 50 per cent is substituted by biofertilizer (BF). The BSS is enriched with rock phosphate and Phosphate Solubilizing Bacteria (PSB) so that the quantity of BSS required to replace 50 per cent RD of N can meet the plant nutrient demand for phosphorus (P). The quantity of BSS and other additives used in the package is shown in Table 2. A 2 m^3 biogas plant discharges about 50 kg wet slurry per day and to obtain 1 metric tonne of fresh slurry, a time period of 20 days will be required. Since the quantity of BSS required for a hectare of land is quite large (Table 2), a farmer has to plan well in advance to collect and store the BSS. It can be stored safely in pits covered with shed.

Table 2: Quantity of biogas plant spent slurry and other additives used for enrichment of BSS

Crops	RD of fertilizer N (kg/ha)	Quantity of fresh BSS* to replace 50% RD of N (t/ha)		Quantity of BF to replace 50% of RD of N (kg/ha)	Quantity of RP (kg/ha)	Quantity of PSB (kg/ha)
		CBP	SSBP			
Mustard	40 (88 kg urea)	20	10	0.5–1.0 (*Azotobacter* for seed treatment)	110	3.5
Rice	40 (88 kg urea)	20	10	3.5 (*Azospirillum* for root deep treatment)	110	3.5

* considering N content of 2% on dry weight basis, total solid (TS) content of conventional biogas plant (CBP) 5% and TS content of solid state biogas plant (SSBP) 10%, phosphorous @ 2% P_2O_5 on dry weight basis of slurry using rock phosphate(RP) containing 18% P_2O_5, BF: biofertilizer

NUTRIENT PACKAGES WERE DEVELOPED IN THE DEPARTMENT OF AGRICULTURAL ENGINEERING, ASSAM AGRICULTURAL UNIVERSITY USING ENRICHED BIOGAS SLURRY AS A SOURCE OF NUTRIENTS FOR CULTIVATION OF RICE AND MUSTARD CROPS USING ORGANIC FARMING PRACTICES.

Package for rice

The package for organic cultivation of rice, using enriched BSS, involves the following steps:

- Enrichment of slurry with *Azospirillum* biofertilizer
- Coating of roots of rice seedlings with *Azospirillum* inoculated slurry
- Enrichment of slurry with rock phosphate and PSB and its application into the field
- Transplanting of rice seedlings following recommended practices.

Enrichment of BSS with *Azospirillum*

A suitable quantity of fresh slurry is enriched with *Azospirillum* which is an efficient N fixing micro-organism and a proven biofertilizer (@ 3.5 kg/ha) for rice in Assam. The amount of slurry depends on the number of seedlings to be inoculated with *Azospirillum* for transplanting which in turn is contingent on the area of land to be transplanted.

Pictures 1 and 2: Inoculation of rice roots with *Azospirillum* and a view of inoculated roots

Inoculation of seedling roots with enriched slurry

The slurry is placed over a plastic sheet (Pictures 1 and 2) with its four sides raised and the *Azospirillum* biofertilizer is mixed uniformly with the slurry. The roots of the 25-day old rice seedlings are dipped into the enriched slurry to form a uniform coating surrounding the roots. After coating the roots, seedlings are brought out of the slurry and kept overnight so that roots are inoculated with *Azospirillum*. New batches of seedlings can be treated with the same enriched slurry till it is exhausted. The rice seedlings with inoculated roots are transplanted in the field during morning hours. The leftover slurry after root treatment is applied uniformly in the field.

Enrichment of BSS with P

For enrichment of the slurry with P, rock phosphate and PSB are mixed thoroughly with the slurry (Pictures 3a and 3b) at least 10 days prior to application and turning is done intermittently. Enriched slurry is applied to the field and mixed uniformly with the soil on the day of final preparation of land. The quantity of slurry, rock phosphate, and PSB required for enrichment are presented in Table 2.

Package for mustard

The amount of slurry required to supply 50 per cent RD of N to mustard crop is worked out based on nutrient and moisture content. The slurry is enriched with rock phosphate and PSB following the same procedure as described for rice. The enriched slurry is applied into the field and mixed thoroughly with soil seven days prior to the sowing of seeds. Prior to the sowing, seeds are coated with *Azotobacter* biofertilizer which is a very efficient free living N fixing microorganism and is found promising under Assam conditions. Initially, seeds are coated with a sugar solution that acts as a sticker and then the biofertilizer is mixed uniformly with the seeds (Pictures 4a and 4b). The seeds inoculated with *Azotobacter* are sown in the field following recommended methods.

Picture 3a: A view of the method of enrichment of slurry with rock phosphate

Picture 4a: *Azotobacter* biofertilizer packets

Picture 4b: Treating mustard seeds with *Azotobacter*

Picture 3b: Phosphate Solubilizing Bacteria (PSB) of biofertilizer packets for treating the slurry

The usefulness of these packages were demonstrated in the farmers' fields (Pictures 5 and 6) of two villages, viz., Katonipar and Nahotia, Jorhat, Assam where five solid state biogas plants were installed under All India Coordinated Research Project on Renewable Sources of Energy (AICRP on RES) for their popularization. The details of the crop, variety, yield, and location of the demonstration sites are shown in Table 3. The crops are grown under rainfed conditions. There was no incidence of diseases and pests in rice and mustard crops. However, Nahotia village being endemic area for mustard saw fly, prophylactic measure was taken using liquid formulation of *Beauveria bassiana* (Brand name: Helcon-L). It was applied at the rate of 1 litre per 200 litres of water, at an interval of 15 days. The biofertilizers used for enrichment of BSS was obtained from the Biofertilizer Production Unit, Department of Soil Science, Assam Agricultural University, Jorhat, Assam.

Picture 5: Field demonstration on organic farming of rice at Katonipar village, Jorhat

Table 3: Details of crop variety, yield, and location of the demonstration site

Crop	Variety	Demonstration site	Soil type	Yield (q/ha)	
				Control plot*	Treated plot
Rice	*Keteki Joha* (scented variety)	Katonipar village, Jorhat	Alluvial with clay loam texture	29**	28
Mustard	TS-36	Nahotia, Jorhat	Alluvial with sandy loam texture	11.9	12.3

* with recommended dose of inorganic fertilizer,** var. *Keteki Joha* is inherently having low yield potential

To create awareness and popularize the nutrient package among the farmers, a field day was organized at Nahotia, Dhekorgorah Block, Jorhat, Assam which witnessed the participation of 50 farmers from nearby villages (Pictures 7, 8 and 9). The biogas plant owners of the locality were convinced through technology demonstration and showed interest to take up organic cultivation of crops using biogas plant slurry as a source of nutrients.

Conclusion

Organic farming has emerged as a major thrust area in the northeastern region of the country. This region is mostly organic by default, however, conscious organic farming has suddenly picked up across the state of Assam and other parts of the North-east. In order to make organic farming a success, availability of organic sources of nutrients is a matter of concern. Among the organic sources of nutrients, biogas plant spent slurry can be a potential source of nutrients for organic agriculture since it contains appreciable quantities of both macro- as well as micro-nutrients and organic matter as compared to other organic sources of nutrients such as FYM, compost, etc. Moreover, it can suitably be combined with other organic sources of nutrients such as biofertilizers and organic manures. More than 85,000 numbers of family type biogas plants have so far been installed in Assam and there is large scope to popularize biogas technology in the region since availability of animal dung as a source of feedstock of biogas plant is abundantly available (~15 million tonnes). Therefore, there is ample opportunity for the biogas plant owners to offer a large share of the nutrient requirement for successful organic agriculture in the region.

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Picture 6: Filed demonstrations on organic farming of mustard at Nahotia, Jorhat, Assam

Picture 7: Field day held at Nahotia Jorhat

Picture 8: Farmers–scientist interaction during the field day

Picture 9: Organically grown mustard crop being demonstrated to the farmers during the field day