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Boyd's Diversity Index of Ponds in Coal Mining City Dhanbad, Jharkhand, India

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***Abstract*— Ten ponds in coal mining city Dhanbad were selected for this study to calculate the Boyd's diversity index for algae in summer season and a total of 36 species were recorded. To elucidate the community structure in each pond, Boyd's index was calculated. The diversity index of Boyd's indicates the pollution index of different ponds in coal mining city Dhanbad affected by different sources. In ten ponds the indices do not go hand in hand indicating higher diversity with higher pollution level. Algal biodiversity indices can be used in detecting the level of pollution in ponds.**

***Index Terms*— Boyd's diversity index, Algae, Coal mining and Lackey's drop method**

I. INTRODUCTION

Dhanbad is famous for coal mining in India, surrounded by major power plants and coal washeries supported power generation and major industrialization in this eastern zone. Due to underground with opencast coal mining the land use changes in original topography and land degradation had taken place in great ways. Cumulative effects of intensive mining and old quarries had resultant air, noise, surface and ground water with land pollution reduced the vegetation and agriculture in this area. The utilization of coal in power plant generation flyash as a waste product resultant air water and land pollution. This can be accessed through environmental impact assessment and environmental management plan. Overall this has resultant in the major changes in socio-economic. But the quality of life has been affected in this area with all other developments (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 45, 66, 78, 87, 100, 102, 105, 106, 107, 122, 123, 124, 129, 131, 132, 140 and 142).

The effect of mining through modeling and simulation were assessed for effective environmental management to achieve sustainable development (47, 49, 69, 70, 71, 72 and 73).

Flora and fauna drastically affected due to many environmental pressure. This leads to changes in the availability of terrestrial and aquatic flora and fauna with avian species. In this connection a study has been undertaken to investigate the availability of different algal biodiversity which is a very good indicator of different type of environment. Algae have different potentiality for the sustainable development of this disturbed area (108, 110, 111, 113, 114, 115, 116, 118, 119, 120, 127, 133, 134 and 141). Water environment is most concern in the mining areas. For the reclamation of wastewater with land, bio-approach is effective one to restore many things.

Through this approach solve the food and environmental problems in this area (31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 46, 48, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 65, 67, 74, 75, 79, 80, 81, 82, 83, 84, 85, 90, 91, 92, 93, 94, 96, 104, 109 and 135).

The bio-treatment of polluted water vis-a-vis socioeconomic development had found effective in this area. Bio-purification also include using algae (62, 63, 64, 68, 76, 77, 86, 88, 89, 95, 97, 98, 99, 101, 103, 112, 117, 121, 125, 126, 128, 130, 136, 137, 138 and 139).

The task of finding, developing and maintaining suitable water supplies has not been limited to modern times. It has had to be faced wherever large numbers of people have crowded together in small spaces; and therefore the popular indifference towards safe, clean water has prevailed.

Planning for the maximum development of our water resources for long time benefit of all our people when properly conceived, can bind together individual and the community, farmer and urbanate as few other conservation activities can do (143). Ponds are valuable water systems and intensively used for production of drinking water, for fisheries and bathing with washing of clothes. The ecological nature of many ponds, however have desecrated, mainly as a consequence of eutrophication (144). Algal diversity in ponds plays an important role in their conservation. More the diversity, more useful is a water body. In the present investigation ten ponds have been selected; of these remains unprotected and free for public use. The algal biodiversity has been studied and diversity indices have been discussed.

II. MATERIALS AND METHODS

A. Study Site

Ten ponds were selected as study areas and water samples were taken to study physic-chemical analysis of water quality parameters and identify the different algaes located within the following study areas which are as follows (**Fig**.1.)

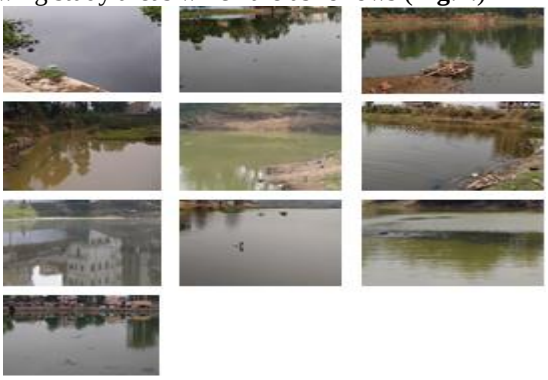

Fig.1: Photographs of ten ponds in coal mining city Dhanbad (a-j)

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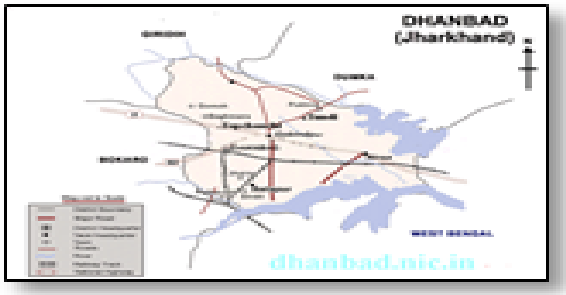
(a) BCCL Koylanagar is located at 23° 48′ 2″ N and 86° 27′ 35″ E.
(b) Saraidhela is located at 23° 48′ 51″ N and 86° 27′ 12″ E.
(c) Rajganj is located at 23° 52′ 36″ N and 86° 20′ 25″ E.
(d) Bhuli is located at 23° 49′ 9″ N and 86° 22′ 32″ E.
(e) Susnilewa is located at 23° 50′ 8″ N and 86° 26′ 9″ E.
(f) Bhuiphore is located at 23° 49′ 3″ N and 86° 28′ 43″ E.
(g) Bank More is located at 23° 47′ 16″ N and 86° 24′ 49″ E.
(h) Wasseypore is located at 23° 47′ 25″ N and 86° 25′ 9″ E.
(i) Jharia is located at 23° 44′ 37″ N and 86° 24′ 55″ E.
(j) Dhaiya is located at 23° 49′ 14″ N and 86° 25′ 59″ E.

The selection of different ponds in coal mining city Dhanbad is selected on the basis of its maximum utilization by the nearby community for their daily uses like washing, bathing except drinking purposes (**Fig.2**). As they get drinking water supply either from Jharia water board from Topchanchi lake or Maithon water supply from Maithon dam. These lakes are live throughout the year. The excess drain water in rainy season comes in these pond of that area.



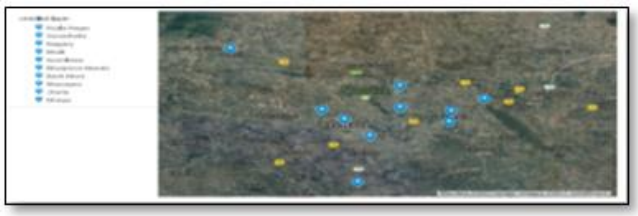


Fig.2: Map showing the sampling location points of ponds within Coal City Dhanbad, Jharkhand, India

B. Estimation of Algae

Water samples were collected from all ten ponds for algal population's analysis in black colored plastic carboys of one liter. Filamentous algae and other floating debris were avoided. For each sample collected, 25 ml of 4% formaldehyde was added (145) with few drops of Lugol's iodine. Sedimentation was done in glass columns. The sediment was finally reduced to 20 ml and was preserved in a glass vial. From each vial one drop was mounted on a slide and a cover slip was carefully put over it. Five high power fields (15x 45x), one in each corner of the cover slip and are at the center were made and the algal populations were estimated.

These observations were at random and were repeated four times for each sample. This procedure was repeated for each sample and the number of each organism was extra plotted to extract number of organism/L (146). Algae count was done by Lackey's Drop Method (147) as mentioned in APHA (148) and by Saxena, the modified method (149).

Formula used for the calculation of algae as units /l is

$$Algae\ Unit\ /L = \frac{n \times v}{V} \times 100$$

Where as
N= No. Of algae counted in 0.1ml.concentrate.
C= total volume of concentrate in ml.
V= total volume of water filtered through net

C. Boyd's diversity index

The diversity index of Boyd indicates the order of pollution of a water body. The main parameter in the index is the number of genera of phytoplankton in a water body and is calculated using the mathematical formula.

$$H = \frac{S - 1}{In\ N}$$

S is the number of genera of algae;
N is the total number of algae and In is the natural logarithm.

III. RESULT AND DISCUSSION

The resultant values indicate the pollution status of the water body under study. If the values obtained are >4 it indicates less pollution and clean water, values of 3 –2 indicate moderate pollution and values <1 indicate that water is heavily polluted. The distribution of algae in ten ponds is presented in **Table 1**.

Name of Algae	Number of Algae										Total no. of Algae
	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	
Actinastrum	2000			2000		2000		2000			8,000
Agmenellum	4000	1000		1000	2000		1000	5000	2000		16,000
Amphora	1000	1000		1000				1000			4,000
Anabaena									3000	2000	5,000
Ankistrodesmus				1000							1,000
Chlamydomonas	6000		5000							5000	16,000
Chlorella		4000					4000			4000	12,000
Chrococcum		5000	4000			4000	5000				18,000
Closterium			1000						1000	2000	4,000
Coelastrum		2000									2,000
Cosmarium	1000				2000						3,000
Cyclotella	1000										1,000
Cymbella	1000		2000				3000	1000	2000	1000	10,000
Desmodesmus		2000	2000				1000				5,000
Diatom	5000	2000	2000			2000	2000	7000	3000	3000	26,000
Dinoflagellates	1000							2000			3,000
Eucapsis								2000			2,000
Euglena		3000	2000			2000	3000		3000	3000	16,000
Gleocapsa	2000		5000		4000	4000	2000	4000			21,000
Gomphonema			1000	2000	1000			1000			5,000
Hantzschia	2000			2000					2000		6,000
Korshikoviella				1000							1,000
Merismopedia				3000	3000						6,000
Navicula	1000	4000				6000	1000				12,000
Oedogonium							3000				3,000
Oscillatoria		1000	2000	3000	6000	1000	4000		7000	6000	30,000
Pediastrum		2000	2000			2000	1000		1000		8,000
Phacus				4000			2000		2000		8,000
Phormidium					4000						4,000
Scenedesmus		2000	11000			9000	8000		4000		34,000
Spirogyra		1000	2000	6000	7000	2000	3000		4000	6000	31,000
Spirulina		1000								9000	10,000
Staurastrum		4000			1000			2000	1000	1000	9,000
Tetradron			1000	1000	2000	1000		1000			6,000
Ulothrix								4000			4,000
Volvox		2000	5000			1000	5000		3000	3000	19,000
Total number of Species	12	16	15	12	10	12	16	12	14	12	36
Total number of Phytoplankton/l	27,000	37,000	47,000	27,000	32,000	36,000	48,000	32,000	38,000	45,000	3,69,000

Table.1: Total algal population in ten different ponds of coal mining city Dhanbad

The calculated value of Boyd's diversity index is shown in **Table 2**.

S.N	Name of Site	No. Of species (S)	Total number of algae (N)	In N	Diversity index $H' = \frac{S-1}{\ln N}$	Order of Pollution
1.	BCCL Koylanagar	12	27,000	10.203	0.767	Heavily polluted
2.	Saraidhela	16	37,000	10.518	0.595	Heavily polluted
3.	Rajganj	15	47,000	10.757	0.650	Heavily polluted
4.	Bhuli	12	27,000	10.203	0.767	Heavily polluted
5.	Susnilewa	10	32,000	10.373	0.937	Heavily polluted
6.	Bhuiphore	12	36,000	10.491	0.791	Heavily polluted
7.	Bank More	16	48,000	10.778	0.611	Heavily polluted
8.	Wasseypore	12	32,000	10.373	0.781	Heavily polluted
9.	Jharia	14	38,000	10.545	0.682	Heavily polluted
10	Dhaiya	12	45,000	10.714	0.809	Heavily polluted

4=Clean water, 3-2=moderately polluted, <1 = heavily polluted

Table.2: Boyd's diversity index for order of pollution

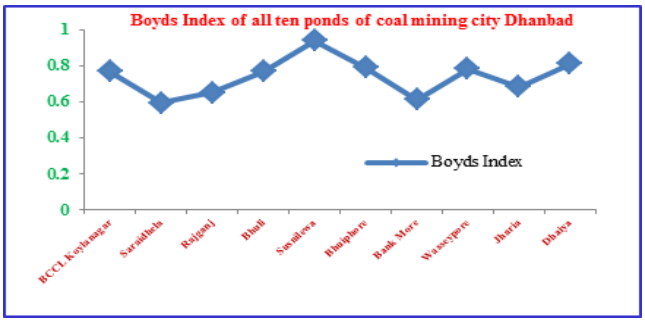


Fig.3: Boyd's index plotted for ten ponds in coal mining city Dhanbad

As per the diversity index of Boyd, Susnilewa ponds nearby Dhanbad airstrip (0.937) is moderately polluted as the index reaching 1 and followed by Dahiya, Bhuiphore, Wasseypur, Bhuli, BCCL Koyalanagar, Jharia, Rajganj, Bankmore and saraidhela in ascending order for heavily polluted (**Table. 2**).

On an average the ponds according to Boyd index is heavily polluted from major disturbances due to different points sources (151). The diversity index (<1.00) indicates that most of the ponds are heavily polluted (**Fig.3**). The major reason behind the pollutions is that the sampling is done in the summer season which causes the concentration.

IV. CONCLUSION

The Boyd's index (1981) indicates that all ten ponds are heavily polluted with distribution of algae which have very close relation to the pollution.

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REFERENCES

[1]R. Abidi, B.K.Tewary, T.B.Singh, Kumar Nikhil and N.C.Saxena (1992), "Reclamation of Surface Mining Degraded Land – A New Strategy", in Fourth National Seminar on Surface Mining at I.S.M Dhanbad (3-4th November, 1992). A MMGMI Publication, pp-206-212.

[2]Kumar Nikhil, S.Gupta, B.K.Tewary and B.B.Dhar (1993), "Impact of Iron Ore Mining on Agricultural Land", in National Seminar on Eco-friendly Approaches in the Management of Pest, Diseases and Industrial Effluents (11-12th November, 1993) at Chandra Sekhar Azad University of Agriulture and Technology, Kanpur (U.P).

[3]R.S.Singh, B.K.Tewary, S.K.Chaulya, Kumar Nikhil and B.B.Dhar (1994), "Evaluation of Tree Species Performance on a Coal Mine Overburden Dumps", in Jharia Coalfield Problems and Prospects, MGMI, Dhanbad Branch Publication Seminar on World Environmental Day at BCCL Dhanbad (5th June,1994).

[4]Kumar Nikhil, B.K.Tewary and B.B.Dhar (1994), "Koyalanchal ke bhumi ke punhaudhar ke ley – kawak ki aham bhumika" in Hindi Seminar on Damodar Ghati ka Paryavaran Sanrakchan at CMRI, Dhanbad.

[5]Kumar Nikhil, B.K.Tewary and B.B.Dhar (1994), " Jharia koyalanchal ke paryavaran sudhar may samajik aivam krishi waniki ka yogdan" in Hindi Seminar on Jharia Satabdi (1894-1994) at CMRI Dhanbad.

[6]T.B.Singh, Kumar Nikhil, R.S.Singh and B.K.Tewary (1995), "Prospects of Minewastes Utilization", in All India Symposium on Converting Wastes into Wealth [Organized by B.I.T Sindri & Institute of Engineers (I), Dhanbad Local Centre] at CMRI , Dhanbad on September 15-16, 1995.

[7]Kumar Nikhil, T.B.Singh, R.S.Singh and B.K.Tewary (1995), Prospects of Agrowastes for land reclamation", in All India Symposium on Converting Wastes into Wealth [Organized by B.I.T Sindri & Institute of Engineers (I), Dhanbad Local Centre] at CMRI , Dhanbad on September 15-16, 1995.

[8]B.K.Tewary, T.B.Singh, S.K.Chaulya, Kumar Nikhil and B.B.Dhar (1995), "Land Reclamation Practices in India", in First World Mining Environment Congress at New Delhi on 11-14 December,1995.

[9]Kumar Nikhil, E. Sarnathan, V.J.Loveson, R.S.Singh, B.K.Tewary (1995), "Watershed Management for Sustainable Development – A case study", in World Environment Day for watershed Management on 5th June, 1995 at CMRI Dhanbad

[10] Kumar Nikhil, T.B.Singh and B.K.Tewary (1996), "Audhogicaran ka vikas, paryavaran sanrakchan aivam ped podhoo ka yogdan", in Jharkand Anchal Ke Van Sampada – Atit aivam Vartaman at CMRI Dhanbad on 5th June, 2016.

[11] B.K.Tewary, Kumar Nikhil, R.S.Singh, T.B.Singh and B.B.Dhar (1996), "Environmental Management of Flyash", in course on stabilization and filling issues in Raniganj and Barakar measures seam for ground control 23-27th December,1996 by HRD, CMRI, Dhanbad.

[12] Kumar Nikhil (1997), "Reclamation of O.B.Dump" in Training Programme in Environmental Pollution for DVC Doctor on 3-7th March,1997 at CMRI, Dhanbad.

[13] Kumar Nikhil, T.B.Singh and T.N.Singh (1997)," Audogikaran ka vikas aivam pedpadho ka yogdan" in Hindi Seminar on Paryavaran awam sanrakchan at CBRI, Roorkee on 5th June,1997.

[14] Kumar Nikhil (1997), "Wasteland Management" , Training Course on the Recent Advancement in the Environmental Management of Mining Areas for the Coal India Executives in CMRI Dhanbad on 3-4th November,1997.

[15] Kumar Nikhil, T.B.Singh and T.N.Singh (1997), " Audogikaran ka vikas aivam pedpadho ka yogdan" in Hindi Seminar on Paryavaran awam sanrakchan at CBRI, Roorkee on 5th June,1997.

[16] P.K.Singh, Kumar Nikhil, V.J.Loveson and T.N.Singh (1998), "Khanan dwara chatigrast bhumi ka Prahitasi punurudhar – ak paricharcha" in Hindi Seminar on Khanan dwara chatigrast parayavaran ka Prahitisi punurudhar on 4th April,1998 at CMRI Dhanbad.

[17] Kumar Nikhil, V.J.Loveson and T.N.Singh (1998), "Effect of Bulk Density of the OB Dump on the growth & biomass of perennial grasses", in 7th National Symposium on Environment on 5-7th February,1998 at ISM, Dhanbad.

[18] Kumar Nikhil (1998), "Impact of Mining on Soil Quality and its Mitigative Measures" in Training programme for Central Pollution Control Board Personals funded by World Bank Aided Course on 16-20th November,1998 at CMRI Dhanbad.

[19] Kumar Nikhil, V.J.Loveson and T.N.Singh (1998), "Change in Nutrient Status of coal overburden dump top material after vegetation – An experimental study" in International Conference on Environment and Agriculture by International Ecological Society at Kathmandu Nepal on 1-3rd November,1998.

[20] V.J.Loveson, Kumar Nikhil and T.N.Singh (1998), "Evaluation of Croplands around a part of fragile hilly tract of lower Himalaya using Remote Sensing and GIS" in International Conference on Environment and Agriculture by International Ecological Society at Kathmandu Nepal 1-3rd November,1998.

[21] P.K.Singh, Kumar Nikhil, V.J.Loveson and T.N.Singh (1998), "Rapid Industrialization in Chotanagpur region and its impact on environment – A case study in Dhanbad District", in XI NCME "Environmental Status of Mining Areas" on 5-6th June,1998 at CMRI, Dhanbad.

[22] Kumar Nikhil (1999), " A field experience with bioreclamation of coal overburden dump" in International Conference on Clean Coal Initiatives on 22-24th January,1999 at Laa Meridian Hotel, New Delhi.

[23] M.Ahmed, M.K. Chakraborty & Kumar Nikhil (2000), " Impact of Mining on Socio-cultural and Economic Dimensions" presented in the National Seminar on the Mining & Environment at Aligarh Muslim University on 11-13, April, 2000.

[24] Kumar Nikhil and M. Ahmed (2000), "Management Of Irrigation Efficiency In Coal Mining Areas of District Dhanbad" presented in the National Seminar on the Mining & Environment at Aligarh Muslim University on 11-13, April, 2000.

[25] Kumar Nikhil (2001), "Reclamation Economics in Rehabilitation of Limestone Mining" Executive Development Aspects of Mining & Environment held at HRD, CMRI, Dhanbad on 21st November, 2001.

[26] Kumar Nikhil, V.J.Loveson, A.K.Singh and Prof.R.Venugopal (2001), "Bio-rehabilitation of Reject Dump around Coal Washery Area – A Conceptual Approach", International on Challenges in Coal & Mineral Beneficiation, Organized by ISM, Dhanbad during 7-8th December 2001.

[27] Kumar Nikhil (2001) "Situation and Strategies for the Utilization of Flyash in Rural Areas", *International Journal of Industrial Pollution Contro*l, Vol.17 (2)2001: 307-312.

[28] Kumar Nikhil (2001) "Bio-fertilizers for the re-vegetation of coal overburden dumps top materials", *Asian Jr. of Microbiology, Biotech & Env. Sc.* Vol.3. (4) 2001: 301-305.

[29] Kumar Nikhil, V.J.Loveson, A.K.Singh and Prof.R.Venugopal (2001) "Bio-rehabilitation of Reject Dump around Coal Washery Area – A Conceptual Approach", *International Conference on Challenges in Coal & Mineral Beneficiation*, ISM, Dhanbad, 7-8th December, 2001.

[30] Kumar Nikhil (2002) "Reclamation Economics in Rehabilitation of Limestone Mining Areas", *International Jr. of Industrial Pollution Control* 18 (1) 2002: 21-28.

[31] Kumar Nikhil, M.Sundararajan, T.B.Singh, A.K.Singh (2002) "Environmental Scenario for small medium scale mining industries in India - Changes & Challenges Ahead", *National Seminar on Policies, Statutes & Legislation in Small and Medium Mines (POSTALE)* CMRI Dhanbad, 5-6th January, 2002 : 111-116.

[32] D.K.Mitra and Kumar Nikhil (2002) "Health Situation of Workers in Mining Industry", *National Symposium on Sustainable Mining Technology: Present and Future*, Anna University Chennai-600025, 14th-15thMarch, 2002: 28-32.

[33] M.Sundararajan, G.K.Banerjee, Kumar Nikhil and D.D.Misra (2002) "Air Quality Dispersion Scenario at Noamundi Iron Ore Mine through Mathematical Modeling and Computer Simulation - A Case Study", *National Symposium on Sustainable Mining Technology: Present and Future*, Anna University Chennai-600025, 14th-15thMarch, 2002: 322-331.

[34] Kumar Nikhil, M.Sundararajan, T.B.Singh and N.C.Saxena (2002) "Water Hyacinth - Boon or Bane for Jharia Coalfield", *National Symposium on Sustainable Mining Technology: Present and Future*, Anna University Chennai-600025, 14th-15thMarch, 2002:347-356.

[35] Kumar Nikhil, M. Sundararajan & D.D.Misra (2002) "Integrated Water Resource Management for the Jharkhand State: A Conceptional Approach", *International Conference on Water and Wastewater: Perspectives of Developing Countries (WAPDEC 2002)*, IIT Delhi -110016, 10th-13th, December, 2002.

[36] M. Sundararajan, Kumar Nikhil, A.Khalkho, T.K.Mondal (2002) "Transport Modeling on Ground Water Contamination in and around mining and allied industrial zones - A Case Study"', *International Conference on Water and Wastewater: Perspectives of Developing Countries (WAPDEC 2002)* , IIT New Delhi-110016, 10th-13th, December, 2002.

[37] Kumar Nikhil, Puran Kishore Singh and C. Bandhopadhyay (2002) "Jharkhand mey Jal Prabandhan", *National Seminar on Krishi Electroniki Upkaran Vinyash*, CSIO, Chandigarh – 160030, 23rd-24th April, 2002.

[38] Kumar Nikhil, M.Sundararajan and Puran Kishore Singh (2002) "Jharkhand kee Krishi mey Urja key Nayey Stroth", *National Seminar on Krishi Electroniki Upkaran Vinyash*, CSIO, Chandigarh – 160030, 23rd-24th April, 2002.

[39] Kumar Nikhil, V.J.Loveson & M.Sundararajan (2002) "Jharkhand mey Suchna Prodhogiki kaa gramin awam krishi Vikas mey Prayog - aik paricharcha", *National Seminar on Krishi Electroniki Upkaran Vinyash*, CSIO, Chandigarh – 160030, 23rd-24th April, 2002.

[40] Kumar Nikhil (2002) "Flyash for Better Composting", *International Journal of Ecology, Environment and Conservation*, Vol.8(2)2002: 331-333.

[41] Kumar Nikhil (2003) "Use of Mycorrhizae for Mined Land Revegetation", *Asian Journal of Microbiology, Biotechnology and Environmental Sciences*, Vol.4(4)2003: 495-498.

[42] Kumar Nikhil (2003),"Nutrient Status of Coal Overburden Dump Top Material After vegetation - An Experimental Study", *International Journal of Ecology, Environment and Conservation*, Vol.8(4)2003: 353-360.

[43] Kumar Nikhil (2003) "Wasteland Rehabilitation around Coal Washery Areas through Bio-remidial Measures", *International Journal of Pollution Research*, Vol.21(3)2003: 249-251.

[44] Kumar Nikhil (2003) "Growth Response in Crops Raised in Flyash amended soil", *International Journal of Pollution Research*, Vol.21(4)2003: 409-416.

[45] M.Sundararajan, B.R.Panduranga, Kumar Nikhil, S.Rufus David and J.Mariyosh (2003) "A View on the Calendar and Cronology of Ancient India in the Light of Scientific, Religious and Archaeological Discoveries", *National Seminar on Indian Calendar & Chronology*, Vigyan Bharati, Dhanbad, 9-10th Aug, 2003.

[46] Kumar Nikhil, M.Sundararajan, N.C.Saxena and D.D.Misra (2003) "Heavy Metal Status in the Species Grown on Coal Overburden Dump- A Case Study", *National Seminar on Status of Environmental Management in Mining Industry(SEMMI-2003)*, Banaras Hindu University, Varanasi- 221005 (UP) 17th-18th, January, 2003.

[47] M. Sundararajan, G.K.Banerjee, Kumar Nikhil, D. Vetriselvam, M.K.Chakroborty (2003) "Computerized Air Quality Dispersion Modeling for the Prediction of SPM in and around Opencast Coal Mining- A Case Study", *National Seminar on Status of Environmental Management in Mining Industry(SEMMI-2003)*, Banaras Hindu University, Varanasi- 221005 (UP) 17th-18th, January, 2003.

[48] Kumar Nikhil (2003) "Suitable Fillers for the Overburden Dump Plantation Pits to Achieve Better and Economical Re-vegetation", *International Journal of Ecology, Environment and Conservation*, Vol.9(1)2003:

[49] Kumar Nikhil and M. Sundararajan (2003) Natural Resource Management for the Sustainable Development in Jharkhand State – A Technological Approach, *All India Seminar on Resource Management through Technology for Development of Jharkhand*, MECON, Ranchi-834002, Jharkhand, 22nd June, 2003.

[50] Kumar Nikhil and Asha Gupta (2004)"Jharkhand ki Jari Butiyo sey Kitnashak Dawaiya: Awashktayai avaim Sambhanayai", *Third Akhil Bhartiya Vigyan Samelan*, NPL, New Delhi, 19th-21st February, 2004.

[51] Kumar Nikhil, M.Sundararajan, Kumar Birendra and Asha Gupta (2004) "Vetiver Grass Technology: An Economical Bio-Reclamation Approach for the Coal Overburden Dump", *National Seminar on Environmental Engineering with special emphasis on Mining Environment*, ISM, Dhanbad, Jharkhand, 19-20th March, 2004. (Published in the Journal of the Institution of Public Health Engineers, India, Special Issue, Kolkata)

[52] Kumar Nikhil (2004) Water Hycinth: A Green Tool for the Sustainable Development of Coalfield, ed. Trivedy, R.K, "*Biotechnological Application in Environmental Management*" : 2-21.

[53] Kumar Nikhil (2004), "Legumes: Importance in the Re-vegetation of Overburden Dumps" ed. Trivedy, R.K, "*Biotechnological Application in Environmental Management"*: 159-173.

[54] Kumar Nikhil (2004) "Effect of Heavy Metals on Planted Species Root Growth and Biomass over Coal overburden dump", *International Journal of Industrial Pollution Control* Vol.20(1)2004: 101-109.

[55] Kumar Nikhil (2004) "Reclamation Bond", *International Journal of Industrial Pollution Control*, Vol.20(1)2004: 97-100.

[56] Kumar Nikhil (2004) "Accumulating Factor of Heavy Metals in Planted Species over coal overburden dump", *Asian Journal of Microbiology, Biotechnology and Environmental Sciences*, Vol.6(4)2004:

[57] Kumar Nikhil (2004) "Importance of Tillage Practices in the Re-vegetation of overburden dump", *International Journal of Ecology, Environment and Conservation*, Vol.10(3)2004: 283-286.

[58] Kumar Nikhil (2004) "Vetiver Grass for the Bio-reclamation of Coal Overburden Dumps" *International Journal of Ecology, Environment and Conservation*, Vol.10(4)2004: 1-14.

[59] Kumar Nikhil, M.Sundararjan, M.Ahmad, M.S.Alam and Asha Gupta (2004) "Impact of Pesticides and Agricultural Wastes on the Environment of Mining Areas", *National Seminar on Pollution in Urban Industrial Environment (NSPUIE-2004)*, RRL, Bhubaneswar-751013, 2nd-3rd December,2004.

[60] Kumar Nikhil, M.Sundararajan, Mobin Ahmad, M.K.Chakraborty and Asha Gupta (2004) "Optimization of Bio-remedial Measures for Coal Mining Contaminated Soil with Agronomical Practices- A Conceptional Approach", *International Conference on Soil and Groundwater contamination: Risk Assessment and Remedial Measuers*, NGRI, Hyderabad-500007, 8th-11th December, 2004.

[61] Kumar Nikhil (2005) "Accumulation Factor of Heavy Metals in Planted Species over Coal Overburden Dump", *Asian Journal of Microbiology, Biotechnology and Environmental Science, Vol.7 (1):2005:1-5.*

[62] Kumar Nikhil (2005) "Ecological Management of Polluted Water due to Mining and allied Industries", *International Jr. of Industrial Pollution Control, Vol.21 (2) 2005, pp.255-271.*

[63] Kumar Nikhil (2005) "Bio-treatment of Polluted Water vis-a-vis Socio-Economic Development in Coal Mining Area", *International Jr. of Industrial Pollution Control, Vol.21(2) 2005, pp.229-236.*

[64] Kumar Nikhil (2005) Water Hycinth: A Green Tool for the Sustainable Development of Coalfield, Ed. Trivedy, R.K, "*Biotechnological Application in Environmental Management*" : 2-21.

[65] Kumar Nikhil (2005) "Legumes: Importance in the Re-vegetation of Overburden Dumps" Ed. Trivedy, R.K, "*Biotechnological Application in Environmental Management"*: 159-173.

[66] M.S.Alam, Kumar Nikhil, M.Sundararajan, Mobin Ahmad and Asha Gupta (2005) Socio-economic Development through optimum utilization of mineral processing wastes, *International Seminar on Mineral Processing Technology (MPT-2005) at Deptt. Of Minerals & Fuel Egg. Indian School of Mines, Dhanbad-826004 on 6-8th Jan.2005*.

[67] Kumar Nikhil and Asha Gupta (2005) A Conceptional Approach for the Restoration of Wastelands in Jharia Coalfield, *Conference on Technological Advancements and Environmental Challenges in Mining and Allied Industries in the 21st Century (TECMAC-2005) at Deptt. Of Mining Egg. National Institute of Technology, Rourkela-769008 5-6th Feb.2005*.

[68] Kumar Nikhil, M.Sundararajan and Asha Gupta (2005) Bio-treatment of Mine Water for Irrigation: A Conceptional Approach, *5th International R&D Conference on Development and Management of Water and Energy Resources at Water Resources and Energy Departments, Govt. of Karnataka and CBIP, New Delhi at Bangalore 15-18th Feb, 2005.*

[69] M.Sundararajan, Kumar Nikhil and M.S.Alam (2005) Prediction of Environmental Scenario of Coal Processing Plants through Modeling and Simulation with special emphasis on water and air pollution, *National Seminar on Environmental Planning & Management in Mining and Mineral Industries at Deptt. Of Geology, M.L.Sukhadia University, Udaipur-313001on 11-12th March,2005.*

[70] M.Sundararajan, M.S.Alam and Kumar Nikhil (2005) Mathematical Modeling on Groundwater Contaminant Transport for Prediction of Toxic Elements in and around Mining Area *in Advance Training on Mathematical Modeling for Groundwater Studies in and around Mining Area Sponsored by Ministry of Science & Technology, Organized by HRD, CMRI During 10th to 23rd March 2005.*

[71] M.S.Alam, M.Sundararajan and Kumar Nikhil (2005) Mathematical Modeling for Classification and Delineation of Groundwater Quality in and around Coal Mining area *in Advance Training on Mathematical Modeling for Groundwater Studies in and around Mining Area Sponsored by Ministry of Science & Technology, Organized by HRD, CMRI During 10th to 23rd March 2005*.

[72] M.Sundararajan, M.S.Alam, and Kumar Nikhil (2005) Mathematical Imitation on Unconfined Wells for Estimating GPF as One of the Most Important Parameters for Groundwater Potential Studies *in and around Mining Area Sponsored by Ministry of Science & Technology, Organized by HRD, CMRI During 10th to 23rd March 2005.*

[73] Kumar Nikhil, M.Sundararajan and M.S.Alam (2005) Application of Mathematical Modeling in Irrigation Projects for Quantification of Water and Solid Constituents *in and around Mining Area Sponsored by Ministry of Science & Technology, Organized by HRD, CMRI During 10th to 23rd March 2005*.

[74] Kumar Nikhil and Asha Gupta (2005), "Nutrient Dynamics and Release on the Re-vegetated Coal Overburden Dumps", *International Seminar on Coal Science & Technology-Emerging Global Dimensions (GLOBALCOAL-2005) by CFRI, Dhanbad-826108 Jharkhand at New Delhi, 7th – 8th April, 2005.*

[75] Kumar Nikhil, M.Sundararajan, M.S.Alam, Mobin Ahmad, M.K.Chakraborty, Asha Gupta, B.K.Tewary and C.Bandhopadhyay (2005), "Green Development for the Coal Capital", *World Environment Day along with Seminar on Green Cities: Plan for the Planet by Institute of Engineers (INDIA) Dhanbad Local Centre at CMRI, Dhanbad, 5th June, 2005*.

[76] M.S.Alam, Kumar Nikhil, M.Ahmad, M.Sundararajan, S.K.Gupta and A.Sinha (2005), " Strategic Plan for Employment Generation in Rural India", *National Conference on Rural Enterprise Leveraging Potential of Rural Jharkhand by Confederation of Indian Industry, Department of Industries, Govt. of Jharkhand, 15th June,2005*

[77] Kumar Nikhil, M.Sundararajan, M.S.Alam and Asha Gupta (2005), :"Ancient Water Harvesting Structures: Status and Its Importance", *12th World Water Congress, New Delhi, India by International Water Resource Association and Central Board of Irrigation & Power, India at New Delhi*, 22nd – 25th November, 2005.

[78] Kumar Nikhil (2006) "Zero Waste Management in Coal Mining Area: Vision for a New Millennium", *International Journal of Pollution Research, Vol.25 (1):2006:69-72.*

[79] Kumar Nikhil (2006) "Medicinal Plants: Future Source of Pesticides", *Asian Journal of Microbiology, Biotechnology and Environmental Science, Vol.8 (1):2006:1-5.*

[80] Kumar Nikhil (2006),"Phytoremediation of coal mining affected contaminated land-optimization with agronomical practices: A conceptional approach", *International Journal of Ecology, Environment and Conservation*, Vol.13 (1)2006: 1-7.

[81] Kumar Nikhil (2006),"Menaces in the planted tree species on coal overburden dump", *International Journal of Ecology, Environment and Conservation*, Vol.13 (1)2006: 8-16.

[82] Kumar Nikhil (2006) "Termiticulture: Environmental Technology for New Millinium", *Asian Journal of Microbiology, Biotechnology and Environmental Science, Vol.8 (1):2006:25-30.*

[83] Kumar Nikhil (2006) "Heavy Metals in Medicinal Plants of Jharia Coalfield Area", *International Journal of Pollution Research, Vol.25 (1):2006:1-7.*

[84] Kumar Nikhil (2006) " Suitable Fillers for the restoration of coal mined out area to achieve better & Economical Re-vegetation", *in Farmer Training on Reclamation on Coal Mined Out Areas in Meghalaya, North Easter Regional Institute of Water & Land Management (NERIWALM) Dolabari, P.O. Kaliabhomora, Tezpur-784027, India on 15th to 17th February, 2006.*

[85] Kumar Nikhil (2006) "Prospects, Cultivation & Economics of Jatropha: A Bio-energy Plant for Degraded Land", *in Farmer Training on Reclamation on Coal Mined Out Areas in Meghalaya, North Easter Regional Institute of Water & Land Management (NERIWALM) Dolabari, P.O. Kaliabhomora, Tezpur-784027, India on 15th to 17th February, 2006.*

[86] Kumar Nikhil, Asha Gupta, Brajendra Kumar Tewary and Amalendu Sinha (2006) " Jharkhand Rajya Key Jalsansadhono key Samuchit Upyog", *Sangosthi Jal Sanrankchan, DVC Training Center, DVC, Chandrapura, Bokaro, Jharkhand-825303 on 3rd to 4th March, 2006.*

[87] Kumar Nikhil, M.Sundararajan, P.K.Arya, Asha Gupta and B.K.Tewary (2006) " Environmental Problems in and around coal washery complexes and an approach towards evaluation of waste disposal site", *International Seminar on Mineral Processing Technology (MPT-2006), Hotel Taz Coromandel, Chennai on 8th to 10th March, 2006 jointly organized by IIME & NML & TATASTEEL*

[88] Kumar Nikhil, M.Sundararajan, Asha Gupta, B.K.Tewary and Amalendu Sinha (2006) " Khanan Chetro mey Jal Sanrakchan", *in Hindi Seminar on Jal Sanrakchan Aivam Paryavaran: Vaigyanik thatha takniki dristikone organized by Vigyan Bharati, Kanpur on 9th to 10th September, 2006.*

[89] Kumar Nikhil, M.Sundararajan, Asha Gupta, B.K.Tewary and Amalendu Sinha (2006) " Jal Sanrakhchan aiyvam prabandhan", Jal Sanrakhchan, Sanchyan aiyvam Prabandhan at RRL Bhubneswar, Orrissa on 7th -8th December, 2006.

[90] Kumar Nikhil, Asha Gupta and B.K.Tewary (2006) "Optimal Greenbelt development around mining areas", in 8th Asian Academic Network for Environmental Safety and Waste Management (AANESVVM-2006) organized by Department of Chemistry and Centre with Potential for Excellence in Environmental Science, Anna University, Chennai-600025 (Madras) India on 10th to 13th December,2006.

[91] Kumar Nikhil, Asha Gupta and B.K.Tewary (2006) "Recovering drgraded ecosystem of mining affected areas", in National Conference on Environmental Pollution & Technology, Department of Zoology, Thakur Collage of Science & Commerce, Shyamnarayan Thakur Road, Thakur village, Kandivili (E) Mumbai-400101on 22nd to 23rd December,2006.

[92] Kumar Nikhil (2007) "Soil Quality Standards (SQS) for Bio-reclamation of Coal Overburden Dumps: ISO-14000 Requirements", *International Journal of Industrial Pollution Control, Vol.23 (1):2007:19-23.*

[93] Kumar Nikhil (2007) "Net Primary Production and Relative Growth Rate of Planted Tree Species on Coal Overburden Dump", *International Journal of Pollution Research, Vol.26 (2):2007:189-192.*

[94] Kumar Nikhil (2007) "Metallophytes: An Integrated Approach for Cleaning the Coal Mining Contaminated Lands", *Asian Journal of Microbiology, Biotechnology and Environmental Science, Vol.9 (3):2007:567-572.*

[95] Manoj Kumar, Kumar Nikhil and M.Sundararajan (2007) " Micro-irrigation system for the improvement of livelihoods in rural India" *Seminar on TECHVITA-2007 Role of Engineering in providing better transportation facilities in micro-irrigational/ rainwater harvesting (cheaper tube wells) in the contest of rural*

development of Jharkhand at BIT Sindri, Dhanbad, Jharkhand, on 2nd February, 2007.

[96] Kumar Nikhil, A.K.Singh, A.K.Soni, V.V.R. Prasad and B.K.Tewary (2007) " Recovering fragile ecosystem at Jowai coal mining areas ubder Jainthia Hills of Meghalaya", *National Seminar on varied Perspectives of Biodiversity ICLES, Motilal Jhunjhunwala Collage, Sector-9A, Vashi, Nevi Mumbai-4000703 on 2-3rd February, 2007.*

[97] Kumar Nikhil (2007) " Khanan Chetro mey Jal Prabandhan", *World Water Day Program in Jharkhand organized by Water & Sanitation Watch (SAATHEE) at Ranch on 19th April,2007.*

[98] Kumar Nikhil (2007) " Damodar River: Effective Role in Industrial & Socio-economic Development in Chotanagpur Platue" *in Jal Jagrukta Abhiayan 2007 at DAV School Patherdih to Surya Mandir Ghat, Sudamdih on 26th May, 2007.*

[99] Kumar Nikhil and B.K.Tewary (2007) " Sustainable Management of Micro-irrigation System in Indian Agriculture", *National Seminar on People Participation in Conservation of Water Resources and Preservation of its Quality, IEI, Premises, Veena Building, Golf Ground, Dhanbad, Jharkhand on 30th May,2007.*

[100] Kumar Nikhil, Asha Gupta, B.K.Tewary and Amalendu Sinha (2007) " Effect of Coal Mining on Soil Characteristics of Acidic Soils: A case study of Wapung Coal Mining Area of Jowai in Jaintia Hills district of Meghalaya State.", *Bhartiya Vigyan Samelan, organized by Councile of Science & Technology, Nehru Nagar, Bhopal-462007 on 23rd to 25th November, 2007.*

[101] Kumar Nikhil, Asha Gupta, B.K.Tewary and Amalendu Sinha (2007) " Bio-treatment of Mine Water for Socioeconomic Development", *National Seminar on Eco-friendly Approach in Water Management and Treatment of Waste Water, H.D.Jain Collage Arrah, Bhojpur, Bihar on 12th to 13th December, 2007.*

[102] Kumar Nikhil, Asha Gupta, B.K.Tewary and Amalendu Sinha (2007) " Jayv Bhibhidta, Khanan Paryavaran aiyvam Arthik Paktch", *Rastriya Sanghosthi " Rasthiya Sanghosthi Vartaman Sandharve Mey Jai Vividita ka Mahatouv, NBRI, Lucknow (U.P) on 22nd to 23rd December, 2007.*

[103] Kumar Nikhil and Mobin Ahamad (2007) "Management of Irrigation Efficiency in Damodar River Basin", *Ed. Fifty Years of Indian Agriculture, Vol.II,* Ali Mohammad, Abdul Munir and Shamsul Haque Siddiqui, Concept Publication, New Delhi, :December, 2007:pp78-90.

[104] Kumar Nikhil (2006),"Restoration of mining wastelands: status and strategies", *International Journal of Ecology, Environment and Conservation,* Vol.14 (1)2008: 51-54.

[105] Kumar Nikhil, Asha Gupta, B.K.Tewary (2008) " Status, Constraints & Prospects of Small Scale Industries in Jharkhand", *National Seminar on Status, Constraints & Prospects of Small Scale Industries in Jharkhand* at Golden Jublee Hall, ISM Dhanbad on 28th to 29th January, 2008.

[106] Kumar Nikhil, A.K.Singh, A.K.Soni and V.V.R. Prasad (2008) "Effect of Coal Mining on Acidic Soils: A case Study in Jaintia Hills of Meghalaya", Ed. Singh, A.K and S.C.Patra in *Characterisation of Land Resources and Agro-Eco-Zones in India* published by Wiley Publishers, Kolkotta (WB) December, 2008.

[107] Kumar Nikhil (2011) " Copper Mining in India", Ed.Kumar Rakesh, Biniwala Rajesh and Sunil Kumar in "*Critical Review of Research on Copper in Environment & Health*" , NEERI, Nagpur, pp.67-108.

[108] Kumar Nikhil and Sunil Kumar (2012) "Development of algae based technology to mitigate energy crisis in coal mining areas", *Ist Brainstorming Workshop on Waste to Energy*, 24-25 August, 2012, Mumbai, Maharastra, conducted by CSIR-NEERI, Nagpur.

[109] Kumar Nikhil, Amar Nath, B.K Tewary and Amalendu Sinha (2013)"Food management in India: Perspective, Prospects & Problems", *National Seminar on World Environmental day, organized by IIE, Dhanbad*, 5th June, 2013.

[110] Kumar Nikhil (2013) "Algal Technology for providing Green Energy solution in Jharia Coalfield areas of District Dhanbad, Jharkhand", *National Seminar on Present Technology & safety Scenario in Mining & Allied Industries (PTSM-2013)* from 25-27, February, 2013 at Department of Mining Engineering, IIT, BHU, Varanasi.

[111] Kumar Nikhil (2013) "Algae based technology to mitigate energy crisis in Dhanbad coal mining areas, District Dhanbad, Jharkhand", *International Conference on Energy Resource & Technology for sustainable development (ICERTSD-2013)* from 7-8, February, 2013 at BESU, Sibpur, Howrah, W.B.

[112] Kumar Nikhil, K.B.Singh and Amalendu Sinha (2013)"Importance of Social Cost Benefit Analysis of Coal Mining Project in India", *National Seminar on POSTALE-2013*, organized by NISM, CSIR-CIMFR, Dhanbad, 31st December, 2013 to 01st January, 2014.

[113] Iqbal Ansari and Kumar Nikhil (2014), "Lignocellulosic Bio Decomposition : A Green Solution in Coal Mining Areas", *International Journal of Engineering & Technical Research (IJETR),* Vol.2, No.3 pp.104-106. March, 2014, (Online).

[114] Ghanshyam Paswan, Saurabh Prakash and Kumar Nikhil (2014), "BIOFUEL AS GREEN ENERGY SOURCE: A REVIEW", *International Journal of Engineering & Technical Research (IJETR),* Vol.2, No.3 pp. 124-126, March, 2014, (Online).

[115] Saurabh Prakash, Ghanshyam Paswan, and Kumar Nikhil (2014), "LIQUID COAL AS A GREEN ENERGY: A REVIEW", *International Journal of Engineering & Technical Research (IJETR),* Vol.2, No.3 pp. 141-143, March, 2014 (Online).

[116] Iqbal Ansari and Kumar Nikhil (2014), "Algal approach for Sustainable Development: A Critical Review ", *International Journal of Engineering & Technical Research (IJETR),* Vol.2, No.4 pp.83-85. April, 2014, (Online).

[117] Ghanshyam Paswan and Kumar Nikhil (2014), "Biopurification of Waste Water Through Algaae – A Review", *International Journal of Engineering & Technical Research (IJETR),* Vol.2, No.4 pp.71-73, April, 2014, (Online).

[118] Saurabh Prakash and Kumar Nikhil (2014), "Algae as a Soil Conditioner ", *International Journal of Engineering & Technical Research (IJETR),* Vol.2, No.4 pp.68-70, April, 2014 (Online).

[119] Kumar Nikhil (2014) "Development of algae based technology to mitigate energy crisis in coal mining areas", International Journal of Environmental Technology & Management, Vol.17, No.2/3/4 May, 2014, pp.334-363. (Online)

[120] Deepanjali Singh and Kumar Nikhil (2014), " Algae for Lipid as Renewable Energy Source in Coal Mining Area: A Critical Review", *International Journal of Engineering & Technical Research (IJETR),* Vol.2, No.5 pp.172-174, May, 2014 (Online).

[121] Kumar Gaurav, Kumar Nikhil and Iqbal Ansari (2014), " Bioreclamation of Mine Waste Water through Algae: An Experimental Approach", *International Journal of Engineering & Technical Research (IJETR),* Vol.2, No.5 pp.265-269, May, 2014 (Online).

[122] Pramod Kumar and Kumar Nikhil (2014), "Environmental Impact Assessment (EIA) Study of Non-Metal Mines: A Critical Review", *International Journal of Engineering & Technical Research (IJETR),* Vol.2, No.5 pp.324-326, May, 2014 (Online).

[123] Ashutosh Kumar and Kumar Nikhil (2014), "Environmental Impact Assessment (EIA) Study of Metal Mines: A Critical Review", *International Journal of Engineering & Technical Research (IJETR),* Vol.2, No.6 pp.1-3, June, 2014 (Online).

[124] Md Toufique Kalim and Kumar Nikhil (2014), "Environmental Impact Assessment (EIA) Study of Coal Mines: A Critical Review", *International Journal of Engineering & Technical Research (IJETR),* Vol.2, No.6 pp.112-114, June, 2014 (Online).

[125] Ashutosh Kumar Agrawal and Kumar Nikhil (2014), "Algal Biodiversity in Coalfield Areas – A Critical Review", *International Journal of Engineering & Technical Research (IJETR),* Vol.2, No.6 pp.176-178, June, 2014 (Online).

[126] Ashutosh Kumar and Kumar Nikhil (2014), "Biopurification of Mine Wastewater through Aquatic Plants– A Review ", *International Journal of Engineering & Technical Research (IJETR),* Vol.2, No.6 pp.286-288, June, 2014 (Online).

[127] Deepanjali Singh and Kumar Nikhil (2014), "Extraction of lipid from algae grown in different coal opencast mining areas of Jharia Coalfield under District Dhanbad, Jharkhand:An Experimental Study", *International Journal of Current Research & Review(IJCRR),* Vol.6, No.18 pp.12-16, September, 2014 (Online).

[128] Ashutosh Kumar Agrawal and Kumar Nikhil (2015), "Algal Distribution Pattern and Quality of Water in Different Aquatic Environment of District Dhanbad", *International Journal of Science & Research (IJSR),* Vol.4, No.2 pp.358-363, February, 2015 (Online).

[129] Mohnish Pichhode and Kumar Nikhil (2015), "Effect of Copper Dust on Photosynthesis Pigments Concentration in Plants Species", *International Journal of Engineering Research and Management (IJERM),* Vol.2, No.2 pp.63-66, February, 2015 (Online).

[130] Pawan Kumar Gupta, Kumar Nikhil and Kumar Mayank (2015), "Phyto-remediation of Waste Water through Aquatic Plants for the Change Detection Analysis in the Chemical Parameters within the District Dhanbad, Jharkhand", *International Journal of Research in Engineering & Technology (IJRET),* Vol.4, No.2 pp.243-252, February, 2015 (Online).

[131] Mohnish Pichhode and Kumar Nikhil (2015), "Effect of Copper Mining Dust on the Soil and vegetation in India : A Critical Review",

International Journal of Modern Sciences and Engineering Technology (IJMSET), Vol.2, No.2 pp.1-5, February, 2015 (Online).
[132] Jyotish Katre, Mohnish Pichhode and Kumar Nikhil (2015), "Effect of Different Mining Dust on the vegetation of District Balaghat, M.P – A Critical Review", *International Journal of Sciences and Research (IJSR)*, Vol.4, No.7 pp.1-5, July, 2015 (Online).
[133] Vyomendra Chaturvedi and Kumar Nikhil (2016), "Effect of Algae Fertilizer on the Growth of Vigna Radiata", *International Journal of Engineering & Technical Research (IJETR)*, Vol.4, No.1 pp.111-115, January, 2016 (Online).
[134] Vyomendra Chaturvedi and Kumar Nikhil (2016), "Effect of Algal Bio-fertilizer on the Vigna radiate : A Critical Review", International Journal of Engineering Research and Applications (IJERA), Vol.6, Issue 2 (part-1) February 2016, pp.85-94.
[135] Dhirendra Kumar and Kumar Nikhil (2016), "Vetiver Grass for Manifold Uses: A Critical Review", *International Journal of Engineering & Technical Research (IJETR)*, Vol.4, No.2 pp.146-1152, February, 2016 (Online).
[136] Shiv Kumar Gupta and Kumar Nikhil (2016), "Ground Water Contamination in Coal Mining Areas : A Critical Review", International Journal of Engineering and Applied Research (IJEAS), Vol.3, Issue 2 February 2016, pp.177-182 (Online).
[137] Shiv Kumar Gupta and Kumar Nikhil (2016), "Ground Water Status, Pollution and Maintenance in District Dhanbad, Jharkhand", International Journal of Engineering and Technical Research (IJETR), Vol.4, Issue 3 march, 2016, pp.187-189.
[138] Shiv Kumar Gupta and Kumar Nikhil and Utkarsh Dubey (2016), "Ground Water Quality Study in District Dhanbad, Jharkhand, India through GIS application", International Journal of Advance Research in Science and Engineering (IJARSE), Vol.5, Issue 03 March, 2016, pp.535-539 (Online).
[139] Shiv Kumar Gupta and Kumar Nikhil, Aditya Shrestkar and Gaurav Gehlot (2016), "Change Detection Analysis of Ground Water Quality and its management in District Dhanbad, Jharkhand, India", International Journal of Advance Technology in Engineering and Science (IJATES), Vol.4, Issue 03 March, 2016, pp.636-641 (Online).
[140] Ambika Asati, Mohnish Pichhode and Kumar Nikhil (2016), "Effect of Heavy Metals on Plants: An Overview.", International Journal of Application or Innovation in Engineering & Management (IJAIEM), Vol.5, issue-03, pp.56-66, March, 2016
[141] Dhirendra Kumar and Kumar Nikhil (2016), "Effect of FYM, NPK and Algal fertilizers on the Growth & Biomass of Vetiver Grass [Vetiveria zizanioides L. Nass", International Journal of Engineering and Applied Research (IJEAS), Vol.3, 85-89, Issue 3 March, 2016, pp. International Journal of Engineering and Applied Research (IJEAS), Vol.3, Issue 2 February 2016, pp.177-182 (Online). (Online).
[142] Sandeep Meshram, Mohnish Pichhode and Kumar Nikhil (2016), "Carbon Sequestration by Teak (Techtona grandis) Plantation at Malanjkhand Copper Project, District Balaghat, M.P.", International Journal of Current Research (IJCR), Vol.8, issue-03, pp.25907-25914, April, 2016.
[143] Frank Rudolph Olson (July 17, 1910 – November 28, 1953, an American bacteriologist, biological warfare scientist, and Central Intelligence Agency (CIA) employee who worked at Camp Detrick (now Fort Detrick) in Maryland. to establish the top secret U.S. bioweapons program beginning in 1943, a time when interest in applying modern technology to warfare was undergoing a boom. Olson's duties included experiments with aerosolized anthrax.After 10 years, he was a senior bacteriologist at the program.
[144] Scheffer, Marten, (1998), "Ecology of Shallow Lakes", (Ed.) Kluwer academic Publisher, P.O.Box 322, 3300 AH Dordrecht, The Netherland.
[145] Welch, P.S., 1948. Limnological Methods. Mc. Graw. Hill Book Co. inc. (USA), 381pp.
[146] Rao, V.N. and S.K. Mahmood, 1995. Nutrient status and biological characteristics of Hubsiguda pond. Envi and Poll. 2 (1): 31 – 34.
[147] Lackey, J.B. 1938. Public Health Reports. 53: 2080 – 2093.
[148] APHA (1985), "Standard methods for the examination of water and wastewater", 16th edition. American Public Health Association, Washington DC.
[149] Saxena, D. (1987), "Soil water and waste water analysis". New Delhi Publication. 283 Pp.
[150] Boyd, C.E., 1981. Water Quality in warm water Fish ponds, Craft master printers Alabama.
[151] Sudeep. B.M* and Shankar P. Hosmani, Algal biodiversity and diversity indices in two lakes of Mysore district, Department of Studies in Botany , University of Mysore, Manasagangothri, Mysore - 570006, Karnataka , India .

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