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Bio-Boosted Decomposition of Wastes for Discouraging Biomass Burning for Clean Air and Prospering Agriculture

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Abstract

Ecology is science dealing balance in entities both alive and non-alive existing in any environment. Mahatma Gandhi's eye lenses are adopted as emblem of new vision for mission sanitation in India. However, there had been merely action of sweeping trashes and collecting at sites, which again reverts back as becoming garbage dumping sites and disposing wastes including pet's droppings. Such garbage wastes easily burned for their disposal. Hence, the mission sanitation did not make any difference between the present and the past scenarios of sanitation and betterment of ecology. Various previous measures for waste utilization provoked towards discouragement for biomass burning, had been attempting without any scientific backing. Objective of present study was to develop a scientific fact application based method of decomposition of such wastes including agriculture wastes, highly liable to insitu or exsitu burning, leading to cause air pollution. A combo of bio decomposer boosted sulphur cycle supporting decomposing and aerobic composting of biomass, established in past, was carved as new route of overcoming the biomass burning for maintaining clean air. The measure also supports utilization of solid Municipal wastes. Thus, organic manure producing innovative method becomes an engine for bringing complete sanitation and many improvements in agriculture and environment. This research with double bio innovation becomes intellectual property for managing bio-wastes as well as bringing complete sanitation in improving ecology and clean air, thereby building double benefits ie becoming a solution of the problem and producing beneficial useful products.

Keywords: Agriculture; Clean air overcoming health hazards; Environment; Employment generation; Mission sanitation and river protection action plans

Introduction

Clean air for breathing is human right of first priority, followed by water and food, and sanitation, the second and third in order of priority, respectively. Emergence of waste is a natural process of any production and consumption system, be it biological or non-biological. The non-biological waste product piles itself becomes attracting commodity for natural decomposers such as fungus, algae and bacteria. The process of wastes decomposition brings several gaseous, toxic substances and insect, which make peoples' life under risk and degrade environment. There occur natural human tendency to get rid of such wastes by any means of quick and easy disposal. Such examples are plentiful viz disposal of paddy straw by insitu or exsitu burning by simple lit of one stick and waiting for some fraction of hour to get paddy fields clear of residue for next crop sowing. Other such example is quick disposal of urban sewage in lowest valley or river, which took form of devastating pollution of river water resources for which huge budget involving river action plans get launched by the Governments. However, no successful result could come in [1,2]. Such limitations of adverse effect occurs in soil pollution either from chemical fertilizers or weedicides etc, which have implicating adverse impact of land degradation and decline of productive capacity of land resources. Thus, these examples amply cover sky, water and land, covering entire domain of universe. Thus, disposal of waste had been huge burden and so far, no affordable, feasible and adoptable means could emerge to control the disastrous situation.

At the most the wastes after decomposition and having brought such afore said nuisances, become compost usable for agriculture. Wastes under sanitation and agricultural biomass insitu and exsitu burning in states of Punjab, Haryana and Uttar Pradesh, release huge volume of smoke polluting air of Delhi and National Capital region and making peoples' breathing

difficult. This situation had been posing a challenging problem for Delhi and such bad situations must be happening in other cities of the world. The problem of air pollution can only get overcome when the biomass burning gets totally eliminated from scene, by any simple means of control and with additional innovative measure for prospering agriculture and environment. Objective of the present study was to develop a fast method of bio-decomposition overcoming problem of biomass burning and converting waste biomass into useful product. The manuscript comprises materials and method, new bio decomposer and new formation of organic manure, its effective response when applied in agriculture and its implicating justification for maintaining clean air. Conclusion of immense values were drawn on manoeuvration of problem enabling solution and conversion of wastes in useful product providing enough justification for gentry leaving problematic practice of any biomass burning.

Materials and Methods

Domain of problem

Figure 1: Paddy residue after combine harvesting liable to *insitu* biomass burning as farmer is waiting for completing next crop sowing in December 2019.

Waste is accompanying rejected product of any production and consumption systems, both ecological and non-ecological, in environment with time. The wastes go self-decomposition and release different toxic gases and salts, and lead to variety of detritus food chains. The detritus food chains serve and foster detritus consumers such as fungus, algae and bacteria, flies and mosquitoes, causing variety of discomforts and health hazards. Therefore, there remain always demand and eagerness of devising measures to overcome the problems related to wastes. These back grounds implicate that quantum of wastes get proportionally enhanced with quantity of food consumption and need of processing. Statistics some years ago (2004) revealed that India generated 62 million tons of bio-wastes every year; in cities @200-600g/person/day. In addition to increase in quantity, characteristic composition has also changed tremendously. The waste in agriculture production systems are wastes from crop residue such as paddy parali (Figure 1) and other farm product processing such as sugar industry, dairy, piggery and even household wastes such as sewage sludge and waste waters etc. There were endeavors to find ways and means of easy and quick disposal. With reference to (Figure 1), simple biomass burning as depicted vide. (Figure 2) is resorted, which causes variety of problems of air pollution [3-5]. (Figures 1 & 2) display situation of problem domain and peoples' easy way of getting rid of biomass by biomass burning, which cause huge problem of air pollution. This situation has been attracting attention of the Governments and even the National Green Tribunal (NGT), had been passing regulations for stopping the problematic practice of biomass burning. However, this problematic practice could not be stopped under varying justifications by the farmers of surrounding States of Punjab, Haryana and Western Uttar Pradesh, usually rejected with repercussions and resentments. There had been lack of insight to convert such waste in wealth, which could become a justification for convincing people stop biomass burning.

Figure 2: *Insitu* and *exsitu* agri biomass burning in Punjab and Haryana, India, causing air pollution in NCR Delhi region.

The problem of open biomass burning and its bad impact on environment and poor air quality was presented by study [6] for Greater Mekong Sub region (GMS) countries Thailand, Combodia, GPR Lao and Vietnam. This study attempted estimation of smoke infested region by using satellite imagery, verified by ground land use conditions. Nearly 15-20% of countries land are devoted to rice cultivation and biomass open burnt in the months of January and February correspond, where high pressure and cold air masses from China cover north and northeaster of Thailand, north of Cambodia, north PDR Laos and north Vietnam. This period also corresponds dry winter season and dry condition propagating fast spread of fire. Therefore, the researchers recommended control of open biomass burning from January to March in two major rice cultivating countries namely Thailand and Vietnam. The referred study support the scientific fact that biomass burning based emanating in Punjab and Haryana get pressurized by cold winds pushing air masses spread in NCR Delhi. Nevertheless the referred study established lack of any innovative measure and recommended not to burn biomass to overcome the problems from paddy residue open burning. Book [7] documented biomass burning: its history, use and its distribution and its impact on environment quality and global climate and biosphere implications, all revealing non availability of any measure to fulfill objectives set in the present study. It implies that there exist global need of stopping biomass burning, which could otherwise be useful in bringing prosperous agriculture and protection of environment. It is needless to say that

the geographical features cannot be changed because of several reasons beyond ones imagination. Thus, objective set in the present study was the most ideally needed research issue for the globe.

Present ongoing practices

(Table 1) contains various sources, waste producing processes, waste products and associating implications. It is clear that both solid and liquid wastes emerge in ecosystem naturally, which implicates that it is strongly proportional to development. Since need is growing with time, every time simple solution remain to be endeavored. The new emphasis her brought in (Table 1) was that wastes emerge from systems and subsystems, which are universal phenomena in ecosystem, thereby consideration of system approach in thinking of any solution to problem should be based on system process based approach [8]. Therefore, bio innovative measure sought in the study will be unique solution for all kinds of wastes (Table 1). Varieties of problems give genesis of products and developing methods to overcome the problems. Process of decomposition is natural, but so far methods remain at its natural pace and decomposition process disposing suffers with variety of problems. Different strategies chalked out in past for maneuvering different wastes were non effective and costly, which remained debatable. It required to make natural process get boosted so that waste decomposition problem is quickly controlled. Further, the waste disposal were taken as burden and suffered with attitude of throw away. Therefore, measures which convert them in profit producing venture will become innovation, being sought in the present study. The solutions arrived at for any problem gets overshadowed by increasing huge volume of wastes. The most common is dump in pile and let it get decomposed in its own way. There were some advancement in composting which was popularly known as Farmyard Manure (FYM), vermin composting and aerobic decomposition (NADEP) with plentiful justifications. The advancements made on such man oeuvres of waste were reviewed, which will provide scientific support for innovative bio-measure sought in the present study.

Table 1: Different sources of producing wastes and associating implications.

S. No	Ecosystem	Waste Process Sources	Waste Product	Disposal System	Associating Implications
Household Wastes					
1	Human	Intestines	Excretory wastes	Appurtenances and enclosures	Pollution and un-scenic
2	Sewer	Wastewater and solids	Sludge	Sewers	Snakes, rats and bacteria etc.
3	Kitchen wastes	Food processing and washing of vessels	Sullage	Sewer	Pollution and un-scenic
4	Fumes and smoke	Air pollution	Polluted air	Exhaust and chimney	Indoor pollution
Animal Husbandry and Dairying Wastes					
5	Dairy	Straw urine and dung	Barn yard	Collect pile for composting	CO_2, CH_4 release and un-scenic, mosquitoes and flies
6	Piggery	Straw, urine and dropping	Air pollution	Collect and pile compost	Air pollution
7	Poultry	Straw, urine and dropping	Air pollution	Collect and pile composting	Air pollution
Agriculture Wastes					
8	Cereals	Residue	N_2O	Burning	Air pollution
9	Pulses	Residue	N_2O	Cattle feed and burning	Air pollution
10	Sugarcane and cotton	Trashes and residue baggage	N_2O	Largely burning	Air pollution
Industrial Wastes					
11	Production	Heating energy	Smoke and fumes	Emit to environment	Air pollution
12	Processing	Heating energy	Waste products	Emit to environment	Air pollution and detritus consumers

Lack of awareness about most appropriate chemical process of decomposition viz sulphur cycle

There are only three types of composting viz FYM, Vermin composting and NADEP composting. Pile/pit composting is the most prevalent ongoing practice of cow dung processing. The vermin composting a biological innovation originated from Britain in which earthworm of specific species are reared on dung under wet condition and worm casting is collected in form of vermin compost. The third type of compost is aerobic composting, which is prepared in raised aerated chamber of different composting materials such as dung slurry or mud from nutrient conveying channels and residue etc [9]. The nutrient contents of these biomaterials contain both macro and micro plant nutrients in the decomposition process. Although composting is practiced, the process of sulphur cycle which governs decomposition in the NADEP composting could not become basis of scientific backing for the composting [9]. The micronutrient sulphur (S) build up is least aware, which was established by studies [9-11]. The microbiological organism being sought by environmental engineering [12,13],

all get killed in the heat generated in NADEPED Chamber. Most of African Environmentalists highlight microbial magnifications in wastewater and solid wastes, implicating that such aerobically digested composting and use of sulphur cycle were not popular in African countries.

Innovative bio decomposer

Biologists attempted to find some biological method particularly microorganism which foster decomposition process. A consortium of few beneficial microorganisms, which was isolated from desi cows (Indian country Cows) dung after over a decade's research constituted to standardize multiplication technique for waste decomposition and for some other microbiological benefits [14]. Waste decomposition microorganisms produce primary metabolites that are precursor viz including polykelides and alkanes. The bio-decomposer has become a proprietary item, which are sold in small liquid bottles packings. The resulting decomposers were assessed for its comparison in fostering decomposition time and enhancement of nutrient [14] will be brought to assess its adoption in advancing waste decomposition.

Bio Booster supported new NADEP sulphur cycle

For fostering decomposition of paddy parali, which is main problem in environment pollution and has high potential of bringing valuable plant nutrient will be taken up in following research part of the study. Creating decomposition following aerobic route produces residues in sultanates and against this the anaerobic route produce hydrogen sulphide, which acts as poison for the plants.

Innovative bio-decomposing booster supported fast method

Innovative bio boosted sulphur cycle aerobic composting is a unique strong measure to eliminate biomass burning and produce sulphate forming nutrient enriched organic manures, which can become in form of practice of converting wastes or crop residue in plant nutrient almost at site of its availability. The paddy straw liable to burning will get converted in to Sulphur containing bio boosted organic manure which will enhance harvest index of crops. Thus, new aerobic bio boosted composting will be an innovative advancement eliminating limitations of not getting adopted by farmers [3-5] and this advancing bio science will convince farmers adopt bio innovation to bring prosperous agriculture.

Utility of NADEPED compost in enhancing soil productivity

The review indicated existence of experimental study, which strongly supported functioning of Sulphur cycle and production of macro and micronutrients. Although research [15,16] also had not brought use of knowledge of sulphur cycle fact in their studies, results in the study produced experimental results which ideally verified working of theoretical aspects of sulphur cycle. Therefore these experimental results were adopted for validating the theoretical application of sulphur cycle and utility of NADEP composting. Thus, field study results of [11,14-16] were used in support of this bio innovation.

Result

Big problem of agri-biomass burning and confusion about the most suitable option

Various types of wastes are disposed of either in rivers or gullies to get self-decomposed or get fired, which cause variety of pollution, imposing health hazard. Paddy parali burning is big issue in Punjab and Haryana (Figures 1 & 2). Legislative measures for leaving burning had been getting resentments by people [3-5] and agitating farmers were demanding a method where it does not involve transporting of paddy parali to different sites, but non availability of suitable measures the biomass burning could not get stopped (Table 2). The present practice causes tremendous air pollution in Delhi and the capital region. So far there seemed to exist no feasible solution to the problem. Therefore, the existing situation demanded innovative measure to tackle biomass burning as well as other bio wastes.

Table 2: Reappraisal of problems, ongoing practices and prospects of existing measures.

S. No	Aspect	Status	Prospects	Further Action	Acceptance
1	Problem on biomass burning	Practice continues	No noticeable reduction	Legislative imposition levied	Retaliation
2	Practices going on	Random and Adhock	Not specific	Undecided	No future hope of acceptance
3	Effect on air pollution problem	No improvement	Not reducing	Not in right perspective	Undecided

Nutrient contents of different composting practices

There can be storage of the paddy parali in a magic pyramid power storage bin (a bamboo frame made pyramid shaped outdoor structure) at site). The paddy stalk chaff can be stored and used in due course for cattle feed, as bedding material in dairy barn, poultry and piggery houses, to harvest urine and dropping, which can be processed for its due decomposition. Thus, the paddy parali can be brought to multiple uses and finally converted into plant nutrients. Such strategy fulfills all requirements and overcome all objections and eliminates its, including consortim of CGIAR regional centres scientists in Delhi in solving problem of biomass burning, eliminating air pollution and enhancing nutrient availability for agriculture [3-5,17]. Thus, it is clear that this management of parali at site is a natural and obvious management of paddy residue in the paddy growing states surrounding Capital Delhi, India, which will be best feasible utilization of various alternative measures being

attempted by thinkers and planners, including management in the fields as provoked by researchers [18]. Uttar Pradesh Government had opened cow rearing shelters, where cows need lot of fodder for their survival, this paddy biomass can become a boon source of fodder for such cattle, which will convert the biomass in cow dung, which will become a bio support in overcoming problems of paddy residue biomass burning. However, such bio measures did not become strategy of overcoming biomass use in right direction [18]. This cited study [18] fondly provoked popularization of unsuitable measure involving the happy seeder, a machinery for sowing wheat in field with paddy stubbles. Governments' attention got diverted for such unsuitable measures and the State Governments provided subsidy for this pseudo practice, which could not convince farmers leave biomass burning [3-5]. Further, this measure could not be productive as this reports by application of NADEP compost Recently Government of Delhi got scientific support from Indian agricultural scientists and attempted spraying of bio decomposer, which is different from the one being used in the present study and reaction of farmers' after such practices will guide them to adopt nutrient building measures. This reveals no existence of suitable measure and lack of use of sulphur cycle in composting of wastes. The insitu decomposer use initiated by the government of Delhi was yet to reach to the source site of pollution creating biomass burning of the paddy and wheat producing states of Punjab and Haryana.

(Table 3) contains nutrient contents of various composts in vogue, with their process involving Green House Gas (GHG) emission. Nutrient components viz macro and micro are available in varying quantities [17]. The aerobically composted manure (NADEP) is superior to the compost with respect to all nutrients, in general. The NADEP contains highest percentage of potassium (K), minimum Fe, Mn and Zn, but Cu is highest. Contrary to this, the vermin composting, innovative biological measure from Britain, although produces high N content, but the quantity of vermin manure gets reduced, hence this fact should be kept in mind while evaluating utility of the manures and low Zn. So far there had been no awareness on enhancement of S as a result of process of aerobic sulphur cycle. Such benefits might be coming up in enhancing crop yields, which is not so in FYM compost or vermin composting. Further, earth worms being delicate to manage and remain prone to prey by birds, ants, frogs, lizards and rats etc., require intensive attention and produce methane, which has high warming factor than the carbon dioxide, highly un scenic and un liked involvement of touching by hand. Further, as the availability of dung is getting reduced, the scope of extension of FYM and vermin compost are getting limited, whereas low dung demanding NADEP composting is getting increasing scope of extension, as emphasis on paddy production is getting enhanced that will always produce sufficient quantity of paddy residue. In comparison to these limitations and drudgeries, the NADEP composting release only carbon dioxide, contains S and requires least intensive care and manageable by machineries. Therefore, for these reasons the NADEP is the best way of composting of crop residue such as parali. The sulphur cycle is most suitable and scientifically correct way for making many improvement in such composting processes [9-11,19]. The NADEP composting chambers can be constructed in one corner of field that will fulfill need of managing parali at sites as demanded in resentments of farmers [3-5], without any expensive transportation and use of NADEP compost in field. This becomes answer for many grudges of farmers [3-5] and many waste get used without going for open biomass burning, being focused on the present study. Chemical analyses data based on reference [17]. Note: There was no visualization of building of S, sulphur in the organic manures, supporting lack of visualization of working of sulphur cycle as established by previous study [9-11].

Table 3: RGray and black chemistry involved in organic manure; elemental composition of organic manures, average values.

Organic Manures	GHG Chemistry	Macronutrients, % Wet Weight Basis	Some Selected Heavy Metals, Mg/kg Dry Weight Basis					
		N	P	K	Fe	Mn	Cu	Zn
Farmyard manure	CO_2, CH_4 Black	0.54	0.31	0.51	440	155	10	78
NADEP	CO_2 Gray	0.93	0.52	1.15	215	96	25	56
Vermin compost	CO_2 Gray	1.36	0.48	0.65	619	245	16	45

Innovative bio-decomposer as booster

The bio decomposer was described in detail in the section 2.4 as consortium of few beneficial microorganisms, which were able to decompose cow dung in 35 days [14], The decomposed product was reported to produce nutrient containing compost in (Table 4). The bio decomposer was being applied for decomposition of crop residue such as paddy parali. The results substantially established that there had been lack of knowledge of sulphur in decomposing by bio-decomposer. The N content is higher than NADEP compost as a result of sole decomposition of dung, but lower than vermin composting, where reduction in volume of manure is high. Thus, it can be said that this bio decomposer might appear better for fostering residue than the vermin composting. This fact supported that bio-boosting decomposition will become further advancement over bio-boosted NADEP composting to produce manure rich in S, Zn, as well as rich in K.

Table 4: Effect of waste decomposer on cow dung composting in 35 days.

Pa	EC	C:N	Organic Carbon	N, %	P, %	K, %	Total Micro Organism	Remark
Bio Decomposer [14]								
7.5	3.8	18:01	18	1.2	0.6	0.6	10 12	No S
Bio Decomposer [14]								
				0.93	0.53	1.15		With S
Innovative Bio Boosted NADEP Composting Ne Combo Bio Innovation in Present Study								
				1.2	0.6	1.15		With S

Innovative bio boosted sulphur cycle guided composting

Innovative method of bio boosted aerobic composting for fast and nutrient rich sulphur containing organic manure was the main objective of the present study, which was fully substantiated in operational management of sulphur cycle (Figure 3). The bio decomposer will fasten process of decomposition and enhance quality of bio manure, which will be richer in nutrient content and reduction of time of composting from usual 16 weeks (i.e., for four month i.e. 120 days) to 35 days or even less than previously studied NADEP composting [9,11,17]. Thus, the bio-boosted NADEP composting will be an innovative management of sulphur cycle for overcoming problems of biomass burning on one hand and producing plant nutrients for bringing prosperity in agriculture and improvement of environment. This new route of solving problem of disposal of wastes will eliminate smoke pollution and produce wealth for agriculture. Thus, paddy growing poor states or regions will be able to boost their economy to get fortified by this innovation. South East Asian countries, where smoke emerging from open biomass burning [6,7] will also be able to get free of such bad atmospheric situations. Thus, the present bio innovation will become an innovative measure to enhance productivity and reduce environmental problem as in NCR Delhi as well as many countries of the world [6,7] and many other with such problems.

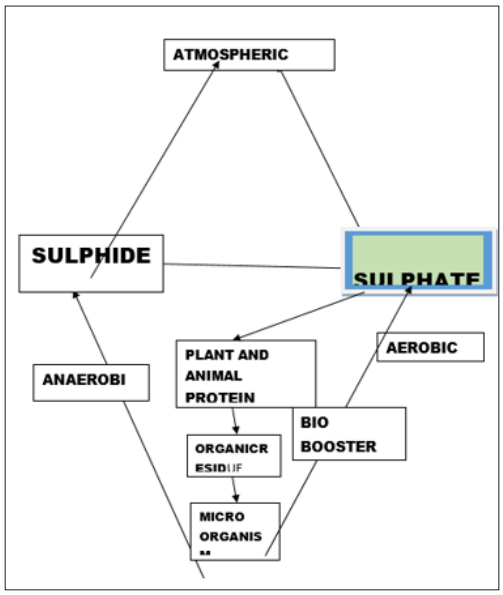

Figure 3: Sulphur cycle of organic and residue protein decomposition [9-11].

Potential utility of Sulphate producing bio decomposer boosted manure

Study [17] on integrated nutrient application in agro-forestry system on enhancing yields of aonla *(Ebmlica offinalica Gaertn)* established efficiency of the NADEP composting. The NADEP is highly suitable for pulse production [19] and reclamation of saline soil [20]. A study showing utility of S containing results were used to substantiate that NADEP compost support in enhancing yield. The process demands that such innovative development will quicken decomposition and bring nutrient rich organic manure rich with S. Thus, this research substantially established that bio boosted NADEP composting i.e., certainly true innovation for overcoming biomass burning and strongly convincing farmers for not to burn, instead go for fast NADEP composting and acquire multiple benefits producing activity in agriculturally rich states of Punjab, Haryana and states surrounding Delhi and NCR region. This research will be savior for South East Asian countries, including southern states of India as well, where paddy is main cropping and remain poor due to paddy low production as well remain highly susceptible to fires and highly smoke polluted environment. These results on yield of paddy irrigated with distilled water substantiated the fact that irrigation with sewage wastewater, which contains sulphur, will form hydrogen sulphide, which acts as poison for crops. It also supports the practice of weeding i.e.; the removed weeds should not be left in submerged condition. Dead decomposing weeds under submerged condition will produce the hydrogen sulphide under [9,11] anaerobic condition. These lessons emerged from knowledge of sulphur cycle [9,10]. The use of NADEP was made a compulsory component in established nature agriculture and its standing superb over vision agriculture 2050 [21-24].

The new bio boosted decomposed NADEP manure contains high N, P,K and Zn as well as S to be a new nutrient providing practice in agriculture as confirmed by results revealed in (Figure 4), where high N, S and Zn enhanced high grain yield and harvest index. Further, high content of K, existing in NADEP, which was not applied in the referred experimental study, will enhance productivity over the yield shown in (Figure 4). When the NADEP compost is used, it will enhance efficacy of zero weeding agriculture as established another bio advancements by studies [25-27]. The supporting innovations of bio-boosted fast decomposed manure application and weed maneuver with zero weeding [28,29] will produce yield to still higher level than those displayed in (Figure 4). Thus, the bio-boosted aerobically composted plentifully available

paddy residue enable bring new acme of harvest index, which will become innovative double advancement in biological sciences. The added innovation of eco-zero weeding, fixes dynamic N during the crop growth, which converts fast ammonification of urea, thereby it will further amplify harvest index. It is expected that this innovative vision will inspire biological scientists conduct research and optimize the levels of NADEP compost, bio decomposer dose and efficiency of zero weeding. This innovative manure will enhance harvest index at same level of water application [19,27]. This bio innovation provides new justifying research supporting paddy wheat cropping pattern, which form main food stake for people world over. Further, enhancement in yields, harvest index and reduction of cost on weed removal will enhance farmers' income in agriculture [28]. The incorporation of N fixing crop insole crop reduces emission of GHG N_2O, fulfilled open challenge declared by American renowned scientist [1,30,31]. These benefits set support for bio innovation enhancing productivity, farmers income and improving environment and building an adoptable route leaving biomass burning. All N sources were applied 100kgN/ha,

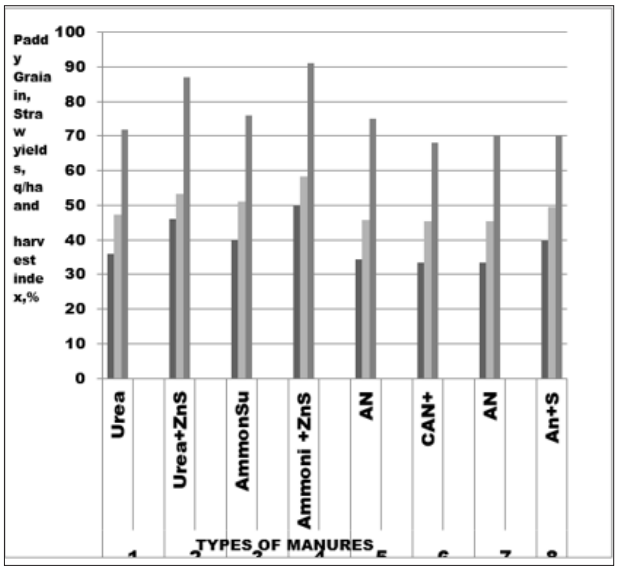

Figure 4: Effect of S supplementation with N and Zn on grain, straw and harvest index of paddy a shown in graph Note 1. Paddy grain; 2. Paddy straw; 3. Harvest index; 4. Grain: Straw ratio. All plots were irrigated by distilled water. Chart developed from experimental data of [15,16]. Means sharing the same letter (s) are statistically non-significant at <0.05 probability. Zn S : Zinc sulphate.

Infrastructure for NADEP composting or innovative bio-boosted NADEP composting chamber

The NADEP composting chamber is constructed on open ground on a raised plate form, three sides walls perforated, and one side opened for facilitating filling and taking out the compost for further application in field. The chamber is filled with dung slurry or mud derived from wastewater conveying streams, bio treated parali chaffs or any other waste followed by soil, each in 10cm depth repeating layers. Four layers filling making last layer domed shape is completed. The filled chamber is provided with thatch shelter and space for frequent sprinkling of water. The over filled material will get decomposed and settling down. Then the filled material comes within the walls of the chamber, it is assumed to be decomposed enough to be applied in field and incorporated in soil at least 20 days before sowing, thus follow irrotational movement order [2,11]. The NADEP will also be getting in aerobic process of decomposing and keep supply in sulphur rich nutrient to bring enhancement of harvest index of crop [21,32] (Figure 5).

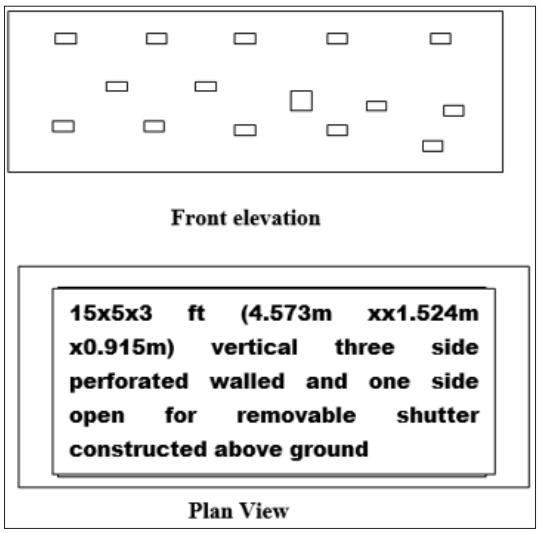

Figure 5: Common design dimension of NADEP Composting chamber of about 5.38m^3 ≅5000kg. Note: The filled chamber is provided thatched cover and maintained moist by space for occasional sprinkling of water).

Peoples participation and employment creation

For individual filling of NADEP chambers it requires collection of materials needed to be used for completing filling process in one operational single instance. Therefore, it requires collective operation in collection of materials and accomplishing manpower help and completing job of NADEP chamber filling. This job requires pooling of material and labor in cooperative manner. For this job all stake holders should form group and cooperate in give and take manner providing and arranging material specially cow dung for filling the NADEP chambers [11,22,24] and cooperative completion of job [33-35]. This participatory action will enable stake holders accomplish the filling task at one time, which otherwise is not possible. Once filling is completed individual's responsibility will be to sprinkle water to keep filled material wet for its complete decomposition. There is no need of inversion after filling as perforations will provide aeration. If this task is taken up as a regular function, Government departments should organize service in regular cadre. This new department will enable fostering agriculture and lot of subsidies on manures and fertilizer will get saved, which will enable creating employment. Such initiative was launched in Directorate of Agriculture, Uttar Pradesh, in 1990s decade, where some benefits emerged, but it lacked scientific support of sulphur cycle. The impact of that program is hard to find

now on ground, one may find abandoned NADEP chambers [11,27]. Thus, new bio-scientific innovations will convince farmers to solve both problems of biomass burning and harnessing new nutritious organic manure.

Discussion

This study developed an innovative bio boosted aerobic composting of agricultural biomass, which get subjected to both insitu and exsitu burning for quick clearing of fields for next cropping. Occasional burning of wastes recovered from other sources also get subjected to same burning and combined impact of such burnings lead to huge problem of air pollution, making breathing difficult. For stopping the burning Government authoritative legislations revolted by people and measures adopted had been not suitable. These innovative measures brings lucrative benefits which will convince farmers adopt it and harness advantage from all biological innovations. Thus, this research will lead to build acceptance of stake holders go for complete halt age of biomass burning. Such elimination of burning of wastes, including agricultural wastes, will create clean air on one hand and enhance productivity of agriculture on the other. Following subhead wise review are set here as further ratification of entire aspects of development, utility, application and ease of adoption. This study fosters Gandhian Mission of Sanitation and ongoing mission of Greenpeace [36] for clean air (Figure 6).

Figure 6: Greenpeace mission (Hash) clean air [38].

Substantiation of its innovativeness

The bio decomposer booster development was not with awareness of sulphur cycle. Hence, this bio innovation is highly applicable for management of wastes and eliminating burning, which cause air pollution and easily adoptable innovative development. Thus, this research brought advancement of innovation supported by another innovation of eco-zero weeding agriculture that will foster utility of new nutrient rich manure.

Less aware domain of sulphur cycle

As mentioned above, the sulphur cycle had been less aware than usual, was scientifically substantiated by study [9,11] Lack of such knowledge of sulphur cycle makes agricultural scientists remain wandering searching suitable measures [11] and not reaching to perfect solution. The sulphur cycle enables one to understand the process and find scientific justification for reaching the perfect solution. Many such examples had been set in the study for building clean air and prosperity in ideal plant nutrient supported agriculture [9,11,23,26-28].

Slow release of organic plant nutrient culminating high harvest index

The organic aerobically decomposed (NADEP) compost goes on decomposing and cyclic humification, becomes slow releasing nutrient source and finally culminating in building high harvest index [21,22]. This organic manure is superior to ongoing practice of green manuring, which brings quick response, remain ineffective for the following crops in the coming season. The sulphate is highly important nutrient bringing improvement in soil health. Sulphur is second important CEC constituent after Nitrogen (N) first, enhancing soil productivity. It is established from the results (Figure 4) that Sulphur supporting fertilizers enhance resource use efficiency at same level of water application. It fits very well in reclamation of saline land [21], enhancing yield of pulse and oil seeds viz rapeseed and mustard [37] and for combating desertification, as new initiative.

Sulphur (S) as one of the core factor of Cation Exchange Capacity (CEC) supporting soil productivity

The sulphur is one of cores element of plant nutrient enhancing soil productivity [23]. The NADEP composting is practical method of building organic S in soil, which is highly useful, as brought out in sub section 6.3.

Foster of sanitation mission of Mahatma Gandhi

This study brought out earlier that political support of mission sanitation ends up at broomed trashes and leaf piling at sites, without taking it to end use or eradication. The innovative bio boosted aerobic decomposition is perfect and ideal method to eliminate burning of bio wastes at sites, arresting air pollution. This innovative measure takes the waste products to its last process, not for eradication, but producing additional wealth of nutrient for agriculture. This research is usable for altering sewer system to overcome several limitations, making costly, non-affordable and reduction of maintenance.

Potential replacement of N and P in wastewater and overcoming eutrophication in water bodies

This innovative measure becomes new route for high cost, not usually done by tertiary treatments of wastewater, which in turn leads to death of water bodies due to eutrophication by high N and P content. This method will reduce cost of installation of sewerages systems and eliminating need of huge cost involving sewage treatment plants (STP), not found effective, in many cases. This research will change routes of wastewater disposal to another route and keeping river water resources clean, for which huge budget involving river action plans get launched, but highly any visible effect appear. This happens by virtue of the fact that whatever cleaning is acquired, it gets overshadowed by addition pollution getting built up in the river systems.

Eliminates burden of tertiary treatments in sewage water treatment

The innovative measure will eliminate need of tertiary treatments of waste waters, which usually not done in developing countries, in general. This new method will provide alternate route and making enterprising use of organic wastes. The cost of infrastructure is insignificant against tremendous wealth created in the NADEP composting.

Enhances nutrient resource use efficient at same level of water availability

The NADEP enhances resource use efficiency at same level of water application. Therefore, application of this bio manure will enhance endurance during drought occurrence and enable plant produce high yield (Figure 4).

Producing commodity for good health

Sulphur is a fortifying compound building element for providing additional energy. The new bio application in field will enhance uptake of sulphur crops producing food commodity, which in turn come in food chain and fortify human health [30,31].

Highly suitable for smart agriculture under changing climate

The smart agriculture is fostered by raised bed and furrow, which acts as an auto drainage during continuous rains and get equipped with additional moisture in sol profile during droughts, which brings resilience during drought providing aerobic condition with sufficient moisture. The long duration lasting soil environment will keep lasting long and producing enhancement in crop yields [25-27].

Organic bio manure supportive of many innovations in agriculture

Tiful innovations have been created with knowledge of sulphur cycle and developing process of bio-manure containing sulphur (S), were created [14-16,25-32]. With bio-boosted fast composting process and products will enable other research to come in future.

Conclusion

The bio decomposer boosted aerobic composting of any bio wastes will eliminate biomass burning, creating clean air and producing ideal plant nutrient containing manure that will create prosperous agriculture. The benefits will become lucrative support for one and all involved in biomass burning, getting fully convinced for leaving biomass burning and foster fulfilling right of clean air of Greenpeace mission. This research provided alternative route and producing wealth and environment, all leading to fulfillment of different people centered important missions. This research brought innovative measure, not visualized earlier, for bringing several reformations, in management of clean air and prospering agriculture as well as land and water resources.

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