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Biological Phosphorus Harvesting for Multiple Uses: A New Scientific Vision

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Abstract

In this study method of harnessing biological Phosphorus (P), an important food and nutritional element for animals and nutrient for vegetation plants, making non dispensable use of water and linking aquatic and terrestrial ecosystems, are dealt with. The methods were devised for biological phosphorus harvesting from the birds feeding on the aquatic ecosystems, secondary consumers such as insects, flees, mosquitoes and fish fingerlings. The study substantiated availability potential of the P by using long time (about 75 year before) published academically accepted data. The measures developed for the harvesting of the biological phosphorous are fact based, feasible and sure to successfully work for the purpose intended for. Although, the quantum of collection will be small, but the material requirement for the useful purposes is also very small. Thus, this study presented a new scientific vision for the scientific development of global concern with regard to phosphorus, its multiple industrial uses and possibility of augmenting supply of source material. The study further broadens utility of terrestrial and terrestrial cum aquatic systems of ongoing fisheries and different birds' rearing farms viz poultry, duck and aquatic bird rearing and harnessing their droppings in this domain. There is scope for up-scaling of this research for further exploration of Iodine (I), another important nutrient derived from sea and ocean ecosystem and customization in the local domain.

Keywords: Aquatic ecosystem; Bird droppings; Biological harvestings; Fluorescent dye; Guano; Nutrition and nutrient and phosphorus

Introduction

Phosphorus (P) is a while waxy non-metallic element, in the periodic table classed in group 15 and period 3 after N and preceding Arsenic As. Detailed discovery, forms, reaction, types and chemical properties of phosphorus is described by Horobin [1]. Phosphorus has characteristics of igniting in air and glowing in the dark as a result of its cheluminescence oxidation process.

Phosphorus is the second abundant mineral, after amino acid and derived protein from it, in human body in every tissue and cell, generally as salt or ester of mono, di and tri basic phosphoric acid. Phosphorus is involved in wide variety of metabolic functions e.g, carbohydrate metabolism and oxidative phosphorylation, which are required to drive many metabolic processes such as active transport, muscle contraction and biosynthesis of fats and macro molecules (nucleic acid and proteins) [2] The importance of phosphorus is tagged to its involvement in the reaction of energy rich compounds viz. ATP (Adenosine triple phosphate), NADP (Neotinamide Adenosine of hydroxide ion phosphate), ADP (Adenosine diphosphate), AMP(Adenosine monophosphate), FAD (Flavin Adenine nucleotide), NADH (added H), $FADH_2$ (Addition of $H_{2)}$. Phosphorus is known to helps maintain acid –base balance and transfer of fatty acids in the human bodies.

Likewise, in plants also phosphorus is second important macronutrients after nitrogen in the list of 14 elements important for plant growth [3]. Some of these essential elements get excessively removed from the soil by the plants and some get chemically changed. These facts make plant deprived of essential elements hence, productivity is drastically reduced. These elements get transformed chemically under decomposition that creates chain of problems of environment, food shortages, behaviour of the ecosystem and disruption of ecosystem services.

The phosphorus nutrition for animals and plants are highly researched upon and ever remain as important topic for scientific research. The nutrition of phosphorus is driven by plants from the soil. The sources of phosphorus have largely been the rock phosphate inorganic, which are supplemented to the soil. The plants, primary auto producers, are the beginner of food chains and food webs

The phosphorus cycles in terrestrial and aquatic ecosystem are described by De. [4]. Phosphate minerals are located in rocks and soils; phosphate exists in soluble and insoluble form. Terrestrial plants absorb inorganic phosphate salts from soil and convert these in to organic phosphates. Animals obtain the phosphate by eating the plants. Plants and animals after their death and decay return phosphates in to the soils, which are converted in to humus by the action of soil micro-organisms. Part of soluble phosphate move to the water bodies which are used by the phytoplankton that in turn get consumed by the zooplanktone and animals. The dead organics again return to soluble phosphates.

The common forms of phosphorus in wastewater are orthophosphate (PO_4), polyphosphates (polymers of phosphoric acids) and organically bound phosphates [5]. Conventional wastewater treatments remove about 20 to 40% of phosphorus contained in the sewage. In the United States of America the prescribed limit of phosphorus content in the waste water disposal streams range from 0.1 mg/l to 2 mg/l as P. In the developing countries, largely, the sewage treatments either not carried out or even if carried out, it is up to secondary stage of treatment [6]. The phosphorus rich sewages, when discharged in the water bodies cause eutrophication leading to siltation and accumulation of dead vegetation and finally disappearance of water bodies. The rich content of phosphorus along wth rich content of nitrogen produces profuse growth of algae and floating plants in the water bodies. These profuse

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growths cause ecological problem of shortage of oxygen leading fish kills and environmental disasters of asthma, cancer and heart related problems [7].

Aquatic productivity is limited by supply of raw materials and biological efficiency of converting them in to various life forms; basic form of life, algae and other green plants are called primary producers. Detailed description of hydrobiology, particularly involving waste waters are available in text book. Birds are the secondary consumers as they feed on the insects and fish fingerlings.

The phosphorus has been subject of concern since long back with regard to food and nutrition for plants and animals. In the recent years phosphorus has been used for various other purposes such as phosphorescent dye and additive in many bright colours making sources. Thus, availability of refined phosphorus is becoming important element for lucrative enterprises developments. Therefore, search of refined phosphorus becomes equally important. In the scientific endeavours many proactive efforts are resorted to augment supply of the scarce resources and materials. For example, very important effort has been on the water harvesting (in long past and researched by many researchers) and biological water harvesting [7]. Biological nitrogen fixation and phosphorus solubilisation by Marra [8] is also similar attempt by using soil bacteria. Biological fixation of nitrogen by leguminous crop based bacteria is widely known and ongoing practice. In the similar way the objective this study was to explore a ways and means of fostering availability of Phosphorus. In the phosphorous cycle, part of phosphorus in take by animals get excreted and makes a small but sustainable source in nature. This can be source of problem for water and environmental pollution causing eutrophication in the water resources. The research effort devoted in this study is aimed at developing a way to remove the phosphorus to eliminate the water pollution problems and make its other use to develop lucrative applications. Guano is the name given for this bird dropping, which is rich source of phosphate fertiliser [1]. Some efforts to artificially generate the bird droppings by erecting raft in the coastal areas, also reported by Horobin [1]. The aquatic birds which derive their foods from fish are known to produce phosphorus in droppings is becoming important with respect to scientific and development interest in view of its upcoming multiple widespread uses and requirements. This study aimed at harnessing by collection and use of the phosphorus from the bird droppings.

The manuscript contains materials and method with regard to substantiation of phosphorus content in bird droppings vis a vis other sources, description of setups for biological harvesting covering entire domain where birds sit for prey and for their night stay. The setups cover created in the study cover sitting time of the birds on them, except time spent on travelling by flying; thereby capture most of bird droppings. The result comprises substantiation of potential of availability of phosphorus. The novelty of method followed by the prospects of research result under various sub heads. The SWOT analyses of the research is followed by conclusion and need for further research. Thus, study covers in detail the novel research on status and development of important element *viz* biological phosphorus. The lack of experimentally collected data gets overshadowed by the novelty of research area and method resorted to in the study.

Materials and Methods

Substantiation of Phosphorus potential of bird dropping vies a vis other sources

The exhaustive literature survey revealed existence of valuable data on sources and content of nitrogen, phosphorus and potassium [3]. In this study the data on the compounds where phosphorus is available in the substances were selected to use as supporting and substantiative resource. This study made use of data to substantiate entirely a different issue from which data was published [3]. Thus, in no way it is forfeiting the publisher's copy right; rather it is an extension of long time known (about 75 years ago) data for enhancing its inherent value in furtherance of scientific research. The study demonstrates utility and application, and promotion of very important subject of food and nutrition, ecology and environment and enhancement of resources uses in the global perspective.

The setups for biological phosphorus harvesting

The setups for biological harvesting of phosphorus were developed to extract the phosphorus from various sites as it naturally occurs.

Collection from trees where birds sit for their night stay: During nights all birds sit on the trees for their night stay. The birds will release droppings intermittently which will fall on the ground. This ground if provided with some litters, it will absorb the droppings. The litter can be replaced at convenient regular interval. In place of the litter the ground can be covered to receive the dropping to be collected at regular interval. The ground spread plastic sheet can be sloped to drain in a collection drum so that the droppings get washed in to the drum which can be removed for transferring the nutrient rich water for its processing and use.

Collection from the birds sitting on the aquatic banks and shore: Birds sit collectively or singly on the aquatic banks e.g. river banks, lakes and sea shores. At such strategic points of bird sitting, clusters of stands of 2-3 m lengths, depending on the population strengths, can be erected at some interval, may be 20-25 m distance along the banks. These stands should have raft/5-8 cm wide strip for sitting of birds and below it a catching tray to receive the droppings. A container (a jerry can) should be kept to collect the rain washed liquids. The jerry can should be replaced at some interval.

Collection of bird droppings from the birds sitting on the boulders right in the river course: It is usual to find protruding stones in the streams covered with bird droppings. Such strategic stones can be covered with a plastic cap of white sheet with bottom edge folded in channel form and a bottle attached to it to receive the rain washed substances. The cap and the droppings washed water are removed with another set of empty ones. At such strategic points the clusters of stones may be covered at any time and replaced as per condition and demand. In this sector of collection of phosphate there is scope to utilise knowledge of experienced ornithologist whether at such sites birds will prefer to sit in cluster or to sit alone in isolation. For the cluster sitting some sitting stands of 1 to 1.5 m length equipped with dropping catching tray and the collection bottle can be placed at places and checked for collection and replacement as the need be.

Collection from birds flying over deep water segment of aquatic ecosystems: Birds also fly over the deep water section of the aquatic ecosystem to catch fish exposed in the wave action of the flow. In order to facilitate these groups of bird floating raft on the boats can be provided. These rafts will have stands for sitting, tray for catching droppings and collection in the storage bottle *viz* jerry cans. These boats once set, can be visited for collection at convenient long intervals.

In view of the waxy nature of the phosphorus the width of stand for sitting should be in 5-8 cm and below this the dropping catching tray should be located. The surface of the catching tray should be fitted with

a thin glass sheet and sloping to drain the liquid substance. The sticky dropping can be scrapped from the glass surface by using wide knife. Thus, four collections set ups become easy and organisable simple setups for biological harvesting of phosphorus from the droppings of birds feeding on the aquatic foods viz the fish fingerlings. These setups can be made from ordinary wooden planks or fabricated in plastic mouldings and painted in the colour matching to the surrounding and ground. The setups can be nailed down for stability, with adequate lengths of holding ropes to allow fluctuations in the water level in the aquatic system and transferred to the changed to any strategic sites of bird sitting.

Results

The results of the study under different heads are presented in the following

Substantiation of the phosphorus potential sources

Table 1 contains list of different sources of phosphorus and corresponding content. The animal ammoniates are renewable source which is aimed at harnessing the biological phosphorus. The results are viewed from various aspects.

Selected data from Gustafson, 1939/2010 to support the hypothesis of potential of phosphorus resources.

Potential sources: Phosphorus is available in the maximum percentage in the animal ammoniate in the bone meals. The guano viz dropping of aquatic fed birds is the maximum renewable resource of the phosphorus (Table 1). The content in the fish and other bird viz poultry and sheep manures are of lower than that in guano. Vegetative plant ammoniates contain low magnitudes of phosphorus which offers low potential for extraction and commercialisation. Many manufactured fertilisers contain high percentage of P but are difficult to get and costly.

Magnification of the phosphorus content: The fish (acid) contain phosphorus 3-6 percent and tankaged (with fresh water) 4-8 percent. Thus, tankaged fish brought more (2.2 to 3.3 times) magnification over the fish in acid water. This implies that fish reared in the ponds and rivers will permit better harvest of phosphate than from the sea fish fed birds. Thus, there is some indication that artificial fish ponds reared fish fingerlings when fed to the birds of aquatic ecosystem dependent or alike species will produce better harvest of phosphorus than the sea fish fingerlings eating birds.

Aquatic birds were able to magnify phosphate 1.7 to3.3 times over the phosphorus content in the fish itself. The dropping of the birds feeding substantially on the fingerlings contain phosphorus 10 percent (Table 1). The P content of guano is almost 15 times more stronger than that in the poultry bird dropping, which is known the best sources of biologically available P. The guano the substance in this study will be a very strong source of P. Further, the phosphorus is useable for other industrial applications in very small quantity in the order of one tenth of nanometre. Therefore, inspite of production of small quantity guano derives significant high value for commercialisation.

The quality characters: The phosphorus is available in fixed and soluble form. The biologically produced P from the guano will be soluble phosphorus (organic phosphate); therefore, it will be of superior to inorganic phosphate in quality.

Phosphorus harvesting setups

The collection setups are simple to facilitate sitting of birds at the banks and right in the river stream protruding boulders and their actions in the deep water segment of the aquatic ecosystems for their strategic position to catch their prey. During the day times birds will be coming and moving from place to place in search of their catch. Therefore, simple, transferable, low cost and catch facilitating setups will go long way in harvesting of the droppings of the aquatic birds, the guano, rich in biological phosphorus. The quality of the guano will be pure and free from any adulteration. The special design of the rafts, the droppings catching tray and the glossy surface will facilitate biological catching of phosphorus.

The birds sit on the tall trees along the banks for their night stay. Their dropping will be coming throughout the night and get collected in the litter spread to receive it. If the ground is smooth, a thin layer of litter such as what straw, grass and paddy straw chaffs or saw dust will be suitable. These materials after collection can be used as soil ammendments for phosphorus supplementation in the fields. Use of poultry manure and sheep manure are well known and in practice and guano litter material is similar in handling.

Quantity and Quality of droppings harvestable from different collection sites and potential uses

All harvestable guanos have similar strength of magnification. The guano from night sitting collected from litters, being larger in volume should be used for supplementation of phosphorus for crops. The guano collected from the aquatic banks or right from the inside of river, being pure should be processed for preparation of phosphorescent dye for various purposes.

Processing of harvested phosphorus

The admixture of bird dropping and water when brought to the laboratory will be processed by chemistry expert. The produce needs expert chemical analysis and product development.

Prospecting of Research Results

The harvested phosphorus becomes an important source of organic phosphorus. Its multiple uses are presented in the following sub heads.

S.No	Compounds	Phosphoric acid content, percent
Animal ammoniates		
1	Bone meal raw	20-25
2	Bone meal steamed	25-30
3	Fish (Acid)	3-6
4	Fish tankage	4-8
5	Guano*	10
6	Meat meal	1-5
7	Milogranite	1-5
7	Poultry manure(dried)	0.65
8	Sheep manure	0.86
9	Tankage	3-13
Vegetable ammoniates		
10	Castor meal	1-1.5
11	Cocoa shell	1.0
12	Cotton seed	2-3
13	Linseed meal	1.5
Inorganic and manufactured ammonites		
14	Ammophos (1)	48
15	Ammophos (2)	20
16	Ammoniated superphosphate	16
17	Leunaphos	20
18	leunasalpeter	20

Table 1: Phosphorus containing compounds*.

Implications of results

Bird droppings (already known and existing as guano [1,3] contain high amount of phosphorus. The bird droppings are also known to cause water pollution by enhancing P and N contents leading to eutrophication a cause of damage to water bodies' existence and worsening of water quality. Thus, research and development under the present study brings two directional solutions i.e removal of the pollutant and making multiple industrial alternative uses. In order to supplement large demands to come up the present study opens avenue for renewable production of phosphorus along the existing and created inland fisheries, ponds and lakes with fresh water.

The birds collectively sit and wait for long hours in search of their feed of small fish on the bank of rivers and on the boulders existing in the river bed having elevation more than the flow depths. The phosphorus is one of the major nutrients for the plants. The profuse growth of water hyacinth absorbs oxygen present in the water that leads of fish kill and deterioration in the water quality. This phosphorus can be extracted by harvesting as dealt with in the present study, can be further manoeuvred by the incorporation of functions of sulphur cycle [9-11] to enhance productivity of crops. Therefore, whatever quantity of phosphorus that gets mixed up in the long stretch of rivers and brings bad effect to the quality of water can be manoeuvred to eliminate the bad effect on one hand and produce useful good effects on the enhancement of productivity of nitrogen and water, on the other.

The collection of the bird droppings along strategic points (where birds cluster along the bank) can be done by erecting bird sitting stands/ rafts. The stands should be equipped with collecting tray channel as an when it is dropped or when the accumulated droppings get washed during rains get collected in jerry cans attached to it. Further, in the river reaches of boulder zones, birds sit on boulder extruding above water surface and keep waiting for the fish for their feed. The protruding stones on which birds sit can be covered with a plastic cap with bottom edge formed as channel and having provision of a collection bottle to collect the washed down droppings as and when rain or mist occur. This cap and collection bottles can be again changed at intervals. Thus, the rare natural resource which produces undesirable effects to the water resources will be harnessed to bring to beneficial uses by biological harvesting of phosphorus.

The phosphorus in addition to being an essential major nutrient for the plant growth is useable in many other applications such as tracer dye and as phosphorescent organic materials. The quantity of the phosphorus needed for other than plant nutrient is very small (at levels of tens of nanograms /per litre (~1 in 10^{11}). Hence requirement of guano is very small amount of solution for injection in the hydrometric practice of measuring river/stream discharge as direct method [12]. The organic phosphorous will be new source for soap manufacture, colour dye and paints in building materials and eradication of ultraviolet light from fluorescent tubes and mercury vapour lamps etc. The use of phosphorescent dye is well known in their commercial uses. Idea of exploration of natural phosphorescent dye source did not emerge earlier, perhaps because there was no easy way to collect these droppings. Now the ways and means are made known by the present study which opens a frontier to harness the bird dropping from aquatic ecosystems for beneficial uses. The use of the phosphorus from the bird droppings needs some research efforts with regard to refinement to eliminate the N content present in it.

Feasibility and scope for harnessing

It is possible to harvest phosphorus in guano from birds feeding on the fish fingerlings. The magnification of P by the birds is almost 15 fold than the content in the other birds vi poultry. Thus, there is good scope for harvesting biological phosphate from the bird droppings in the aquatic ecosystems of sea, rivers and lakes. There is also indication that guano collection farms can be organised to produce quality biological phosphorus, which can be chemically refined of nitrogen and used in fluorescent appliances such as tubes and bulbs for illumination and paints as well as soap manufacturing. Thus, a new source of phosphorus will be possible by the harvesting of the biological phosphorus [13].

Extension of the research for collection of another nutrition i.e Iodine (I)

Iodine is produced from the cod lever oils produced from the fish. The magnification may also be existing in the bird droppings as in case of the biological phosphorus. Thus, the iodine deficiency can be removed in large population and disease of the goitre controlled to larger extent. This indication and speculation needs to be experimentally explored [14].

Non dispensable use of water resources in pond, lakes, rivers and ocean, a way to interlink people, environment and water bodies

The fish reproduction and dependence of aquatic birds has been all time known function in the aquatic ecosystems. Likewise bird droppings have been occurring and causing water pollution. Harnessing of P from the bird dropping adds a new avenue to link ecosystem and people in the non dispensable water use. Water is already becoming scarce commodity and the biological harvesting makes indispensable use of water. It opens scope for development of phosphorus harvesting along the existing or created ventures of fisheries. Thus, it creates a strong link between aquatic ecosystem, environment and people. Vast ocean stretches (Ocean two third and terrestrial one third approximately) offer unlimited scope for phosphorus harvesting. Contribution of ocean in absorption of carbon dioxides has been well recognised. This research enables make ocean resource to produce biological phosphorus and bring new global business and improvement in the quality of living.

Multiple uses of biologically harvested phosphorus

The composition of Phosphorus in different types of substances is available in Gustafson [3]. The phosphorescence properties and areas of its uses are also available in Horobin [1].

Results of the present research will be applicable for various purposes (Table 2). The ecosystem service based application, pollution elimination at sources, wastewater treatment domain increase ecosystem services. The other uses are known, but its extensive use had been limited by availability and the cost of product. Application of biological harvesting of phosphorus will produce material at lower cost by way of increasing availability than that exists when it is scarce. This situation will promote use of the biological phosphorus, thereby conserve resources, make indispensable use of water and enhancement of resources use efficiency. Phosphorus is also used as impurity additive in small fraction in semiconductor material for increasing their conductivity by several fold.

SWOT Analyses

Swot analyses a weighting mechanism for evaluating merit of any new development is dealt with in the following.

Strength

The present research on biological harvesting of phosphorus is

Areas of application	Existing known Action	Example of application	Supporting References
Enhancement in the aquatic ecosystem services			
Reduction of water pollution at source	Not recognised as serious problem	Reduction of eutrophication in whatever volume it may exist	Mark and Mark Jr 2005
Wastewater management and utilisation	Recognised but low reliance is observed	Birds will extract the growing fish fingerlings sprawling in the eutrophicated water bodies	Mark and Mark Jr 2005
Nondispensable water use for bonus producing enterprises			
Utilisation of inland pond, lakes and rivers fisheries	New secondary food consumer birds can be reared	New farm on the line of poultry and duckery farms can be opened for biological phosphorus harvesting	This research
Linking of people, environment and ocean	Coastal areas erected raft and dispensed food to invite birds	Collection from costal	Horobin, (2003b)
Linking of vast ocean aquatic ecosystem, people and bird kingdom	Entire domain of bird dropping collection covered	Litter collection, raft collection, boat collection and cap collection	This research
Extension of multiple uses			
Agriculture	Not specific	Biological phosphorus will be in high demand for organic agriculture	Yadav,2013a,b,2014
Phosphorescent dye	Phosphorus dye find place for textile bright washing	Basis for use explained	Becoming accepted by the textile manufacture company.
Building materials	Trace additive for bright colour getup	It will find uses in the paints and polishing material	Horobin, 2003a and this study.
Textile colouring	Fast colour printing	The phosphorescent dye additive will increase the brightness of colours	Horobin, 2003a and this study.
Cloths and clothings maintenance, soap and detergent	It removes yellow tint and produces white tint	Some bands of soap already use.	Horobin 2003a
Instrumentation	Used as phosphorescent chemical dye	Used in instrumental panel and dash boards	Horobin,2003b
Additive as impurity	Phosphorus is used as impurity additive in silicon for increasing conductivity of semiconductors	Used in electronic semiconductor materials	Horobin 2003c
Scientific research studies	Used as tracer dye in scientific research on velocity measurements	Used in chemical method of direct measurement of river discharge	Subramanya, 2005

Table 2: Extension of multiple uses of biologically harvested Phosphorus.

substantiated with well documented and academically accepted data hence is free from any scientific flaw. The biological harvesting methods are easy to comprehend, visualise, organise and operate for harnessing the P. Thus, it has very good academic, scientific, economical and environmental improvement strength in it. The functioning of the operation of biological harvesting is comprehendible and it will go in future uses beyond any doubt.

Weakness

There is no scientific weakness. Lack of data collected on the biological phosphorus harvesting get over shadowed by the novelty of research issue and pending development. This study will supplement inspiration of research interest. In the due course of time data on biological phosphorus harvesting will eliminate whatever weakness one may think and will make it a highly operational enterprise.

Opportunity

The study opens ocean of opportunity for augmenting supply of biological phosphorus for agriculture and other industrial uses. It opens opportunity for organising business and employment without dispensation of the existing water resources. Thus, it can be called as research producing bonus more than any main business.

Threat

There is no threat or any side adverse effect of application of this research for development.

Conclusion and Research Needs

The aquatic ecosystem, dependence of birds on fish fingerlings has existed for all times and same was the situation about the bird droppings. This study, while substantiated the potential of phosphorus harvesting by using long time existing and known, academically accepted data, has brought in a new approach to biologically harvest this bird dropping i.e. guano rich source of phosphorus. Thus, this study enables method for enhancement of ecosystem services and extension of its uses for development of new enterprises on the inland fisheries and enabling strong linkage between ocean-people and environment. Nondispensable use of water resources suggested in the present study leads to conservation and efficient utilization of primary and secondary natural resources of global as well as local domain.

Further researches are needed to extend study to determine the magnification of iodine (another important nutritional product derived from ocean) content in the guano, simple and effective method of refinements of individual contents of guano as well as development of products of industrial application [15].

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References

1. Horobin W (2003b) Phosphorus. How it works Science and Technology, Marshall Cavendish Corporation. USA: 1698-700.
2. Gupta US (2000) Crop Improvement, Quality characters. Science Publishers, Inc Enfield NH, USA.
3. Gustafson AF (1939/2010) Hand Book of Fertilisers. Agrobios, Jodhpur, India.
4. De AK (2010) Environmental Chemistry. Seventh Edition, New Age Publishing house, New Delhi: 12-13.

5. Hammer MJ, Hammer MJ Jr (2005) Water and waste water technology. Fourth Edition Printice Hall, India.
6. Yadav RC (2014) A Drainage Engineering: A savvier for Sustainable Resources use, Protection of Environment and Professional Development. Proton Journal of Civil Engineering. Photon 107: 200-213.
7. Yadav RC, Vijay Kumar O (1983) Biological water harvesting: A Method of Enabling Dryland Crops to Endure periods of Droughts J Arid Environ 6: 115-117.
8. Marra LM, Soares, GRFS, Oliveira SM, Ferreira PAA, et al. (2012) Biological nitrogen fixation and Phosphate solubilisation by bacteria isolated from tropical soils. Plant Soil 357:289-307.
9. Yadav RC (2012) Innovative application of scientific facts for nutrient recovery from waste water Streams for sustainable agriculture and protection of environment. Hydrology: Current Research.
10. Yadav RC (2013) A Racy nature agriculture versus other alike technologies: A technologies contrast. Journal of Digital Sciences, Middle East Journal of Scientific Research (MEJSR) Dubai.
11. Yadav RC (2013b) Innovative applications for scientific facts for zero methane emission and enhancing productivity of paddy fields for sustainable global food security: A conceptual model. Frontiers of Environmental Sciences and Engineering.
12. Subramanya K (2005) Engineering Hydrology. (2ndedn.) Tata McGraw Hill Publishing Co. New Delhi.
13. Horobin W (2003a) Luminescence. How it works, Science and Technology, Marshall Cavendish Corporation. USA, 1301-1302.
14. Horobin W (2003c) Semiconductors. How it works -Science and Technology, Marshall Cavendish Corporation. USA, 2052-2954.
15. Yadav RC (2014b) Innovative application of scientific facts for arresting GHG-N2O and improvising lucrative ventures with enhanced land, water and nutrient use efficiency. The Journal of Energy and Environmental Science. Photon 128: 486-520.

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