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ORIGINAL PAPER

Impact Study on Use of Gobargas Slurry Based Organic Products in Agriculture

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ABSTRACT

The popularization of *gobar*gas technology due to commissioning of farmer user friendly flexi *gobar*gas plants has re-emphasized the importance of the technology for upliftment of the farmers socioeconomic status. This has become possible through several benefits accrued with the use of *gobar* under the value added manure management model as developed by the National Dairy Development Board (NDDB), Anand. The "SuDhan" brand organic fertilizers using *gobar*gas slurry are known for their quality and hence useful for use in agriculture. However, the farmers' perception and their experiences are more important for its acceptance and popularization. In view of this fact, an impact study was carried out in Anand and Kheda districts on selected framers' fields for demonstration of the effect of SuDhan products on various crops in the region. The study is presented with its outcome and also captures perception of the farmers towards use of SuDhan products in agriculture.

The production of SuDhan brand *gobar*gas slurry products as a part of the NDDB's Manure Management Model enables farmers to use the products and augment their income by reducing cost incurred towards chemical fertilizers. This also serves a step forward in combating environmental pollution and providing sustenance to the crop productivity and soil health.

Key-Words: *Gogar*gas, *Gobar*gas slurry, Manure management, SuDhan brand organic products, Biogas, NPK, Micronutrients.

INTRODUCTION

In India, around 17 million dairy farmers belong to about 186,000 village level cooperatives. The vast majority of these farmers are small land holders, owning just two to three cows or

buffaloes. Rearing of dairy animals by the farmers mostly depend on the returns fetched from milk. Though, milk prices have seen an increasing trend but achieving sustained returns for farmers remains a challenge owing to increase in input costs, especially the costs of labour, water, feeds and fodder. In this environment, the significance of dung, the other by product, as manure has been increasing in view of ill effects caused due to injudicious use of chemical fertilisers.

The average dung production is about 1.5 tonnes per household annually. The *gobar* of the animals could be utilised to generate biogas and produce bio slurry solids. Usage of cattle dung in biogas to produce clean cooking fuel and bio slurry as an alternative to inorganic input is a win-win from both dairying and agriculture point of view. It can help dairy farmer save on cooking fuel, fetch returns from bio slurry as by-product while helping other farmers to avail alternate agricultural inputs at low cost which improves the soil health and crop yield. The potential of bioslurry based products processed from dairy farmers related to dairy cooperatives is estimated to replace the chemical fertilisers containing NPK by about 4.5 % and 0.4 % for micronutrients of the total annual requirement.

The organic solids derived from bio slurry could be utilised as organic fertilisers by incorporating or enriching with natural substances / compounds / useful microorganisms having importance with regard to plant nutrition and crop growth. Such products could be utilised as an efficient fertiliser / growth stimulant by the farmers in agriculture. Keeping this in view, the organic products were developed by processing the biogas slurry under the manure management value chain model developed by National Dairy Development Board, Anand.

This article attempts to present the processing technology of SuDhan organic products and their usages in agriculture. The experiences of farmers of Kheda and Anand districts on usage of the products are discussed and results of field demonstration studies are presented on the effectiveness of the products in terms of growth and yield of crops besides perception of farmers on quality of the produce.

MANURE MANAGEMENT MODEL (VALUE CHAIN)

The manure management model (value chain) has been developed around two *Sakhi Khad Sahkari Mandlis* at Mujkua in Ankalav tehsil and at Zakariapura in Borsad tehsil of Anand district. In all about 450 flexi biogas plants are under operation to utilise the *gobar* for *gobar*gas production in these villages which are owned by women as members of the *Mandlis* (Fig. 1).

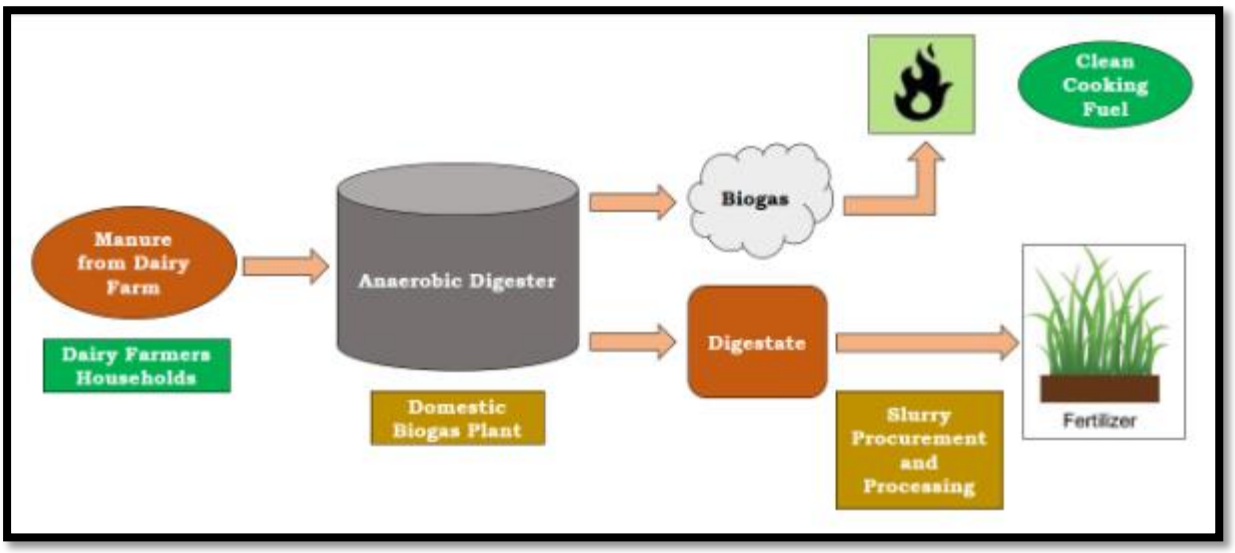


Fig.1: NDDB's Manure Management Basic Framework

The biogas slurry is purchased and collected from the biogas plants of dairy farmers based on its quality. The quality is judged on the basis of EC and Brix values to decide the rate of the slurry for procurement. The rate varies from Rs 0.75 to Rs 2.00 per liter of *gobar*gas slurry. The slurry is transported for manufacturing of different organic products at SuDhan Processing Unit at Vasana, tehsil Borsad. The different products are branded as SuDhan products for their use in agriculture among the farmers.

PROCESSING OF *GOBARGAS* SLURRY

The "Sudhan" brand agri-input products produced by "Mujkuva Sakhi Khaad Sahkari Mandli Ltd." Mujkuva, Ta: Anklav, District: Anand are known for their beneficial effect in crop production, quality of agricultural produce and soil health. The following "SuDhan" brand organic products of the *Mahila Khaad Sahkari Mandli* are produced in SuDhan Processing Unit at Vasana (Fig 2).

SuDhan Organic Products

The different SuDhan products are developed considering the nutrients requirement at different growth stages. The solid Phosphorus Rich Organic Manure (PROM) is for basal application to meet the phosphorus requirement of the crop during the initial germination and growing stage. The RootGuard is to help the roots growth and protection from the diseases during roots establishment stage. The Micronutrient Rich Liquid (M.R.L.) and GroMax are prepared to supplement the micronutrients requirement during crop growth period and to promote the crop growth, respectively.

Fig.2: Gobargas slurry based different DuDhan organic products

(1) Phosphorus Enriched Organic Fertilizer (SuDhan PROM): Phosphorus enriched organic fertilizer, produced from the organic solids separated from *gobar*gas slurry and high grade natural rock phosphate, can be used for basal application as well as supplementary fertilizer in various crops. It is processed as per the FCO specifications of PROM; and its use mainly replenishes phosphorus and adds organic matter to the soil; thus, provides alternative to the chemical phosphatic fertilizer and sustains the soil health.

(2) Root Guard: Root Guard is an organic liquid product which is produced by using the *gobar*gas slurry separated liquid after addition of root protecting and growth enhancing natural substances. It is used for soil application by drenching around the stem of the plant in root zone area after transplanting or sowing of the crop during root establishment period. It promotes root growth and protects the root against soil borne diseases also.

(3) Micronutrient Rich Liquid (M.R.L.): This product is developed by enriching the liquid separated from *gobar*gas slurry with essential micronutrients (Fe, Mn, Zn, Cu, B) for plants as per Government Notified Grade. The spraying of this liquid organic product on plants supplements the micronutrient requirement when the crops attain development stage.

(4) GroMax: The plant growth stimulating organic liquid is prepared by using *gobar*gas slurry separated liquid after enriching with seaweed extract having natural plant growth promoting substances. The use of this liquid as a foliar spray helps in improving growth of crops.

FARM STUDY OF SUDHAN PRODUCTS

With a view to study and demonstrate the effect of SuDhan organic products mainly Phosphate Rich Organic Manure (PROM) and Micronutrient Rich Liquid (MRL) on growth and yield of different crops; a systematic study was undertaken on fields of selected farmers in Anand and Kheda District. The demonstration trials were conducted during the year 2020-2021. The villages were selected falling under operational area of Kaira Milk Union in Anand and Kheda district. The soils in these villages are light textured *goradu* having slightly alkaline reaction with some salt accumulation and lower organic carbon content; showing low to medium fertility status with respect to nutrients availability.

The selection of the farmers was done from total 250 villages (200 villages in Anand district while 50 villages from Kheda district) of 19 Talukas of Anand and Kheda district with the help of village level Dairy Cooperative Societies (DCS) affiliated with Kaira District Milk Union. The cluster meetings (20-40 farmers) were arranged in various villages and farmers were informed about slurry-based products, its uses and application rate on crops.

The SuDhan products package of PROM and MRL, sufficient for growing crop on one *bigha* were offered to different DCS members / farmers of Anand and Kheda districts through the local DCS for testing their effectiveness under field application on various crops.

The major crops grown in Anand and Kheda districts are rice, pearl millet (*bajara*), vegetables viz., cabbage, cauliflower, chili, brinjal, okra; and other crops like pigeon pea, banana, papaya, lemon, tobacco, wheat, mustard, groundnut, maize, grams etc. The farmers growing these crops besides some other crops were also selected to use SuDhan products for application on their crops.

Monitoring of product trials at farmer fields was carried out randomly by field assistant staff of the *Mandli* during the growing season. The farmers were advised to follow the package and practices as applicable to different crops besides use of SuDhan products. The farmers usual practice was continued for the similar crops in other part of the fields or adjoining fields. Later, the selected farmers were provided with the feedback forms; and information was gathered through DCS after harvest of the crops. The farmers were approached; and the maximum possible outreach was done either through personal meeting or telephonically during the year 2020-21.

RESULTS AND OUTPUT

Nearly 5200 farmers of Anand-Kheda districts used SuDhan products for growing 35 different crops during the year 2020 and 2021. Out of these feedbacks about SuDhan product effects was collected from 680 farmers. However for the analysis purpose 640 farmers were considered due to data insufficiency in 40 feedback forms.

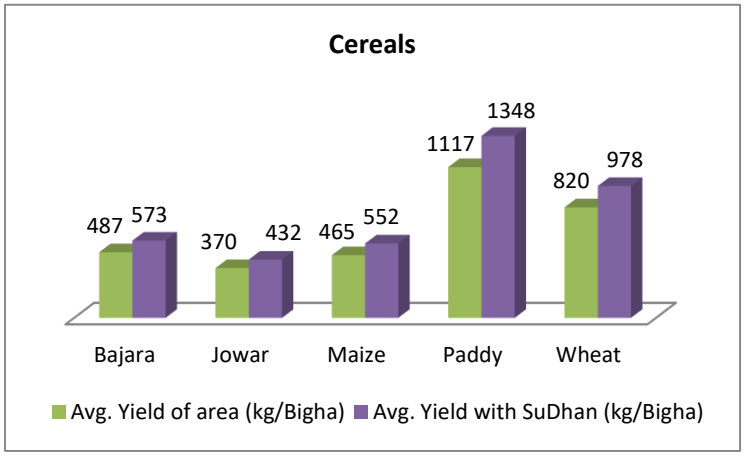
The data were appropriately processed for certain computations like quantity of different fertilisers / nutrients as well as organic manures utilised per *bigha*, yield of different crops (with SuDhan products) compared to normal average yield (per bigha) of the area (without SuDhan products) and per cent yield increase over farmers' normal practices in the area. The data were also subjected for computation of yield averages (crop wise) under important

seven groups (i) Cereals (ii) Vegetables (iii) Cash Crops (iv) Pulses (v) Oilseeds (vi) Forage Crops and (vii) Other Crops with ranges of minimum to maximum yield.

The farmers of these districts generally use chemical fertilisers viz., Urea, DAP, AS and SSP; while some farmers growing cash crops and vegetables use MOP, ASP, NPK complex fertilisers also. Further, all the farmers were not using organics but some farmers used FYM as organic manure; and very few used concentrated organics. The yield improvement due to the use of SuDhan products has also been depicted graphically for different crops. The results are discussed and interpreted hereunder.

1. The effect of the SuDhan products on yield of different crops

I Cereals: The important cereals in which the SuDhan products used were *pearl millet*, sorghum, maize, paddy and wheat. The number of farmers who used these products in*pearl millet*, sorghum, maize, paddy and wheat were 8, 8, 23, 9 and 114 of 5, 3, 12, 5 and 34 villages, respectively. The average yield obtained with SuDhan products in*pearl millet*, maize, sorghum, paddy and wheat ranged from 487.5, 370.0, 465.7, 1117.8 and 820.9 kg/*bigha* which was higher by 17.8, 16.9, 18.7, 21.2 and 18.8 per cent over farmers' practices. The average yield increase due to use of SuDhan products in case of cereals was noticed to the extent of 18.7 per cent over control i.e. without use of SuDhan products (Fig 3).



Crop	No. of Farmers	No. of villages
Pearl millet	8	5
Sorghum	8	3
Maize	23	12
Paddy	9	5
Wheat	114	34

Fig 3: Effect of SuDhan products application on yields of important cereals

II Vegetables: In all, total 15 vegetable crops like cabbage, cauliflower, okra, tomato, potato, chilli, bottle gourd, little gourd, *beans*, onion, garlic, brinjal, coriander, yam and moringa are grown in the area in which the SuDhan products were used by total of 193 farmers in 93 villages of both the districts. The per cent yield improvement in different crops was noticed ranging from 17.9 (*beans*) to 25.0 (Yam) with an average of about 20.7 per cent due to use of SuDhan products over traditional practice of farmers. In all important vegetables, the increase was about 20 per cent indicating the remarkable impact of SuDhan products on yield of vegetables (Fig 4).

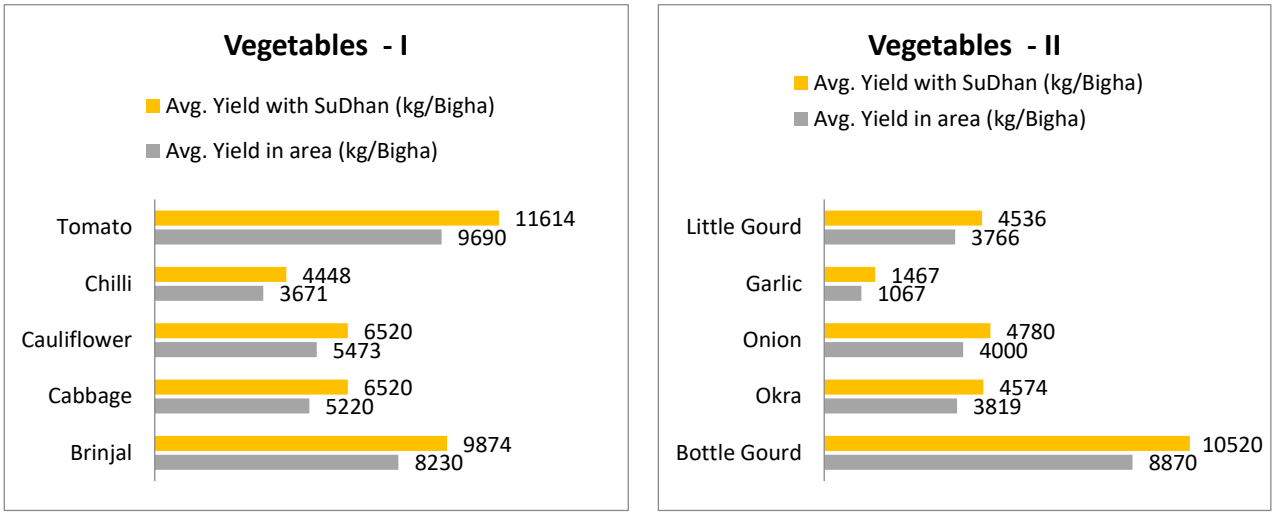
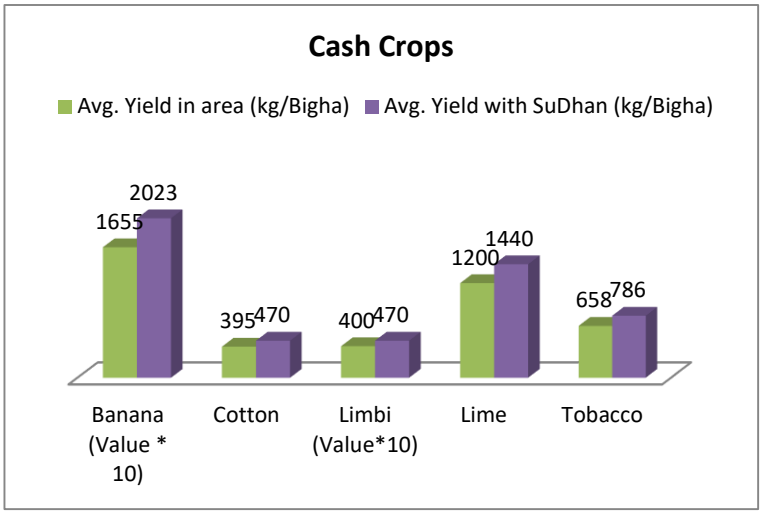


Fig 4: Effect of SuDhan products application on yields of important vegetables

III Cash Crops: The yield of different important cash crops viz., banana, cotton, lemon, lime and tobacco was found increased due to use of SuDhan products. The maximum improvement was in case of Banana (22.3%) while minimum improvement was noticed in case of cotton and lemonby about 17.5 per cent over without SuDhan use. The average response was also similar to those observed in case of vegetables i.e. 20 per cent (Fig 5).



Crop	No. of Farmers	No. of villages
Banana	54	5
Cotton	2	3
Lemon	1	12
Lime	1	5
Tobacco	244	34

Fig 5: Effect of SuDhan products application on yields of important cash crops

IV Pulses: The use of SuDhan products in important pulses like chickpea, cluster bean and pigeon pea registered higher yield by about 19.3 per cent over without SuDhan products use. The maximum response was noticed in cluster bean (19.2%) whereas the minimum increase was recorded in chickpea (17.6%). The SuDhan products were tested by 6 farmers of 6 villages of the districts.

V Oilseeds: The crops viz., castor, groundnut and mustard were grown by six farmers of six villages using SuDhan products. The average yield enhancement was to the tune of about 18.7 per cent over without SuDhan practices. The maximum response was noticed in groundnut which was recorded as 20 per cent over farmer's practice.

VI Forage Crops: Napier hybrid and Fodder sorghum are two important crops grown in the area, The SuDhan products were used by 12 farmers of 8 villages. The fodder yield improved due to the use of SuDhan products in both the crops. The yield increase was almost similar in both the crops i.e. about 21 per cent over no SuDhan use (Fig 6).

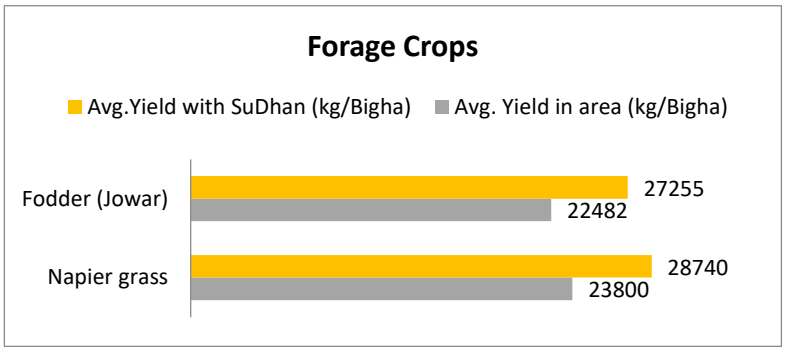


Fig 6: Effect of SuDhan products application on yields of important forage crops

VII Other Crops: In all, 6 farmers of 3 villages in the area growing other crops like rose (flower crop), chicoryand sage also utilised the SuDhan products. It was noticed that the product was found beneficial in enhancing the yield of these crops due to use of SuDhan products. The average response was noticed to the tune of about 10.8 per cent over no SuDhan use. The maximum yield increases due to use of SuDhan products was recorded in chicory(16.4%) while minimum was registered in sage (5.9%) over traditional practices of the farmers in growing of these crops.

2. The beneficial effect of PROM and MRL SuDhan products in crops

The use of SuDhan products were found beneficial in increasing the yield of all the crops; however, the increase in important crops varied from about 17 to 22 per cent with an average of about 19 per cent over farmers' practices i.e. without use of SuDhan products. The visual growth differences were also found in favour of SuDhan products. The results also indicated that the response of SuDhan products individually or in combinations showed positive effect on crop growth and yield. Thus, the use of SuDhan products was found most encouraging in increasing the yield of different crops and thereby farmers' income. The products are also expected to improve and sustain the soil health in a long run.

3. The farmers' perception

The farmers' perception on quality and impact on crop growth and yield was found positive. About 99 per cent of the farmers rated the SuDhan products as "Good" to "Very Good" whereas very few respondents rated the products as "Medium". These farmers have also opined that the growth parameters like plant height, flower and fruiting, greenness of the leaves and general growth of the crop were noticed better than the similar crops grown

without use of SuDhan products.

The farmers were found satisfied and they have rated the products Good for agricultural use. Further, most of the farmers were of the opinion that they would use these SuDhan products in future also and recommend to other farmers to use these products in their agriculture.

The overall perception of the farmers was found most satisfactory and encouraging so far as the quality of products and their effect on different crops is concerned.

SUMMARY AND CONCLUSION

The Manure Value Chain for dairy cooperative farmers is developed by the NDDB in Anand district. The slurry of *gobar*gas plants is processed for the production of SuDhan brand organic products which were utilized in fields of different farmers at different locations under demonstration trials during the year 2020 & 2021.

The application of SuDhan organic products PROM and MRL has shown enhancement in the growth and yield of important crops of different groups like cereals, vegetables, cash crops, pulses, oilseeds etc. over the farmers' practices. The use of PROM and MRL in place of phosphatic and micronutrients containing chemical fertilizers helped the farmers to reduce the load of chemical fertilisers; and thereby beneficial effect on soil health.

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