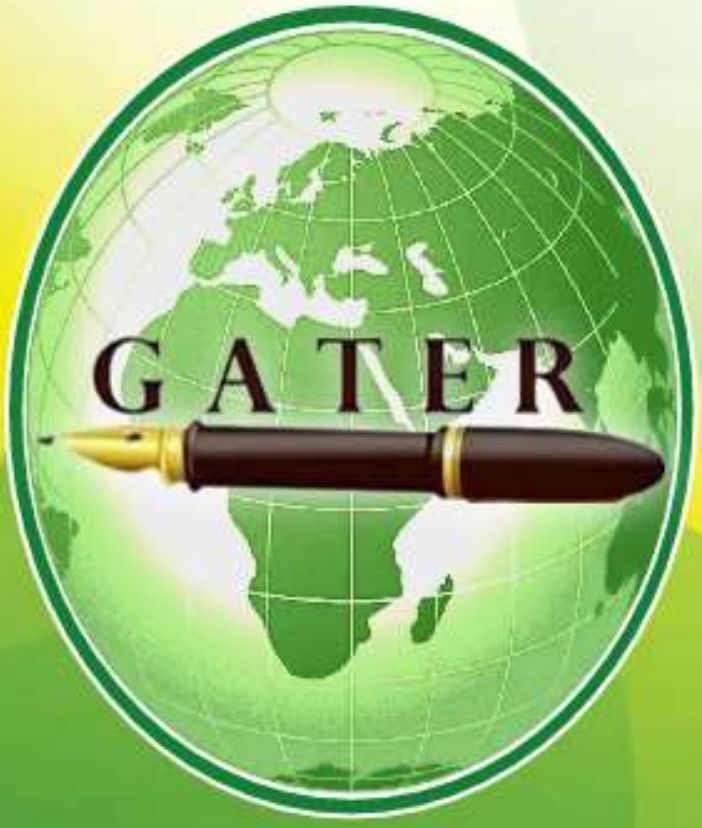
GATER

International Multidisciplinary Research

E-JOURNAL

International Indexed & Peer Reviewed Journal

VOLUME 1 | ISSUE 1 | July - Dec. 2023



PUBLISHER

GLOBAL ASSOCIATION FOR TRAINING, EDUCATION & RESEARCH

(Global Consortium of Professionals, Trainers, Academicians & Researchers)
Corporate Off.: 201 - 2nd Floor 51 Hasanpur I.P. Extension
New Delhi India - 110092
Website: www.gater.in E-mail :office@gater.in

Prof. Ashish Agrawal
(Chief Editor)
Director -IGNOU H.Q., New Delhi

Dear Colleagues,

Heartily Greetings …

I take pleasure to announce the first issue of our "GATER International Multidisciplinary E-Journal". to align it with our GATER's objective. Global Association for Training Education & Research (GATER) is a global association of Professionals from Training, Education and Research areas across the globe to strengthen collaborative association perspectives for mutual professional growths and to cater overall needs of the Industry, Academia & Society.

GATER has reached its membership to more than 25 countries i.e. India, Germany, Japan, Indonesia, Phillipines, Ireland, Mauritius, Bangladesh, Egypt, Iran, Guatemala, Srilanka, Sudan, Zimbabwe, Ethopia, Tanzania, Tajikistan, Republic of Congo, Surinaam, Seria. The vision of the group is to expand our membership to every country of the globe, for mutual association and growth of Academia, Industry and Society.

In this first issue we have collected highly innovative and quality research papers and articles with multidisciplinary approach across the globe. No doubt, this will lead a new dimension, contribution and addition to the field of domain knowledge. Later on, we have planned to publish thematical issues and to start E-Journal discipline wise.

I would like to express my heartfelt thanks to the esteemed Authors, Editors, Reviewers, Readers, Researchers, and Academicians and whole GATER family. I would give a special thanks to the my own team of research publication committee Prof. Santosh Sar (Deputy Chief Editor), Dr. Ankush Padle (Executive Editor) and whole Advisory committee and Review committee members.

Finally I would like to express my sinc thanks to the Management Committee members (Dr. D. S. Chauhan (President), Ms. Indu Lxmee Mohes, Muriious & Prof. Sanjay Agrawal (Vic – Prridnts), Dr. Atul Mishra (Secretary) & Mr. Dhirndra Tiwari (Joint Secretary) for their overall support.

This initiative will take GATER Community on the Top of the highly academic and research achievements.

I wish all the very best for the bright future.

Prof. Ashish Agrawal

International Multidisciplinary Research E-Journal *Online Available at http://gater.in/*

INTERNATIONAL PEER REVIEWED JOURNAL

OF GLOBAL ASSOCIATION FOR TRAINING, EDUCATION & RESEARCH

(GLOBAL CONSORTIUM OF PROFESSIONALS, TRAINERS, ACADEMICIANS & RESEARCHERS)

Author's Guidelines

All the research papers and articles must be sent (with Copyright Form) to : office@gater.in.

Submitted papers will be scrutinised, plagiarism tested and reviewed by Editorial board and review committee. After acceptance the papers will be published in particular issue. The authors will get softcopy / Link of the issue of his / her published research paper on email & website www.gater.in.

- **Language :** Manuscripts must be in English Language.
- **Title :** Title should be specific, suitable and clears. It should give over all idea of the research paper/article.
- **Author's Names and Affiliations / Personal Information :** (Name, Designation, Department, Institute, Country Name, E-mail ID and Mobile Number)
- **Corresponding Author :** Indicate the Corresponding Authors details with additional Mobile No., Email address and the complete postal address.
- **Sponsoring Information :** If the research is sponsored or supported by an organization, please mention it.
- **Abstracts :** Abstract should be specific and give overall idea of the research investigation. 200-300 words
- **Keywords :** 5-7 keywords which describe the terms ; avoid general, plural terms & multiple concepts.
- **Sections in the Article** : Sections and subsection should be clearly defined and numbered.
- **Figures / Table** : Table & figures should be numbered and titled (Table No. / Figure No. etc.)
- **Length of the Research Paper/Article :** Should not exceed more than 25 pages.
- **Citations in the Text :** Every ref. cited in the paper should be present in the reference list (and vice versa).
- **References** : References should be followed by latest edition of APA style in referencing.
- **Paper / Article format (software, font and size) :**

  The paper will be accepted only in soft copy. The research paper must be saved as type: Microsoft Word 1997-2003, so it can be open in any version of the MS-Word. Papers/articles should be typed in the font "Calibri (Body)" with Font Size: Title: 16', Subtitles: 14' and use 12' size for body text. Line spacing should be at least 1.5 inch.
- **Timeline :** Paper must be sent before timeline given. For any query drop your mail on office@gater.in.
- **Publication Fees (non-refundable) : (Free of Charge for all GATER Members)**

  1. For Non - Members : Rs. 1000 /- per Author (Inland)
  2. For Non - Member : $15 (Outland)
  3. Fee payable to : Global Association for Training Education & Research

     (A/c No.- 10165231050, IFSC - IDFB0041382)

- **Submission Checklist :** Manuscripts not published elsewhere & Submit in PDF and MS Word.

- **Disclaimer:** The material/data/opinions/views/facts/pictures/ any other matter expressed in the research papers submitted by concerned authors are purely his/her/their own and responsibilities are respective authors only. Editorial board, Advisory Board, Review Committee or Publisher are not responsible and nor agree with/ for that. For any infringement of copyright laws, the respective authors are responsible for the published content.

International Multidisciplinary Research E-Journal Online Available at http://gater.in/
INTERNATIONAL PEER REVIEWED JOURNAL
OF GLOBAL ASSOCIATION FOR TRAINING, EDUCATION & RESEARCH
(GLOBAL CONSORTIUM OF PROFESSIONALS, TRAINERS, ACADEMICIANS & RESEARCHERS)

TABLE OF CONTENT

S. N.	Title of the Research Paper / Article	Author/s	P. N.
1.	Nutrition and Vertebral Abnormalities of Orange-Spotted Rabbitfish Siganus Guttatus (Bloch) Juveniles	Prof. Gemma Fe A. Balanay, Philippines	06
2.	Farmer Producer Organizations (FPOs): The Rising Stars of Agricultural Start-Up Ecosystem - Issues and Solutions	Dr. Dushyant Singh Chauhan, India	17
3.	An Update: Pesticide Causing Immense Risk on Agricultural Sustainability	Chahat Sharma [1], Atul Mishra [2], Pooja Sharma [3]*	26
4.	Evaluation of the Current and Desirable State Of Adult Education Curricula In Primary And Post-Primary Education In Iran	Dr. Leila Rezaii, Iran	34
5.	Pesticide Contamination and Their Possible Effects on Rural Population, A Case of Anawalikheda –Madhya Pradesh	Manju Yadav [1], Praveen Yadav [2]	51
6.	Study Of High Energy Ignition System - Advantages and Application	Rishi Tiwari, Germany	57
7.	Renovation & Modernization, Uprating of Carbon Neutral Hydro Power Plants Using Computer Simulation	Manoj Yadav [1], Shailendra Pandey 2	68
8.	Perspectives on Sustainability from Eastern Traditions and Quantum World View and Its Relevance on Our Contemporary Earth	Dr Sumit Roy	77
9.	The Impact of Biotechnology on Food Production: A Paradigm	Mini Devi [1], Nikita Tushir [2], Nidarshana Chaturvedi Parashar [3]*	85
10.	The Role of Business Management Schools in Teaching Business Students Professionalism and How to Be Green Entrepreneurs	Manoj Kumar Mishra	96
11.	Socio-Economic Analysis of Triboelectric Nanogenerators for Harvesting Energy in Northeast India	Chandrajita Chakraborty [1], Dr. Shweta Tripathi [2]*	108
12.	Artificial Intelligence and Iot Enabled Waste Management System: A Review	Varun Kumar [1], Om Ji Shukla [2]	119
13.	A Comprehensive Review on Performance Improvements of Various Solar Dryer	Lalit Kumar [1], Jyoti Singh Parihar [1], Harish Kumar Ghritlahre [1], Sanjay Agrawal [1,2] * Sunita S. Singh [3]	127
14.	Blockchain Secured-Surveillance Camera	R. Kothai [1] * Logeshwaran B [2] Rohan C [3], Prasanaa J [4] Ulaganathan A [5]	134
15.	Changing Dynamics of Entrepreneurship in India	Dr. Kavita Indapurkar [1]* Dr. Sangeeta Jauhari [2]	140
16.	A Safe Destination for Women Tourists	Dr. Ranjana Mishra	151
17.	Exclusion of Radionuclide from Aqueous Medium through Sustainable Green Approach	Poonam Deshmukh [1]*, Santosh Kumar Sar [2]	154
18.	Concept Note for Skills Based University Course Structure	Lalit Kumar	159
19.	Role of Stock Exchanges in Sustainability: In the context of Indian Stock Exchanges	Dr. Ankush G Padle	163

International Multidisciplinary Research E-Journal Online Available at http://gater.in/
INTERNATIONAL PEER REVIEWED JOURNAL
OF GLOBAL ASSOCIATION FOR TRAINING, EDUCATION & RESEARCH
(GLOBAL CONSORTIUM OF PROFESSIONALS, TRAINERS, ACADEMICIANS & RESEARCHERS)

Nutrition and Vertebral Abnormalities of Orange-Spotted Rabbitfish Siganus guttatus (Bloch) Juveniles

Gemma Fe A. Balanay.[1]

[1]*Northern Mindanao School of Fisheries, Matabao, Buenavista, Agusan del Norte, 8601, Philippines*
*Corresponding Author: gfabalanay@tesda.gov.ph

Abstract :

Nutrition is one of the key factors affecting morphogenesis of fish. The quality of fish larvae and juveniles greatly affects aquaculture production and profits. There were two phases conducted, the larval and the nursery rearing phase using the same group of fishes. There were two treatments used with six replicates during the larval and nursery phase. In the larval phase, treatment 1 was fed with P. monodon feeds and treatment 2 was fed with fry booster feeds. In the nursery phase, Treatment 1 was fed with unenriched feeds and treatment 2 was fed with enriched feeds with vitamins. Screening out larval feeds for Siganus guttatus post larvae was done during the larval rearing phase. The results of the study showed higher rate of metamorphosis on fish fed with P. monodon compared to fry booster fed fish on the first week of rearing (37 dph) and complete metamorphosis was observed at 51 dph. A significant difference on the growth rate, specific growth rate, and feed conversion ratio was observed. However, no significant difference was observed on the rate of survival and vertebral abnormalities. In the nursery rearing phase, results showed significant effect of enriched feeds on growth rate, survival rate, and rate of vertebral abnormalities. This indicates that enrichment of feeds with vitamins significantly led to higher growth, survival, and lesser abnormalities in S. guttatus juveniles. This presented information can help future researchers to further study on other parameters that would greatly affect the occurrence of vertebral abnormalities in siganid juveniles.

Keywords : Siganus guttatus, Nutrition, Vertebral abnormalities, Rabbitfish, Juveniles

Introduction :

Good nutrition in fish is essential to produce healthy and high quality fish larvae and juveniles (Craig et. al., 2002). Feeding marine fish larvae is often limited to the administration of a few live prey organisms such as rotifers and Artemia. Although live feeds are good sources of nutrition, these food sources are found to be inadequate to support larval development. The nutritional content of the prey will vary depending on the culture conditions reared on or enriched with as well as the time the prey was deprived of food. This may lead to nutritional imbalances or nutritional deficiencies (Watanabe, 1993).

Co-feeding fish larvae with live feed and artificial feed were given for weaning fish to artificial feeds. Suitable artificial feeds for fish larvae that are nutritionally complete are essential for fish growth and survival. Artificial feeds mostly used by fish farmers contain all the required protein (39-56%), lipid (10-25%), carbohydrate (15-20%), ash (< 8.5%), water (< 10%), and trace amounts of vitamins and minerals (Craig et. al., 2000). Co-feeding fish with live feed and commercial feeds showed good growth. Larvae rely on exogenous enzymes from the prey to aid in digestion and activate zymogens (inactive enzymes) released by the larvae; thus increasing digestion and growth rates (Borlongan, 1990). Fish co-fed with microparticulate diet and Artemia showed good growth and survival in seabass, Dicentrarchus labrax; gilthead seabream, turbot Scophthalmus maximus; Atlantic halibut, Hipoglossus hipoglossus (Rosenlund et. al., 1997).

Enrichment of live feeds and artificial feeds has been developed to produce quality fry for aquaculture. Various vitamins, antioxidants, carotenoids and many other combinations have been studied as enrichment media (Parakarma et. al., 2009). Methods of artificial feeds enrichment include enrichment with vitamin E, vitamin D, vitamin C, cod liver oil, and astaxanthin emulsion. In the study, commercial feed was enriched with Sanoguard Top F vitamin following the method used by the manufacturer (INVE Aquaculture). Sanoguard Top F is a complete top-dressing for fish diet that generates optimal resistance to disease and stress, resulting in maximal survival and growth. It is an adapted formulation of the Sanoguard Aquastim (in-feed) premix, for specific use on the farm by top coating the administered feeds. This has a variety of immune stimulants, selected yeast species, specific plant extracts, amino acid (lysine, methionine), vitamins including high levels of vitamin B (thiamine, riboflavin, panthothenic acid, niacin, and pyridoxine), vitamin C (ascorbic acid, phosphate) and vitamin E, choline, inositol, minerals (including selenium) and antioxidants.

Nutritional deficiency was reported as one of the factors which cause deformities in fish (Estevez and Kanazawa, 1995; Divanach et. al., 1997; Haaparanta et. al., 1997; Dedi et. al., 1998; Favaloro and Mazzola, 2000; Koumoundouros et. al., 2001; Gavaia et. al., 2001; Lewis et. al., 2004). Nutritional factors such as high level of vitamin A and its precursor and low level of vitamin C in the diet have shown to affect the development of skeletal structures. Among the abnormalities reported caused by vitamin C deficiency was fusion of vertebra in Senegal sole (Gavaia et. al., 2001) rainbow trout (Madsen and Dalsgaard, 1999) and due to high level of vitamin A in Japanese flounder (Dedi et. al., 1995); sea bass (Boglione et. al., 1993); and sea bream (Boglione et. al., 2001). Vertebral deformities like scoliosis (abnormal lateral curvature), lordosis (excessive inward curvature), kyphosis (excessive outward curvature) and ankylosis (abnormal stiffening and immobility of joint due to fusion of bones), have been recorded for many species of teleosts (Dawson, 1966, 1971, 1976) cited by Omotayo et. al., 2011. In S. guttatus, fusion of vertebra, kyphosis, and lordosis were among the abnormalities observed. To address the problem on vertebral abnormalities in Siganus guttatus juveniles, this nutritional study was conducted to screen out larval feeds and to determine the effect of enrichment of feeds with vitamins in relation to the occurrence of vertebral abnormalities.

Materials and Methods :

Description of the area :

This study was conducted at Mindanao State University at Naawan, Naawan Misamis Oriental consisted of two rearing phases: larval rearing and nursery rearing phase. The larval rearing phase used 12 fine mesh net hapa with a dimension of 1x1x1m, installed inside a 60-ton circular tank. The rearing period was 21 days in a complete randomized design. In the nursery rearing phase, fish were reared for 40 days or until 91 dph in b-net hapa installed in the pond.

Stocking Siganus guttatus post larvae and juveniles :

The 30 dph Siganus guttatus post larvae, were stocked in the fine mesh net hapa at a stocking density of 400 fish/m3 reared for a period of 21 days. Each treatment had six replicates. After 21 days, the juveniles were transferred to the B-net hapa installed in pond and reared until it reached to 90 dph. Fish previously fed with fry booster were stocked separately into six replicates and labeled TF and fish fed with P. monodon were labeled TP.

Feeds and feeding frequency of Siganus guttatus post larvae and juveniles :

Siganid post larvae were fed with P. monodon feeds as control diet for treatment one and fry booster feeds for treatment two. Artemia salina was co-fed at a density of 1.8 x102 per hapa throughout the experimental period. For the nursery rearing phase, fish were fed with enriched and unenriched feeds.

Rate of metamorphosis, growth, survival evaluation and feed conversion ratio

Fish that metamorphosed to the juvenile stage were monitored during the sampling period. The following formula was used in the calculation. % Metamorphosis = 100 x A/B Where; A = the total number of fish that metamorphosed to juvenile stage; B = total number of fish survived. Condition factor and specific growth rate were calculated using the formula of Fulton's Condition Factor (K) (Schram, et. al., 2009). K = w / L3 x 100; where; W = fish weight in g; L= fish total length in cm. Specific growth rate (SGR) was calculated using the formula; SGR = (100) (LnWf - LnWi / t (Schram et. al., 2009) using the formula SGR = is the net change in body mass per day; where: Wf = average weight mass of all fish at the end of the experiment; Wi = average weight mass of all fish at the beginning of the experiment; t = no. of days in the experiment. Survival rate (%) = 100 (FN/IN) (Akatsu et. al., 1983, as cited by Zaki, 2004) Where: FN = total number of fish survived; IN = total number of fish stocked. The feed conversion ratio was calculated for each treatment to assess the performance of the feed using the formula: Feed Conversion Ratio (FCR) (Hopkins, 1992) FCR = F/Wf - Wi ; where; F = the total weight of feed offered to fish (g) Wf = the final weight of the fish (g) Wi = the initial weight of the fish at stocking (g)

Assessment of vertebral abnormalities in Siganus guttatus juveniles :

The flesh of the fish samples was manually removed to determine the vertebral abnormalities since fish radiography was not effective in small sizes of fish due to under mineralization of the vertebral column. Vertebral deformities were recorded and classified according to the following category: haemal lordosis, pre-haemal lordosis, vertebral fusion/compression and pre-haemal kyphosis and haemal kyphosis (Koumoundouros, 2009). Percentage of vertebral abnormalities was calculated as VB= (total no. of fish with vertebral abnormalities / total fish sampled) x100.

Results and Discussion :

Table 1

SUMMARY OF RATE OF METAMORPHOSIS, WEIGHT GAIN, SPECIFIC GROWTH RATE (%), FEED CONVERSION RATIO, CONDITION FACTOR, AND SURVIVAL RATE OF SIGANID POST LARVAE FED WITH P. MONODON FEED AND FRY BOOSTER FEED. VALUES IN A ROW WITH THE SAME SUPERSCRIPT ARE NOT SIGNIFICANT (P > 0.05).

	T1 P. monodon feed	T2 Fry booster feed
Metamorphosis rate (37 dph)	88.14 a ± 1.4	78.0 b ± 1.4
Metamorphosis rate (51 dph)	100a ± 0.23	100a ± 0.23
Weight gain (g)	0.33a ± 0.04	0.27b ± 0.04
Specific growth rate (%)	5.69a ± 0.07	4.72b ± 0.04
Feed conversion ratio	1.85b ± 0.21	2.1a ± 0.21
Condition factor	1.60a ± 0.05	1.53a ± 0.05
Survival rate (%)	96.5a ± 0.05	96.0a ± 0.05

In the larval rearing phase, it was observed that fish fed with *P. monodon* feeds had higher rate of metamorphosis on the first week of rearing (37 dph). Complete metamorphosis was observed at 51 dph and there was no significant difference at (P> 0.05) observed (Table 1). In the study, larval diet influenced the rate of metamorphosis of *S. guttatus* post larvae to the juvenile stage. Diet plays an important role in modulating endogenous hormones. The *P. monodon* feed has higher crude protein and crude fat compared with fry booster feed. *P. monodon* feed had 53.50 - 56.27 % crude protein, while fry booster feed had 45 - 48%. Generally, the nutrient requirement of fish larvae are protein (39-56%), lipid (10-25%), carbohydrate (15-20%), ash (< 8.5%), water (< 10%), and trace amounts of vitamins and minerals (Craig et. al., 2000). Fish fed with *P. monodon* had higher growth rate and

metamorphosed earlier. The fast growing larvae generally metamorphose earlier (Power, 2008). A significant effect of the experimental diets was observed in terms of weight gain, specific growth rate and feed conversion ratio (Table 1). Dietary protein is considered of primary important in fish feeding (Jauncey and Ross, 1982). Fish larvae grow rapidly when provided with sufficient dietary protein (Kamler, 1999; Conceicao, Grasdalen and Ronnestad 2003). Protein is the major source of energy during the larval stage of most marine teleost species ((Ronnestad, Tonheim, Fyhn, Rojas-Garcia, Kamisaka, Koven, Finn, Terjesen, Barr and Conceicao, 2003).

Fish fed with *P. monodon* had better feed efficiency than fish fed with fry booster feed, although feed conversion ratio of the two feeds showed no significant difference (Table 1). Slower growth rate in siganid post larvae fed with fry booster signifies that the nutrients present in the diet were not sufficient for growth metabolism. Stevenson (1987) reported that FCR greater than 2.0 has poor efficiency; however FCR in larval and juvenile rearing is expected to be high because feeding is done adlibitum to ensure that the larvae have higher chances of feeding.

Vertebral Abnormalities *Signus guttatus* 51 dph

Figure . *1 PRE-HAEMAL KYPHOSIS OF VERTEBRA*

Figure 2 *HAEMAL FUSION OF VERTEBRA*

NURSERY REARING PHASE :

In the nursery rearing phase, commercial feed was enriched with Sanoguard Top F vitamins following the method used by the manufacturer (INVE Aquaculture). Sanoguard Top F is a complete top-dressing for fish diet that generates optimal resistance to disease and stress, resulting in maximal survival and growth. It is an adapted formulation of the Sanoguard Aquastim (in-feed) premix, for specific use on the farm by top coating the administered feeds. This has a variety of immune stimulants, selected yeast species, specific plant extracts, amino acid (lysine, methionine), vitamins including high levels of vitamin B (thiamine, riboflavin, panthothenic acid, niacin, and pyridoxine), vitamin C (ascorbic acid, phosphate) and vitamin E, choline, inositol, minerals (including selenium) and antioxidants.

Table 2 *GROWTH RATE, SPECIFIC GROWTH AND FEED CONVERSION RATIO OF THE SIGANID JUVENILES 90 DPH. VALUES WITH THE SAME SUPERSCRIPT IN A COLUMN ARE NOT SIGNIFICANT (P > 0.05).*

Treatments	Weight gain (g)	% SGR	FCR	Survival rate
T1 (unenriched feed)	1.55 ± 0.25b	4.05 ± 0.29a	1.65 ± 0.11	76.0 ± 1.56b
T2 (enriched feed)	1.90 ± 0.25a	4.46 ± 0.29b	1.50 ± 0.11	78.0 ± 1.56a
Group P	1.75 ± 0.40a	4.08 ± 0.25a	1.60 ± 0.04a	76.0 ± 1.56b
Group F	1.70 ± 0.40a	4.43 ± 0.25a	1.55 ± 0.04a	78.0 ± 1.56a

Enriched feed have shown significant effect on the survival rate of siganid. High mortality rate was observed on fish fed without enrichment. A previous study of feed enrichment using Sanoguard Top F vitamins was done in a partial recirculation system at the facilities of Carditech Testing Laboratory, (Cadiz, Spain) wherein Gilthead seabream fry (*S.aurata*) was used and found effective. Enrichment of feed with Sanoguard Top F vitamin contains vitamin C, inositol, methionine and lysine of which affected the survival rate of the siganid juveniles. Higher survival rate was observed in fish fed with enriched feed. Vitamin C promotes growth, survival stress resistance, and immune response as observed in *Clarias gariepinus* (Merchie et. al., 1995). Methionine and lysine are among the limiting nutrients and must be incorporated in the diet. Vitamin E aid in the protection of lipid and/ or fatty acids in the body tissue. Vitamin C and E are considered as activators of the phagocyte population and immunostimulants (Eo and Lee, 2008). Vitamins improve the non-specific defense mechanisms and at the same time extend the duration of the specific immune response (Blazer, 1992).

Vertebral Abnormalities of *Siganus guttatus* post larvae and juveniles :

During the larval phase, it was observed that there was no significant effect of the experimental diets in the total percentage of vertebral abnormalities in *S. guttatus* post larvae as shown in Table 3. It was found out that fish fed with P. monodon have higher percentage of abnormalities of 5.6% while fish fed with fry booster has 5.1% respectively. Common abnormalities observed were haemal fusion of vertebra and pre-haemal kyphosis (Figure 1 & 2).

Table 3

SUMMARY OF THE TOTAL PERCENTAGE OF VERTEBRAL ABNORMALITIES IN SIGANID DURING THE LARVAL REARING PHASE. VALUES IN A COLUMN WITH THE SAME SUPERSCRIPT ARE NOT SIGNIFICANT (P > 0.05).

Treatment	Total no. of fish sampled (pcs)	Total no. of normal fish (pcs)	% of Normal fish	Total no. fish with vertebral abnormalities(pcs)	vertebral abnormalities (%)
P. monodon feed	180	169	94.4	11	5.6a
Fry booster feed	180	171	94.9	9	5.1a

The morphological deformities in larvae resulted from disruptions in the skeletal developmental process. Skeletal disorder is a result of mixture of vertebral and spinal malformations in larvae and juvenile fish has been linked to a poorly understood relationship between nutrition, environment and genetic factors (Lall and Lewis Mc Crea, 2007). Zambonino *et al*., 2005, reported that diet induce malformation.

The work of Fernandez *et al* (2008) reported that early larval nutrition was also shown to exert a strong effect on skeletogenesis and further larval performance in sea bream. The skeletal system consists of bones and cartilage which serves multiple physiological functions, of which the most important

is to support the structural integrity of the body for normal posture, development and locomotion Lall and Lewis Mc-Crea (2007). Pre-haemal kyphosis usually occurs in late larval stage affecting the vertebral column (V5-V6 as in *D. labrax*). This deformity may be associated with deformations of the brachiostegal rays. For instance in *D. labrax* species, this deformity is characterized as highly lethal up to 25-30 mm TL. This was also frequently associated with vertebral fusion.

In the juvenile rearing phase, pre-haemal kyphosis abnormality was also observed in *S. guttatus* 90 dph. Fish fed without enrichment had higher frequency rate of abnormality occurrence than enriched feeds (21.7 and 20.55%), respectively.

FIGURE 3 FIGURE 4
HAEMAL LORDOSIS OF 90 DPH
PRE-HAEMAL KYPHOSIS OF 90 DPH

Similarly, there was no significant effect between experimental groups of fish in the prevalence of pre-haemal kyphosis; however, fish fed with fry booster diet had higher frequency of vertebral abnormality occurrence than fish fed with *P. monodon* diet (21.15 and 21.10 %), respectively.

CONCLUSIONS :

Based on the results/findings derived from the study, the following conclusions are made; 1). Fish fed with P. monodon and fry booster feeds had no significant difference on the rate of metamorphosis, feed conversion ratio, and survival rate during the larval stage. On the other hand, enriched feeds had significant effect on weight gain, feed conversion ratio, and survival rate during the larval stage 2) Fish fed with P. monodon during the larval stage and fish fed without enrichment during the nursery stage had higher rate of vertebral abnormalities. 3) In terms of economic analysis, fish fed with fry booster feeds and fish fed with enriched feeds had lower production cost or more cost-effective.

RECOMMENDATIONS :

The use of fry booster feeds in the culture of S. guttatus at larval stage is recommended due to the following reasons: (1) lower production costs, and (2) lower percentage of vertebral abnormalities Likewise, in the nursery rearing phase of S. guttatus the use of feeds enriched with Sanoguard Top F is recommended because it had (1) higher growth rate, (2) better feed conversion ratio (3) higher survival rate, and (4) lower rate of vertebral abnormalities. Further studies are recommended to determine the nutritional components of the experimental diets such as amino acid profile, fatty acid profile and vitamins analysis to determine its effect on the occurrence of vertebral abnormalities in S. guttatus juveniles.

References :

1. Adhikari, S. 2003. Fertilization, soil and water quality management in small- scale ponds. Part II- Soil and water management. Aquaculture Asia Vol. 7 no. 4 pp. 6-8
2. Alexis, A. 1997. Fish meal and fish oil replacers in Mediterranean marine fish diets. Aquaculture Journal 22: 183-204.
3. Al-Harbi, A. H., 2001. Skeletal Deformities in Cultured Common Carp *Cyprinus carpio* L. Asian Fisheries Society, Manila, Philippines Asian Fisheries Science 14: 247-254
4. Ambasankar, K., S. Ahamad Ali, and J. Syamadaya. 2009. Nutritional requirements of Asian seabass, *Lates calcarifer*. National Training on Cage Culture of Seabass, Central Marine Fisheries Research Institute, Kochi. pp. 60-65.
5. Anadu, D. L., O. C Anozie, A. D. Anthony. 1990.Growth responses of *Tilapia zillii* fed diets containing various levels of ascorbic acid cobalt chloride. Aquaculture, 88:329-336.

6. Andrades, J. A., J. Becerra, P. Fernandez-Llebrez. 1996. Skeletal deformities in larval, juvenile and adult stages of cultured gilthead sea bream *(Sparus aurata* L.). Aquaculture 141:1-11
7. AOAC (Association of Official Analytical Chemists). 2000. Official methods of analysis of AOAC International, 17th edition. AOAC International, Gaithersburg, Maryland, USA.
8. Barbaro, A., A. Francescon, and R. Guidastri. 1984. Extensive rearing in a "valle" of the lagoon of Venice of *Sparus aurata* L. obtained by induced spawning. Nova Thalassia, 6, Suppl.: 281-286.
9. Baskerville-Bridges B. and L. J. Kling. 2000. Early weaning of Atlantic cod *Gadus morhua* larvae onto a microparticulate diet. Aquaculture 189:109-117.
10. Boglione, C., G. Marino, B. Bertolini, A. Rossi, F. Ferreri,, S. Cataudella. 1993. Larval and post larval monitoring in sea bass: morphological approach to evaluate finfish seed quality. In: Barnabe´, G., Kestmont, P. (Eds.), Aquaculture 92. Production, Environment and Quality. Eur. Aquacult. Soc. Spec. Publ. 18, 189– 204.
11. Boglione, C., F. Gagliardi, M. Scardi, and S. Cautaudella. 2001. Skeletal descriptors and quality assessment in larvae and post-larvae of wild-caught and hatchery-reared gilthead seabream (*Sparus aurata* L. 1758).J. Aquaculture 192, 1-22.
12. Borlongan. I. G. 1990. Studies on the digestive lipases of milkfish, *Chanos chanos*. J. Aquaculture Vol. 89 (3 - 4): 315- 325
13. Borlongan, I. G. 1991. Arginine and threonine requirements of milkfish (*Chanos chanos* Forsskal) juveniles. J. Aquaculture Vol. 93 (4): 313-322
14. Borlongan, I. G. 1992. The essential fatty acid requirement of milkfish (*Chanos chanos* Forsskal). Fish Physiol. Biochem. Vol. 9 (5-6): 401-407
15. Borlongan, I, G. 1992. Dietary requirement of milkfish (*Chanos chanos* Forsskal) juveniles for total aromatic amino acids. J. Aquaculture Vol. 102 (4): 309-317
16. Blazer, V. S. 1992. Nutrition and disease resistance in fish. Annu. Rev. Fish Dis. Vol. 2:309-323.
17. Conceição, L., H. Grasdalen, I. Ronnestad. 2003b. Amino acid requirements of fish larvae and post-larvae: new tools and recent findings. Aquaculture 227, 221–232.
18. Craig, S. and L. A. Helfrich. 2002. Understanding Fish Nutrition, Feeds, and Feeding. Virginia Cooperative Extension Publication 420 p. 256
19. Cahu, C. L. and J. L. Zambonino Infante. 1995. Effect of the molecular form of dietary nitrogen supply in sea bass larvae: Response of pancreatic enzymes and intestinal peptidases. Fish Physiology and Biochemistry Vol. 14, Issue 3: 209-214.
20. Cahu, C. L., J. L. Zambonino-Infante and T. Takeuche. 2003. Nutritional components affecting skeletal development in fish larvae. Aquaculture Vol. 227 (1-4): 254-258.
21. Cahu, C. L., E. Gisbert, L. A. Villeneuve, S. Morais, and J. L. Zambonino-Infante. 2009. Influence of dietary phospholipids on early ontogenesis of fish Aquaculture Research. Vol. 40, Issue 9: 989 - 999
22. Chatain, B. 1994. Abnormal swimbladder development and lordosis in sea bass (*Dicentrarchus labrax)* and sea bream (*Sparus auratus*). Aquaculture. Vol. 119, Issue 4: 371-379.
23. Copeman, L. A. 2002. Effects of docosahexaenoic, ecosapentaenoic, and arachidonic acids on the early growth, survival, lipid composition and pigmentation of yellowtail flounder: a live food enrichment experiment. Aquaculture Vol. 210: 285-304.
24. Coutteau, P. and P. Sorgeloos. 1997. Manipulation of dietary lipids, fatty acids and vitamins in zooplankton cultures. Freshwater Biology Vol. 38:501-512.
25. David, M., N. Glynatsi, M. Darias, S.

Christodoulopolou, C. L. Cahu, J. L. Zambonino-Infante and G. Komoundouros. 2009. Optimal levels of dietary vitamin A for reduced deformity incidence during development of European sea bass larvae (*Dicentrarchus labrax)* depend on malformation type. Aquaculture. Vol. 294, Issues 3-3: 262-270

26. Dedi, J., T. Takeushi, T. Seikai, T. Watanabe. 1995. Hypervitaminosis and safe levels of vitamin A for larval flounder (*Paralichtys olivaceus*) fed *Artemia* nauplii. J. Aquaculture Vol. 133:135-146.
27. Dulcic, J. 2004. Incidence of Spinal Deformities In Natural Populations of Grass Goby, *Zosterisessor ophiocephalus* from the Karin Sea, Eastern Middle Adriatic. Institute ofOceanography and Fisheries. Cybium Vol. 28, 1: 7-11
28. Divanach, P., C. Boglione, M. Menu, G. Kounoundouros, M. Kentouri, S. Cataudella. 1996. Abnormalities in finfish mariculture: an overview of the problem, causes and solutions. Sea bass and Sea bream culture: problems and prospects. Verona, Italy, October 16- 18. European aquaculture Society, Oostende, Belgium, pp. 45-66.
29. Divanach, P., Papandroulakis, N., Anastasiadis, P., Koumoundouros, G. and Kentouri, M. 1997. Effects of water currents during post larval and nursery phase on the development of skeletal deformities in sea bass (*Dicentrarchus labrax* L.) with functional swimbladder. J. Aquaculture Vol. 156: 145-155.
30. Duray, M. 1997. Larval rearing of the grouper *Epinephelus suillus* under laboratory conditions. Aquaculture. Vol.150: 63-767.
31. Estevez, A., and A. Kanazawa, 1995. Effect of (n-3) PUFA and vitamin A *Artemia* enrichment on pigmentation success of turbot, *Scopthalmus maximus* (L.) Aquaculture Nutrition. Vol. 1:159-168.
32. Eo, J. and K. J. Lee. 2008. Effect of dietary ascorbic acid on growth and non-specific immune responses of tiger puffer, *Takifugu rubripes*. Fish Shellfish Immunol. 25:611-616.
33. Favaloro, E. and A. Mazzola. 2000. Meristic character analysis and skeletal anomalies during growth in reared sharp snout seabream. Aquaculture International Vol. 8: 417-430
34. Feed Development Section 1994. Feeds and Feeding of Milkfish, Nile Tilapia Asian Sea Bass, and Tiger Shrimp. SEAFDEC Aquaculture Department, Tigbauan, Iloilo, Philippines p.97.
35. Fernandez, I., F. Hontoria, J. B. Ortiz-Delgado, Y. Kotzamanis, A. Estevez, J. L. Zambonino-Infante, and E. Gisbert. 2008. Larval performance and skeletal deformities in farmed gilthead sea bream (*Sparus aurata*) fed with graded levels of Vitamin A enriched rotifers (*Brachionus plicatilis*). J. Aquaculture Vol. 283: 102-115.
36. Fernández, I.,F. Hontoria, J. Ortiz-Delgado, Y. Kotzamanis, A. Estévez , J. L. Zambonino-Infante, E. Gisbert. 2008. Larval performance and skeletal deformities in farmed gilthead sea bream (Sparus aurata) fed with graded levels of Vitamin A enriched rotifers (*Brachionus plicatilis)*. J. Aquaculture Vol. 283:102-115.
37. Furuita, H., Takeuchi, T. Uematsu, K., 1998. Effects of eicosapentaenoic and docosahexaenoic acids on growth, survival and brain development of larval Japanese flounder (*Paralichtys olivaceus*). J. Aquaculture Vol. 161, 269-279.
38. Gapasin, R. S., J. Bombeo, R. Lavens, P. Sorgeloos, H. Nelis, 1997. Enrichment of live food with essential fatty acids and vitamin C: effects on milkfish (*Chanos chanos*) larval performance. J. Aquaculture Vol. 162: 269-286.
39. Gavia, P. J., M. T. Dinis, and M. L. Cancela. 2001. Oestological development and abnormalities of the Vertebral column and caudal skeleton in larvae and juvenile stages of hatchery-reared senegal soles (*Solea senegalensis*) J. Aquaculture Vol. 294 (3 - 4) 194-201.
40. Gavaia, J. 2002. Osteological development and abnormalities of the vertebral column and

caudal skeleton in larval and juvenile stages of hatchery-reared Senegal sole (Solea senegalensis). J. Aquaculture Vol. 211: 305–323

41. Ghanawi, J. 2010. Effects of dietary lipid levels on growth performance of marbled spinefoot rabbitfish *Siganus rivulatus*. J. Aquaculture Vol. 310: 395–400
42. Halver, J. E., and R. W. Hardy. 2002. Fish Nutrition. Third edition. Academic Press, New York. p. 824
43. Hara, S., H. Kohno, M. Duray, T. Bagarinao, A. Gallego , and Y. Taki . 1986. Feeding habits of larval rabbitfish, *Siganus guttatus.* in the laboratory. In: The First Asian Fisheries Forum, 25-31 May 1986. Ed. by J. L. Maclean, L. B. Dizon, L. V. Hosillos. Manila, The Asian Fisheries Society, p. 573-576.
44. Haaparanta, A., E. T. Valtonen, R. W. Hoffmann. 1997. Gill anomalies of perch and roach from four lakes differing in water quality. J. Fish Biol. 50, 575– 591.
45. Henry, M. S., W. N. Ferreira, D. L. Barkley. 2005. Costs and Return Analysis for South Carolina Shrimp Trawlers. Regional Economic Development Research Laboratory. Research Report. pp. 1-10
46. Hopkins, K. D., 1992. Reporting fish growth: A review of the Basics. J. World Aquaculture Society Vol. 23: 173–179.
47. Ibiyo, L. M., 2007. Vitamin C (ascorbic acid) requirements of *Heterobranchus longifilis* fingerlings. African Journal of Biotechnology Vol. 6 (13), pp. 1559-1567.
48. Jauncey, K. and B. Ross. 1982. A guide to tilapia feeds and feeding. Institute of Aquaculture, Univ. Stirling, Scotland.
49. Jawad, L. A., 2004. First record of an anomalies mullet fish (*Mugil cephalus*) from New Zealand Tuhinga, Vol. 15:121 – 124.
50. Jawad, L. A. and A. Oktener. 2007. Incidence of lordosis in the freshwater mullet, *liza abu* (Heckel,1843) Collected from Ataturk dam lake,Turkey Anales de Biologia Vol. 29:105- 113.
51. Kamler, E., 1992. Early Life History of Fish: An Energetic Approach. Chapman and Hall, London.
52. Kohno, 1988. Transition from endogenous to exogenous nutrition sources in larval rabbitfish *Siganus guttatus*. Aquaculture Vol. 54 Issue 7: 1083-1091.
53. Kosutarak, P. A. Kanazawa, S. Teshima, S. Koshio, S. Itoh. 1995. L-ascorbyl-z- phosphate Mg as a vitamin C source for red bream juveniles. Proceedings of the Third Asian Fisheries Forum, Singapore 1992 (Chou, L. M., Munro, A. D., Lam, T. J., Chen T. W. Cheong, L. K. Ding, J. K. Hooi, K. K., Khoo, H. W., Phang, V. P., Shim, K. F and Tan C. H., eds). Manila, Philippines: Assam Fisheries Society. pp. 727-737.
54. Kolkovski, S., A. Arieli, and A. Tandler. 1997. Visual and chemical cues stimulate microdiet ingestion in seabream larvae. Aquaculture Int., Vol. 5: 527-537.
55. Kolkovski, S., W. M. Koven, and A. Tandler. 1997. The mode of action of Artemia in enhancing utilization of microdiet by gilthead seabream Sparus aurata larvae. Aquaculture, Vol. 155: 193-205.
56. Kolkovski, S., and A. Tandler. 2000. The use of squid protein hydrolysate as a protein source in microdiets for gilthead seabream *Sparus aurata* larvae. Aquacult. Nutr. Vol. 6: 11-17.
57. Kolkovski, S., J. Curnow, and J. King. 2010. Development towards commercialization of marine fish larvae feeds – Microdiets. Project No. 2004/258. Fisheries Research Report No.198. Department of Fisheries, Western Australia. p.180.
58. Koumoundouros, G., F. Gagliardi, P. Divanach, C. Boglione, S. Cataudella, M. Kentouri. 1997. Normal and abnormal osteological development of caudal fin in Sparus aurata L. fry. Aquaculture 149, 215–226.
59. Koumoundouros, G., P. Divanach, E. Mangot, M. Kentouri and D. Stefakianakis. 2000. Osteological development of the vertebral column and of the fins in *Diplodus sargus* (Teleostei: Perciformes:

Sparidae). Mar. Biol., Vol. 139:853-862.
60. Koumoundouros G., P. Divanach, M. Kentouri. 2001. The effect of rearing conditions on development of saddleback syndrome and caudal fin deformities in *Dentex dentex* (L.). Aquaculture, 200: 285-304.
61. Koumoundouros G., Maingot E., Divanach P., Kentouri M., 2002. Kyphosis in reared sea bass (*Dicentrarchus labrax* L.): ontogeny and effects on mortality. Aquaculture, 209: 49-58.
62. Koumoundouros, G. 2009. Malformation Diagnostics Description, Classification & Application. Biology Department University of Patras, Greece.
63. Kotzamanis, Y., E. Gisbert, F. J. Gatesoupe, J. L. Zambonino Infante, C. L. Cahu. 2007. Effects of different dietary levels of fish protein hydrolysates on growth, digestive enzymes, gut microbiota, and resistance to Vibrio anguillarum in European seabass (*Dicentrarchus labrax)* larvae.
64. Comparative Biochemistry and Physiology Part A: Molecular & Integrative Physiology; Vol. 147, Issue 1: 205-214.
65. Kvellestad, A., S. Hoie, K. Thorud, B. Thorud, and A. Lyngoy. 2000. Platyspondyly and shortness of vertebral column in farmed Atlantic salmon *Salmo salar* in Norway description and interpretation of pathologic changes. Vol. 39: 97-108.
66. Lall, S. P. and L. M. Lewis-McCrea. 2007. Role of nutrients in skeletal metabolism and pathology
67. in fish – An overview. Canada. Aquaculture Vol. 267, Issues 1-4: 3-19.
68. Lewis, L. M., S. P. Lall and P. E. Witten. 2004. Morphological descriptions of the early stages of spine and vertebral development in hatchery-reared larval and juvenile Atlantic halibut *(Hippoglossus hippoglossus).* J. Aquaculture, Vol. 241: 47-59
69. Lovell, T. 1989. Nutrition and feeding of fish. Van Nostrand Reinhold, New York.
70. Madsen, L. and I. Dalsgaard. 1999. Vertebral column deformities in farmed rainbow trout (*Oncorhynchus mykiss*).J. Aquaculture Vol. 171: 41-48.
71. Mazurais, D., N. Glynatsi, M. J. Darias, S. Cristodoulopoulou, C. L. Cahu, J. L. Zambonino-Infante and G. Koumoundorous. 2009. Optimal levels of dietary vitamin A for reduced deformity incidence during development of European sea bass larvae *(Dicentrarchus labrax*). Aquaculture Vol. 294, Issues 3-4: 262-270.
72. Merchie, G., P Lavens, P. Dhert, R. Pector, A. Mai Soni, M. Abbes, H. Nelis, F. Ollevier, A. De Leenheer, P. Sorgeloos. 1995. Live food mediated vitamin C transfer to *Dicentrarchus labrax* and *Clarias gariepinus*. J. Appl. Ichthyol. 11, 336-341.
73. North, B. P. 2006. Stocking density practices of commercial UK rainbow trout farms. Aquaculture Vol. 259: 260–267
74. Olatunji-Akioye, A.O., O. K. Adeyemo, and O. T. Akomolafe. 2010. Photographic and radiographic study of osteological abnormalities of the head of adult african catfish *(Clarias gariepinus).* Int. J. Morphol.,Vol. 28 Issue 3:719-722.
75. Omotayo, F. and J. Abayomi. 2011. Skeletal malformations among the *Clarias* species from fish mongers in Ekiti State, Nigeria. Continental J. Fisheries and Aquatic Science 5 (2): pp. 32-7.
76. Parakarma, M. G., K. D. Rawat, G. Venkateshwarlu and A. K. Reddy. 2009. Feeding vitamins, antioxidants and cod liver oil enriched formulated feed influences the growth, survivaand fatty acid composition of *Macrobrachium rosenbergiii* (de Man, 1879) post larvae. Sri Lanka J. Aquaculture. Sci. Vol.14: 59-74
77. Preziosi, R., S. Gridelli, P. Borghetti, A. Diana, A. Parmeggiani, M. Fioravanti, F. Marcer, I. Bianchi, M. Walsh and I. Berzins, 2006. Spinal deformity in a Sandtiger shark, *Carcharias taurus* Rafinesque: A clinical-pathological study. Fish Diseases Vol. 29 Issue 1: 49-60.

78. Parazo, M. 1990. Effect of dietary protein and energy level on growth, protein utilization and carcass composition of rabbitfish, *Siganus guttatus.* Aquaculture Vol. 86:41-49.
79. Power, E., S. Pittman, C. Hildahl, S. Silva, Galay-Burgos, and E. Bjornsson. 2008. The molecular and endocrine basis of flatfish metamorphosis. Reviews in Fisheries Science Vol. 16:95- 111
80. Ronnestad, I., S. K. Tonheim, H. J. Fyhna, C. R. Rojas-Garcıa, Y. Kamisakaa, W. Kovenc,
81. R. N. Finna, B. F. Terjesend, Y. Barrd, and L. E. Conceicao. 2003. The supply of amino acids during early feeding stages of marine fish larvae: A review of recent findings. Aquaculture Vol. 227: 147–164
82. Rosenlund, G., L. Joergenses, R. Waagboe, and K. Sadnes. 1990. Effects of different dietary levels of ascorbic acid in plaice (*Pleuronecies platessa* L.). Comp. Biochem. Physiol. 96:395-398.
83. Saoud, I. P., C. Mohanna and J. Ghanawi. 2008. Effects of temperature on survival and growth of juvenile spinefoot rabbitfish (Siganus rivulatus), Lebanon, Aquaculture Research Vol. 39, 491- 497
84. Sargent, J. R., D. R. Tocher, and J. G. Bell. 2002. The lipids, Third edition. In Fish Nutrition (Halver, J. E. and Hardy, R. W., eds), Academic Press, London, pp. 182-259.
85. Schram, E., M. C. Verdegem , R. T . Widjaja , C. J. Kloet, A. Foss, R. Schelvis-Smit, B. Roth, A. K. Imsland. 2009. Impact of increased flow rate on specific growth rate of juvenile turbot (*Scophthalmus maximus*, Rafinesque 1810). Aquaculture Journal Vol. 292: 46–52
86. Shimizu, H., 1987. Bone abnormality of hatchery reared black porgy, *Acunthopagru.s shlegeli* (Bleeker). Bull. Tokai. Reg. Fish. Res. Lab., Vol. 122: 1-11.
87. Shimizu, H. and H. Takeuchi. 2002. Bone abnormality of hatchery-reared bluefin tuna *Thunnus orientalis.* Japan Aquacul. Sci., 50(1): 7 1-78.
88. Singh, S. K., U. Mishra, S. D. Roy, N. K. Chadha, G. Venkateshwarlu. 2012. Effect of Feeding Enriched Formulated Diet and Live Feed on Growth, Survival and Fatty Acid Profile of Deccan Mahseer, *Tor Khudree* (Sykes) First Feeding Fry. Aquaculture Res. Dev. Vol. 3:143
89. Tonheim, S. K., M. Espe, K. Hamre, I. Ronnestad. 2005. Pre-hydrolysis improves utilization of dietary protein in the larval teleost Atlantic halibut (*Hippoglossus hippoglossus* L.). J. Exp. Mar. Biol. Ecol. 321, 19-34.
90. Tongjun, R., S. Kioshio, S. Teshima, M. Ishikawa, S.Tokoyama, and O. Uyan. 2006. The Efficiency of L-ascorbic Acid in Micro Bound Diet for Larval Red Sea Bream (*Pagrus major)*. Aquaculture Science 54 (4), 561-566.
91. Untundag, C., Y. Ciftci, and F. Sakamoto. 2002. Rearing of larvae and juveniles of Black Sea Turbot, *Psetta maxima*, in Turkey. Turkish Journal of Fisheries and Aquatic Sciences Vol. 2:13-17
92. Usman, R., S. Lante, and T. Ahmad. 2007. Rabbitfish *Siganus guttatus* breeding and larval rearing trial Marine finfish research and development at the Research Institute for Mariculture, Gondol, Bali, Indonesia. Aquaculture Asia Magazine pp.34 - 41.
93. Villeneuve, L., E. Gisbert, J. L. Zambonino-Infante, P. Quazuguel, and C. Cahu. 2005. Effect of nature of dietary lipids on European sea bass morphogenesis: implication of retinoid receptors. British Journal of Nutrition Vol. 94 Issue 6: 877-884.
94. Watanabe, T., 1993. Importance of docosahexaenoic acid in marine larval fish. J. World Aquaculture Society 24, 152-161.
95. Yadegari, M., R. Mehdi, and A. Mahsa. 2011. A Radiographical Study on Skeletal Deformities in Cultured Rainbow Trout (*Oncorhynchus mykiss*) in Iran. Global Veterinaria 7 (6): 601-604.

International Multidisciplinary Research E-Journal Online Available at http://gater.in/
INTERNATIONAL PEER REVIEWED JOURNAL
OF GLOBAL ASSOCIATION FOR TRAINING, EDUCATION & RESEARCH
(GLOBAL CONSORTIUM OF PROFESSIONALS, TRAINERS, ACADEMICIANS & RESEARCHERS)

FARMER PRODUCER ORGANIZATIONS (FPOs): THE RISING STARS OF AGRICULTURAL START-UP ECOSYSTEM - ISSUES AND SOLUTIONS

Author*: Dr. Dushyant Singh Chauhan, Ph.D , MBA

Institutions:

- Ex-CGM, NABARD, HO, Mumbai (M.S.)-India
- Visiting Faculty, Lal Bahadur Shastri Institute of Management, New Delhi (India)
- Member Advisory Board & Adjunct faculty –Medhavi Skill University, Sikkim (India)

Email: dush_chn@yahoo.com, Mob. No. : +91 9176876101, 7007276202

ABSTRACT :

India is an agrarian society. The dwindling farm income resulting into higher incidences of poverty in the rural areas, has always been a cause of concern for the respective governments and the policy makers. Some of the basic reasons attributed to low agricultural income are-

- Inherent nature and degree of risk involved in agricultural operations,
- Small landholdings of less than an hectare coupled with low technology adaption on account of weak extension services and low investment capacity of an Indian farmer,
- Inadequate private capital infusion with lower gross capital formation (GCF) , and
- Weak Demand and Supply chain management and volatile primary markets leading to unfavourable Terms of Trade (ToT) in the agriculture sector.

Policy decisions to mitigate the hardships of the Indian farmers have met with average to moderate success. A recent policy initiative by government of India to promote 10000 Farmer Producer Organizations (FPOs) across the country to overcome the farmer's hardships is one of the flag-ship programs aimed at raising the farmer's income by gradually turning the agriculture sector into a world of professionally managed micro-corporates. FPOs , once established will take care of the Demand and Supply chain of the respective agro-commodity value chain and pep-up the dwindling farm gate income. It promises an exciting era of new age agro start-ups in the country side. The article is an attempt to define and illustrate –

- The profile and requirement for FPOs,
- Governance model in FPOs,
- Issues in governance and likely solutions for mitigating the issues in governance

Key Words : Community Based Organizations (CBOs), Demand- Supply Chain Management, Farmer Producers Organization (FPO), Producer Organisation Promoting institution (POPI) , Terms of Trade (ToT).

1.0 What are Farmer Producer Organisations (FPOs)

1.1 A FPO has its origin in a Producers Organization (PO). A Producer Organisation (PO) is defined as a legal entity formed by primary producers, viz. farmers, milk producers, fishermen, weavers, rural artisans, craftsmen. Thus, FPO is a category of PO where the members are farmers[1]. In some forms like in the producer companies, institutions of farmers

who are primary producers can also become a member of the FPO.

1.2 Since a FPO is a legal entity, it can be in the form of a PO which is registered under, any of the following-

- A Producer Company under Section 378 of Indian Companies Act, 1956, as amended in 2020
- A Section 25 Company of Indian Companies Act, 1956, amended as Section 8(1) in 2013.
- A Cooperative under State Cooperative Societies Acts – of respective states of India
- A Cooperative under Multi-State Cooperative Society Act, 2002
- A Public Trust registered under Indian Trusts Act, 1882

1.3 A FPO, in any of its form shall provide for bulk purchase and supply of inputs to its members, collectivisation of produce, marketing of the produce-with or without any processing undertaken and sharing of profits/benefits among the members.

1.4 A typical Memorandum of Association for a FPO, as per Section 378F of The Companies (Amendment) ACT, 2020, Chapter XXI enumerates as follows-

- Name of the FPO and the State in which the registered office is situated.
- The main objects of the FPO (one or more of the objects specified in section 378B).
- Names and addresses of the persons who have subscribed to the memorandum.
- Amount of share capital with which FPO is to be registered and division thereof into shares of a fixed amount.
- Names, addresses and occupations of the subscribers being producers, who shall act as the first directors.
- Against the subscriber's name, the number of shares each subscriber takes provided that no subscriber shall take less than one share
- That the liability of its members is limited.
- That in case the objects of the FPO are not confined to one State, the States to whose territories the objects extend.
- As per Section 378G of the Companies (Amendment) Act, 2020, Chapter XXI along with Memorandum, its articles duly signed by the subscribers to the memorandum shall be presented, for registration to the Registrar of the State to which the registered office of the Producer Company is situated at the time of registration .
- As per 378H a Producer Company may, by special resolution, not inconsistent with section 378B, alter its objects specified in its memorandum.
- The major components of Articles of Association are-

➢ Members profile.
➢ Terms and Conditions for continuance/ cancellation of membership Conditions and procedure for transfer of shares Constitution, composition and objectives of the apex governing body i.e., the Board of Directors (BoDs) Conduct and Election process Directors profile as per the Companies (Amendment) Act, 2020, Chapter XXI A Appointment of Expert Directors Appointment of Chief executive Officer (CEO) and other paid employees.
➢ Election of BoDs and the chairman.
➢ Vacation of office by Directors Liabilities of the Directors Constitution and composition of various committees, if required.
➢ Share allocation, issuance of share certificates and holding pattern Details of Equity and Funds Distribution of bonus.
➢ Types and nature of economic activities Amalgamation and Method of dissolution. Convening and conduct of Annual General Body Meetings (AGMs).
➢ Terms of trade to be followed Procedure to amend bye-laws Thus , FPOs are the organisations which are *'Of the farmers - Managed by the farmers - For the farmers'*.

1.5 The number of registered FPOs operating in the country is depicted below:

TABLE 1 Status of FPOs in India

State	Number of FPOs registered
Andhra Pradesh	584
Bihar	724
Gujarat	390
Haryana	803
Karnataka	746
Madhya Pradesh	891
Maharashtra	5611
Odisha	721
Rajasthan	571
Tamil Nadu	936
Telangana	620
Uttar Pradesh	1981
West Bengal	681
Total	14675

Source: Ekta Joshi, Assessing India's FPO Ecosystem, Tata-Cornell Institute, May 2022

1.6 The profiling of these registered FPOs based on the paid up capital is shown below.

TABLE 2
Profile of FPOs based on the size of paid-up capital

State	PAID UP CAPITAL			
	Less than 1 lakh	1-3 lakhs	3-10 lakhs	More than 10 lakhs
Andhra Pradesh	37%	35%	21%	7%
Bihar	27%	42%	25%	6%
Gujarat	33%	41%	19%	8%
Haryana	2%	74%	12%	12%
Karnataka	33%	23%	16%	27%
Madhya Pradesh	16%	49%	25%	10%
Maharashtra	10%	62%	22%	7%
Odisha	29%	53%	16%	3%
Rajasthan	11%	58%	24%	6%
Tamil Nadu	31%	21%	22%	26%
Telangana	50%	26%	19%	4%
Uttar Pradesh	5%	55%	30%	10%
West Bengal	14%	49%	25%	12%
Total	17%	51%	22%	10%

Source: Ekta Joshi, Assessing India's FPO Ecosystem, Tata-Cornell Institute, May 2022

1.7 The profile of FPOs based on the number of shareholders is depicted below.

TABLE 3 Profile of FPOs based on the number of shareholders

State	FPO membership size		
	Small Less than 100	Medium 100 to 500	Large Above 500
Andhra Pradesh	57%	23%	20%
Bihar	62%	15%	23%
Gujarat	53%	21%	26%
Haryana	70%	16%	14%
Karnataka	37%	16%	47%
Madhya Pradesh	49%	23%	28%
Maharashtra	43%	38%	19%
Odisha	79%	8%	14%
Rajasthan	67%	16%	17%
Tamil Nadu	35%	22%	43%
Telangana	39%	30%	31%
Uttar Pradesh	37%	17%	46%
West Bengal	23%	29%	48%
Total	47%	25%	28%

Source: Ekta Joshi, Assessing India's FPO Ecosystem, Tata-Cornell Institute, May 2022

International Multidisciplinary Research E-Journal Online Available at http://gater.in/
INTERNATIONAL PEER REVIEWED JOURNAL
OF GLOBAL ASSOCIATION FOR TRAINING, EDUCATION & RESEARCH
(GLOBAL CONSORTIUM OF PROFESSIONALS, TRAINERS, ACADEMICIANS & RESEARCHERS)

2.0 Why are the farmer Producer Organisations (FPOs) required

2.1 Majority of the Indian farmers are from socially and economically challenged segment of the population. A study conducted in 2014 inferred that, given an opportunity, the Indian farmer would like to switchover to any other profession[2]. However innocuous it may sound but the fact remains that in this country of 1400 million, the farmer is the least celebrated entity. In spite of the best efforts of respective governments, the *Anndata* -the 'Farmer'- continues to struggle to etch out a life, characterized with a comfortable standard of living.

2.2 The table below depicts the demographic profile of the farming community.

TABLE – 4 Demographic profile of farmers in India
(In Millions)

Year	Total Population	Growth Rate (%)	Number of Farmers	Growth Rate (%)	Farmers to total Population (%)
1951	361	-	70	-	19
1971	548	52	78	11	14
1991	846	54	111	42	13
2011	1211	43	119	07	10

Source: Census Report, 2011

Although the population of farmers increased by 1.7 times from 1951 to 2011, as compared to 3.35 times increase in the total population in the corresponding period, in absolute terms the number of farmers grew from 70 million in 1952 to 119 million in 2011. This also surmises the fragmentation of farm lands and its per capita distribution among the farmers

2.3 A more interesting phenomenon however was unfolding in the rural area as the number of agricultural labourers outpaced the number of farmers as depicted below:

TABLE: 5 Demographic profile of farmers in India
(In Millions)

YEAR	NUMBER OF FARMERS	GROWTH RATE (%)	NUMBER OF AGRICULTRAL LABORERS	GROWTH RATE (%)	FARMER TO RURAL POPULATION (%)	AGRICULTURAL LABORER TO RURAL POPULATION (%)
1951	70	-	27	-	23	09
1971	78	11	48	77	17	11
1991	111	42	75	56	18	12
2011	119	07	148	97	14	17

Source: Census Report, 2011

Source: Self Enumeration

2.4 The major reasons cited for this demographic shift are as follows[3,4]

- Decreasing average size of per capita farm land Increased cropping intensity leading to more demand for agricultural labourers.
- Selling of agricultural land for urbanization and industrialization Capital and labourer intensive farming on account of HYV seeds Lower rate of farm mechanization Marginalized agrarian interests Thus,

the agriculture sector is the major segment which provides large scale employment.

2.5 Based on the ownership of the land holdings the Indian farmers are classified into five categories as shown below[5].

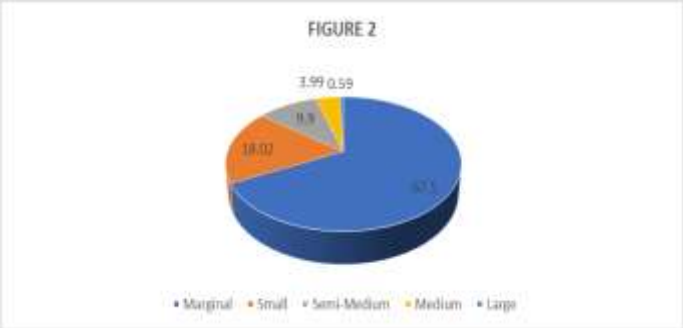
TABLE: 6 Distribution in terms of land holding

S.No.	Category Assigned	Land Holding
1	Marginal	Less than 1 Hectare
2	Small	1 to 2 Hectares
3	Semi-Medium	2 to 4 Hectares
4	Medium	4 to 10 Hectares
5	Large	More than 10 Hectares

2.6 Accordingly the agricultural census, 2011 has classified the 119 million farmers in the country as per the following [6].

TABLE: 7 Category wise Spread of Farmers in India

S.No.	Category Assigned	Number of Farmers (In Millions)	Share in the Total
1	Marginal	80.32	67.50
2	Small	21.45	18.02
3	Semi-Medium	11.78	09.90
4	Medium	04.75	03.99
5	Large	0.70	00.59
6	TOTAL	119.00	100.00



Source: Self Enumeration

It is evident from above that almost 86% of the total farmers are the farmers with small and marginal land holdings. The average farm size in India at 1.15 hectare[7] is one of the lowest in the world.

2.7 The fact remains that though farming is considered a very pious profession it is beset with risks which no other profession has to face and the farmer's prosperity remains an eluding factor for the policy makers. According to Dalwai committee[8] , "...Prices determine the farmers' welfare and influence the welfare cycle on both the ways. The Wholesale Price Indices (WPI) for agricultural commodities may be considered as representative index for the prices received by the farmers. An increase in the prices received will escalate the value of output even if the physical output remains the same. On the other hand, changes in the Consumer Price Index (CPI) will reflect the changes in overall expenditure and determine the cost of living. For ensuring the farmers' welfare, WPI should increase more than CPI to have a positive impact on the farmers' welfare...". Computing the income of the farmer has been approached by some of the economists by deducing that net value added (NVA) or net domestic product (NDP) of the agriculture as the income of the farmer, however this may not be giving the true and fair picture of the farmers income as it does not takes into consideration the fact that NVA or NDP of the agriculture sector also includes the wages earned by agricultural labourers and this amount does not accrue to a farmer instead it is an expense incurred by the farmer by way of cash or kind outflow. Therefore, a more scientific way of arriving at the income of a farmer is by reducing the wage bills from the NVA or NDP of the agriculture sector[9]. The real income of a farmer is dependent on farm productivity, input cost, the expenditure on farm labourer, prices of agricultural commodities at the farm gate and the level of inflation. It can be observed from Table 8 that during the period 1983-84 to 2011-12, a farmer's income has multiplied 18 times , while that of an agricultural labourer it has

multiplied 22 times and in case of a non-agricultural labourer it has seen a 19 times jump.

TABLE 8 Income Distribution Among farmers and Agricultural and Non agricultural labourers
(In Rs./Year)

Year	Farm Income Per Farmer	Income per Agricultural Labourer	Income per Non-Agricultural Labourer
1983-84	4286	1467	12786
1987-88	5653	2201	18036
1993-94	12365	4784	37763
1999-2000	24188	8938	78565
2004-05	26146	10043	106688
2011-2012	78264	32311	246514

Source : As computed by Chand et al (Ref.8)

A more recent, NABARD All India Rural Financial Inclusion Survey (NAFIS) [10,] indicated that an agricultural household owning less than 1 hectare of land has an annual income which is 24% less than that of an agricultural household owning land in the range of 1 to 2 hectares and 48% less than those who owned more than 2 hectares of land.

Thus, it is amply clear that a great majority of small and marginal farmers in India are living in a condition of impoverishment and this underlined a farmer's Distress, Desperation and Depression.

2.8 The way forward seems to be based on the fact that Community based Organisations (CBOs) such as self-Help Groups (SHGs), Joint Liability Groups (JLGs) and Activity Groups, as also cooperative endeavours such as *Amul* and *Safal*, to name a very few, have played a crucial role in creating income generating opportunities and pepping up the lively hood prospects for the rural people. Each of these micro, mini and even medium enterprise have an ecosystem of their own but a common thread which runs among all these entities is aggregation, processing and marketing of identified produce and a greater role for self-governance. The Government of India has acknowledged and noticed this inherent power of 'Cooperation' , 'Coordination' and 'Collaboration' in CBOs and has launched a Centrally Sponsored Scheme to promote and establish 10000 Farmer Producers Organisations (FPOs) , which will be legally registered CBOs undertaking farm produce related business. The sole aim is to promote, nurture and establish mini-corporates owned, managed and governed by the small and medium farmers so that their difficulties pertaining to supply chain management, marketing, economy of scales are taken care-of and the farm gate level income can be increased.

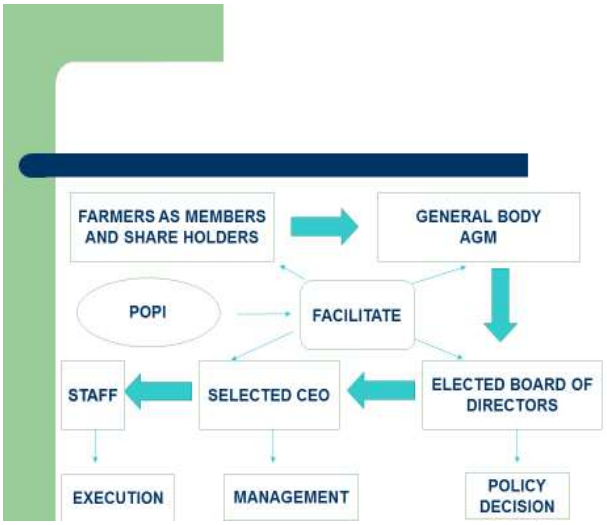
2.8 The FPO can thus undertake input supply business, both for its members and also non-members of the area and can act as an aggregator, processing unit and sell the produce in the market. Organisations like National Bank for Agriculture and Rural Development (NABARD), Small farmers Agri-Business Consortium (SFAC) and various State Governments departments will be the implementing agencies for this centrally sponsored scheme. Moreover, these organisations also promote FPOs from their own resources. It is envisaged that FPOs will not only play a big role in pepping up the farmers income but will also act as nurseries for evolving agri-preneurs and creating a professional ecosystem which will reduce exploitation of both producers and consumers. Thus, courtesy FPOs, thousands of start-ups will evolve in the countryside.

3.0 The governance model in FPOs

3.1 As indicated above a FPO can register itself under its choice of form. Irrespective of the form chosen the broad governance model adopted by an FPO is depicted below.

FIGURE 3

Organizational Structure for Governance in FPOs



Source: Self Enumeration

3.2 The Corporate Governance structure in a FPO devolves around shareholders, Board of

Directors, Committees of the Board, CEO and the producer Organization promoting institution (POPI). The size, characteristics, composition and interaction among them determine the efficiency and effectiveness of the overall governance structure and hence the performance of the FPO is directly proportional to the quality of governance transgressing it.

3.3 In order to have an efficient and effective governance model the following aspects are to be kept in sight by the managers[11].

- The Board of Directors (BoDs)
- Appointment of Directors to the BoDs
- Duties, Responsibilities, Authority and Accountability of a Director
- Risk Management and Internal Control
- Statutory Reporting and integrity towards FPO
- Audit of books of accounts, operational activities and internal control system performance
- Fostering healthy, cordial and professional relationship with shareholders and other key stakeholders

3.4 The principles to be followed by an FPO, in order to have an efficient governance model are enumerated as follows

- Principle 1

The Board of Directors (BoDs) should consist of directors having an ability to take independent decisions, without any fear, favor, coercion or influence. This will thwart the dominance of an individual or a small group of individuals on the functioning and operations of the FPO and will lead to a decision making which will be in the larger interest of the FPO. A fair mix of representation in terms of gender, socio-economic status and age profile may be considered while electing the BoDs. Required numbers of board level committees may be put in place to ensure delegation of power and focused attention to issues pertaining to the FPO. It will facilitate the board in effective decision making and management of the affairs of the FPO, which in turn lead to safeguard of the interests of the general members, who are the primary shareholders of the FPO.

- Principle 2

Appointment of Directors to the BoDs should be a formal, rigorous and transparent exercise based on the rules of a democratic administration and procedures. A director to the board should be elected should on the basis of merit she posseses on the laid down objective criteria which may include a set of skills, knowledge and experience required to manage the affairs of the FPO.

- Principle 3

Duties, Responsibilities, Authority and Accountability of a Director should be well laid down and directors be made aware of them. It is expected that directors will demonstrate and foster high ethical standards and a strong ethical culture in the FPO by leading with example. Conflicts of interest should be disclosed and managed transparently and fairly based on the rules and regulations. The board should be transparent, fair and consistent in determining

the remuneration policy for directors, CEO and other paid executives.

- Principle 4

Risk Management and Internal Control are one of the primary responsibilities of the board and it should be accountable for risk management and therefore should ensure that the FPO develops a robust system of risk management. The board is also responsible for the implementation of a sound internal control and compliance mechanism.

- Principle 5

Statutory Reporting and integrity towards FPO, both in words and deeds has to be complied with and the CEO and BoDs are responsible for the accomplishment. A fair and transparent Annual Report and statement of accounts which should reflect a true picture of the organization's financial, environmental, social and governance position, and performance is the pillar towards the good governance.

- Principle 6

Audit of books of accounts, operational activities and internal control system performance, has to be an effective and independent internal as well as external function which should be evolved and respected by all the stakeholders in the FPO. Therefore, the BoDs should establish a formal and transparent arrangements to appoint and maintain FPO's auditors.

- Principle 7

Fostering healthy, cordial and professional relationship with shareholders and other key stakeholders is also one of the key responsibilities of the BoDs. The board should ensure that a meaningful and honest communication is established among all the stake holders. Therefore, convening and conduct of statutory meetings, issuance of other formal communications by way of circulars/letters and other modes of communications takes place among the shareholders and other key stakeholders.

4.0 CHALLENGES FOR THE FPOs[12]

4.1 Challenges faced by the FPO sector in its Ecosystem

- Difficulty in mobilising enough members
- Limited organisational and management skills
- Limited participation in value chains
- Inability of FPOs to access institutional credit

4.2 Challenges faced by an FPO in its Governance System

Ownership Conflicting interests Knowledge and professional skills Lack of openness Low financial literacy and business skill Lack of clarity on role and responsibility Gender barriers (poor involvement of women)

4.3 Challenges faced by an FPO in its Management System

- Availability of qualified and experienced manager/personnel to run the company professionally, issue of adequate remuneration for personnel Availability of local talent to run the FPO
- Availability of a good accountant for proper maintenance of books of accounts –
- Adequate Information flow and documentation – availability of technology and ability to use the technology Dependence on Chartered Accountants located far away – financial and regulatory compliances The CEO, BoDs and members lacking business skills Lack of capital for establishing backward and forward linkages Difficulty in accessing credit for want of collateral and credit history required by financial institutions to finance them.

5.0 Suggestions towards the ways to resolve these challenges

- Awareness creation programs on regular basis in the rural areas
- Building capacities of BoD members on roles and responsibilities, mapping the business opportunities, evolving business profile of FPOs, designing business development plans and compliance functions.

- Conduct of board meetings under handholding support by the POPI in the initial years
- Build a pool of professionals from amongst the members of the FPO by the POPI
- Evolving , through capacity building interventions a pool of rural youth who are capable of managing FPO business as CEOs and accountants.
- Institutionalised support in the initial years to the FPO to meet its operational cost
- Build and incubate adequate professional leadership from among the members of FPOs
- Continuous Training arrangements to build capacity and awareness of staff and stakeholders by apex organisations like NABARD, SFAC etc
- Standardized Modules on MIS may be made available to FPOs by apex organisations like NABARD, SFAC etc
- Standard operating manuals for HR, Financial Management, Business operations and Effective governance to be made available to FPOs apex organisations like NABARD, SFAC etc
- Digital Management Information System (MIS) and other Operating systems should be developed by GoI and/or respective state governments and established in FPOs.

References :

1. NABARD (2015), Farmer Producer Organisations (FPOs), FAQs, NABARD HO Mumbai, India
2. Lokniti (2014), State of Indian Farmer, Centre For the Study of Developing Societies, New delhi , India
3. Gupta, N. (2016). Decline of Cultivators and Growth of Agricultural Labourers in India from 2001 to 2011. International Journal of Rural Management, 12(2), PP 179–198, India https://doi.org/10.1177/0973005216665939
4. Bandyopadhyaya, N. (1977) , Causes of Sharp Increase in Agricultural Labourers, 1961-71: A Case Study of Social-Existence Forms of Labour in North Bengal. Economic and Political Weekly, *12*(53), A111–A126,India http://www.jstor.org/stable/4366246
5. Ibid
6. All India Report on Agricultural Census (2011) , PP 18 , Ministry of Agriculture & Farmers Welfare , Government of India, New Delhi, India
7. Ibid
8. Report of the Committee on Doubling Farmers' Income (Ashok Dalwai Committee), Vol.I (2017), 'March of Agriculture since Independence & Growth Trends' , Ministry of Agriculture and Farmers' welfare , GoI, New Delhi, India.

International Multidisciplinary Research E-Journal Online Available at http://gater.in/
INTERNATIONAL PEER REVIEWED JOURNAL
OF GLOBAL ASSOCIATION FOR TRAINING, EDUCATION & RESEARCH
(GLOBAL CONSORTIUM OF PROFESSIONALS, TRAINERS, ACADEMICIANS & RESEARCHERS)

An update : pesticide causing immense risk on agricultural sustainability

Chahat Sharma[1], Atul Mishra[2] and Pooja Sharma[3]*
[1]Department of Biosciences and Technology, Maharishi Markandeshwar (Deemed to be University), Mullana
[2] National Institute of Technical Teachers' Training & Research, Bhopal, M.P.
[3]Department of Biosciences and Technology, Maharishi Markandeshwar (Deemed to be University), Mullana
*Corresponding Author :
Pooja Sharma, Dept of Biosciences and Technology, Maharishi Markandeshwar Deemed to be Univ, Mullana

---

Abstract :

The agricultural industry is significantly boosting the economy. To ensure the food security of the world's population, which is expanding quickly, there is a demand of pesticides for crop production is also increasing. Pesticides are the organic chemicals that allegedly designed to enhance the yield of crops. Without the usage of pesticides, the reduction in yields of fruits would be 78%, vegetables would be 54%, and grains would be around 32%. The global yearly use of chemical pesticides is 4.6 million tones, with agriculture accounting for 85% and other sectors accounting for the remaining 15%. Pesticides are categorized on the basis of their various qualities. They breakdown and forms new compounds. They are transferred from the actual site of application to other place using adsorption, leaching, volatilization, spray drift, and runoff mechanism and contaminates the site. In this review, we are mainly focusing on pesticide behavior, classification, its mechanism, strategies for overcome and comparative analysis of consumption of pesticide at globally and within India. The basic study regarding pesticide and incorporation of "all organic" nano-pesticide technology must be beneficial for future to reduce the harmful effects of pesticide and agricultural sustainability.

Keywords : Pesticide, Adsorption, Sustainability, Agriculture, Nano-pesticide

Introduction:

Pesticides are organic chemicals that are allegedly designed to enhance the yield of crops, soil efficiency, the quality of the product, prevent crop Peet losses, and control disease causing insects in humans and animals. Use of pesticide in agriculture has also been increased for food storage [1]. Global grain output has climbed from 500 million tones at the end of the twentieth century to 700 million tones now. Pests harm food during its development or storage. As an example, China is primarily a food-producing nation, yet every year, 40 million tones, or nearly 8.8% of total grain output, end up in vain due to a wide range of pests such as insects [2]. Crops are harmed by around nine thousand species of insects, fifty thousand classes of plant pathogens, and eight thousand kinds of wildflowers worldwide. Pests are expected to cause losses of around 14%. Pesticides play an important role in agricultural productivity. Pesticides are used in the production of approximately half of agricultural harvests. Without the usage of pesticides, the reduction in yields of fruits would be 78%, vegetables would be 54%, and grains would be around 32%. When insecticides are employed, crop loss is reduced and productivity increased from 35% to 42% [3].

The global yearly use of chemical pesticides is 4.6 million tones, with agriculture accounting for 85% and other sectors accounting for the remaining 15% [4]. Each year, around 2 million tons of pesticides are expended globally, out of which, United States consuming 24%, Europe consuming 45%, and others consuming 25%. The trend of pesticides in India is around 0.5 kg/ha, with organophosphorus pesticides accounting for the majority of the total, and herbicide consumption is the greatest [5]. With an annual production of 90,000 tones, India ranks second in Asia

(after China) and 12th in the world for pesticide consumption [6]. Many pesticides are used without considering their permanence in the environment or the deleterious consequences they would have on future generations. Furthermore, these compounds begin to build in the environment, becoming a component of soils and sediments, water bodies, and groundwater resources. The residues of pesticides begin their inclusion in the food web by accompanying the fundamental reservoirs of the food chain [7]. One of the problems caused by the excess usage of pesticide is the loss of soil fertility, as well as human and animal health [8]. Pesticide residues penetrate groundwater and eventually the food chain via the biomagnification process [9]. Each pesticide has a varying amount of toxicity based on its concentration in the environment. According to research, only 1-10% of applied pesticide reaches the target body, rest of 80-90% spread throughout the environment, such as woodland, soil, or fluctuating in the air, and immersed with sand to produce aerosols [10]. At this point, we should look beyond the present to find long-term answers. There is widespread agreement that further research towards improved food production and higher-quality food production is required. Moreover, it is widely accepted that productive soil is a limited resource (as is water) and that, in order to assure continuing food production, agriculture must work alongside soil and ecosystem preservation, restoration, and agronomic research on higher yield cultivars. As a result, it is critical to have a broad consensus on pesticide application and the implementation of viable agricultural practices, like Integrated Pest Management strategies [11,12].

Current status of pesticides in India and world level :

Utilization of pesticides in India commenced in 1948, by the introduction of DDT for control of malaria and BHC to suppress locust. In 1952, India began pesticide manufacture with the establishment of a DDT and BHC manufacturing plant. India developed around five thousand metric tons of insect repellent in 1958 [13]. Pesticide usage globally is around two million tons per year, with the United States alone consuming 24%, Europe consuming 45%, and others consuming 25%. There is 3.75% stake in India. Pesticide use in India is barely 0.5 kg per hectare, but it is 6.60 kg per hectare in Korea and 12 kg per hectare in Japan [5,14]. The top 10 pesticide-using nations in the world are Italy, Turkey, Colombia, India, Japan, Bolivia and Ecuador [15,16]. Pesticide usage in India is highest in Maharashtra, which is then followed by Uttar Pradesh, Punjab, and Haryana. Total utilization climbed in Maharashtra and Uttar Pradesh during the recent decade, while it fell marginally in Punjab and Haryana. Total consumption has fallen drastically in states like as West Bengal, Gujarat, and Karnataka. On the other hand, overall pesticide usage increased dramatically in Chhattisgarh and Kerala. According to the reports of 2016-17, Pesticide usage per acre was greatest in Punjab, followed by Haryana and Maharashtra, while least in state of Bihar, Rajasthan, Karnataka, and Madhya Pradesh [17,18]. The Indian pesticide market appears to be increasingly export-oriented, with exports growing over time. India's top global export markets include the USA, the England, France, South Africa, Netherland, Malaysia, Bangladesh and Singapore. According to latest export statistics (2015), 'Dicamba' is the most distributed herbicide from India, near around 30 thousand kg with a price of US dollar 6,51,578, and is followed by 'Cypermethrin' insecticide with the amount of 19 thousand liters [19].

Classification of pesticides :

Pesticides are categorized on the basis of their various qualities. This categorization makes it simple to handle and utilize for the intended purpose. Pesticides are very toxic in nature. However, some of them are less and weak toxic in nature [20]. Some of them are organic while others are inorganic. Different classes have diverse chemical backbones, and their modes of action. Keeping all of this in mind, pesticides are grouped into numerous categories such as mode of action, method of entrance, chemical type, toxicity level, target pest, and so on [21, 22] (Fig.1)

Fate of pesticide in environment :

Pesticides could infiltrate into the surroundings when they are used to kill the target pest. Pesticides that enter into the ecosystem, can experience mechanisms like transformation (or movement) and degradation [23]. Its breakdown in the atmosphere results in the formation of new compounds. Pesticides are transferred from the actual site of application to other areas by mechanisms such as adsorption, leaching, volatilization, spray drift, and runoff [24]. With the passage of time, research has been made to understand the nature of secondary products formed after the degradation of pesticides as well as their side effects and toxic level [25]. A large proportion of pesticides do not target the insects only but they also trigger non-target plants and animals. Continuous implementation of pesticide into the environment, results deprivation of biodiversity. Most of pesticides are persisting in nature; they remain on the surface of earth, circulate into groundwater and pollute the ecosystem as a whole. On the basis of their poisonous behavior, they may step into the body by invading into the food chains, and hence have a bad impact on human health [26] (Fig. 2)

a. **Adsorption-** It is the process through which chemicals are absorbed by plants, animals or microbes. Pesticide absorption by target and nontarget species is regulated by environmental factors as well as the physiochemical characteristics of the pesticide and the soil [27].

b. **Volatilization-** The process of transformation of a solid or liquid compound into a gaseous one is termed as volatilization. The movement of pesticide vapors in the atmosphere, known as vapor drift, can result in the transfer of a pesticide in a gaseous condition from a treated region by air currents. Moreover, vapor drift is undetectable, in contrast to spray drift and dust drift, which may occasionally be detected during an application [24].

c. **Run-off-** The flow of water across a sloping surface is referred to as runoff. Pesticides are transported, either mixed in the water or via disintegrating surface. The amount and frequency of pesticide runoff is governed by factors such as the area's slope condition; ability to erode, quality, and humidity of the soil; and the quantity of irrigation and the season of rainfall [28].

d. **Leaching-** Another technique that transports pesticides in water is leaching. In contrast to runoff, which happens when water flows across the soil's surface, leaching occurs when water goes downward within the soil. Pesticide leaching is influenced by a number of parameters. These include the pesticide's water solubility. Pesticides that dissolve in water can easily migrate with the water as it percolates through the soil. The quantity and durability of pesticide adsorption on soil particles are influenced by soil structure and texture [29].

Pesticide is a pollutant in ecosystem :

Insecticides account for 80 % of overall pesticide usage, herbicides include fifteen percent of total, fungicides cover 1.5 % part and less than three percent are covered by others. but at the world level, herbicides consumed around fifty percent of the total, insecticides at thirty percent, fungicides at eighteen percent and others at six percent [13,30]. Pesticides must not only be used and preserved carefully, but they must also be disposed of properly. Pimental and Lavitan discovered in early 1986 that only 0.1 % of pesticides reach their goal, while the majority of them pollute the environment [31]. These pesticides are categorized as persistent organic pollutants (POPs), and their use is rigorously restricted globally by the Stockholm agreement on persistent organic pollutants [32]. Several toxic persistent pesticides retain by products in biosphere for very long duration of time and somehow thought to be responsible for a wide range of recognized and undiscovered harmful effects. Even when present in trace amounts, their diversity, toxicity, and durability have a negative impact on the environment such as amphibians, reptiles, aquatic animals and plants which are directly linked to human beings [13].

a. **Contamination of water bodies-** Pesticides may find their way into water through drift during pesticide spraying, runoff from treated areas, and leaching through the soil. Pesticides can be

administered straight to the water's surface in some instances. Water contamination is primarily determined by pesticide qualities (water solubility and hydrophobicity), soil properties, meteorological conditions, geography, and the distance between an application site and a water source [33]. Pesticides found in bodies of water include pronofos, dimethoate, chlordane, diuron, and fluometuron. Streams and rivers were typically more contaminated than groundwaters, especially if they are located near regions with extensive agricultural or urban land use [34].

b. Contamination of soil system- Pesticide transport, retention, and breakdown in soil are determined by their chemical characteristics as well as physical, chemical, and biological features of the soil. All of these parameters influence pesticide sorption/desorption, volatilization, degradation, absorption by plants, run-off, and leaching [35]. Pesticides may be transported by erosion and flood waters from treated land and storage sites to soils downstream and in the flood plain. Plants and microbes may be harmed when excessive amounts of active chemicals are discharged. Because of toxicity to non-target species, there may be health hazards when animals and humans approach polluted places [36].

c. Hazardous impact of pesticides on terrestrial as well as on aquatic biodiversity- Pesticide deposition in food chains is of major concern since it has immediate effects on predators and prey. Pesticides, on the other hand, can indirectly lower the number of weeds, bushes, and insects on which higher species feed. Spraying pesticides, herbicides, and fungicides has also been associated to population decreases in relatively rare animal and bird species [37]. Pesticides sprayed on land end up in aquatic habitats, where they are hazardous to fish and other non-target animals. These pesticides are not only dangerous to those marine species but they also interact with stressors such as destructive algal blooms. Pesticide usage is causing a drop in the populations of certain fish species [38].

Pesticides have also harmed terrestrial animal populations. The use of broad-spectrum pesticides such as carbamates, organophosphates, and pyrethroids can dramatically reduce populations of beneficial insects such as bees and beetles. The population of insects have also been observed to be higher on organic farms than on non-organic farms [39].

Pesticides have had major health consequences for both humans and the environment. Production workers, formulators, sprayers, mixers, loaders, and agricultural field workers are among the high-risk populations exposed to pesticides [22]. Pesticides may be linked to a variety of ailments, including cancer, as well as having neurological, mental, and reproductive implications, according to research. Pesticide exposure can also cause disorders of the immune system in people. Children may be more vulnerable to pesticide effects due to greater exposure through food and breast milk, immature detoxification mechanisms, and a higher life expectancy for illnesses with extended latency periods. Pesticide contamination of foods and crops, as well as ingestion of contaminated foods causes severe illnesses in people and animals [40].

Strategies for pesticide remediation :

Conversion is a significant process that might affect pesticide levels in the environment. Pesticide conversion is sometimes referred to as pesticide degradation by oxidation-reduction reactions, which can lower pesticide toxicity. Pesticides that are administered to the environment undergo rapid conversion through a variety of processes such as degradation [41]. Physical methods involve adsorption and use of percolator filters while the chemical approaches such as advanced oxidation can also be employed, which involves the incorporation of strong transient species like OH^- radical [42]. Another strategy utilized for the degradation of pesticide is heterogeneous photocatalysis with TiO_2, by the production of stated radical [43]. High temperature incineration furnaces is one of the most popular methods nowadays [44]. All of these approaches, however, have many drawbacks, including the usage of chemical catalysts such as TiO_2,

also the use of costly equipment for ozone. These traditional physicochemical techniques turn out to be costly, and the process of degradation is not fully satisfactory because of formation of secondary metabolites from the parent compound which are equally harmful and long lasting in the environment [45].

Microbial conversion is a powerful remediation strategy for pesticide molecule breakdown [46]. When pesticide molecules are applied, enzymes and microorganisms break down their structure with the aid of chemicals and enzymatic activity [7]. Abiotic factors, may also have ability to degrade pesticides. When these pollutants are exposed to sunlight, photodegradation can occur [21,47]. Pesticide degradation may be triggered by one or more of the following processes: biotransformation, biomineralization, bioaccumulation, biodegradation, bioremediation, and co-metabolism [16,48,49]. Microbial degradation is the utilization of efficient microorganisms for the enzymatic breakdown of harmful pesticides into harmless compounds on polluted locations such as soil, ground water, sludge, industrial water systems, and so on [50]. Microbes undergo some series of steps and perform enzymatic reaction to degrade the target pesticide (Fig.3). Bioremediation of pesticides by microorganisms has several benefits, including minimal investment of cost, a long-lasting removal procedure, a simple and easy requirement of equipment, inexpensive and efficient safety for the environment. It can play a significant role in limiting the possible damage posed by pesticides on the natural ecosystem while maintaining agricultural production and yield [21,51].

Future prospective and conclusion :

In the previous decades, the unfocused, hazardous, and widespread use of lethal pesticides has polluted the land, water, air, food, and ecosystems [52]. In order to overcome the lethal effects of pesticides in the biosphere, advanced and cost-efficient techniques as well as sustainable steps such as integrated pest management (IPM), laws prohibiting heavily toxic pesticides, and the development NIP, should be executed [11,24]. Additionally, it should be mandatory to communicate the systematic findings of exposure and health risk assessments in order to provide scientific training for the proper handling of these chemicals to prevent the side effects and promote healthy guidelines for farmers and normal people in order to maintain the health atmosphere [53]. To reduce pesticide contamination, biopesticides or organic pesticides should be industrialized alongside chemical or inorganic pesticides [54]. In addition to this, the use of nanoparticles in pest control has grown significantly with the acceptance of nanotechnology. In comparison to conventional pesticide formulations, nanoformulated pesticides provide a number of benefits, such as enhanced environmental stability, controlled release of active components, higher permeability, targeted delivery, etc.

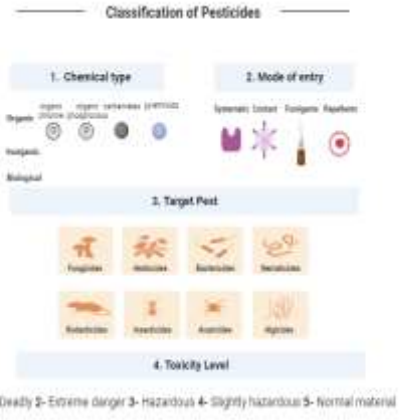


Fig.1 Categorization of pesticides on the basis of its various qualities

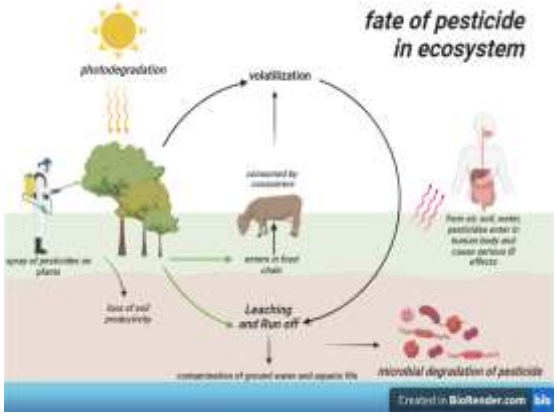


Fig.2 Fate of pesticide in environment and its side effects on ecosystem

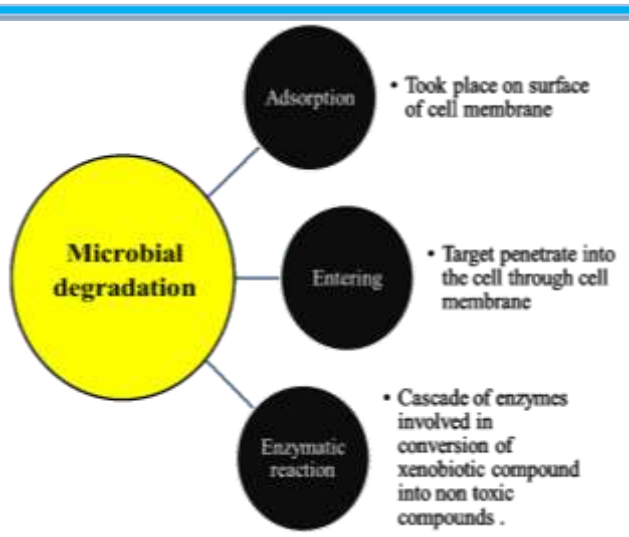


Fig.3 Steps of microbial degradation of pesticides by using enzymatic reactions.

References :

1. Satish, G., Ashokrao, D. M., & Arun, S. K. (2017). Microbial degradation of pesticide: a review. *African journal of microbiology research*, *11*(24), 992-1012.
2. Huang, Y., Xiao, L., Li, F., Xiao, M., Lin, D., Long, X., & Wu, Z. (2018). Microbial degradation of pesticide residues and an emphasis on the degradation of cypermethrin and 3-phenoxy benzoic acid: a review. *Molecules*, *23*(9), 2313.
3. Ortiz-Hernández, M. L., Sánchez-Salinas, E., Dantán-González, E., & Castrejón-Godínez, M. L. (2013). Pesticide biodegradation: mechanisms, genetics and strategies to enhance the process. *Biodegradation-life of science*, *10*, 251-287.
4. Zhang, W., Jiang, F., & Ou, J. (2011). Global pesticide consumption and pollution: with China as a focus. *Proceedings of the international academy of ecology and environmental sciences*, *1*(2), 125.
5. Umadevi, S., Ayyasamy, P. M., & Rajakumar, S. (2017). Biological perspective and role of bacteria in pesticide degradation. *Bioremediation and Sustainable Technologies for Cleaner Environment*, 3-12.
6. Niti, C., Sunita, S., Kamlesh, K., & Rakesh, K. (2013). Bioremediation: An emerging technology for remediation of pesticides. *Research Journal of Chemistry and Environment*, *17*, 4.
7. Wang, X., Sial, M. U., Bashir, M. A., Bilal, M., Raza, Q. U. A., Ali Raza, H. M., ... & Geng, Y. (2022). Pesticides
8. xenobiotics in soil ecosystem and their remediation approaches. *Sustainability*, *14*(6), 3353.
9. Hasan, S. A., Ferreira, M. I. M., Koetsier, M. J., Arif, M. I., & Janssen, D. B. (2011). Complete biodegradation of 4-fluorocinnamic acid by a consortium comprising Arthrobacter sp. strain G1 and Ralstonia sp. strain H1. *Applied and environmental microbiology*, *77*(2), 572-579.
10. Revitt, D. M., Ellis, J. B., & Llewellyn, N. R. (1999). Herbicide behaviour in the runoff from an urban catchment. In *Proc. the Eighth International Conference on Urban Storm Drainage*.
11. Ye, X., Dong, F., & Lei, X. (2018). Microbial resources and ecology-microbial degradation of pesticides. *Natural Resources Conservation and Research*, *1*.
12. Carvalho, F. P. (2017). Pesticides, environment, and food safety. *Food and energy security*, *6*(2), 48-60.
13. Binetti, R., Costamagna, F. M., & Marcello, I. (2008). Exponential growth of new chemicals and evolution of information relevant to risk control. *Annali-Istituto Superiore di Sanità*, *44*(1), 13.
14. Gupta, P. K. (2004). Pesticide exposure—Indian scene. *Toxicology*, *198*(1-3), 83-90.
15. Uqab, B., Mudasir, S., & Nazir, R. (2016). Review on bioremediation of pesticides. *J Bioremediat Biodegrad*, *7*(343), 2.
16. FAO (2010) (Food and Agriculture Organization of The United Nations) (http://faostat.fao.org/site/424/default.aspx#anco r
17. Verma, J. P., Jaiswal, D. K., & Sagar, R. (2014). Pesticide relevance and their microbial degradation: a-state-of-art. *Reviews in Environmental Science and Bio/Technology*, *13*, 429-466.
18. Subash, S. P., Chand, P., Pavithra, S., Balaji, S. J., & Pal, S. (2017). Pesticide use in Indian agriculture: trends, market structure and policy issues.

19. Subash, S. P., Chand, P., Pavithra, S., Balaji, S. J., & Pal, S. (2017). Pesticide use in Indian agriculture: trends, market structure and policy issues.
20. Devi, P. I., Thomas, J., & Raju, R. K. (2017). Pesticide consumption in India: A spatiotemporal analysis §. *Agricultural Economics Research Review*, *30*(1), 163-172.
21. Akashe, M. M., Pawade, U. V., & Nikam, A. V. www. ijrap. net.
22. Randika, J. L. P. C., Bandara, P. K. G. S. S., Soysa, H. S. M., Ruwandeepika, H. A. D., & Gunatilake, S. K. (2022). Bioremediation of Pesticide-contaminated Soil: A Review on Indispensable Role of Soil Bacteria. *Journal of Agricultural Sciences (Sri Lanka)*, *17*(1).
23. Anjum, R., Rahman, M., Masood, F., & Malik, A. (2012). Bioremediation of pesticides from soil and wastewater. *Environmental protection strategies for sustainable development*, 295-328.
24. Liu, Y., Mo, R., Tang, F., Fu, Y., & Guo, Y. (2015). Influence of different formulations on chlorpyrifos behavior and risk assessment in bamboo forest of China. *Environmental Science and Pollution Research*, *22*, 20245-20254.
25. Tudi, M., Daniel Ruan, H., Wang, L., Lyu, J., Sadler, R., Connell, D., ... & Phung, D. T. (2021). Agriculture development, pesticide application and its impact on the environment. *International journal of environmental research and public health*, *18*(3), 1112.
26. Bourguet, D., & Guillemaud, T. (2016). The hidden and external costs of pesticide use. *Sustainable Agriculture Reviews: Volume 19*, 35-120.
27. Elango, K., & Rao, K. S. (2020). Sudhanshu Bala Nayak1, Alok Kumar Sahoo2.
28. Kaur, R., Mavi, G. K., Raghav, S., & Khan, I. (2019). Pesticides classification and its impact on environment. *Int. J. Curr. Microbiol. Appl. Sci*, *8*(3), 1889-1897.
29. Bhatt, P., Bhatt, K., Sharma, A., Zhang, W., Mishra, S., & Chen, S. (2021). Biotechnological basis of microbial consortia for the removal of pesticides from the environment. *Critical Reviews in Biotechnology*, *41*(3), 317-338.
30. Sur, S., & Sathiavelu, M. (2022). A concise overview on pesticide detection and degradation strategies. *Environmental Pollutants and Bioavailability*, *34*(1), 112-126.
31. Shakrawar, M., Naberia, S., & Pande, A. K. (2018). Indigenous technical knowledge for pest, disease and weed management in agriculture. *Int J Chem Stud*, *6*(4), 497-498.
32. Pimentel, D. (2005). Environmental and economic costs of the application of pesticides primarily in the United States. *Environment, development and sustainability*, *7*, 229-252.
33. World Health Organization. (2011). *The use of DDT in malaria vector control: WHO position statement* (No. WHO/HTM/GMP/2011). World Health Organization.
34. Hassen, W., Cherif, H., Souissi, Y., Raddedi, N., Neifar, M., & Cherif, A. (2020). Rhizobacteria and their metabolites as a promising green approach for the treatment of pesticide contaminated agricultural soils. *MOJ Ecol. Environ. Sci*, *5*, 244-254.
35. Maurya, P. K., & Malik, D. S. (2016). Bioaccumulation of xenobiotics compound of pesticides in riverine system and its control technique: a critical review. *J. Ind. Pollut. Control*, *32*(2), 580-594.
36. Eqani, S. A. M. A. S., Malik, R. N., Cincinelli, A., Zhang, G., Mohammad, A., Qadir, A., ... & Katsoyiannis, A. (2013). Uptake of organochlorine pesticides (OCPs) and polychlorinated biphenyls (PCBs) by river water fish: the case of River Chenab. *Science of the Total Environment*, *450*, 83-91.
37. Mrema, E. J., Rubino, F. M., & Colosio, C. (2013). Obsolete pesticides–a threat to environment, biodiversity and human health. In *Environmental security assessment and management of obsolete pesticides in Southeast Europe* (pp. 1-21). Springer Netherlands.
38. Mahmood, I., Imadi, S. R., Shazadi, K., Gul, A., & Hakeem, K. R. (2016). Effects of pesticides on

environment. *Plant, soil and microbes: volume 1: implications in crop science*, 253-269.

39. Scholz, N. L., Fleishman, E., Brown, L., Werner, I., Johnson, M. L., Brooks, M. L., ... & Schlenk, D. (2012). A perspective on modern pesticides, pelagic fish declines, and unknown ecological resilience in highly managed ecosystems. *Bioscience*, *62*(4), 428-434.

40. Pilling, E. D., & Jepson, P. C. (1993). Synergism between EBI fungicides and a pyrethroid insecticide in the honeybee (Apis mellifera). *Pesticide Science*, *39*(4), 293-297.

41. Cohen, M. (2007). Environmental toxins and health: the health impact of pesticides. *Australian family physician*, *36*(12).

42. Gavrilescu, M. (2005). Fate of pesticides in the environment and its bioremediation. *Engineering in life sciences*, *5*(6), 497-526.

43. Andreu, V., & Picó, Y. (2004). Determination of pesticides and their degradation products in soil: critical review and comparison of methods. *TrAC Trends in Analytical Chemistry*, *23*(10-11), 772-789.

44. Environmental Occurrence, Toxicity Concerns, and Degradation of Diazinon Using a Microbial System Xiaozhen Wu1,2, Jiayi Li1,2, Zhe Zhou1,2, Ziqiu Lin1,2, Shimei Pang1,2, Pankaj Bhatt1,2, Sandhya Mishra1,2 and Shaohua Chen

45. Mulla, S. I., Hu, A., Sun, Q., Li, J., Suanon, F., Ashfaq, M., & Yu, C. P. (2018). Biodegradation of sulfamethoxazole in bacteria from three different origins. *Journal of environmental management*, *206*, 93-102.

46. Arora, P. K. (2020). Bacilli-mediated degradation of xenobiotic compounds and heavy metals. *Frontiers in Bioengineering and Biotechnology*, *8*, 570307.

47. Sun, Y., Kumar, M., Wang, L., Gupta, J., & Tsang, D. C. (2020). Biotechnology for soil decontamination: opportunity, challenges, and prospects for pesticide biodegradation. *Bio-based materials and biotechnologies for eco-efficient construction*, 261-283.

48. Das, S., & Dash, H. R. (2014). Microbial bioremediation: A potential tool for restoration of contaminated areas. In *Microbial biodegradation and bioremediation* (pp. 1-21). Elsevier.

49. Park, J. H., Feng, Y., Ji, P., Voice, T. C., & Boyd, S. A. (2003). Assessment of bioavailability of soil-sorbed atrazine. *Applied and Environmental Microbiology*, *69*(6), 3288-3298.

50. Finley, S. D., Broadbelt, L. J., & Hatzimanikatis, V. (2010). In silico feasibility of novel biodegradation pathways for 1, 2, 4-trichlorobenzene. *BMC systems biology*, *4*(1), 1-14.

51. Minsheng, Y., & Xin, L. (2004). Biodegrdation and bioremediation of pesticide pollution. *Chinese Journal of Ecology*, *23*(1), 73-77.

52. Bhatt, P., Bhatt, K., Sharma, A., Zhang, W., Mishra, S., & Chen, S. (2021). Biotechnological basis of microbial consortia for the removal of pesticides from the environment. *Critical Reviews in Biotechnology*, *41*(3), 317-338.

53. Dileep Kumar, A. D., & Reddy, D. D. N. (2017). High pesticide use and its Health Implications. *Health Action, August*, *8*.

International Multidisciplinary Research E-Journal Online Available at http://gater.in/
INTERNATIONAL PEER REVIEWED JOURNAL
OF GLOBAL ASSOCIATION FOR TRAINING, EDUCATION & RESEARCH
(GLOBAL CONSORTIUM OF PROFESSIONALS, TRAINERS, ACADEMICIANS & RESEARCHERS)

Evaluation of the current and desirable state of adult education curricula in primary and post-primary education in Iran

Dr.Leila Rezaii

The Manager of the educational complex, Ministry of Education, Tehran, Iran.
Email: rezaii.leli@gmail.com

Abstract :

The purpose is to investigate the current and desirable status of adult education curricula in elementary and post-elementary. This research is mixed type (qualitative and qualitative) and application. The statistical population consisted of 20 people who were curriculum experts. They were selected by snowball sampling. The data collection tools are: survey form, researcher-made questionnaire and interview. Interview data were analyzed by content analysis during three stages of descriptive coding, interpretive coding, and integration through inclusive themes. The results showed the twelve components form the core of the post-elementary curriculum. These components include philosophical foundations, sociological foundations, psychological foundations, political foundations, content, goals, evaluation, teaching and learning strategies, learning time and space, teaching and learning activities, learning materials and resources, and teamwork. The results of this study showed that there is a significant difference between the current situation and the desirable status of adult education curricula in elementary and post-elementary education.

Keywords: Adult education, Curriculum, Primary education, post-elementary education

Introduction:

Adult education system, as the most prominent manifestation of human resources investment, plays an important role in the training and provision of efficient human capital. This system with a significant share of each country's budget can have a decisive role in different economic, cultural and political aspects of society. Today, the role of literacy, knowledge and awareness in the technological, economic and social development of societies is well known. That is why the development of education and the reduction of illiteracy is one of the important indicators of progress. If our primary focus is on human development, growth and excellence, the first step is to equip them with the skills that can best communicate with each other and prepare them for a constructive and effective role in society. Therefore, education and its Infrastructure, literacy is one of the most important tasks. Adult literacy and education as a factor in building these capacities for productive and effective strata of sustainable development is of particular importance.

Adult education is a broad concept that encompasses all formal, informal and casual adult learning activities in a variety of occupational, social, political, economic, cultural, educational, religious, industrial, agricultural and educational contexts. As Ryan (1994) put it: " The realm of adult education is as the breadth as the life".". Adult education is an activity organized to create a learning community through the transfer of up-to-date knowledge and skills to adults so that they can move towards evolution and excellence and participate actively in the social, cultural, political and economic life of their community (Ebrahim Zadeh, 2006). One of the goals of education is to promote the level of general

culture of society which requires the improvement of knowledge and general literacy of the community.

In this way, literacy has been considered as a central axis of general culture development (Fundamental Transformation Document, 2014).

Given that the literacy movement plans include elementary education by the end of elementary school, as well as the specific characteristics of adults, as well as the number of people who graduate annually and who have a high school diploma and are interested in studying in the post-elementary period, this study seeks to investigate the factors affecting the adult education curriculum by describing the quo status, drawing the desirable status of adult education in the elementary and post-elementary education.

Unfortunately, the evidence suggests that many children are enrolled in school each year, but there is growing evidence that a large number of them are connected to the employment and work flow after acquiring primary literacy skills. It means that after a while, these children are joining the low-educated adults, and even thousands of students drop out of school every year, with an uncertain future ahead. To this end, the most important goals and needs of the education system can be to ensure people's self-awareness and effective participation in working life(Lindsay & Johnson, 1990), improvement and attention to the major issues and social developments of the present day and the ability to play an active role in social development, increasing awareness of the relationships between people and their physical and cultural environments and enhancing their desire for environmental remediation and the preservation of nature, public heritage and public property (Robinson, Pant, 2003), the use of mass media, especially radio, television, cinema, the press and the interpretation of various messages that it is presented by the community(Aberge, 2011) , the training of active and knowledgeable workforce whose work reduces the development gap between regions and countries (Jarvius, 1981).In short, can name talent boom, rich Adaptation of knowledge, information and life skills of adults in order to transform their attitudes and behavior in both personal and social aspects (Shafiei, 2012).

In Iran, literacy has been the subject of various programs in the country for many years, and it is the priority of governments of the time despite shortcomings in this area, including inadequate textbooks in introductory Literacy courses (Abedii , Dehaghi, 1370; Haghi, 1991 Kurd Zanganeh, 1993; Lotfi, 1996; Chopani Keshtaii and Bakhshayeshi, 1998; Hafezi, 2000); inapplicability and Inadequacy of Education with Cultural Characteristics (Mahnaei, 2000; Ojaghi and Hashemnejad, 2000; Shah Aliloo and Ghaniimi, 1998) and Problems Related to management of plans, policy making false and multiple bugs in the implementation of programs in this area has not been made significant progress(Ghaffari, 2000).

In recent years, especially since 2011, a wide range of structural and content reforms have begun. Integration of executive management across the country with the integration of the Literacy and Education Movement Organization, restructuring of literacy courses that reached the end of elementary education in the new structure of literacy development (sixth grade), re-authoring of all textbooks in literacy courses, development of root program Kennedy illiteracy, revitalization of the Supreme Council for the Support of Literacy, formation of citizenship literacy level and establishment of a registry database, concluding about 30 agreements with government and non-governmental organizations, designing multiple projects (such as training illiterate family members). , Age group 10-20, education and skills integration plan Computer training foreign nationals, tribal education, training illiterate parents, students, etc.), including measures that to show the growth of literacy rates in the country and to keep pace with changes in the country and the world.

Based on the results, teacher-centered and learner-centered learning activities in all books were based on expected with content and text learning index of all three books and the way they were edited was inactive. The book's shapes and images learning index, familiarity with the life of plants, animals, and so forth were based on expected, and their formulation active, and the book's shapes and images learning index was less than expected for facts about life and its editing method was inactive. Mir Hosseini (2008) also conducted a study entitled "Content Analysis of Non-literate Books of Literacy Movement Learners, which showed that in literacy books, life skills needs (to say" no", interpersonal trust, self-esteem, social connection and anger control), Spiritual education, proper occupational education, sport education, continuing education, healthy nutrition education, and health education have not been addressed and awareness of sexuality has not been addressed. Therefore, in compiling literacy textbooks the needs of this group of learners should be addressed Horner (2008) examines the impact of teaching methods on the andragogy approach in the context of the academic environment, and the researcher states that the andragogy approach in the context of higher education context isn't ideal and he designed quasi-experimental research with andragogy approach in the context of the university's foundation.

Perrin (2009) has examined the content validity of andragogy and whether it actually reflects the learning characteristics of adults. Learners return to education to earn their future money and jobs, and are interested in anagogical strategies in the classroom such as self-leadership, skill building, and choice of training, tailored to their needs.

Also, there are great deal of emphasizes in high-level documents on the importance of the higher education system and its role in the cultural promotion of the country including: according to Article 30 of the Constitution of the Islamic Republic of Iran: "the government is obliged to provide free education to all people by the end of high school and expand the means of higher education to the extent of self-sufficiency for free."

Also, according to the twenty-year vision document which is one of the most important documents after the constitution, the characteristics of the Iranian society have been seen in the horizon of this landscape in 1404, that is emphasized on the development of culture, education and research.

According to this perspective, in the Fourth Development Plan, in the area of eradication of illiteracy, was designed to achieve literacy of persons under at least thirty years until the end of the Fourth Development Plan, and subsequently in the Fifth Development Plan, Completion of the Fifth Five Year Development Plan will achieve full literacy of the 10–49-year-old group. Dispersal in the adult education curriculum, lack of a coherent and integrated system for identifying, accepting and recruiting illiterate adults, inadequate text and curriculum content, inadequate educational facilities and facilities, inappropriate curriculum and taste ،activities and process of education, outputs and in addition to the above problems, the lack of accurate statistics and information from illiterate adults has made literacy difficult to control.

Another important issue in this area is the illiterate and illiterate reluctance to complete and complete literacy courses. The main problem of the target community itself is the illiterate person, who are not required to attend literacy programs and do not consider themselves obliged to become literate during the government effort and investments made for literacy. Another important issue in this area is the illiterate and illiterate reluctance to complete and complete literacy courses. The main problem of the target community itself is the illiterate, who are not required to attend literacy programs and do not consider themselves obliged to become literate during the government effort and investments made for literacy.

Studies show that despite efforts, illiterate entry is not blocked, about 3% of 6-year-olds do not

enter elementary school annually, plus the transition rate from elementary to upper secondary is up to 100%, so There are about 164,000 survivors primary school , about 225,000 in the first secondary and about 592,000 in the second.

The severity of falls in girl's at all three levels of education was higher than boys. Students in rural areas and girls in secondary school are more deprived. The rate of transition from secondary school to secondary school, as well as the percentage of girls out of all secondary school students and the gross enrollment rate, all indicate that girls and rural populations have always been in a poorer position.

The statistics reflect the fact that a significant portion of the country's active and effective population are lacks the knowledge and skills needed to play a role in the country's development and development process within the context of the Islamic-Iranian model of achieving and achieving the goals of the 20-year vision of the country.

The results of comparative studies of the adult education system in other countries show that in most countries the purpose of the adult education system is to prepare people to enter the labor market in order to achieve economic and social goals, to educate good citizens with the capacity to respond to the needs of today, Bridging educational gaps and establishing greater equality and social justice in the field of education is the development of adult personality and the development of membership and participation in society (Shafiei, 2012). Adult education should be based on experimentation and the project, the learners' needs and interests. Adult education should consider the use of communication and technological information in adult education with emphasis on technical and vocational training and flexibility in time and place (Target, 2013). The problem that has arisen for the researcher in this research, given that the researcher has been active in this field for many years and is concerned with addressing and resolving it, how is that the current and desirable status of adult education in primary and secondary education in post-elementary?

The researcher in this research seeks to answer the following questions: 1- What is the quo status of adult education curriculum in the country in primary and post-elementary education? 2- What can be the desirable status of adult education curriculum in the country in the post-elementary?

Research methodology :

The purpose of the present study is descriptive and is practical in terms of purpose. Due to the nature of the problem and the objectives of the study, a mixed method (quantitative and qualitative) and exploratory was used. In order to collect data in the qualitative part of this research, which is the dominant part, documentary research methods were used and then the qualitative part results were used to develop a researcher-made questionnaire to answer the quantitative research question; Data were collected using a researcher-made questionnaire.

The statistical population of this study included: All upstream documents related to adult education and training curriculum such as the Constitution of the country, Basic Education Transformation Document, National Curriculum Document, Comprehensive Scientific Plan of the Country, Vision Document in Horizon 1404, Policies the whole system has been approved by the Supreme Council of the Cultural Revolution and the Supreme Council of Education, the Statute of the Literacy Movement and the Eradication Program.

For analyzing research data, upstream documents, scientific papers, research articles, books, Iranian Internet resources and curriculum reviews of some countries in the field of adult education and related elementary and post-elementary curricula were reviewed. Descriptive statistics (frequency, mean, etc.) and inferential statistics (factor analysis, independent t-test) were used.

Research findings :

Question 1: How is the quo status of adult education curriculum in the country in primary and post-elementary education?

Table 1: Descriptive indicators of research variables (quo status)

Variables	Number	Average	Middle	extent	Standard deviation	Variance	variation range	Minimum	Max
philosophical foundations	۲۵	2.397	2.500	2.500	0.718	0.515	3.750	1.250	5.000
sociological foundations	۲۵	2.499	2.600	3.000	0.697	0.486	3.800	1.200	5.000
psychological foundations	۲۵	3.421	2.500	2.500	0.696	0.484	4.000	1.000	5.000
political foundations	۲۵	2.426	2.333	3.000	0.848	0.719	4.000	1.000	5.000
content	۲۵	2.318	2.333	2.333	0.776	0.603	4.000	1.000	5.000
goals	۲۵	2.410	2.333	3.000	0.860	0.739	4.000	1.000	5.000
evaluation	۲۵	3.471	2.667	3.000	0.847	0.717	4.000	1.000	5.000
teaching and learning strategies	۲۵	2.474	2.667	3.000	0.804	0.647	4.000	1.000	5.000
learning time and space	۲۵	3.440	2.333	3.000	0.830	0.689	4.000	1.000	5.000
teaching and learning activities	۲۵	2.586	3.000	3.000	0.827	0.683	4.000	1.000	5.000
learning materials and resources	۲۵	3.576	3.000	3.000	0.801	0.641	3.333	1.667	5.000
Teamwork	۲۵	۲.٥10	۲.۴33	3.000	0.٨٥	0.7۴9	4.000	1.000	5.000

Table 1 lists the 12 descriptive indicators of the research. As can be seen, the variables of psychological foundations (mean 3.42), evaluation (mean 3.47), learning time and space (mean 3.46) are also learning materials and resources (With a mean of 3.57, they are above the theoretical mean of the research instrument (mean 3). It can be said that among the 12 variables studied, these variables have the closest distance to desirable status. In other variables the calculated average is less than 3, which is not desirable in the adult curriculum.

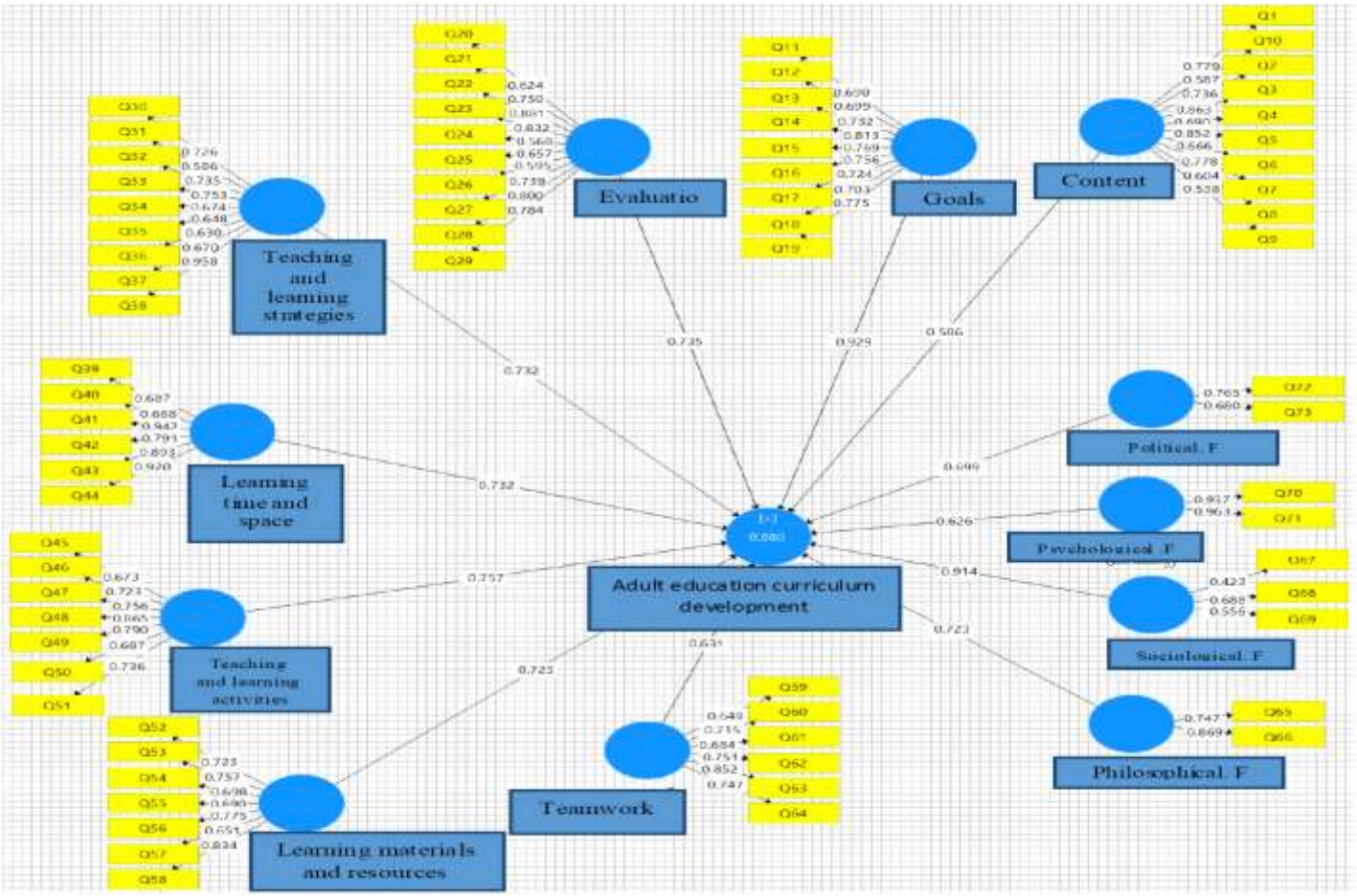
Question 2: How can be the desirable status of adult education curriculum in post-elementary?

Table 2: Descriptive indices of research variables (desirable status)

Variables	Number	Average	Middle	extent	Standard deviation	Variance	variation range	Minimum	Max
philosophical foundations	۲۵	3.293	3.286	3.143	0.624	0.390	3.857	1.143	5.000
sociological foundations	۲۵	3.457	3.667	4.000	0.719	0.518	4.000	1.000	5.000
psychological foundations	۲۵	3.430	3.600	3.600	0.698	0.487	3.800	1.200	5.000
political foundations	۲۵	3.514	3.714	4.000	0.666	0.443	3.286	1.571	4.857
content	۲۵	3.417	3.333	4.000	0.758	0.575	4.000	1.000	5.000
goals	۲۵	3.460	3.333	4.000	0.803	0.645	4.000	1.000	5.000
evaluation	۲۵	3.484	4.000	4.000	0.836	0.700	4.000	1.000	5.000
teaching and learning strategies	۲۵	3.431	3.667	4.000	0.859	0.738	4.000	1.000	5.000
learning time andspace	۲۵	3.577	3.833	4.000	0.735	0.540	3.833	1.167	5.000
teaching and learning activities	۲۵	3.569	3.636	4.000	0.582	0.338	3.000	1.727	4.727
learning materials and resources	۲۵	3.422	3.480	3.480	0.521	0.272	2.760	2.000	4.760
Teamwork	25	3.۵60	3.۴33	4.000	0.۸۱3	0.6۵5	4.000	1.000	5.000

It is clear in Table 2; the correct answer to all the research questions is compiled. Also the mean of all variables is above the mean of 3. Moderate and fashion show that most respondents chose options 3 and 4. Each research question was analyzed separately using the partial least squares technique. Finally, the overall model of the research was tested using the same technique. Based on this table, the desirable status of the research variables is presented. According to the calculations, the average of all the variables calculated has increased. This evaluation indicates that experts need to revise and upgrade the components of the desirable adult curriculum component.

Figure 1 : External partial least squares diagram (measurement model)



Based on the results of the measurement model shown in Fig. (1), the observed factor load has a magnitude greater than 0.3 in all cases, indicating that there is a good correlation between the observable variables and their hidden variables. Therefore, it can be concluded that each of the main variables has been correctly measured and the results of this scale can be tested with research hypotheses.

International Multidisciplinary Research E-Journal Online Available at http://gater.in/
INTERNATIONAL PEER REVIEWED JOURNAL
OF GLOBAL ASSOCIATION FOR TRAINING, EDUCATION & RESEARCH
(GLOBAL CONSORTIUM OF PROFESSIONALS, TRAINERS, ACADEMICIANS & RESEARCHERS)

Table 3: Convergent validity and reliability of research variables

	Cronbach's alpha	AVE	CR
philosophical foundations	0.793	0.549	0.844
sociological foundations	0.826	0.631	0.897
psychological foundations	0.784	0.706	0.836
political foundations	0.847	0.598	0.877
content	0.806	0.631	0.849
goals	0.781	0.592	0.799
evaluation	0.852	0.648	0.854
teaching and learning strategies	0.744	0.573	0.782
learning time and space	0.843	0.581	0.899
teaching and learning activities	0.795	0.632	0.808
learning materials and resources	0.817	0.601	0.864
Teamwork	0.785	0.623	0.884

Cronbach's alpha for all variables was greater than 0.6 so all variables were validated. The mean value of the variance extracted (AVE) is always greater than 0.5, so convergent validity is also confirmed. The composite validity (CR) value is also greater than the AVE.

Testing research variables in the quo status

Figure 2: Graphic partial least squares graph of general research model (status quo)

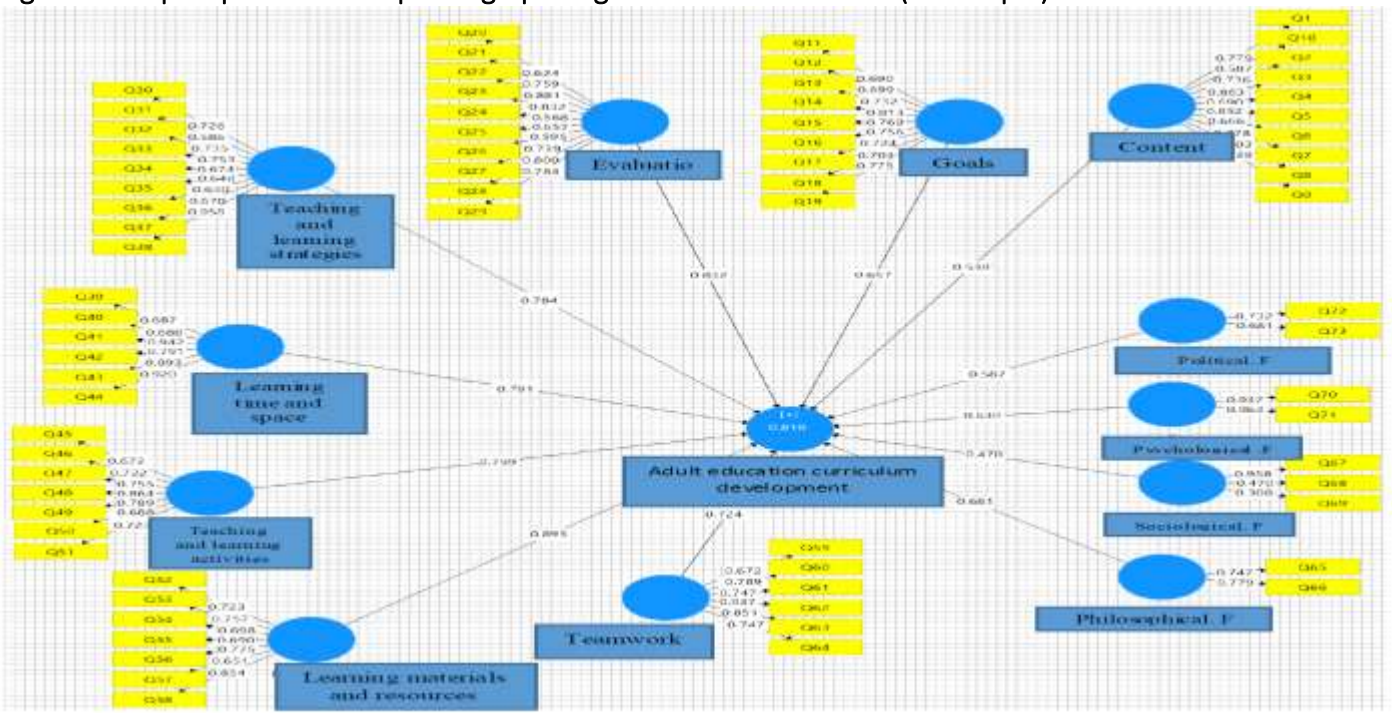


Figure 3: T-value statistic diagram of general research model with Bootstrapping technique (status quo)

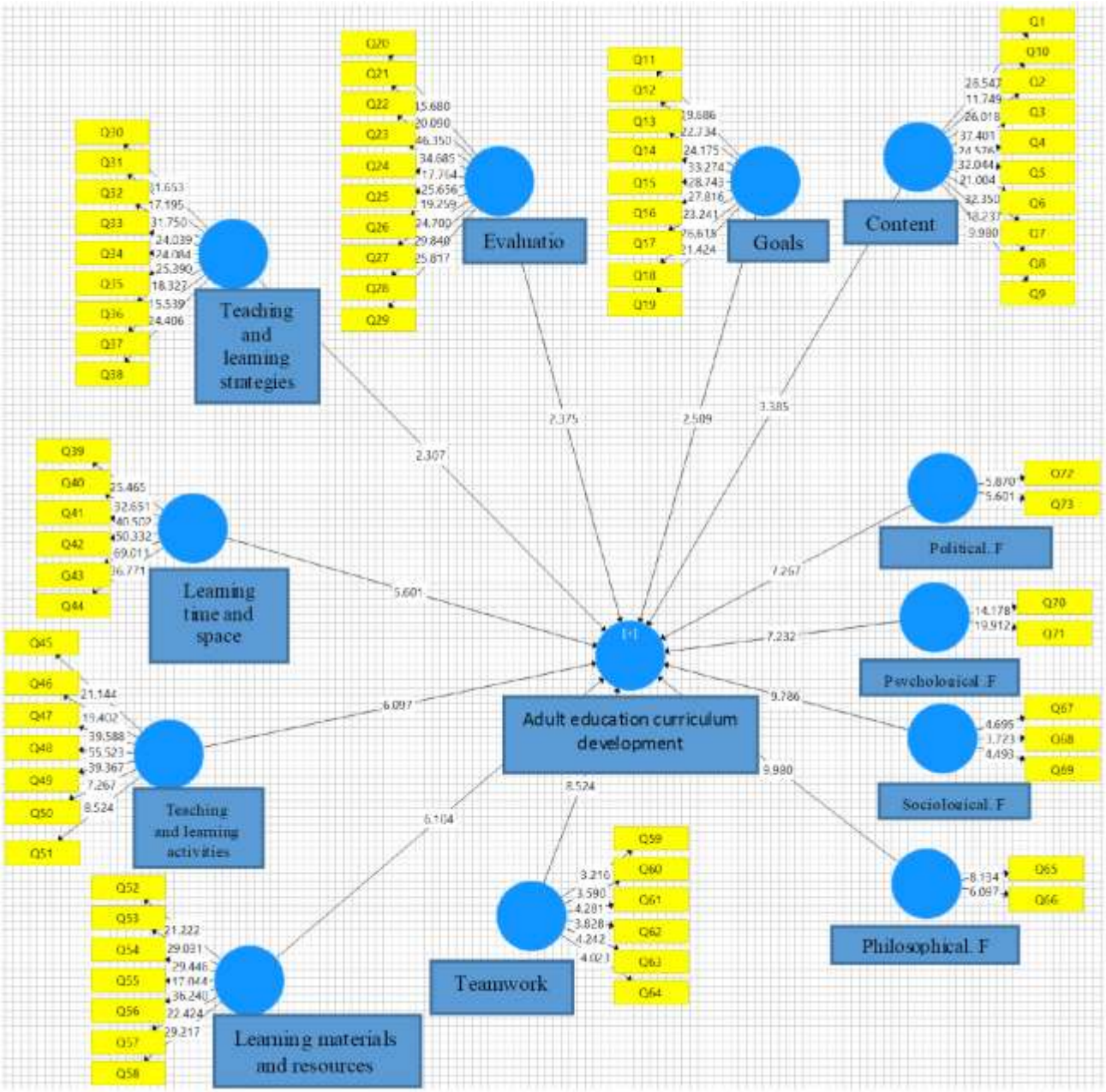


Table 4: Status of research variables (status quo)

Variables	Factor load	T statistics	Rating
philosophical foundations	۰/۶۸۱	۹/۹۸۰	۷
sociological foundations	۰/۴۷۰	۹/۸۷۶	۱۲
psychological foundations	۰/۶۳۰	۷/۲۳۲	۹
political foundations	۰/۵۸۷	۷/۲۶۷	۱۰
content	۰/۵۳۸	۳/۳۸۵	۱۱
goals	۰/۶۵۷	۲/۵۰۹	۸
evaluation	۰/۸۳۲	۲/۳۷۵	۲
teaching and learning strategies	۰/۷۸۴	5.867	۴
learning time and space	۰/۷۹۱	3.621	۳
teaching and learning activities	۰/۷۵۹	4.950	۵
learning materials and resources	۰/۸۹۳	۶/۱۰۴	۱
Teamwork	۰/۷۲۴	۸/۵۲۴	۶

Testing research variables in desirable condition

The relationship of the variables studied in the research is tested based on a causal structure with PLS partial least squares technique. In the general research model depicted in Figure 4-11, the measurement model (relationship of each of the variables visible to the hidden variable) and the path model (relationship of the hidden variables to each other) are calculated. To evaluate the significance of the relationships, the t-statistic was calculated using the bootstrapping technique presented in 4-12. In this model, which is the output of the Smart PLS software, we summarize the results of the standard factor loadings of the research variables relationships. Testing the research hypotheses based on the relationships of each variable is also presented separately.

Figure 4: Partial least squares technique diagram of general research model (desirable status)

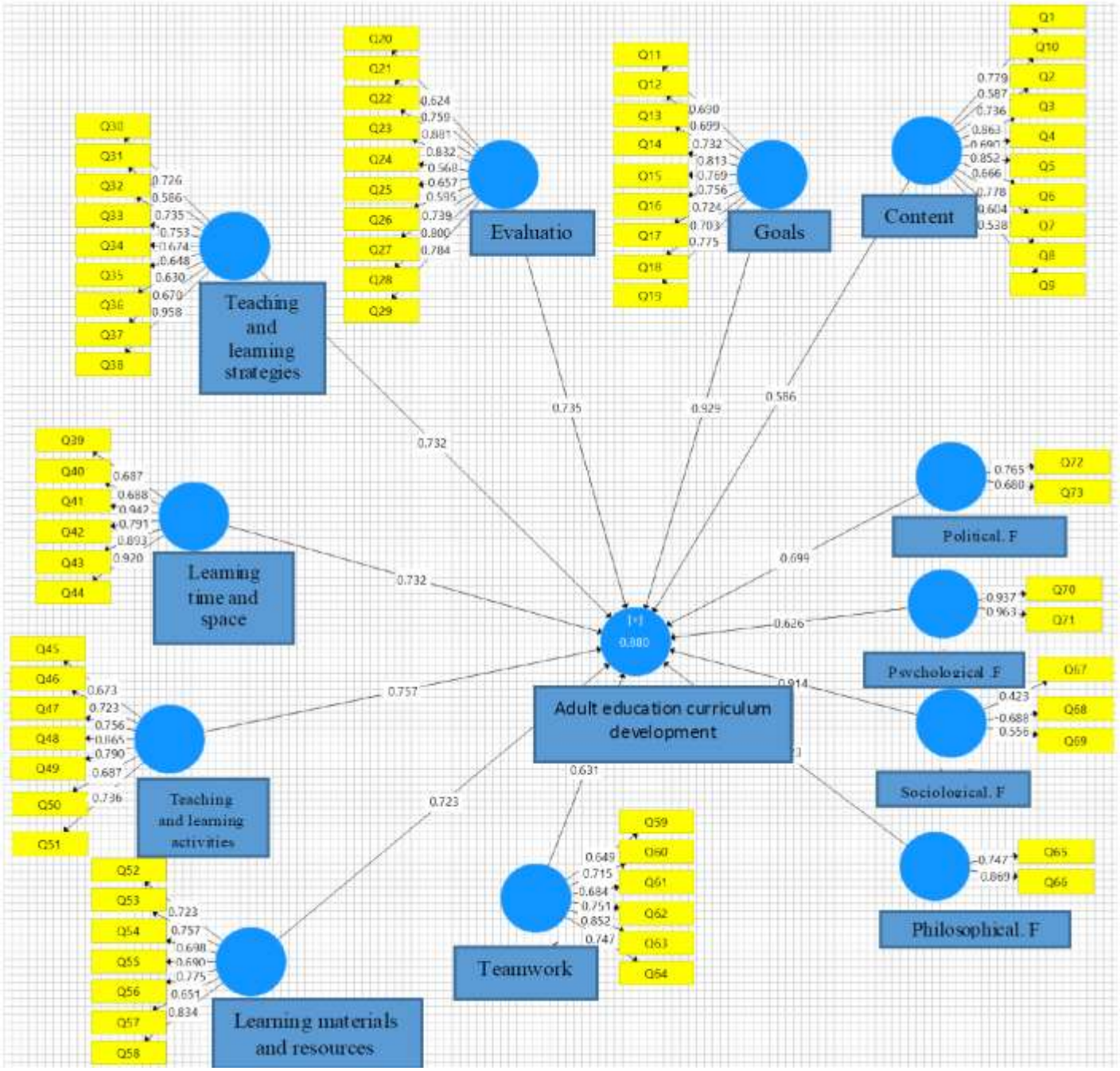


Figure 5: T-value statistic diagram of general research model with bootstrapping technique (desirable status)

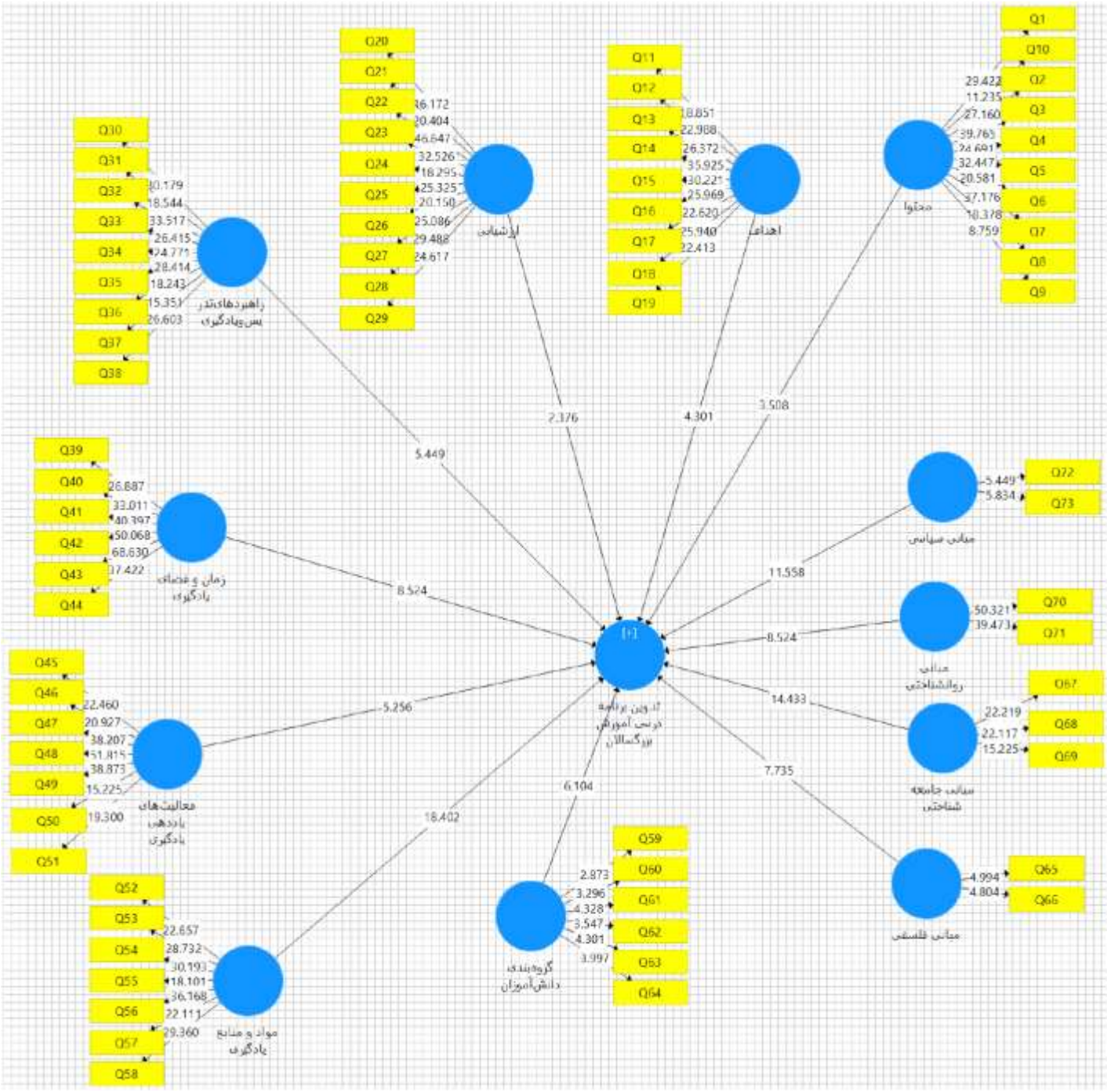


Table 5: Independent t-test for estimating the difference between the current and desirable situation.

Significance of mean difference		Assume variance equality		Average difference	Average	Condition	Researchvariable
Significance	T	Significance	F				
0.003	3.416-	0.002	6.31	0.929	3.011	quo status	Adult Curriculum Design in Post- elementary
0.004	3.228-				3.940	Desirable status	

In the post-elementary adult education curriculum design variable, the value is significantly smaller than the error level, f = 6.319 and 0.002 significant because the variance of the quo status and the quo status are heterogeneous, we use the second line because t equals 228 / 3 and significance is 4../, so the difference of experts' viewpoints in designing adult education curriculum in post-elementary school is better than the quo status. This difference indicates there is a difference in the status of the program implementation compared to the quo status.

Discussion and conclusion

From the experts' point of view, all the twelve components of the adult education curriculum, including philosophical, psychological, content, objectives and has not acceptable situation. The findings of Ebrahimzadeh and Mohammad Davoodi's research (2009) also showed that the main components of adult education in the country include technology, course management, coaching skills, educational space design, learning approaches and educational planning, goals, evaluation system, educational content, the principles, methods, roles, and competencies are not at the desired level. Dehghani (2015) also showed that the cognitive and attitudinal goals of the five-year literacy movement have been achieved at a relatively desirable level. And the content of the curriculum in different dimensions was not desirable. In explaining this finding, it can be stated that the goals of adult education curriculum in post-elementary education are probably not based on the educational needs of adults with entrepreneurial, process-oriented and research-oriented approaches. As mentioned, the conceptual scope of adult education goals is varied and varied due to the immense needs of adults in the psychological, economic, religious, political, cultural, and other fields.... Therefore, one of the major causes of undesirability of the goals of the adult curriculum in the post-elementary is the neglect of the social, cultural, economic, and design goals.

Kurd Noghani (1998) showed that the most important causes of failure to achieve literacy goals are neglect of social, economic and cultural needs of learners. For example, in designing goals, content, educational strategies, and other elements of the curriculum, less attention is given to housework, women's fertility, women's family business, and child rearing. The research also showed that the quality of adult education programs in educational resources, teaching methods, teaching aids, etc. is low. This has led to the inefficiency of the adult curriculum.

The results of the descriptive statistics showed that from the point of view of experts, twelve components of qualitative findings were identified as the main components of the post-elementary education curriculum. On the other hand, the

demetel method showed that the affective criteria in the curriculum include goals, teaching strategies and content, and the influential components consisting of teaching activities - learning, learning time and space, cardio, evaluation, learning materials and resources. This finding is in line with the results of Ebrahimzadeh and Mohammad Davoodi (2009). Ebrahimzadeh and Mohammad Davoodi (2009) also showed that the main components of adult education showed that technology components, course management, coaching skills, educational space design, learning approaches and educational planning on goals, evaluation system, educational content, principles and methods, roles, and competencies are effective.In explaining this research finding, it can be stated that the nature of goals is influential on the type of content, learning environment and learning strategies, and so on ،because of knowledge and procedural goals require linear and mechanical content. An instructional strategy tailored to these goals is also an explanatory and lecture-based teaching method. In contrast, goals related to the development of learners' creativity and critical thinking are achieved through indirect teaching strategies such as induction, problem solving, and so on. Therefore, , the content structure and consequently educational strategies, learning resources and evaluation were form based on the nature of the educational goals. In the present study, one of the experts also found direct training strategies appropriate to convey structured content with predetermined and linear goals. Indirect training is useful for fostering creative and critical thinking. Of course, in his view, the usefulness of both approaches depends on mastery, tip-making, the appeal of the word, and the ability to motivate and guide coaches. According to one expert, designing time and space for education also depends on the nature of the goals and the quality of the educational content. This means that sometimes it is not possible for adults to teach one subject at a time and there is no proper training environment for such activities. Thus interacting with real and virtual social and political environments can replace the classroom teaching environment. Or, when the adult curriculum is aimed at social education, active citizenship, social responsibility, or enhancing learners' critical thinking, educational strategies are also shaped by interactive and participatory learning Knowles introduces the adult self-directed learning model as instructional strategies influenced by learners' content and individual differences. Based on this model, situational teaching means that different instructional strategies are used with regard to the goals, content, readiness, ability and motivation of learners. In this regard, trainers play various roles from transmitter and facilitator to inclusive self-direction with regard to the content and characteristics of learners (Yarmohammadian, 2010). Based on the qualitative findings of this study, the choice of training space and time are influenced by factors such as educational goals, content and strategies. This impact can be explained by the proportionality feature. For example, the appropriateness of the number of learners with teaching methods, learning environments, teaching aids, and evaluation methods should be considered. Participatory approaches such as group discussion, seminars, conferences, journal clubs, brainstorming, etc. require a limited number of participants. Or it is important to teach skills and hands-on activities to balance the learning environment with the number of learners. Teamworking as a component of the curriculum, should also be influenced by content goals, content, and instructional strategies such as activity-centered, heterogeneous be proportionate, ethical and inclusive (Mohammadi, Marzoughi, 2016).

Knowles's (1998) theory study is another reason for the interplay of elements of adult education curriculum including philosophical, psychological, political, sociological, goals, content, educational strategies, learning resources. Because Knowles's theory also considers the most important factor in determining the goals of adult education with regard to adult characteristics. The features of this theory

include: adult self-sufficiency and self-healing, adult experience in various social roles, adult intentions and desires for learning, and learning to meet immediate needs. Adults have independent self-concept and self-direction. So they have valuable experiences, they can share in learning. Thus, there is an intrinsic relationship between psychological foundations, educational goals and strategies, and learning resources. Learning strategies derived from educational foundations can consist of helping learners to express their expectations, identify their needs, identify problems, and facilitate material conditions conducive to interactive and participatory learning and learning. Abdullah (2008) also introduces the most important factor in the adult education curriculum in the self-directed learning model to fit goals, content with educational needs. He puts forward the underlying hypothesis of a self-guided learning model; if the curriculum is tailored to learners' abilities, needs, and motivations, it leads the learner to self-directed and effective learning (Ebrahimzadeh and Davoodi, 2009).). In fact, the first thing to consider in relation to the goals of adult education in the learning process is that the goals of adult education should be designed based on the philosophical, sociological, psychological, political, entrepreneurial, process oriented, and research-oriented principles ,learners' needs, their basic and actual issues in the environment (Shaabani, 2008).

Miziro (1977) considers the application of participatory teaching methods to enhance critical thinking effective in adult learning (Sarmad, 2004, p. 101). The results showed that twelve components constitute the main foundation of adult curriculum in the post-elementary. These components included philosophical foundations, sociological foundations, psychological foundations, political foundations, content, goals, evaluation, teaching and learning strategies, learning time and space, teaching and learning activities, learning materials and resources, and karmic learning. The results of this study suggest:

- developing and designing the goals, content, teaching and learning strategies, evaluation, learning time and space, teaching - learning activities based on philosophical, sociological, political and psychological principles.
- Adapting goals of adult education based on learners' real needs with an entrepreneurial, inclusive, and research-oriented approach.
- Designing objectives in three areas of knowledge, insight and skill.
- Designing the goals according to indigenous values, human values and social norms.
- Organizing and designing content with connectivity, comprehensiveness, fit, interactive, contextual and flexibility features. - Focusing on fostering creative, critical thinking and fostering a research spirit in content design
-Objectives provide and create social, political, responsibility, role-playing, strengthening verbal and non-verbal communication skills, self-direction and decision making.
-Evaluating with a process-based approach in cognitive, emotional, insight, and skill dimensions.
- Integrating direct and indirect teaching strategies according to the nature of the goals, content, and teaching position.
- Using the interactive spaces with two simultaneous and asynchronous in-person and virtual approaches, given the nature of the goals and content
- Using diverse, flexible and resilient learning environments.

References :

1. Aberge, R., Mogstad, M., & Peragine, V. (2011). *Measuring long-term inequality of opportunity*.Journal of Public Economics, 95(3), 193-204.
2. Abedii, Dehaghi, Lotfali (2002*). Review of Literacy Programs Fit to the Needs and Conditions of Literacy Students*, Isfahan, Faculty of Education
3. Abdullah, M. H. (2008). *Adult Participation in Self-Directed Learning Programs.* Internatinal education studies.www.ccsenet.org, journal. Vol 1, no, 3, p 68.

4. Dehghani, Marzieh; Amin Khandaghi, Maghsoud; Jafari Sani, Hossein; Nogani Dukht Bahmani, Mohsen. (2011). *Exploring Conceptual Patterns in the Curriculum Area: A Critique of Studies Conducted by the Pattern Design Approach in the Curriculum, Curriculum*. Research Principles of Education, 136-1999.
5. Ebrahimzadeh, Isa and Mahmoud Davoodi, Amir Hossein (2009). *Investigating the Principal Components of Adult Education to Present an Appropriate Model in Iran*, Journal of Educational Leadership and Management, Islamic Azad University of Garmsar Branch, Third Year, No. 4, and pp. 29-33. - Ebrahimzadeh, Jesus (2006*). Adult Education*. Tehran: Payam Noor Publications.
6. *Fundamental Transformation Document*. (2014). Ministry of Education, Higher Education and Cultural Revolution Council, Tehran.
7. Ghaffari, Saeed (2000). *Adult and Toddler Education*. Tehran: Print.
8. Haghi, Nasser (1992). *Causes of Illiteracy in Basic Literacy Students*, Tehran: Literacy Movement Organization.
9. Hushangi et al. (1990). A Study of the Causes of Academic Deprivation of Students, Tehran: Literacy Movement Organization
10. Jarvius, Peter (2012). *Adult Education and Continuing Education*. Translated by Gholamali Sarmad. Tehran. Side Publications and Fourth Edition.
11. Kurd Zangana, Shahnaz (2005). *Evaluation of the Relevance of Behavioral Goals in Persian Basic Course Book with Learning Levels*, Tehran: Literacy Movement Organization.
12. Kurd Noghani, Razor (1998). *Predictors of Illiteracy Returns to Literacy Graduates*. Journal of Sociology of Education, Successive 1 (1), pp. 70-61.
13. Lotfi, Ahmad (1996). *Investigating the Level of Basic Literacy Students' Reading Skills*, Tehran: The Literacy Movement - Lindsay & Johnson, 1992, *for a more extended.... from whom one initially learned it-Allen* & Jacoby1990.
14. Mahnaei, Seyyed Qasim (2000). *Investigating the Reasons for Fifth Adult Literacy Attendance of Yazd 1999, Kohkiloyeh & Boyer Ahmad Provincial Planning and Literacy Office*, School of Human Resources Training, 78.
15. Meziro, O. K. (2009). *Automotive engineering curriculum development: case study for Clemson University,* Journal of Great Lakes Research, Vol. 28, No. 1, p. 11 - Mir Hosseini, Zohreh and Arjomandnia, Ali Akbar (2008). *Content Analysis of Non-Textbook Students' Literacy Movement in Tehran, Quarterly Journal of Islamic Azad University*, No. 1. - Mohammadi, Mehdi and Marzoukhi, Rahmatollah (2016). *Higher education curriculum based on a lifelong learning approach - a qualitative approach*. Journal of Higher Education Curriculum Studies, Spring & Summer 2016, Volume 7, Number 13. -Mokhabat, Mohammad; Ghodrati, Mehdi and Rezapurlakani, dawn. (2014). *Content Analysis of Learning Indicators in Educational Books of the Literacy Movement Follow-Up Study Groups*. Journal of Modern Educational Thoughts. Volume 9, Number 2. Pages: 109-130. -Mulayi, Behzad (1999). *Investigating the Factors Affecting Adult Sisters' Failure to Attend Literacy Movement From the Perspectives of Sanandaj Teachers*, Planning and Human Resources Training Office, Kurdistan Province. Ojaghi, Ali; Hashemnejad, Alireza (1999). *The Effect of Applied Education on Preventing Academic Dropout of East Azarbaijan Students*, Office of Planning and Human Resources Training of East Azarbaijan Province
16. Perrin, For MemRS (2009). *Sound of evaluation, Sage*, Thousand Davidson, EJ 2005, Evaluation methodology basics: the nuts and bolts of sound evaluation, Sage, Thousand Oaks, California.
17. Robinson, Pant) 2003). *Existing research on adult literacy.* Roeper Review, 25(3), 280-329.

18. Secretariat of Higher Education Council. (2009). *Approvals Collection.*Tehran: School. -Shah Aliloo, Behzad; Ghannimi, Mohammad (1998). *Investigating Barriers to Illiterate Absorption Foundation of West Azerbaijan Literacy Movement in 1997*, Urmia: Literacy Movement of West Azerbaijan Province.
19. Shafiei, Nahid. (2012). *Adult Education Website. Islamic Azad University*, Islamshahr Branch, Second Edition.

-Ryan, J. (2005). *Improving teaching and learning practices for international students*: implications for curriculum, pedagogy and assessment. New York: Routledge.

International Multidisciplinary Research E-Journal Online Available at http://gater.in/
INTERNATIONAL PEER REVIEWED JOURNAL
OF GLOBAL ASSOCIATION FOR TRAINING, EDUCATION & RESEARCH
(GLOBAL CONSORTIUM OF PROFESSIONALS, TRAINERS, ACADEMICIANS & RESEARCHERS)

Pesticide Contamination and Their Possible Effects on Rural Population A case of Kathotiya and Anwali-Kheda settlement –Madhya Pradesh

[1] Manju Yadav, [2] Praveen Yadav
[1] Consultant and Landscape Architect– Tata Consulting Engineers (Bhopal)
[2] Practicing Architect and Urban Planner (Gurgaon)
[1] 8120634084, manjuarck@gmail.com; [2] 09971062444, praveenarck@gmail.com

ABSTRACT:

Though the use of pesticides has offered significant economic benefits by enhancing the production and yield of food and fibres and the prevention of vector-borne diseases, evidence suggests that their use has adversely affected the health of human populations and the environment. Pesticides have been widely distributed and their traces can be detected in all areas of the environment (air, water, and soil). This chapter will explain the current scenario of an Indian village and explore the possibilities of pesticide alternatives. When we see the possible effects of pesticide pollutants, every part of the human body is affected by pesticide pollutants. For example, lead and mercury (the Mad Hatter) affect the brain; arsenic, the skin; carbon monoxide, the heart; and fluoride, the bones. Vector-borne diseases are among the major causes of illness and death in the WHO South-East Asia Region. Vector control plays a key role in the prevention and control of major vector-borne diseases such as malaria, dengue, leishmaniasis, and chikungunya, and often constitutes the first line of activity in case of epidemics. Chemical control (use of pesticides) is still the most important element in the integrated approach to vector control. In the village, there were frequent cases of malaria, eye infection, urine infection, chicken pox, Typhoid, and Dengue in most of the families living there. There is a strong and urgent need for developing methodologies to assess the effects of pesticides in a consistent way for agricultural practices. This paper describes a life cycle assessment method to determine the impact of pesticides on human health and ecosystems of the study area. The approach considers a full-fate analysis and the exposure to toxic pollutants in the forest village of Kathotiya- Madhya Pradesh.

THE GENESIS :

Since the 1940s, chemical pesticides of one form or another have become a dominant and essential form of pest control throughout the world. Thousands of different commercial pesticides were available in the market. DDT (dichlorobiphenyls-trichloroethane) was first synthesized in 1877 but did not come into use as a pesticide until 1942.

In India, The Annual Health Survey (AHS) was conceived during a meeting of the National Commission of Population held in 2005 under the Chairmanship of the Prime Minister wherein it was decided that "there should be an Annual Health Survey of all districts which could be published/monitored and compared against benchmarks". The objective was to monitor the performance and outcome of various health interventions of the Government

including those under National Rural Health Mission (NRHM) at closer intervals through these benchmark indicators. The AHS has been made an integral part of the NRHM, Ministry of Health & Family Welfare. these benchmark indicators. The AHS has been made an integral part of the NRHM, Ministry of Health & Family Welfare.

1.1.2 Government *Regulations in Pesticide Application*

The government has enforced limits on the sales and use of pesticides (Table 25.16). Usually, Quality control of pesticides must be ensured through a

rigorous procedure requiring testing as per different climatic conditions and other important geographical factors and data analysis. The usage of pesticides in farming is being regulated under 'The Insecticides Act, of 1968' and the rules are framed there to firmly crosscheck the availability of quality and safe pesticide products to the farming community, comprehensive regulations to ensure that no part of the pesticide industry operate outside its watchful eye.

India also has a BIS standard (Bureau of Indian Standards) for pesticide application equipment. Still, the implementation of legislation and standards needs to be carefully examined and strengthened by the responsible agencies to prevent misuse.

Table 25.16: Major Pesticide Control Legislations in India

Sl. No.	Legislation	Regulatory body
1.	Insecticides Act, 1968 and the Insecticides Rules, 1971	Ministry of Agriculture Department of Agriculture & Cooperation
2.	Environment Protection Act, 1986	Ministry of Environment & Forest
3.	Prevention of Food Adulteration Act, 1954	Ministry of Health & Family Welfare

Any disputes in the results of the analysis are settled by a referral laboratory of the Central Government, called the Central Insecticides Laboratory (CIL). Besides, State Governments also established their own Pesticides Testing Laboratories with their available resources in different areas.

2 ROLE OF EXCESS USAGE OF PESTICIDE IN AGRICULTURE

2.1.1 Fertilizers are generally added to agricultural lands to increase productivity, but excessive and repeated use of same will pollutes the fertile soils. For example, when ammonium sulphate is used repeatedly as fertilizers some part of is used up by crops only remaining get accumulated in the soil. Being acidic in nature, it makes the same soil acidic too. This acidic soil is responsible for creating wasteland. Also, it promoted the excessive growth of weeds.

Table 25.12: Pesticides commonly used in India

	Pesticide: common name	Chemical family
Ia.	Extremely hazardous*	
	1. Phorate	Organophosphate
Ib.	Highly hazardous*	
	2. Monocrotophos	Organophosphate
	3. Profenofos & Cypermethrin	Combination pesticide
	4. Carbofuran	Carbamate
II.	Moderately hazardous*	
	5. Dimethoate	Organophosphate
	6. Quinalphos	Organophosphate
	7. Endosulphan	Organochlorine
	8. Carbaryl	Carbamate
	9. Chlorpyrifos	Organophosphate
	10. Cyhalothrin	Pyrethroid
	11. Fenthion	Organophosphate
	12. DDT	Organochlorine
	13. Lindane	Organochlorine
III.	Slightly hazardous*	
	14. Malathion	
IV.	Unlikely to present acute hazard in normal use*	
	15. Carbendazim	Carbamate
	16. Atrazine	Triazine

*WHO classification [54]

2.1.2. Issue of Salination in the Soil

When we talk about improving the yields of crops using fertilizers, it will depend on agricultural fields that would be well irrigated. If there is no outlet for unused water, then salts would get accumulated in the soil and make that soil highly saline. Saline soil is not appropriate for any kind of agriculture fields. It can further create wasteland and reclamation of saline soil will require removal of sodium and calcium.

2.1.3 Issue of Water pollution and their harmful effects Water Act 1988

Water pollutions is caused by many types of pollutants. The most harmful are chemical and biological agents. Agrochemicals like fertilizers, pesticides etc they find their ways to nearest water body and natural water reservoir and can further mix into public drinking water supply system. It become hazardous to human health. These Pesticides which are used to kill harmful pests in agriculture fields, when mixed with the rainwater they find their way into water body and leached the ground water as well. These pesticides damage the central nervous system and kidneys. Nitrates are used as fertilizers. They get mixed in water supply and intake of excess nitrate through water and food reduces the oxygen

International Multidisciplinary Research E-Journal Online Available at http://gater.in/
INTERNATIONAL PEER REVIEWED JOURNAL
OF GLOBAL ASSOCIATION FOR TRAINING, EDUCATION & RESEARCH
(GLOBAL CONSORTIUM OF PROFESSIONALS, TRAINERS, ACADEMICIANS & RESEARCHERS)

carrying capacity of blood and damages the lungs.

3 CASE STUDY:

3.1.1 A case study on forest village –Madhya Pradesh

Kathotiya Region was chosen as a study area due to its diversity in physiographic features and the probability of finding richness in flora and fauna in that region is high. This village topography of the village is such that we see a specific pattern of agriculture and settlement. To study its landscape and various patterns formed by natural and man-made processes- different aspects such as spatial and temporal patterns of climate, landform patterns, hydrological patterns, vegetation, and ecological patterns as well as agriculture and settlement patterns were looked upon.

Fig. 1Fig.2

Fig 1&2- Map showing village Kathotiya

During the visit it was found that village community comprised of large number of tribal people of Bhil tribe and the area of their fields were quite small, irregular in shape and comprised of mixed farming. From the survey conducted in the village, the information recorded showed that most of the population used pesticides in their fields, but not aware of the contents of the pesticides and its impacts on their family members. This also reflects that using pesticide or herbicides in their fields is not a conscious choice but an outcome of lack of awareness in farming practice and poor economic status. The crops mainly grown are Maize, Wheat, and Soya bean. The stream flowing through the village is the major source of irrigation and sometimes used by tribal people as a source of drinking water.

Primary purposes of the villagers for harvesting practices in early farming systems was to remove as much plant residue from the field as possible so that pests had no food source to sustain them. Pesticide was also incorporated into the soil through tillage as mechanical methods of pest control were minimized or eliminated, chemical methods of pest control began to assume a key role in the management of unwanted organisms. Pesticides are toxic by natures so it is a natural concern that impact of their presence on the environment and human health will be negative.

3.1.2 *Study Area- Kathotiya and Anwali Khedavillage – Bhopal (Madhya Pradesh)*

Houses (Anwali kheda) are set up in the fields for the protection of crops. The populace, mainly consisting of bhils are scattered, as living on the farm is tradition. At the same time, it is also a generalized notion that bhils help each other during sowing and harvesting and even lend livestock during tending of fields.

While the locals practice agriculture foe self-sustenance, the revenue generating factors comes from the presence of prehistoric caves and a hiking camp.

Fig3&4

Fig 3 &4 – Images of village Kathotiya

Fig 5 &6

Fig 5&6 – Map showing houses in the fields of Anwali kheda

3.1.3 Comparative analysis of Kathotiya and Anwali kheda

Anwali Kheda

Multicrop Farming -the agriculture practice in Anwali kheda is found to be domintated by khari crop. Due to dry climate main crops are Soyabean, Maize and Wheat

Intensive farming – intensive farming uses large amount of labor and resources by applying fertilizers, pesticides, and irrigation system to achieve profitability.

Rectangular farming – Two main lanes intersect each other at right angles at centre. Rectangular settlements are developed over flat, fertile, alluvial plains and wide valleys

Clustered Settlements- A rural settlement where several families live in a close proximity to each other, with fields surrounding the farms houses.

Kathotiya Village

Ranching – Ranching is the practice of grazing animals (fig4) on public lands and may also include raising livestock on public land.

Dispersed Settlements – A rural settlement which has farmers living on individual farms isolated from neighbours rather than alongside other farmers.

Mixed Farming – Here villagers use mixed farming where two or three crops are grown with rotational system.

3.1.4 Following Insecticides are used for soya bean crop in Kathotiya Village

a) Chlorpyriphos 20%
b) Triamiphos 40%
c) Emamectin benzoate 5%
a) For Regular use
b) For precaution
c) For extreme cases

4 CONCLUSIONS AND ALTERNATIVE MEASURES

Based on a review of research papers and case studies it can be concluded that pesticides and insecticides are some of the major contributors to the degrading health of people which makes them more vulnerable to life-threatening deceases. Excessive and indiscriminate use of pesticide has harmful effect on agricultural soil and drinking water which is directly connected to the health of villagers.

Various acts were passed by the parliament for the protection of environment such as Water Act 1974, Air Act 1987 Environment Act 1986 etc. Water act objective is to control and prevent water pollution of water including streams, river water, inland water etc. it is also very important to study pesticide impact on non-target species as well.

Although there are acts that allow the Board to ban or restrict the use of any pesticide product still a lack of awareness about the use of pesticides. Despite the ban of DDT and HCH in India, they are still in use, both in domestic and agricultural settings. More than 3200 metric tons of active ingredients of DDT (about 80% of the global use of this use of DDT has been for malaria and leishmaniasis vector control in India, while organophosphates and Pyrethroids were applied against vectors of malaria, leishmaniasis, dengue and filariasis in the Region. (Source:

Guidelines on Public Health Pesticide Management Policy Regional Office for South-East Asia &WHO Pesticide Evaluation Scheme (WHOPES) Geneva. strict penalties and punishments should be imposed for not complying the procedures of the act otherwise it will only be a formality.

References:

1) Research paper- Use of HCH (BHC) and its environmental effects in India – K.N. Mehrotra (division of entomology, Indian Agriculture Research Institute, New Delhi – 110012- revision 1985)

2) Guidelines on public health pesticides management policy – WHO Pesticides evaluation scheme (WHOPES) Department of control of neglected tropical diseases, Geneva

3) PESTICIDES-Children's Health and Environment-WHO Training Package for the health sector – World Health Organization – July 2008

4) Manual of Methods of Analysis of Foods – Pesticide Residue- By Food Safety and Standard authority of India Ministry of health and family welfare- Government of India –New Delhi-2016

5) Annual Health survey Bulletin 2011-12 – Madhya Pradesh- office registrar general and Census commissioner, India – Ministry of home affair- New Delhi - 110011

6) Research paper – status of persistent organic pesticides residue in air, water and soil

7) Article – Essay on Pesticides: Characteristics, Historical Aspect and Classification- By Tiyasha M

8) Environmental Studies – Basic concepts, By VK Ahluwalia (TERI)

9) Report – Regional landscape Studio Report (SPA Bhopal 2015-2017 under guidance of Saurabh Popli and Manju Yadav)

International Multidisciplinary Research E-Journal Online Available at http://gater.in/
INTERNATIONAL PEER REVIEWED JOURNAL
OF GLOBAL ASSOCIATION FOR TRAINING, EDUCATION & RESEARCH
(GLOBAL CONSORTIUM OF PROFESSIONALS, TRAINERS, ACADEMICIANS & RESEARCHERS)

Study of High Energy Ignition System - Advantages and Application

Rishi Tiwari (PhD –Mechanical Engineering), BERTRANDT AG, Germany

r.tiwari@technologyandstrategy.com

Abstract :

Nowadays environmental legislations are becoming stricter, and it is getting more difficult for automotive manufacturers to comply their restrictions. For this reason, alternatives for the commonly used spark ignition are under investigation. Ignition systems are the fundamental parts of spark ignition engines which determine the engine efficiency and pollutant emission With the latest developments in machine technology, the demand for high power is high. This article examines the developments in alternative energy sources that provide high-energy and more efficient energy conversion to fuel mixtures. Compared with the integrated circuit, non-traditional components such as power conversion, generation time and exhaust gas are improved. This article also attempts to identify the advantages and limitations of advanced techniques as well as the use and applications of advanced data science in the field.

Keywords *– High*

Introduction to High Energy Ignition System (HEI)

The High Energy Ignition(1) system replaces the breaker points and condenser with a transistorized switch within an ignition module that also handles the task of triggering the ignition coil to generate high-voltage current This has proven to be useful as the use of this generator means there is less movement from electrical explosion and it is easy to diagnose and repair. They also provide a consistent high voltage spark throughout the life of the engine, meaning less misfire. But when the fault points in the electrical power change, these machines still use the emitter and rotor to do the same job of sending current to spark power. Using traditional chemical products means they will eventually wear out and need to be replaced, keeping maintenance costs high. Additionally, ignition timing cannot be controlled as precisely as in many engines, resulting in reduced fuel consumption and poor acceleration.

The development of electronic control and the use of automatic equipment for activation of the body have made the electric generator have good performance and reliability. However, some future improvements to SI engines will require more power. Higher power and energy enable earlier flame development and improved tolerance to higher exhaust gas recirculation (EGR) rates to reduce NOx emissions.

High Energy Ignition System (HEI) Types:

High energy ignition systems are different types of systems today uses. Detonation and laser ignition systems, corona spark plugs, plasma jet and rail spark igniters, homogeneous ignition systems and combustion injection, etc.

International Multidisciplinary Research E-Journal Online Available at http://gater.in/
INTERNATIONAL PEER REVIEWED JOURNAL
OF GLOBAL ASSOCIATION FOR TRAINING, EDUCATION & RESEARCH
(GLOBAL CONSORTIUM OF PROFESSIONALS, TRAINERS, ACADEMICIANS & RESEARCHERS)

During a fault, the current increases rapidly and the power and energy sent to the spark also increases. Increasing energy ionizes the gap, thus reducing the voltage required to maintain the arc. Therefore, the decay of phase (2) takes only a few nanoseconds and is characterized by the transition from positive electricity to plasma spark, a very fast process, and the energy stored in the live electrodes near the gap is placed in the volume of two electrodes. This force completely separates the gas in the volume. Its release time is 10,000 times shorter than normal ignition and provides a large amount of energy in a short time, making it more powerful. The estimated power is in the range of 1-2 MW, the model is in the range of 10W-1KW. Faster distribution improves the performance of the engine as there is less heat and causes the flame to grow faster. There was also an increase in flames.

Diagram of the typical Breakdown Ignition System is shown in Figure.1

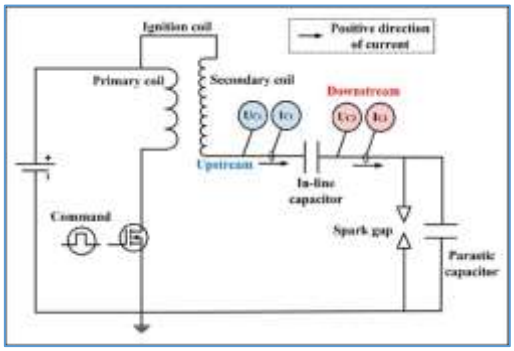


*Figure 1 **Breakdown Ignition System**(1)*

Advantages:

(1) Fast delivery ensures better engine operation

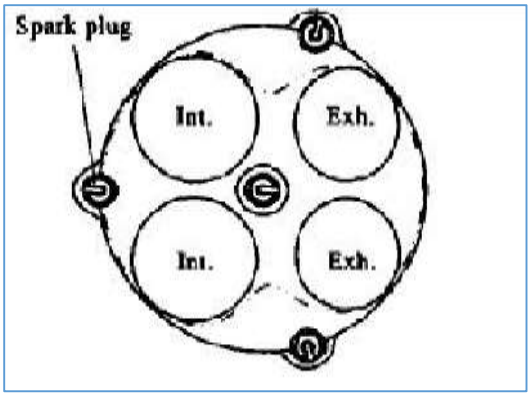
(2) Heat loss is lower, thus promoting early flame development and improving the treatment of large flames.

(3) Nitrogen Oxide Reduction - The amount of NOx produced depends on the temperature in the flame and the presence of nitrogenous oxygen. A fast generator reduces the total time required for nitrogen oxides to form.

1. Multiple ignition sources

Multiple spark plugs (3) are arranged so that ignition starts simultaneously in the center and around the combustion chamber wall.

The schematic diagram of a multi-channel electrical circuit is shown in Figure 2



Int – Inlet Valve

Exh – Exhaust Valve

*Figure 2 **multiple spark plug layout** (3)*

Advantages:

(1) Advantages include reduced flame spread and therefore shorter combustion time, the ability to use high compression ratios, and improved fuel efficiency.

(2) Reduce nitrogen oxides.

(3) Reduced hydrocarbon emissions due to reduced extinguishing area and reduced partial combustion at high air-fuel ratios.

1. Plasma Continuous Ignition System

Plasma Jet Ignition (4) uses electricity in a small volume. The ionizing spark immediately moves from where it started to where the thermodynamic conditions in the combustion chamber are more conducive to rapid flame. Both use energy in small feed channels. The difference between the plasma jet igniter and an ordinary flame is that the discharge occurs in a small gap, and a suitable plasma environment for a small gap can be provided through the resulting small capillary. The high temperature in

the discharge causes the plasma to be expelled from the mouth as a supersonic jet.

A schematic diagram of a typical plasma continuous firing system is shown in Figure

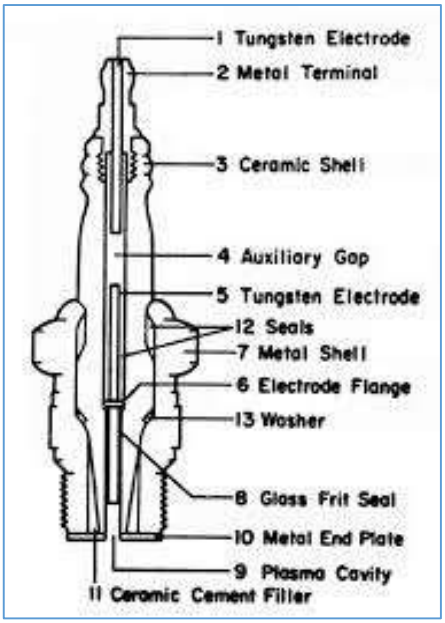


Figure 3 ***Plasma Sustained Ignition System****(4)*

Advantages:

(1) Extension in lean operation
(2) Improvement in engine power
(3) Improvement in engine efficiency

1. Spark ignition without ground electrode

The four types of spark plugs have the same number of electrodes, but the number of ground electrodes is different. This test involves starting the engine using a generator with only one ground electrode and changing the output to no ground electrode, two ground electrodes, and four ground electrodes.

The picture shows the spark plug ignition system diagram without ground electrode. 4.

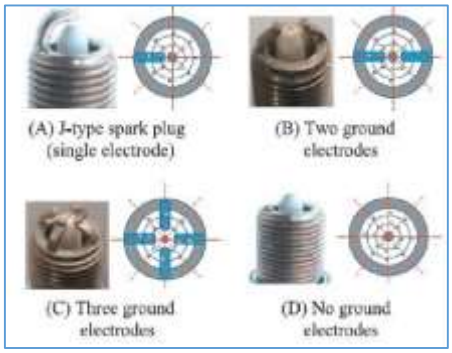


Figure 4 ***Ignition System without Ground Electrodes****(5)*

Advantage:

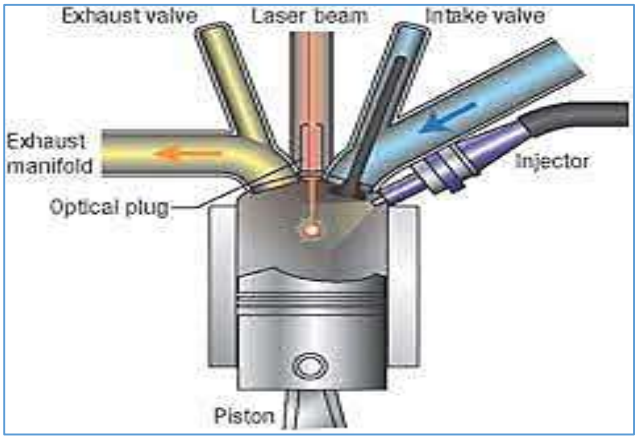
Solar energy helps burn more energy and extends the limit of electricity, which makes the timing of the connection important. (5)

2. Laser Ignition System (LIS)

Laser ignition or laser-triggered ignition (6) is the process of initiating combustion by excitation of a laser light source. Although there are other laser ignition mechanisms such as photochemical mechanisms and resonance or thermal detonation, such ignition systems are mainly based on non-resonant gas explosion of a tightly focused pulsed laser beam due to the freedom and ease of choosing the laser wavelength. use. Spark

The laser light passes through the convex lens and focuses on the point in the combustion chamber where it needs to be ignited, thus changing the spark.

A diagram of a typical Laser Ignition System (LSI) is shown in Figure 5.



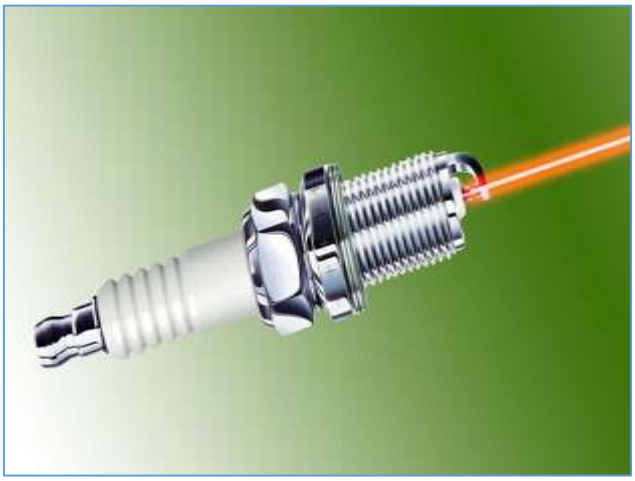


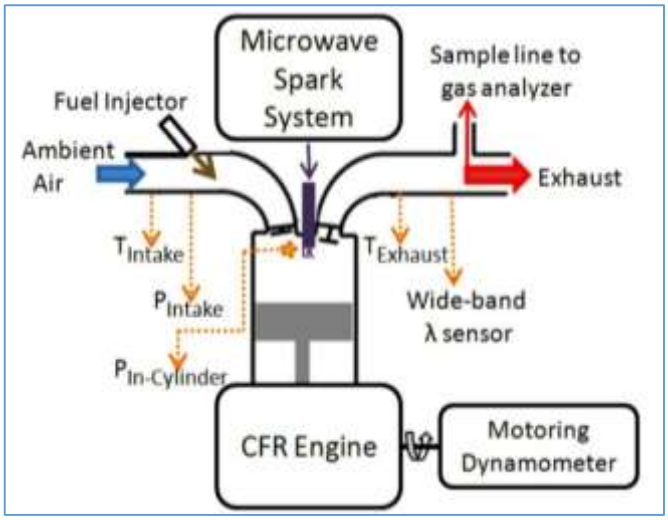
Figure 5 ***LaserIgnition System (LIS)*** *(6)*

Advantages

(1) The best position of the ignition plasma in the combustion cylinder can be selected arbitrarily.
(2) A mixture of LIS thinner than wire may ignite. This means lower temperatures and therefore lower NOx emissions.
(3) Since there is no surface material near the fire source, it reduces the effect of fire during flame formation, therefore the life of LIS is expected to be longer than the setting life.
(4) High pressure can be achieved in the combustion chamber, thus increasing efficiency. This is achieved by using precise ignition timing and optimizing the ignition process. Additionally, easier access to more energy helps improve overall engine performance and fuel efficiency.
(5) Laser-induced spark is a convenient point energy source. Its power, accumulation rate and ignition time
(6) Laser ignition will provide many ignition points and control the ignition point. Simultaneous ignition of a gaseous flammable mixture.

1. Microwave Assisted Spark Ignition

A spark ignition system that combines microwave (7) energy with an electrical source. Used to create or develop plasma in the combustion environment microwaves. The microwave assisted spark plug initiates plasma using a capacitive discharge spark which enhances electron energy and expands
Plasma is created by propagating microwaves into far space. Microwaves produced by a magnetron at a specific frequency. Look into the combustion chamber through the spark plug insulator. In the combustion chamber, microwaves are absorbed by free electrons in the spark discharge, creating a non-thermal plasma.
An electric generator that uses electricity is shown in Figure



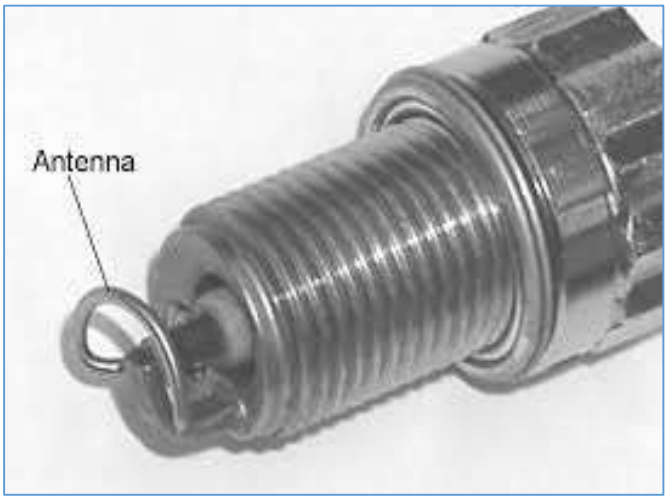


*Figure 6****Microwave AssistedIgnition System****(7)*

Advantages:

(1) Improve ignition to make the ignition time shorter compared with normal ignition.

(2) This energy-efficient method can increase the electricity limit of a low-energy mixture up to 10% and the electricity limit of a rich mixture up to 15%.

1. Homogeneous Charge Compression Ignition (HCCI)

HCCI combines the features of gasoline engines and diesel engines [8-10]. The first concept combines homogeneous charging with combustion, the second concept combines stratified charging with compression ignition. The main working principle of this electric fire is to create a good mixture of fuel and oxidizing agent (usually air) until it ignites. Like an electric generator, fuel is injected during entry into the vessel, but instead of using an arc to ignite it, compression increases the speed and temperature of the mixture until an exothermic reaction occurs.

A homogeneous charge compression ignition (HCCI) system is shown in Figure 7.

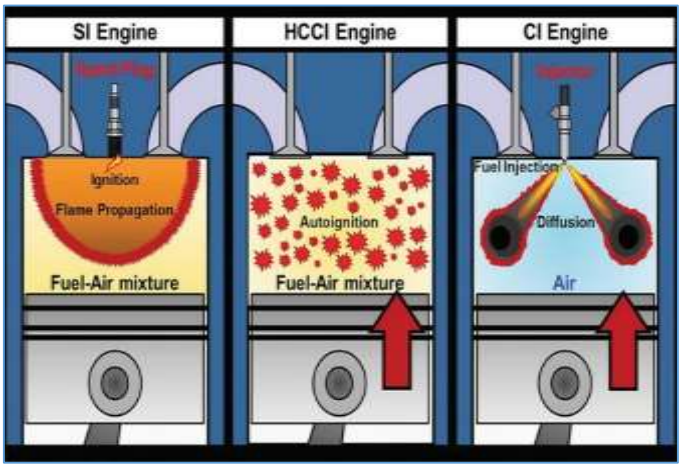


Figure 7Homogeneous charge compression ignition (HCCI)(9)

Advantages:

(1) Higher efficiency due to reduced gas pollution, thus reducing carbon dioxide emissions.

(2) Fuel burns faster.

(3) Combustion occurs at low temperature (<1300 °C), resulting in almost zero emissions of nitrogen oxides.

1. Corona discharge ignition system

A corona ignition system (11) for igniting the fuel in the combustion chamber of the internal combustion engine, for example an The oscillation circuit consists of an electrical circuit and a frequency generator connected to the oscillation circuit. AC voltage is designed to power the oscillating circuit; the converter is used to generate the input voltage of the high-frequency generator from the on-board supply voltage; the voltage controller is used to stabilize the input voltage generated by high frequency. Voltage controller is used to control the converter generator and high frequency generator. A control center in the control unit sends an approaching load change from the converter to the voltage regulator before the load change occurs due to activation or deactivation of the mind. - Frequency generator. The schematic of the corona discharge ignition system is shown in Figure 8.

Figure 8Corona Discharge Ignition System(11)

Advantages:

(1) Gas can be converted into mechanical energy more effectively due to fast ignition and fast connection
(2) Initial power generation and heating Faster, faster
(3) More combustion
(4) Lower NOx emissions

1. Radio frequency radiation (RFSI)

Smoke and radio frequency radiation (RFSI) (12). Use backup radio frequency voltage to keep the electrons close to the spark electrode. The spark plug must have a resonant RLC circuit with an inductor. Since there is no ground electrode, RFSI has a larger volume than standard electric current, has a higher voltage transfer rate, and can change the time difference according to the operation of the machine.

Diagram of a typical Radio Frequency Spark Ignition (RFSI) system is shown in Figure 8.

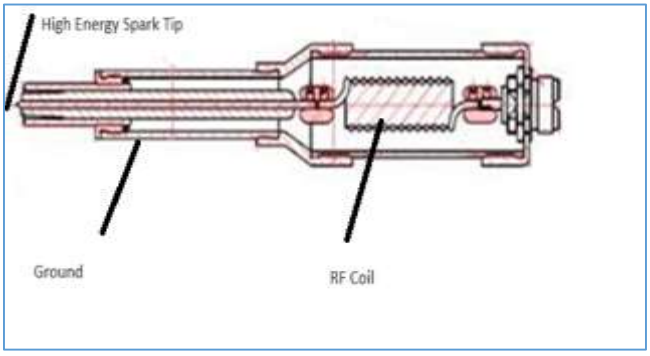


*Figure 9**Radio Frequency Spark Ignition (RFSI)**(12)*

Advantages:

(1) The RFSI is composed of a resonant transformer circuit which amplifies the input voltage.
(2) The Radio Frequency Ignition System (RFSI) allows stable operation with highly diluted mixtures.
(3) A reduced flame travel distance,
(4) Increased tolerance to EGR,
(5) Higher compression ratios with a given fuel and improvements in fuel efficiency.

Applications of high Energy Ignition System(4):

(1) Ignition System for modern lean burn high compression ratio engines.
(2) Engines where higher EGR ratio at idle and low throttle opening.
(3) Engines with alternative fuels like methane.
(4) Homogeneous charged spark Ignition engines for early flame propagation.
(5) Improve the delivery of ignition energy to the combustible mixture
(6) In High Energy Ignition system, the ignition energy is dispersed throughout the combustible charge.
(7) High Energy Ignition system is used to improve the fuel economy in high compression lean burn engines.
(8) High Energy Ignition system life is equal to life of Vehicle.

Main features of the considered ignition systems are summarized in Table 1.

The advantages and limitations of advanced Ignition Systems with reference to the traditional Ignition System based on advanced research reported in sources [1 -12]

Summary

Table 1

Sr No	System	Cost	Energy	Emission	Fuel Efficiency	Enhance Flame
1	Breakdown Ignition System	+	++	+	+++	+
2	Multiple Spark Plug Ignitions	+	++	++	+++	+
3	Plasma Sustained Ignition System	++	+++	No Improvement	++	++
4	Spark Ignition with No Ground Electrodes	+	+++	++	++	+
5	Laser Ignition System (LSI)	++	+++	++	++	++
6	Microwave Assisted Spark Ignition	+++	+++	++	+	+++
7	Homogeneous charge compression ignition (HCCI)	+++	+++	+++	+++	+++
8	Corona Discharge Ignition System	++++	++++	+++	+++	+++
9	Radio Frequency Spark Ignition (RFSI)	++++	++++	++	++	+++

International Multidisciplinary Research E-Journal Online Available at http://gater.in/
INTERNATIONAL PEER REVIEWED JOURNAL
OF GLOBAL ASSOCIATION FOR TRAINING, EDUCATION & RESEARCH
(GLOBAL CONSORTIUM OF PROFESSIONALS, TRAINERS, ACADEMICIANS & RESEARCHERS)

List of abbreviations

++++ High advantage

+ Low advantage

10 Working Mechanism of HCCI engine

Homogeneous Charge Compression Ignition (HCCI) is an advanced combustion technology that blends the best attributes of conventional spark ignition and diesel compression ignition engines. In an HCCI engine, a homogeneous air-fuel mixture is introduced into the combustion chamber, similar to a spark ignition engine. Unlike traditional spark ignition engines, however, ignition in HCCI occurs through compression rather than a spark plug.

The working principle of HCCI involves achieving a precise balance between air and fuel within the combustion chamber, creating a homogeneous mixture. This mixture is then compressed to a point where autoignition spontaneously occurs,

triggered by the high temperature and pressure. The absence of a spark plug and the reliance on compression-induced ignition contribute to improved efficiency and reduced emissions in HCCI engines. Precise control of factors such as temperature, pressure, and the air-fuel ratio is essential for optimizing performance and ensuring stable combustion in HCCI technology. HCCI engine's four strokes include intake, compression, combustion, and exhaust.

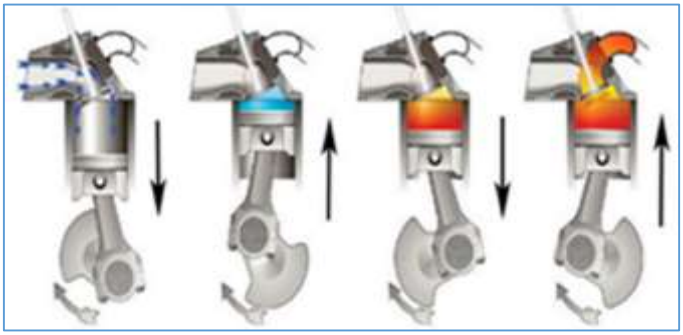


Figure 10 Four Stroke internal combustion engine

Intake: The piston moves from the TDC to the BDC while the intake valve opens and the mixture of air and fuel is drawn into the engine due to the low pressure in the chamber created by the piston movement.

Compression: At this stage, the piston moves from BDC to TDC while both the intake and outlet valves are closed, air and fuel are compressed to produce high temperatures and pressures so that the mixture of fuel and air is ignited. One of the biggest challenges of this process is how to control the combustion timing Combustion: The piston moves from TDC to BDC due to the high temperature and pressure generated by the combustion **Exhaust:** The exhaust valve opens, the piston moves from BDC to TDC, and the combustion exhaust gas is discharged.

10.1 Calculation Methodology

Figure 10 illustrates internal structure of the HCCI engine.

B represents for crank arm radius,

S represents piston diameter.

L *represents* stroke length,

a represents crank arm radius,

$\mathrm{Vc}$is the clearance volume,

Vd is the displacement volume

$\mathrm{Vd}$is the displacement volume

$(\mathrm{Vc} + \mathrm{Vd}$ is the cylinder volume),

? represents for crank angle and

l is the Piston rod length.

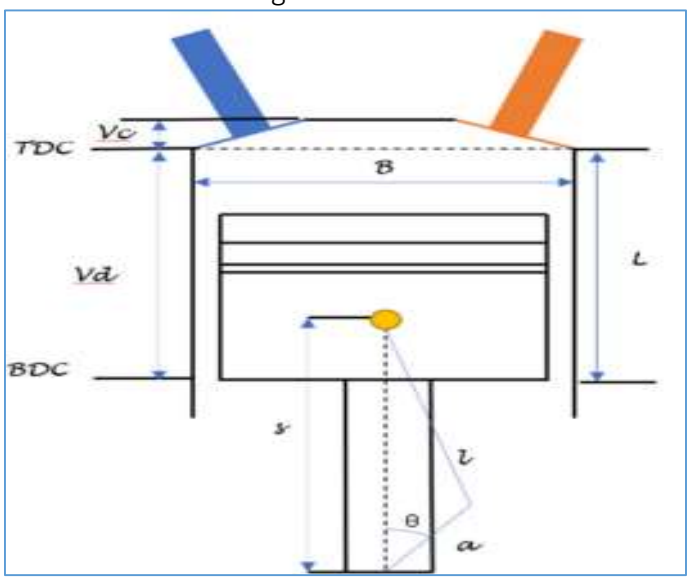


Figure 11 HCCI cylinder sketch

Based on the Fig. 10 model and simple geometry relationship. Some parameters can be calculated:

International Multidisciplinary Research E-Journal Online Available at http://gater.in/
INTERNATIONAL PEER REVIEWED JOURNAL
OF GLOBAL ASSOCIATION FOR TRAINING, EDUCATION & RESEARCH
(GLOBAL CONSORTIUM OF PROFESSIONALS, TRAINERS, ACADEMICIANS & RESEARCHERS)

Tab.1 Related parameter calculation formula

$S(?)$	$a\cos??+(l^2-a^2\sin^2??)^{l/2}$
$V_d(?)$	$(pB^2/4)[(l+a)-s(?)]$
$V_d(?)_{(\max)}$	$pB^2L/4$
$CR_{(\text{Compression Ratio})}$	$(V_d+V_c)/V_c$

Then some basic thermal parameters can also be calculated:

Tab.2 Thermal parameter calculation formula

$dQ/\,d\theta_{(\text{ROHR})}$	$[k/(k-1)]P(dV/d?)+[1/(k-1)]V(dP/d?)+(dQ_{heat/d}?)$
$?_{(Thermal\ Efficiency)}$	W_{net}/mQ
W_{net}	$\int pdV$
$\text{IMEP}_{(\text{Indicated Mean Effective Pressure})}$	W_{net}/V_c+V_d

Here, ROHR means the rate of heat release, k refers to the ratio of specific heat value [5]. In some related experiments, heat loss is used as an important indicator to express the efficiency of the HCCI heat engine. The heat loss is mainly determined by the following equation:

$$Q_{\text{loss}} = hA\left(T_{\text{cylinder}} - T_{\text{wall}}\right)$$

where G_{loss} is the heat loss, $T_{\text{cyclinder}}$ is the mean cylinder temperature. The air is approximated as an ideal gas.

Therefore, the average cylinder temperature is calculated using the ideal gas equation of state. The air is approximated as an ideal gas. Therefore, the mean cylinder temperature is calculated using the ideal gas equation. T_{wall} is the cylinder wall temperature.

Wall temperature is assumed to be 400K for all the wall. A is the total surface area of the cylinder, which is also a constant in the experiment. h is the heat transfer coefficient :

$$h_c = 130P^{0.8}T_{cy\,\text{linder}}{}^{-0.4}V^{-0.06}\left(v_p+1.4\right)^{0.8}$$

In Eq.(2), P is the in-cylinder pressure. V is the volume of the cylinder and v_p is the mean piston speed. The air-fuel equivalent ratio $(?)$ will be calculated by the following equation:

$$\varphi = \frac{\left(\frac{m_{\text{fuel}}}{m_{\text{oxidant}}}\right)}{\left(\frac{m_{\text{fuel}}}{m_{\text{oxidant}}}\right)_{\text{stoichiometric}}} = \frac{\left(\frac{n_{\text{fuel}}}{n_{\text{oxidant}}}\right)}{\left(\frac{n_{\text{fuel}}}{n_{\text{oxidant}}}\right)_{\text{stoichiometric}}}$$

Conclusion :

The target of this study is to focus on recent developments in ignition systems for engines. As it can be seen from the Table 1 the Homogeneous Charge Compression Ignition System is preferable for lean burn gas mixture combustion. As HCCI is medium cost system with advantages on energy discharge, emission improvement, fuel efficiency and advanced flame propagation. The HCCI systems presently in use are reliable, inexpensive to make and deliver adequate energy for automobile engines using gasoline fuel at near stoichiometric air-fuel ratios. For meeting future fuel efficiency improvements and future CO_2 emission strict regulations, high compression, lean burn technology engines are required, then higher energy and enhanced ignition systems are necessary.

Way forward

For future development more work to be done on understanding the chemical kinetics of ignition processes which might lead to new concepts in ignition. There are many possible replacements for conventional ignition systems. Each of the systems has certain inherent

advantages. Most of the alternative spark systems have potential for high ignition energy when compared to the ignition systems which presently dominate the field. This higher energy is advantageous for engines running on very lean mixture avoiding the poor ignition reliability and irregularity which occurs in such mixtures, additional energy ensures better ignition of present engines leading to greater engine efficiency, greater fuel economy and less exhaust emissions.

The excellent fuel economy expectation and latest emission regulations requires enhancement of ignition system of the engine, which in a way favors the government policy of efficient utilization of energy. This is of utmost importance for human beings and for protection of the environment.

References :

1. *Review on performance of High energy ignition techniques.* Jubin V Jose, Sreenath V R. 2015.
2. *Influence of a breakdown ignition system on performance.* Ziegler G.F.W, Wagner, E.P, Saggau, B, Maly R and Herden.W.
3. *Surrounding Combustion Process (SCP)-New concept for lean bum engine.* Yamamoto H, Horita.S and Matsuoka.T. 1992.
4. *Application of high energy ignition systems to engines.* J.D. Dale, M.D. Checkela and P.R. Smy. 1997.
5. *Impact of spark plug number of ground electrodes on engine stability.* Abdel-Rehim, Ahmed A. 2012.
6. *Review and recent developments of laser ignition for internal combustion engines applications.* H.Morsy, Mohamed. 2013.
7. *Enhancement of flame development by microwave-assisted spark ignition in constant volume combustion chamber.* Benjamin Wolk A, Anthony DeFilippo , Jyh-Yuan Chen , Robert Dibble , Atsushi Nishiyama,Yuji Ikeda. 2012.
8. *Homogenous Lean Burn Combustion for Gasoline Engines.* Andreas Paa, Gregor Rottenkolber, Woerner M, Thomas Friedrich, Spang C. 2017.
9. *Homogeneous Charge Compression Ignition .* Hammad Iqbal Sherazi, Yun Li. Huddersfield, UK, : University of , 2010.
10. *Analysis of Performance and Emission Characteristics of a Homogeneous Charge Compression Ignition (HCCI) Engine.* Sayed Yaser Hussian, Subhash Lahne, N G Patil. 2016.
11. DR. John burrows, Jim lykowski,Kristapher mixell.*Corona ignition system for highly efficient gasoline engines-.* 2013.
12. *Radio frequency spark plug-An ignition system for modern internal combustion engines.* Antonio Mariani, Fabrice Foucher. 2014.
13. Ting DSK, Checkel MD.*The effects of turbulence on spark-ignited, ultra lean, premixed methane–air flame growth in a combustion chamber.* 1995.
14. Maly R. and Vogel, M,.*Initiation and propagation of flame fronts in Lean CH4-air mixtures by the three modes of the ignition spark.* 1978.
15. *Heavy-duty spark ignition engines fueled with methane. ASME J Eng Gas Turbines Power.* Gambino M, Iannaccone S, Unich A. 1991.
16. *The impact of natural gas composition on fuel metering and engine operational characteristics.* SR., King. 1992, SAE Paper 920593.
17. *Development of a MercedesBenz natural gas engine M366LAG with a lean-burn combustion system.* Borges LH, Hollnagel C, Muraro W. SAE Paper 962378, p. 1996.
18. *The first and second law analysis of spark ignition engine fueled with compressed natural gas.* Sobiesiak A, Zhang S. 2003, SAE Paper 2003- 01-3091.
19. *Ignition delay and combustion duration with natural gas fueling of Diesel engines. .* Mtui PL, Hill PG. 1996, SAE Paper 961933.
20. *Development of a high efficiency, low emission SI-CNG bus engine. .* Tilagone R, Monnier G, Chaouche

A, Baguelin Y, De Chauveron S. 1996, SAE Paper 961080.

21. *Development of CNG fueled engine with lean burn for small size commercial van.* Kato T, Saeki K, Nishide H, Yamada T. 2001, JSAE Rev 2001;22:365–8.

22. JB, Heywood.*Internal Combustion Engine Fundamentals.* New York : McGraw-Hill Inc, 1988.

23. *Lean burn natural gas spark ignition engine–An overview.* Manivannan A, Tamil Porai P, Chandrasekan S, Ramprabhu R. 2003, SAE Paper 2003-01-0638.

24. *Spark ignition natural gas engines—A review Haeng .* Muk Cho, Bang-Quan He.

25. *Numerical simulation of combustion characteristics and emission predictions of methane-air and hydrogen-air mixtures in a constant volume combustion chamber using multi-point laser-induced spark ignition.* Nandgaonkar, Prashant Mahadev Patane & Milankumar Ramakant. 2021.

26. J.B, Pischinger S and Heywood.*A study of flame development and engine performance with breakdown ignition systems in a visulization Engine.*

27. *Impact of spark plug number of ground electrodes on engine stability.* Rehim, Ahmed A. Abdel. 2012.

International Multidisciplinary Research E-Journal Online Available at http://gater.in/
INTERNATIONAL PEER REVIEWED JOURNAL
OF GLOBAL ASSOCIATION FOR TRAINING, EDUCATION & RESEARCH
(GLOBAL CONSORTIUM OF PROFESSIONALS, TRAINERS, ACADEMICIANS & RESEARCHERS)

Renovation & Modernization, Uprating of Carbon neutral hydro power plants using Computer Simulation

[1] Manoj Kumar Yadav
Manager (Centre of Excellence- Hydro Machines)
[2] Shailendra Pandey
Manager (Centre of Excellence- Hydro Machines)
Email: [1] mkvaday@gmail.com [2] shailendra_audri@outlook.com

ABSTRACT :

All development indices of society are directly or indirectly linked to per-capita Energy requirement and usage. Therefore, it is utmost essential for all planners to have an energy development model which is sustainable and does not create an environmental imbalance. There is no doubt that carbon emissions and ensuing global warming is one of the major threats of this century. Thus the need for low-carbon and affordable electricity has brought hydropower back onto the development agenda of many developing economies. With all knowledge and experience gained, the renewed attention on hydropower also provides an opportunity: the opportunity to develop affordable, low-carbon and flexible renewable energy without causing irreversible damages to the environment. Renovation & Modernization, Uprating and Life Extension (RMU&LE) of old Hydro power stations is an attractive proposition in the present scenario, when creation of new generating capacity is extremely difficult. Capacity addition through RMU of the existing old hydroelectric power projects is considered to be a cost-effective option to ensure high efficiency, environment friendliness and meeting sustainability requirements.

With the advent of latest technological tools, designers are equipped with the advantages of a high-end numerical tool, by the help of which, the complex 3D flow inside a hydraulic turbine can be solved accurately with minimum assumptions and in a much smaller time cycle. These technological tools not only help to remedy the various ongoing problems in the water-wetted components but it also helps the Designer to extract more performance from the machine in terms of power output, efficiency, improved cavitation and silt erosion behavior.

An optimization design methodology adapted to rehabilitation and upgrading projects of hydropower plant by means of digital design and performances estimation based on 3D viscous flow numerical simulations of the complete hydro turbine passage at multi-operating conditions is presented in this paper.

Keywords: Renovation, Modernization, Numerical Simulation

1. INTRODUCTION :

All societies require energy to meet basic human needs (e.g., lighting, cooking, space comfort, mobility, communication,) and to serve productive processes. For development to be sustainable, delivery of energy services need to be secure and have low environmental impacts. The role of the hydroelectric power plant is increasing in importance because water power is a clean energy source amply available in nature furthermore; requirements for hydroelectric generation have been raised as a means of generating energy quickly in response to demands of electricity systems. Renovation and modernization of hydro power plant offers opportunity to contribute to social and economic development, energy access, secure energy supply, climate change mitigation, and the reduction of

negative environmental and health impacts. It is very important to utilize existing old hydroelectric power plants effectively and efficiently, as well as to build new. Renovation of hydro plants needs for a systematic approach, as there are a number of factors (hydraulic, mechanical, electrical and economic), which play a vital role in deciding the course of action. For techno-economic consideration, it is desirable to consider the upgrading along with Renovation & Modernization/Life extension. Recognizing the benefits of R&M scheme, Govt. of India set up a National Committee in 1987 to formulate strategy on renovation and modernization of hydro power plants. Based on the recommendations of the National Committee and subsequent reviews, 55 hydro schemes were identified and its policy on hydropower development declared in 1998 has laid stress on need for renovation and modernization of hydro power plants. In India most of the state electricity boards and Power utilities on account of their financial conditions are not in a position to invest in creation of new generating capacity. The economy in cost and time essentially results from the fact that apart from the availability of the existing infrastructure, only selective replacement of critical components such as turbine runner, generator winding with class F insulation, excitation system, governor etc. can lead to increase in efficiency, peak power and energy availability apart from giving a new lease on life to the power plant/ equipment.

1.1 NECESSITY OF R&M

- The unplanned outages continued showing increasing trends in some machines.
- At some Power Houses the effect of silt erosion is predominant which necessitates the use of modern technologies to retard the damage.
- Over the years, many powerhouses have come upstream and downstream leading to changed operating conditions necessitating
- RMU to improve operational efficiency, working range and decrease downtime.
- There is a huge shortage of peaking power and possibilities existed for Up-gradation.

1.2 OBJECTIVES OF R&M :

Technological advancements especially in improving the turbine efficiency, turbine operating range, metallurgy, better insulation materials for electrical equipment and advanced numerical controls and protections and it is often found feasible to up-rate the machines further within the same space and enhance the peaking capacity. The main objectives of R&M of Hydro Plants are:

- To increase the capacity and energy with up-graded turbine runners for more effective utilization of reservoir discharge.
- To ensure safe, reliable and economic electricity production by replacement of worn-out, deteriorated or obsolete electrical, mechanical, instrumentation, controls and protection system by state-of-the-art equipment.
- To ensure greater availability of Power Houses especially during peaking hours.

2. FORTHCOMING RENOVATION & MODERNIZATION PLAN IN INDIA

The Renovation, Modernization, Uprating and Life Extension works at 67 Hydro Electric Plants (HEPs) with an aggregate installed capacity of 12325.60 MW is programmed for completion during the year 2022-27 with its break-up as 2641.8 MW through R&M at 13 HEPs, 7595.80 MW through Life Extension at 41 HEPs and 2088 MW through Life Extension and Uprating at 13 HEPs. The 13 HEPs where both Life Extension & Uprating are envisaged, the aggregate installed capacity of 2088 MW shall get uprated after completion of R&M works to 2335.5 MW resulting in additional benefit of installed capacity of 247.5 MW. As such, the revised aggregate installed capacity after completion of RMU&LE works

of these 67 projects would be 12573.10 MW. Out of these 67 Schemes, Seven (7) Schemes with an

aggregate installed capacity of about 1469.8 MW have been completed till June, 2023 which has resulted in benefit of extension of operational life for installed capacity of 510 MW.

The Renovation, Modernization, Uprating and Life Extension works at 21 Hydro Electric Plants (HEPs) with an aggregate installed capacity of 2879.20 MW is programmed for completion during 2027-32 through Life Extension and Uprating

Sl. No.	Category	No. of Projects			Capacity covered under RMU&LE (MW)	Benefit (MW)
		Central Sector	State Sector	Total		
1.	Programmed	8	59	67	12325.6	9931.30 [9683.80(LE)+ 247.5(U)]
2.	Completed	0	7	7	1469.8	510 [510 (LE)+ 0(U)]
3.	Under Implementation	4	21	25	3949.75	2505.25 [2367.75(LE)+ 137.5(U)]
4.	Under Tendering	2	4	6	1619	1639 [1619(LE)+ 20(U)]
5.	Under DPR Preparation/ Finalisation/ Approval	0	5	5	790	696 [690(LE)+ 6(U)]
6.	Under RLA Studies	2	22	24	4497.05	4581.05 [4497.05(LE)+ 84(U)]

Table 1:Programme of R&M works during 2022-27 (Source: www.cea.nic.in)

Sl. No.	Category	No. of Projects			Capacity covered under RMU&LE (MW)	Benefit (MW)
		Central Sector	State Sector	Total		
1.	Programmed	3	18	21	2879.2	2890.03 [2879.2(LE)+ 10.83(U)]
2.	Under Implementation	0	0	0	0	0
3.	Under Tendering	0	1	1	115	125.83 [115(LE)+ 10.83(U)]
4.	Under DPR Preparation/Finalisation/ Approval	0	0	0	0	0
5.	Under RLA Studies	3	17	20	2764.2	2764.2 [2764.2(LE)+ 0(U)]

Abbreviations:
MW – Mega Watt; Res. – Restoration; U – Uprating;
LE – Life Extension; RLA- Residual Life Assessment

Table 2:Programme of R&M works during 2027-32 (Source: www.cea.nic.in)

3. OPTIMIZATION METHODOLOGY OF HYDRO TURBINE RMU BASED ON NUMERICAL SIMULATION

With development of numerical simulation technology, R&M of hydro turbine based on numerical simulations can be implemented with the help of advanced computing power and commercial CAD/CFD/CAE software. Its main functions are as shown in Fig.1.The data for the components to be retrofitted can be captured from 3D measurements and the 3D models of the actual components are constructed by CAD software with reverse engineering. According to engineering drawings of original hydro turbine, all the other flow passage components (such as spiral case, stay vane, guide vane, runner and draft tube) are constructed by 3D CAD software such as UG-NX ,So the actual geometrical model of complete water passage of hydro turbine can be numerically analyzed. After model generation, the computational domains are meshed with pre-processing software of CFD, and then CFD software such as CFX is employed to numerically simulate the flow at each operating condition according to hydropower plant's operating conditions. Based on the simulated results, comprehensive analysis of internal flow behavior of flow passage components is carried out and meanwhile the performance matching of flow passage between renovated and existed components is taken into account, which can indicate the existing problem of hydro turbine to be retrofitted. In order to solve the existing problem and get optimum performance the flow passage of components to be retrofitted should be re-designed under some constraints of the existing hydro turbine firstly, then the complete retrofitted flow passage can be geometrically modeled, numerically simulated for internal flow, considering the interaction of each component and performance matching of flow passage are analyzed as mentioned

International Multidisciplinary Research E-Journal Online Available at http://gater.in/
INTERNATIONAL PEER REVIEWED JOURNAL
OF GLOBAL ASSOCIATION FOR TRAINING, EDUCATION & RESEARCH
(GLOBAL CONSORTIUM OF PROFESSIONALS, TRAINERS, ACADEMICIANS & RESEARCHERS)

above. During this hydraulic development course, the traditional model test is replaced by numerical simulations. As far as a renovated scheme's results satisfy requirement from flow numerical simulations and performance estimation, the detailed parameter-models of the renovated components are built by the 3D CAD software. Afterward, these models are imported into the preprocessing of structure analysis software, and structure analysis such as strength analysis, stiffness analysis and modal analysis of rotational parts are performed with CAE software.

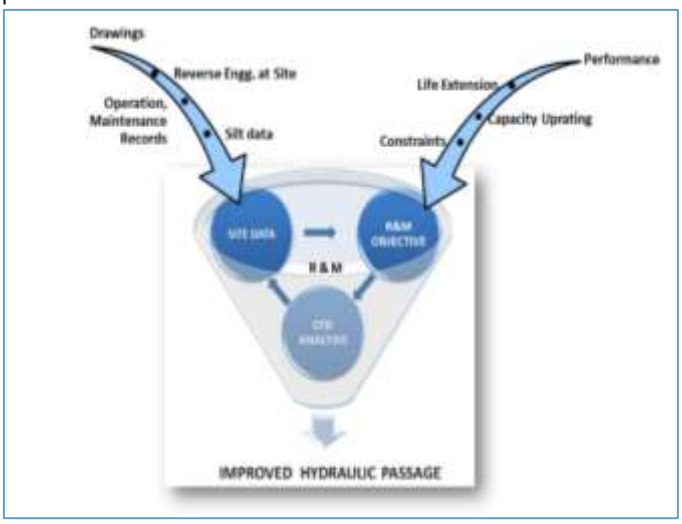


Figure 1: Optimization methodology for renovation, modernization and uprating of Hydro Power

4. PROCESS OF CFD ANALYSIS

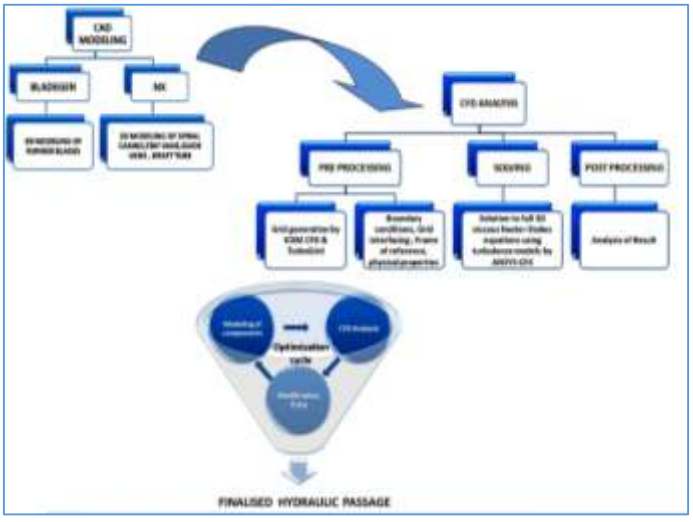


Figure 2: CFD analysis process flowchart

Figure 3: CFD Setup and model test set-up

CFD pre-processing starts with 3-D CAD modeling of all the water passage components. Blade profile created in the Blade-Gen software facilitates optimization based on project criteria. This complete model, used for the full CFD analysis, consisted of three main parts. The inlet volume constituted the part for the application of inlet flow at the inlet of spiral casing. The runner blade segment represented the second part as a rotating domain and the full draft tube was joined as the third part of the CFD model. Spiral casing and draft tube segment were meshed in ICEM-CFD software and the runner, guide vane and stay vane segment were meshed in the ANSYS Turbo Grid v.19 software.

After pre-processing which includes steps like 3d modeling, good quality grid generation and boundary condition application to capture flow physics accurately CFD solver comes in the picture. In general, the internal flow of hydro turbine is very complex turbulence flow. Studies on 3D in-viscid and viscous flow numerical simulations of hydro turbine's internal flow field have been carried out in recent years and meanwhile some experience and achievements have been obtained. Because of geometrical shape of flow passage of hydro turbine

is very complex, so it is very significant to ensure the correctness of numerical simulation of hydro turbine's internal flow that the turbulence model is properly applied. Through careful research and numerous experiment, the hydro turbine's internal flow is numerically simulated by adopting k-Ɛ turbulence model based on Reynolds averaged equation, in this case simulated results can satisfy the practical engineering requirement. As mentioned in the above section, the 3D geometrical models of renovated flow passage of hydro turbine are established with 3D CAD software and the computational domains are meshed with pre-processor of CFD software, then the computational domains are imported and simulated with commercial CFD software such as ANSYS-CFX. The detail setup before computing is as follows: solver is selected as explicit separated solver, turbulence model is selected as k-Ɛ turbulence model, and standard wall function is used for near wall treatment. Continuity equation, momentum equation, turbulence kinetic energy equation and turbulence kinetic dissipation equation are computed by second order upwind discrete scheme.

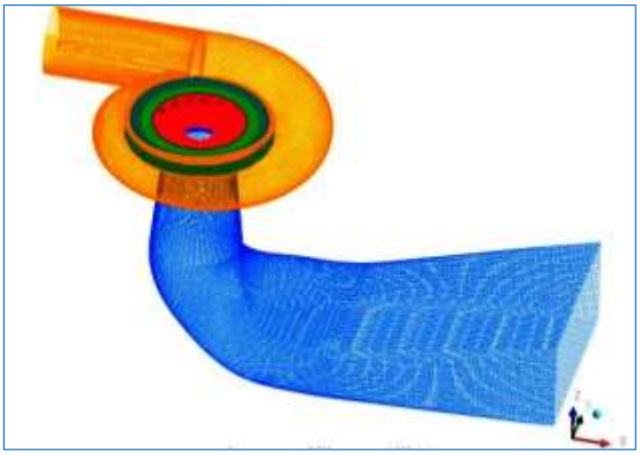
Figure 4: Numerical simulation of reaction turbine and Governing Equations :

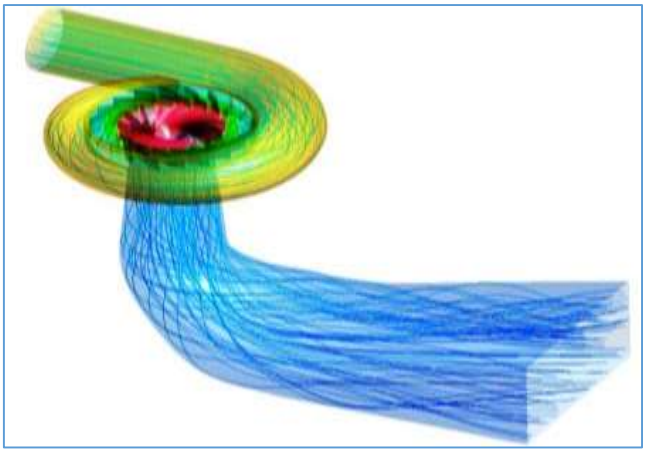
In post processing of CFD analysis hydraulic efficiency of hydro turbine at each operating condition can be estimated according to transformation of energy. We can calculate the average total pressure of inlet and outlet of hydro turbine at each operating condition with total pressure integral along inlet and outlet surface of hydro turbine and on average of the surface area, so the hydraulic head by energy transformation can be defined. Hydraulic efficiency in the operating range of hydro turbine can be predicted through calculation at each simulated operating condition, so efficiency hill chart can be predicted numerically with a serial of simulated operating points which is similar to the model test at hydraulic laboratory. According to equivalent operating head of hydro power station, the relationship between the discharge of hydro turbine and efficiency predicted by 3D viscous flow numerical simulations are applicable to prototype. Considering flow distribution analysis at each operating condition as well as weighted average efficiency and hydraulic stability, the global performance of hydro turbine would be finalized.

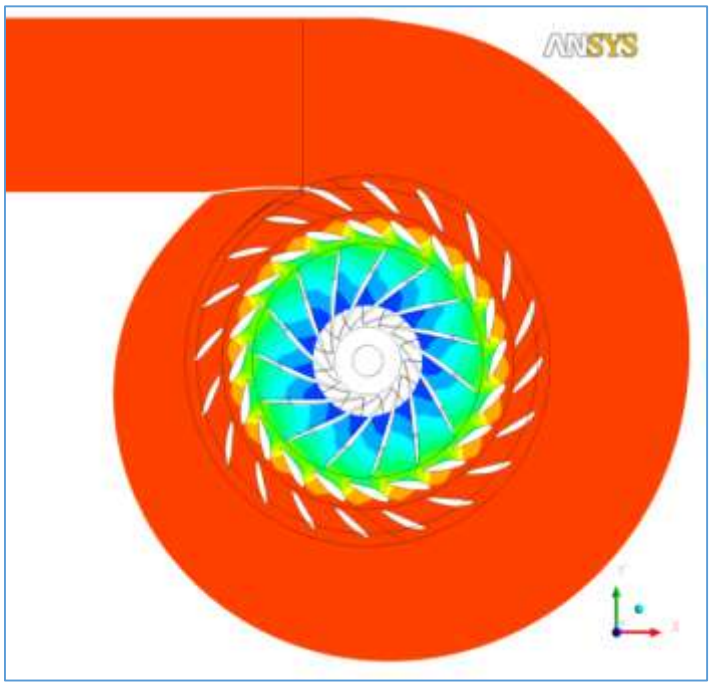
Another benefit of numerical simulation is to measure the internal flow field distribution inside flow passage components, which is otherwise very difficult in model test. Also it is easier to obtain the distribution of flow field in numerical simulation. It is very helpful to improve performance and evaluation of renovated scheme by analysis of distribution of flow field. Flow velocity distribution including absolute velocity and relative velocity at each simulated operating condition can be obtained by means of flow numerical simulation. The magnitude and direction of velocity have a close relationship with abrasion on flow passage's surface and affect hydraulic efficiency of a hydro turbine in some degree. The velocity's magnitude and direction are the basis for estimation of abrasion of hydro turbine's flow passage components.

Flow streamline inside the draft tube can be obtained through flow numerical simulations at each simulated operating condition, which can approximately describe situation of vortex rope in the draft tube. Based on the situation of vortex rope in the draft tube, the hydraulic stability of hydro turbine in operation can be roughly judged. The pressure fluctuation inside the draft tube can be further predicted through unsteady flow numerical simulations. These pressure fluctuations are responsible for vibration in draft tube cone, so accurate prediction of vortex rope frequencies is very much important to avoid resonance condition.

On the basis of 3D flow numerical simulations of complete flow passage, hydraulic loss of each flow passage component can be calculated. Hydraulic loss of each flow passage component is the difference of average total pressure between inlet and outlet of each component.







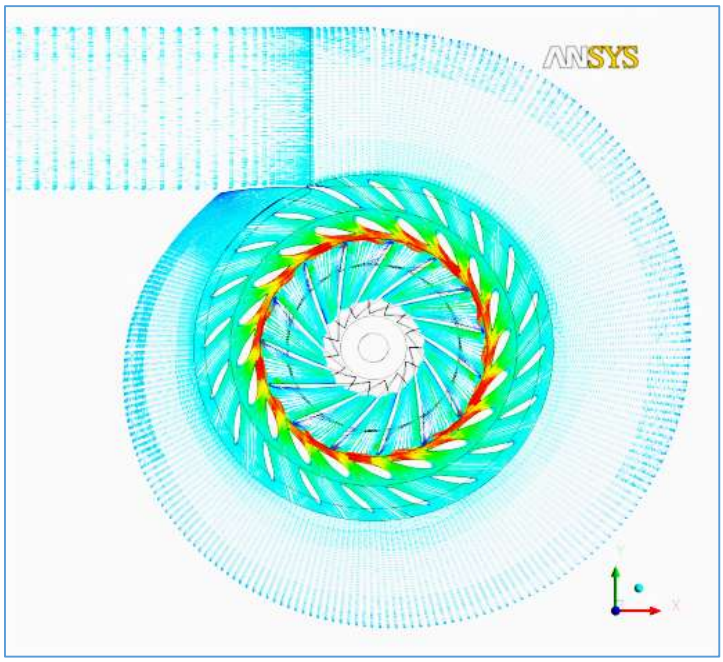
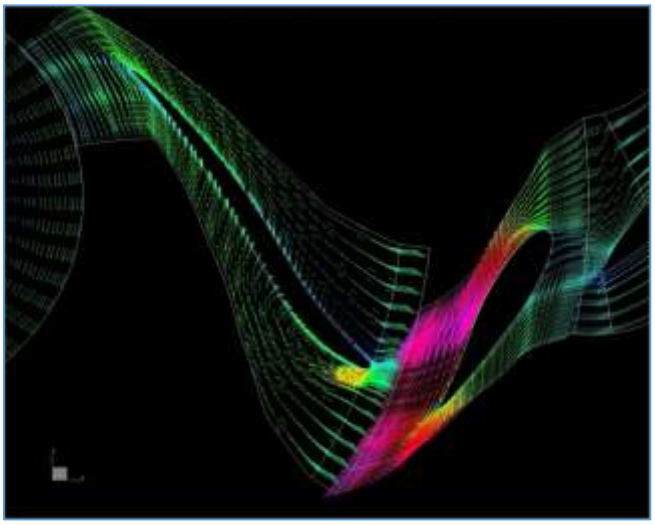
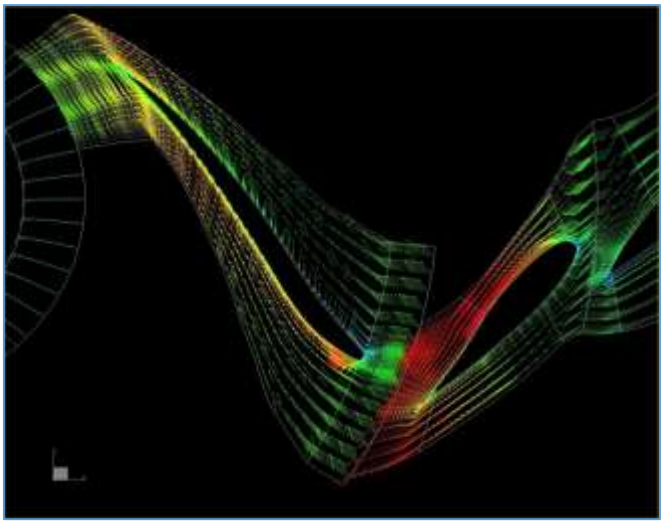
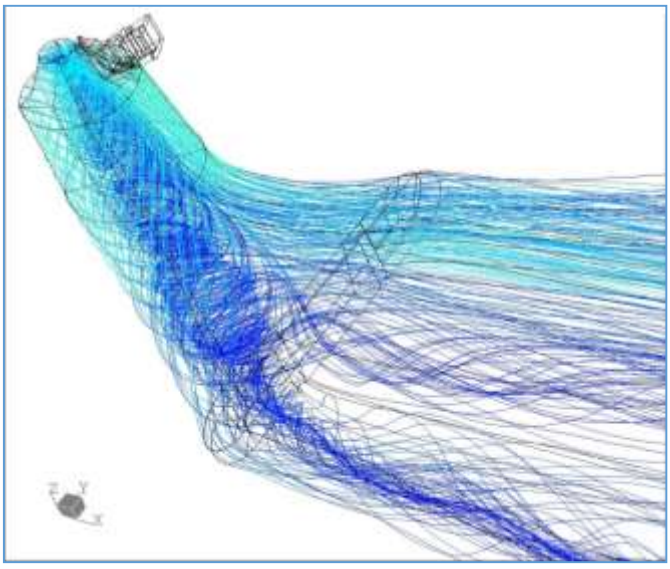


Figure 5: The computational Domain in CFX & a typical view of streamlines, pressure and velocity plot







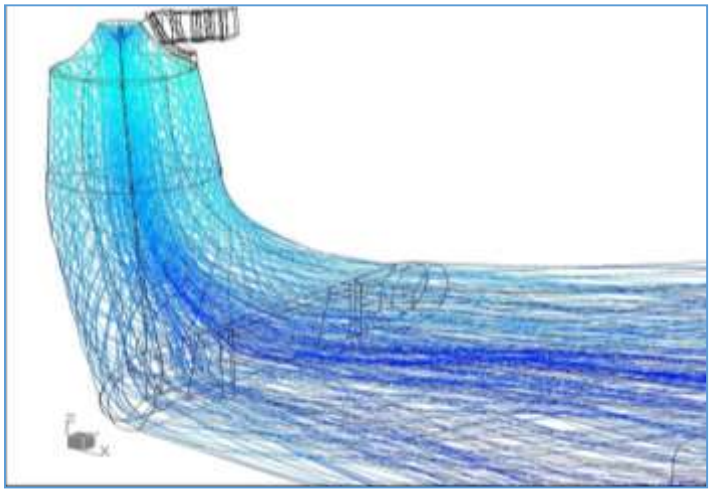


Figure 6: Numerical optimization of Hydro Turbine components

5. SPECIAL FEATURE STUDIES :

5.1 SILT EROSION

Special studies like erosion of water wetted areas can be conducted using CFD. Using numerical tool more insights can be thrown into the mechanism of erosion of underwater components by silt. This erosion causes losses in terms of power generation, equipment damage and machine down time. Using numerical tool, simulation of the flow of silt particles in the turbine passage can be performed. Exact location, where a silt particle of a typical size will hit the surface and the damage done by it can be assessed by this numerical tool. In case of runner, adjustment of blade angle near outlet edge to match flow angle is employed to reduce erosion. To compensate the effect on efficiency, blade angle at inlet and mid-span is suitably modified, as the velocities are lower compared to outlet edge.

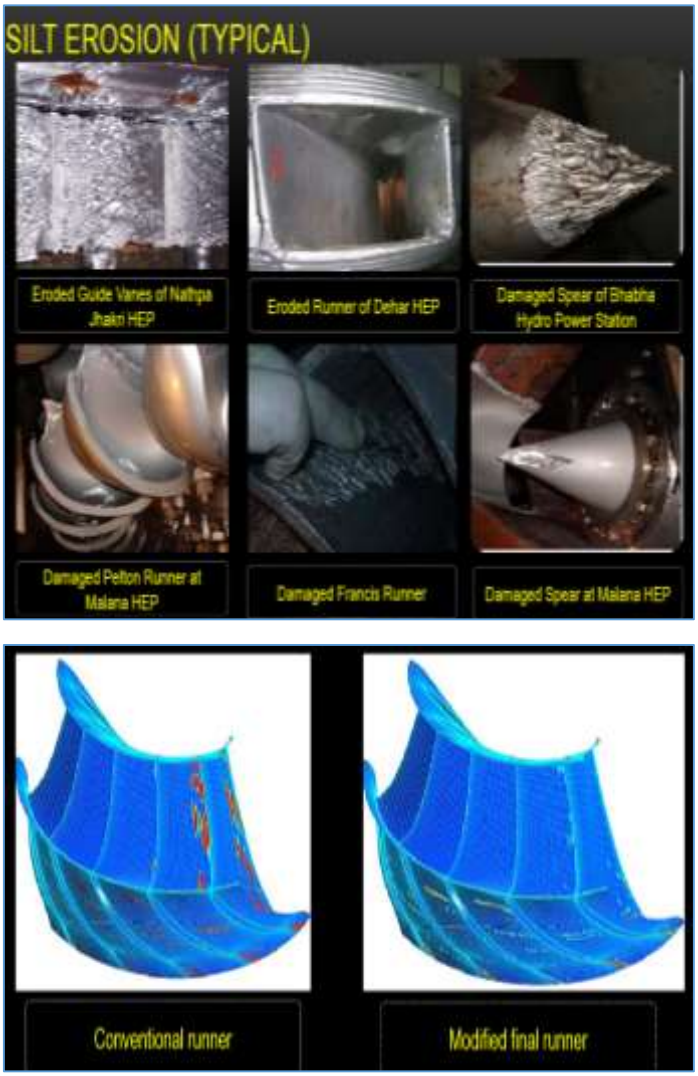
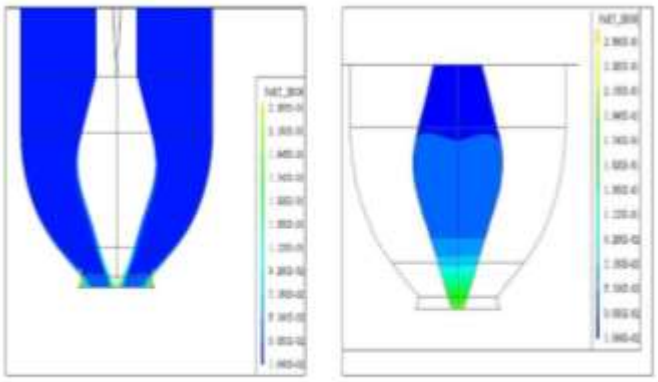


Figure 7: Silt Erosion of Hydro Turbine components



Erosion Loss in Nozzle & Spear

Figure 8: Erosion pattern on hydro turbine components and numerical simulations

5.2 CAVITATION ANALYSIS

The same model from the optimization process was used for prediction of cavitation parameters. Through flow numerical simulations inside hydro turbine, the distribution of pressure including static pressure, dynamic pressure and total pressure at each simulated operating condition can be obtained. The static pressure distribution on blade surface is the most concerned, which may induce cavitation if the static pressure is lower than vaporization pressure at site. The distribution of static pressure and dynamic pressure inside draft tube are also concerned because of which closely relate to operation stability of hydro turbine.

6. CONCLUSION :

With a low-carbon portfolio, Hydro power is well positioned for a future carbon neutral clean power generation. In order to enhance hydro power performance of old power plant, rehabilitation & upgrading of hydro power station has been increasingly demanded for hydro power industry and power equipment manufacturing industry. With the numerical simulation techniques, which consist High Performance Cluster (HPC) dedicated for CFD analysis and commercial CAD/CFD/CAE software, it is an effective approach for replacing traditional Model Test during preliminary study of hydraulic turbine retrofit project. The estimated performance results obtained from 3D viscous flow numerical simulations of the complete flow passageway are basically consistent with the practical situation, and it has shown that the numerical simulation technology can satisfy requirement of rehabilitation & upgrading of hydro power station. By adopting rehabilitation method of hydro turbine's flow passage with numerical technique, it has been shown that not only the development cycle could be reduced but also the reliability of rehabilitation project can be guaranteed as well as the R&D cost can be decreased. Multiphase flow simulation and fluid-solid coupling simulation are further expected to put into practical use in hydro

turbine's optimization design. It reflects that this methodology has a great technical advantage in rehabilitation and up gradation of hydro turbine after incorporation of computer aided design and numerical techniques.

REFERENCES :

1. Central Electricity authority (CEA) report "R&M of Hydro-electric power station" published at www.cea.nic.in.

2. ANSYS-CFX -19.0 " User Manual & Theory"

3. Mangla M., Shrinivas Rao V. Sharma S., "Role of CFD analysis in Accelerated and Customized Hydro Power Development", 2nd National Conference of CFD application in power and industry sector 2009.

4. Pande V.K., Shrinivas Rao V., "A new design approach for combating silt erosion", Hydro - 2003, Hydro Power and Dams.

International Multidisciplinary Research E-Journal Online Available at http://gater.in/
INTERNATIONAL PEER REVIEWED JOURNAL
OF GLOBAL ASSOCIATION FOR TRAINING, EDUCATION & RESEARCH
(GLOBAL CONSORTIUM OF PROFESSIONALS, TRAINERS, ACADEMICIANS & RESEARCHERS)

Perspectives on Sustainability from Eastern Traditions and Quantum World View and its Relevance on Our Contemporary Earth

Dr Sumit Roy, Associate Professor, Sri Balaji University, Pune, Mh, India
E-Mail : sumitroyg212@gmail.com

Abstract :

Our civilization has grown to be with nature and a compassionate sense and a deep reverence always prevailed for nature for most of the ancient traditions. Contemporary civilization is a conglomeration of products, people, resources, and the environment. Our planet is finite and resources get generated from nature, marketing emphasizes consumption, and hence generation of products and drive towards innovation is at an all-time high. Man tends to get oblivious and takes nature for granted. This research article explores the environmental philosophical view from traditions like Vedanta, Jainism, Buddhism, Taoism, and Quantum world and its relevance in the present times.

Keywords: Buddhism, Industry Jainism, Quantum, Tao, Vedanta

Introduction:

The current pervasive pattern of behavior of consumption and Industrialization has given a tremendous surge to the introduction of varieties and options in product and service usages. These have made it possible for people to have a life of comforts. Sustainable consumption encompasses the sustainable management of resources. Considerations for the natural environment and having the right perspective of referring to the interplay between people, consumption, and nature is a matter of concern. Though a lot of effort has been taken to curb environmental hazards but still the menace to the environment is drastically growing. We are at the crossroads of getting material comforts and ensuring a sustainable living. To what extent can science, technology and surveillance systems guide us? A lot of environmental problem is attitude based and can attitude to be changed by technology? This research article aims in getting some key tenets from select eastern traditions and dwell how it can change our attitude towards environment.

nd the macrocosm is connected. In the present context the environmental damage is caused by excessive innovations and stuffing our planet with excess products and wastes and the same is coming

1 Vedic Approach to Environment

Nature was considered a protector and parent by the Vedic Aryans. Nature has inherent forces and they get visible through earthquakes, floods, drought, heavy lightning, storms, avalanche, thunderclaps, and ecological cycles. These are the demonstrable forces of nature that make man aware of nature at times. The distinct aspect of nature from the Vedic perspective is nature is divine – It is in *Rig Veda* where *vayu* or air is regarded as the soul of human beings. Lord *Vayu* is the soul and spirit of *Indra* and all other gods and living beings is the seed of the world. Such a divine lord flows according to its own will. The *Vedic* gods were not anthropomorphic rather they were very natur*al like Agni*(fire*), Prithvi*(Earth)*, apah*(water)*, and Vaayu*(air). In *Yajurveda*, one of the dictum is "*Yatha pinde, tatha Brahmande, Yatha Brahmande tatha Pinde*". As is the body or the individual so is the universe or the external world and as is the universe or the external world so is the body. It conveys that the microcosm a

to us as a health hazard. Taking lessons from *vedic* tradition particularly the *advaita* school which has many tenets to delve into.

1.1 The Advaita Perspective of Discipline :

Advaita is one of the prominent schools of *Vedanta* that got widespread by Adi Shankaracharya around the 8th century AD. The main tenet of *Advaita* tradition is the concept of oneness and that is represented through *Brahman*. The *Advaita* tradition has systematized and summarized the requirement of discipleship into four interrelated qualities or values. These are collectively referred to as the fourfold means *(sādhanacatustaya)* and include *Viveka, vairāgya, samādisatkasampatti,* and *mumukksutvam*. Sankara's commentary on the *Brahmasutra* gives importance to "discrimination between the eternal and non-eternal, dispassion for the enjoyment of the fruits (of work) here and hereafter; perfection of such practices as control of the mind, control of the sense organs. In the marketing parlance, the relevance of the above four tenets as a practice is very pertinent. Considering the four values in the context of an individual's responsibility towards the environment are.[1]

1) ***Viveka–*** *Viveka* is the capability to discriminate between the timeless (*nitya*) and time-bound (*anitya*). In the *Vedic* perspective, it is *Brahman* that is eternal and the material world is temporal. *Brahman* is an abstract concept and mortal humans have difficulty in comprehending it and surrendering to it for liberation, but the same mind can develop the capability to make it simpler in taking the temporal present world to *nitya* in considering it as nature, which evolved and continues to evolve as a timeless entity. As the knowledge of the *Brahman* is an outcome of inquiry (*jignasa*) into the nature of *Brahman* and the same attitude that is *jignasa* can be for the eternal nature which is our home.

Understanding the *Upanishads* demands a sharp mind and understanding the workings of nature demands an intrusive, spirited, and observant mind. Applying *Viveka* in the decisions of marketing policy, innovation, and consumption keeping the timeless entity as nature in place can have significance. 2)

Vairāgya – *Vairāgya* is not having an attachment for the objects. Marketing throws objects physically on the shelves of the stores and the mind through audiovisual media. In the age of virtual media and e-shopping, the attachment to glittering objects is magnified. The activity of marketing facilitates both the physical and mental indulgences in many products that get generated in the factories. *A vairāgin* (one who possesses *vairāgya*) does not criticize worldly objects but is detached and in a state of joy. Products and objects have their necessities as it gives comfort and progress to humanity. What is detrimental is the state of greed and hyper-consumption that leads to the stuffing of the planet. We dwell in consumption and consumption is too much rampant in our society. A sense of dispassion for material objects and remaining contended with just the necessities can save the earth from excess waste.

3) ***Śamādhisatkasampatti***– This discipleship requires six qualities which are: *sama, dama, uparana, titiksā, sraddhā*, and *samādhāna*. These qualities are like culturing our minds to look into the realities of things as they are. The mind we possess is conditioned and this conditioning generates us to be always in a state of demanding and unsatisfied as if redemption in this world is only possible through objectification. Getting an understanding of these six qualities can be liberating from the present matrix that is created in a consumption-driven world.

[1] Rambachan, Anantanand. The Advaita Worldview (Delhi: Divine Books, 2012), 21.

Śama – *Sama* is controlling one's mind. A mind is the product of the surroundings and the habits that are cultivated and it is the natural tendency of the mind to get attracted to objects and anything used in the zone of familiarity. A person who has cultivated the quality of *sama* can look beyond the objects by reflecting on anything that has a determinate dimension. We tend to buy objects because our mind directs us to purchase them. A sense of discriminatory power can facilitate us to develop *sama*

Dama– *Dama* is regulation over the senses. Sales promotion and advertisement titillate the senses. *Dama* as a quality is mastering the actions of the senses and giving rest to the senses as they demand. If one falls prey to all the stimulations of the surroundings, then our life would revolve around the object of stimulations. We are sensorial beings and man is always striving to satisfy the senses and this leads us to indulge. A sense of awareness of the abstract world like aesthetics, art, culture and being in the abstractness can help us not be too indulgent.

Uparana– *Uparana* is the authentic conduct of one's duties. An inward look and less focus on the externalities are the essences. In the Hindu tradition, it is the *asrama* (one's stage) of life and *Varana* (one's caste) that defines one's dharma which is also referred to as a duty. The integration of the two is known as *varnashrama* dharma. This system has its critics in the dimension of creating inequality. But seeing it from the perspective of sacredness and performing one's duty as an obligation tunes one to be with time and remain focused inward. Societies have changed and progressed and surpassed many ancient scriptural tenets. Considering the *asrama* that is one's stages (*brahmacharya, grihastha, vanāprasthya,* and *sannyāsa*) has significance. If one contemplates how long can one remain in the state of influence by the bombardments of glitz through all media? The *āsrama* offers discipline and sobering lessons of tunings one's passion and being tuned to self and not getting too much attached to the externalities.

Titikkshā – This is the ability to withstand life's contraries. Pain, pleasure, comfort, and discomfort are the very parcel of life. Marketing aims in promising a life that can be filled with comfort and that creates a production-centric economy. A sense of endurance to be cultivated. Man tends to ease out stress by binge shopping and consuming. An equilibrium point is part of normative ethics that balances the very existence of life.

Śraddhā – *Śraddhā* is the faith in the ultimate. The sacred scriptures across the world have tenets to be

contemplated. Having faith in the scriptures is an attitude that is lacking in a large part of humanity. Reading habits has fallen drastically for the present generation. The ancient *rishis* that is seers have experienced something profound and then created the scriptures. The *Upanishads* comments, it is for humans to cultivate a mind to penetrate and develop an inquiring mind to cogitate on *Brahman*. Here in contemporary times, it is cogitating on the ecology and its subtle intelligence that keeps life throbbing. Most of the scriptures emphasis on the connectedness among the being and nature. Having faith in planetary intelligence is like having the respect for ultimate intelligence that sustains life.

Samadhānā– *Samādhāna* is the ability to focus and be able to stay on a path without getting side-tracked. Once one decides to follow a path of accountability towards a larger goal, the mind gets cultivated to follow the principle which is beneficial for a larger goal. Marketing as a discipline offers a panorama of material fineness and the fineness of the subtle intelligence that makes life to breathe gets side-tracked.

Mumukshutva– This is an intense desire for liberation arising from the exploration of the fact that

anything finite does not resolve one's experience of wants and dissatisfactions. Organizations are busy with strategic and tactical marketing formulations. In the present context liberation from too much material concern and developing the mind to appreciate the subtleties and nuances of nature can have a calming effect.

1.2 Dharma and R.ta

The word '*dharma*' comes from the verbal root *'dhr'* which means 'to hold', 'to sustain', or 'to support'. Thus *dharma* stands for the individual essence of objects or for the inner law by which they are sustained or supported and *'ṛta'* is taken to have come out of the root 'R' which is supposed to have two primary groups of meanings. It signifies 'to move' and (through movement) 'to fit or to arrange' in its original form the concept of *ṛta* is found to be a repository of cosmic order, especially the order of the heavenly bodies, the day and night, and the various seasons.[2]

In considering *dharma*, we find the essence that is sustained and binds *dharma* as a concept, is the root of all supporting elements, and in the context of sustainability, the essence of the objects of the earth must be there as it is. Yes, man has the intelligence and will to harness the earth to fit its existence but that has a limit. The present criticism of the anthropocentric view is domination which surpasses the diversity and the intrinsic intelligence of the planet. The planet to thrive has to have a diversity of species and the diversity has evolved to make all the species closely knitted in ecology, we call it through cycles of life like the water cycle, carbon cycle, phosphorus cycle, oxygen cycle, and so on. These cycles are cycles as they continue with their services uninterrupted and make life happen.

There is intelligence in ecological cycles that makes life vibrant and proliferous. The concern is how marketing disrupts these sensitive cycles and creates an unsustainable pattern of life. Here, the more radical question is why we need to discuss the issue of sustainability when it is not an issue as the planet as an organic unity has evolved to make life sustainable. The earth is given to us where we can enjoy the fruits of evolution and the state of the earth in a pristine form is sustainable for the generation to enjoy. The teleological view is to sustain and that is the *dharma* of the earth which is supported by the course of things and that is in order. Considering the native proverb "*We do not inherit the earth from our parents, we borrow it from our children"* this is a profound saying as it makes us concerned about the generation which is in the way. The way to remain smooth depends on the order; the order that is the essence of the earth gets chaotic by the single species' domination. *Dharma* makes us expand the view from single-species domination to a biocentric view where all other organisms are valued as their intrinsic domain. In addition to the bio-centric view, *dharma* facilitates to value eco-centric approach which believes that the communities and ties among the diverse biology have an inherent value that has to be protected. So contemplation on the tenets from *dharma* and *rta* helps us to expand our intellectual horizon and realize that sustainability itself is the intrinsic dimension of our planet Earth and we are fouling our nest with distorted intelligence and that requires a correction and that requires us to see the pattern and order that evolved to make life sustainable.

2.The Jaina Perspective :

Rishabha was the founder of *Jainism*. It was taught by twenty-four *Tirthankāras* who attained liberation. *Jaina* ethics is the ethics of *ahimsa* (non-violence) and asceticism. The *Jaina* religion is the worship of the *Tirthankāras* and the attainment of liberation by sheer self-exertion. It is the religion of self-help. Divinity is innate in the human soul. It

[2] Tiwari, Nath Kedar. Classical Indian Thought, A Philosophical Study of Hindu, Jaina, and Buddha Morals, (Delhi: Motilal Banarsidass Publishers, 2007), 121

shines forth in its innate glory when it completely extirpates the veil of *karmic* matter that covers the soul and obscures its infinite knowledge, infinite perception, infinite bliss, and infinite power. The ethical discipline of *Jaina* philosophy is comprehensive and a path towards self-purification and some of its tenets are similar to the *Vedic* perspective. The subjective inhibition is brought by seven disciplines and they are vows, careful attitude, restraints, observances, meditations, victory over troubles, and right conduct.[3]

Marketing generates ongoing stimulations and as we are walled and caged by the media, the barrage of products creates a subconscious realm to use and be gratified. Our subconscious is ninety percent of our existence and our consciousness is driven by the subconscious and this subconscious space is being controlled by the billion-dollar industry of advertisement. There is a minimal chance that one can be away from the assaults of space and place-based marketing promotion. Even if one forces oneself to stay away from media, one's interaction with others who are exposed to the assault of media and promotion can result in getting hooked and surrendering to consuming patterns. Here meditation as one of the ethical tenets can come to rescue. In the marketing context, how can this point get processed? It may sound too far-fetched in the world of hyper industrialization where the collective mind is conditioned to remain logged always in some type of notifications. *Jainism* offers us a realistic perspective as it gives us the perspective to go beyond the now and look into the cycles of empirical life. In marketing there is a product life cycle that is, every product has its origin, maturity, growth, and death, and then a new cycle gets incepted and this goes on and on. Capitalists taking heed from *Jainism* can have an understanding of the cycles of nature and get conscious and responsible with the production system which can be in harmony with the cycles of nature. In this connection the book *Natural Capitalism–Creating the Next Industrial Revolution,* Paul Hawken, emphasizes a new business model that enables companies to fully realize natural capital and the ecological systems that provide life-support services to society and all living beings. The author's emphasis on the four points has a paradigm shift in the way business is done conventionally and they are: radically increasing the productivity of natural resources, shifting to biologically inspired production models and materials, moving to a "service and flow" business model, reinvest in natural capital. The cycles of life are organic and marketing can take the lessons primarily in making reinvestment in the natural capital then it can be considered as the right conduct which can have a positive impact on the natural environment.

3. The Buddhist Ethics :

Buddha's teaching aims at the total extinction of suffering and the attainment of *nirvana* here on earth. The theme of Buddhism is moderation.
Buddha has given the doctrine of ethical means. The eightfold path (right understanding, right thought, right speech, right action, right livelihood, right effort, right mindfulness, and right concentration) is the path towards an ethical practice to cultivate self and lead towards a life free from suffering. Modern man suffers from a state of non-well-being. The progress of a nation is calculated through GDP which is just a fragment of a larger spectrum. organizations exist to multiply and the principle applied is of multiplication and proliferation of innovations and ensuring that products have a shorter life cycle and letting people buy more. Creating a built-in product that doesn't last long and creating substandard products has become the marketing tactic. This leads to more products cycling the market and the revenue that is generated is amassed which makes the directors and owners of organizations happy but alas, the ignorance of the directors, entrepreneurs, and

[3] Sinha, Jadunath Sinha. Outlines of Indian Philosophy, (Kolkata: New Central Book Agency (P) Ltd, 2013), 120.

policymakers is stark and their eyes are transfixed towards the bottom line of revenue and not towards the ecological crisis. Buddha's point on 'Right livelihood' consists of earning a living by honest means. Earning one's livelihood by under-weights, fraudulence, bribery, ingratitude, crookedness, mutilation, persecution, confinement, robbery, and plunder is forbidden. Heeding the right livelihood is again a reinforcement of normative ethics.[4]

The doctrine of *pratityasamutpada* in Buddhism is the ultimate knowledge that has the potential to end all misery. According to Buddha, all phenomenal things hang between reality and nothingness, avoiding both extremes. Buddha proposes the doctrine of the middle path, *Madhyama Pratipat*, which avoids both eternalism and nihilism. This is the learning where extreme consumption and wastages have to be regulated and move towards a conscious living. Modern consumption and production are showing enough environmental symptoms to get cautious, and nature works according to its law which is dharma. Nature follows flows and cycles and that is its dharma. He who sees *Pratityasamutpada* sees the Dharma, and he who sees Dharma sees the *pratityasamutpada.* Failure to grasp it, is the cause of misery.[5]

4. Taoist Perspective :

Lao Tzu was perhaps the world's first theoretical physicist. He devoted all of his intellectual energy to observing nature and its physical laws and to noting the interdependent relationship of all things. He saw a unified field of forces that he called Tao, but because what he saw could not be expressed in a logical, analytical fashion, he conveyed it through paradox. Lao Tzu believed that everything that exists comes into reality through the polarity of yin and yang. Lao Tzu believed that people and their attitudes and actions are inseparable from the physical phenomena surrounding them; and that either might alter the reality of the other.[6] Tao offers tremendous insight into the working of our way. The deeper one wants to go, the deeper one can penetrate. Our knowledge of the external world and our internal world has been explored and we do have a great deal of knowledge Tao gives an additional dimension in an intuitive way that has the potency for transformation. The cognitive understanding of nature leads us to deal with environmental science and the intuitive understanding facilitates us to deal with environmental philosophy.

Tao as a philosophy is the philosophy of alignment and it explores the power that is possessed by every individual which is denoted by *Te*, and *Te* emerges, when one is in a state of awareness and tune with the forces in nature (Tao). Environmental ethics as a discipline is also the ethics of self as self and nature is in a participatory dance. As the physicist, Werner Heisenberg stated, "Natural science does not simply describe and explain nature; it is a part of the interplay between nature and us, what we observe is not nature itself, but nature exposed to our method of questioning." This questioning attitude can be the genesis to change our attitude toward the way we are in the world. Marketing has conditioned us as we have allowed it to condition us and this conditioning has gone deep. As competition increases the tools for conditioning the population are getting more potent. Tao offers the power and this can be of help if it is exercised. Marketing promotes competitive value and the marketing literature is filled with developing and honing a competitive advantage on the contrary, Tao promotes non-competitive value.[7] All things are in interrelations and connected and in harmony and this is the wisdom of Tao. One of the principle of Tao is reversal that is turning back. When anything goes to one extreme then it will turn to its origin. Can the economy be growing infinitely? Are there any limits

[4] Ibid., Jadunath Sinha, 97.
[5] Sharma, Chandradhar. A Critical Survey of Indian Philosophy (Delhi: Motilal Banarsidass Publisher, 2009), 73.
[6] Wing, R. L. The Tao of Power, A Translation of the Tao Te Ching by Lao Tzu (New York: Doubleday, 1986), 14.
[7] Ibid., R.L. Wing, 8.

to capitalistic growth? The present capitalistic society is in the momentum of growth. Can the policy makers and marketers imbibe the wisdom of Tao in Business.?

5.Quantum World View :

Newton's great work showed that the Earth, the moon, and the planets are governed by the same law as falling apples. The French mathematician, Rene Descartes, invented a way of drawing pictures of relationships between different measurements of time and distance. This process (analytic geometry) is a wonderful tool for organizing the wealth of scattered data into one meaningful pattern.[8] The world is better understood from a reductive material perspective and this still prevails but there is more to understand the world. The world of determinism is being paved through scientific principles and it has its efficacy but is that all.? "Quantum worldview" as proposed by some leading-edge physicists such as David Bohm (1983), Fritjof Capra (1982) and Danah Zohar (1990) has a different perspective where we dwell in the subatomic world. Quantum mechanics, the discipline of physics, posits that the realm of the atom and its beyond doesn't have any predefined structure and the emergence of the structure manifests only when humans or the observer participates. Amit Goswami in his book *Self-Aware Universe* gives his argument in having an idealist theory of ethics through a scientific foundation. One of the ideas that Goswami poses is that "the idea that we are classical machines and therefore determined by our genetic and environmental conditioning has played a major role in eroding the importance of ethics and values in our society". It is our explosive society that is exploding with greed and manufactured needs that seeds consumption as if the redemption of humans is in consuming and experiencing pleasure. Quantum theory defines our consciousness as the chooser. Is the purpose of idealist ethics to define good choices as opposed to bad choices, to categorize right and wrong better than the realist ethics ?[9]

The worldview is schemas or leitmotifs that we carry and mix our sense of self with others and get the connection with nature, our surroundings, our society, our planet, and to the higher power. As Danah Zohar in her book The Quantum Self says "A successful worldview must, in the end, draw all these levels—the personal, the social, the spiritual—into one coherent whole. If it does so, the individual has access to some sense of who he is, why he is here, how he relates to others, and how it is valuable to behave".[10]

The quantum worldview stresses the dynamic relationship between the observer and the thing observed. There is a difference between environmental science and environmental ethics and sometimes they are in contradiction. Science is domineering and things it can tame and solve environmental problems but nature has its way of responding. In the book, *Buddha and the Quantum*, Samuel Avery says, "Science in the twentieth century reached a point where it could no longer ignore consciousness. At extremes of distance, size, time, velocity, mass, and temperature, things were happening that depended on someone experiencing them. Science discovered something that it did not understand and has not understood since the quantum, it found the quantum in the objective world—in space—but it was not really in space, it was space".[11]

[8] Zukav, Gary. The Dancing Wu Li Masters–An Overview of the New Physics (New York: A Bantam New Age Book, 1980), 304
[9] Goswami, Amit. The Self-Aware Universe—How Consciousness Creates the Material World (New York: Jeremy P. Tarcher/Putnam, 1995), 261.
[10] Zohar, Danah. The Quantum Self, Human Nature and Consciousness Defined by the New Physics, New York: Quill/William Morrow, New York, 1990), 233.
[11] Avery, Samuel. Buddha, and the Quantum (Boulder CO, Sentient Publications, 2011), 4.

Conclusion :

Reality is in now and man's interaction with the environment is based on beliefs and these beliefs are the mental models to function. Whatever happens

now has a bearing on the surroundings. In contemporary civilization, our educational system is modernized, and keeping pace with time we have moved far away from our tradition and ancient system of thoughts and practices. The ancient systems of knowledge emphasis on the interrelationship with man and nature and we are all connected. The question is to what extent the wisdom from the ancient times and modern revelations can get implemented by the industrialists, marketing practices, management

students. Can the curriculum of ancient knowledge system be a vital part of engineering and

management disciplines? Contemplating traditions and ancient knowledge systems like Vedanta, Jainism, Buddhism, Taoistic philosophy, and cutting-edge knowledge from quantum theory opens up from the cognitive jail. In environmental ethics, the instrumental and the intrinsic view are widely discussed, and getting to the crux of the intrinsic value is slippery and also subjective. Taking into account the ancient view, the intrinsic view of nature can be better realized.

Declaration – There is no conflict of Interest

International Multidisciplinary Research E-Journal Online Available at http://gater.in/
INTERNATIONAL PEER REVIEWED JOURNAL
OF GLOBAL ASSOCIATION FOR TRAINING, EDUCATION & RESEARCH
(GLOBAL CONSORTIUM OF PROFESSIONALS, TRAINERS, ACADEMICIANS & RESEARCHERS)

The impact of biotechnology on food production : a paradigm

Mini Devi[1], Nikita Tushir[1] and Nidarshana Chaturvedi Parashar*[1]

[1]Department of Biosciences and technology
Maharishi Markandeshwar (Deemed to be University), Mullana, Ambala (Haryana) India
*Email of corresponding author: nidarshanachaturvedi@gmail.com

ABSTRACT :

Biotechnology, a dynamic and evolving field, has emerged as a paramount force shaping our scientific, economic, and societal landscapes. This comprehensive review paper offers a panoramic view of biotechnology, spanning its historical trajectory, contemporary influence, and the impending trends and challenges that defines its future. Tracing the historical roots of biotechnology, from early agricultural practices to the Green Revolution, the transformative power of genetic engineering and precision breeding techniques were explicated that have revolutionized crop production and food security (Pingali, 2012). Genetic modifications, exemplified by crops like Bt cotton and drought-tolerant maize, has ushered in an era of resilient and high-yielding varieties. Concurrently, biotechnological advancements have redefined food processing and preservation, elevating food safety and nutritional enrichment (Gosal et al., 2010), (Yang et al., 2023). Looking forward, several pivotal trends can be discerned. The precision of gene editing tools, epitomized by CRISPR-Cas9, promises unprecedented accuracy in genetic manipulation, with applications spanning medicine, agriculture, and beyond (El-Mounadi et al., 2020). Personalized medicine, driven by genomic insights, holds the potential to revolutionize healthcare, tailoring treatments to individual genetic profiles. Synthetic biology, on the other hand, offers the prospect of designing bespoke biological systems, addressing challenges from renewable energy production to environmental remediation. Agriculture is poised to embrace climate-resilient crops and sustainable practices, further enhancing food security and ecological stewardship (Das et al., 2023). However, this biotechnological conquest is not without its challenges. Ethical and regulatory landscapes must adapt swiftly to safeguard responsible innovation and equitable access to these breakthroughs. Data privacy concerns loom large, particularly in the era of personalized medicine and genomic data sharing. Environmental sustainability is of prime importance, as biotechnology's expanding footprint requires vigilant monitoring and resource management to mitigate potential impacts (Frewer et al., 1994). The path ahead invites profound exploration, promising to redefine the boundaries of science, medicine, agriculture, and industry (Moshelion & Altman, 2015),(Barea, 2015) In conclusion, the future of biotechnology is a narrative of promise and complexity. This review thus primarily emphasizes the need for a balanced, ethical, and informed approach to harness biotechnology's potential while addressing its ethical, environmental, and societal dimensions.

Key words: Biotechnology, Gene modification in agriculture, CRISPR-Cas, Gene editing, Food processing, Agricultural innovation.

1. INTRODUCTION :

In broad terms, biotechnology is a method that employs living organisms or their components to produce or adjust products for a practical purpose (N.Swapna, 2010).The most essential and fundamental necessity of man is for staple foods to meet his minimal nutritional needs and maintain human life on earth.

Since the beginning of time, man has relied on agriculture and cattle to supply his food needs (Benefits, n.d.). However, there will be a significant need to substantially increase crop production to meet the demand. Biotechnology's potential to serve as a tool in addressing this challenge is far from being fully realized (Najafi & Lee, 2014). The impact of biotechnology on food production has been nothing short of revolutionary in the realm of agriculture and the global food supply. In recent decades, biotechnological advancements have not only transformed the way we cultivate and harvest crops but have also played a pivotal role in addressing the mounting challenges of a growing global population, climate change, and food security (Amiri et al., 2021). This dynamic field of science has enabled the development of genetically modified organisms (GMOs), precision breeding techniques, and novel agricultural practices that enhance crop yields, augment crop resilience, and reduce the environmental footprint of agriculture (Tsatsakis et al., 2017). As we delve into the multifaceted effects of biotechnology on food production, it becomes evident that this technological frontier holds immense promise and potential for shaping the future of sustainable and abundant food resources for humanity (Grover, n.d.), (Frewer et al., 1994). In addition to bolstering crop yields and agricultural sustainability, biotechnology has ushered in a new era of precision and specificity in food production. One of its significant contributions lies in the development of genetically modified crops that are engineered to exhibit specific traits, such as resistance to pests, tolerance to herbicides, or enhanced nutritional content (F. Hossain et al., 2004). Genetically modified crops have not only streamlined farming practices by reducing the need for chemical pesticides and excessive water usage but have also led to the creation of more resilient crops capable of withstanding challenging environmental conditions (Burnham, 2003). Furthermore, biotechnology has paved the way for the development of specialized crops tailored to the dietary and nutritional needs of diverse populations, potentially addressing malnutrition and enhancing the nutritional value of staple foods. As we explore the nuanced impact of biotechnology on food production, it becomes evident that this field continues to evolve and redefine the possibilities of sustainable and efficient agriculture (Sharma et al., 2014).

Moreover, biotechnology has extended its reach beyond crop modification to encompass various aspects of food processing and preservation. The utilization of biotechnological tools in food manufacturing and processing has led to innovations in food safety, shelf-life extension, and the development of novel food products (Tyczewska et al., 2023). Enzymes and microorganisms derived from biotechnological processes are employed to enhance the flavor, texture, and nutritional profile of a wide range of food items. Additionally, the application of biotechnology in food preservation methods, such as fermentation and bio-preservation, has also played a pivotal role in reducing food waste and enhancing the availability of nutritious food products (Benefits, n.d.). These advancements not only contribute to the diversification of food choices but also have the potential to address the challenge of providing safe and nutritious food to a growing global population while minimizing the environmental impact of food production and distribution. The intersection of biotechnology and food science holds promise for the continued improvement of food quality, safety, and accessibility, making it a crucial component of the

modern food production landscape (Selvakumar, P., n.d.),(Vågsholm et al., 2020). Biotechnology's profound influence on food production is reshaping agriculture and addressing critical challenges in food security and sustainability. The current review exploration will delve into the myriad ways biotechnology is transforming the global food landscape, offering insights into its promise and complexities (Mattick, 2018).

2. Historical perspective – History of biotechnology in agriculture and food production.

The history of biotechnology in agriculture and food production is a fascinating journey through scientific breakthroughs, technological innovations, and their profound impact on how we produce, process, and consume food. To understand this historical perspective, explore key milestones and developments in the field(Selvakumar, P., n.d.).

1. Early Agricultural Practices: Biotechnology's roots in agriculture can be traced back thousands of years when early farmers began selectively breeding plants and animals to enhance desirable traits. This rudimentary form of biotechnology laid the foundation for modern crop improvement (Tyczewska et al., 2023),(Rischer et al., 2020).

2. The Green Revolution (mid-20th century): This period saw the emergence of high-yielding crop varieties, such as dwarf wheat and rice, developed through conventional breeding techniques. These varieties, coupled with increased fertilizer and pesticide use, significantly boosted agricultural productivity and helped alleviate food shortages in many parts of the world (Pingali, 2012), (Mattick, 2018).

3. The Advent of Genetic Engineering (1970s): The 1970s marked a turning point with the development of genetic engineering techniques, including the creation of the first genetically modified organism (GMO) in 1973. This breakthrough allowed scientists to directly manipulate the DNA of organisms, opening up new possibilities for crop improvement (Khan et al., 2023).

4. Commercialization of GMOs (1990s): In the 1990s, GMO crops, such as Bt cotton and Roundup Ready soybeans, were introduced commercially. These crops were engineered for traits like pest resistance and herbicide tolerance, reducing the need for chemical inputs and increasing yields(Brookes & Barfoot, 2017),(Tsatsakis et al., 2017),(Robert M. Goodman, n.d.).

5. Biotechnology and Food Processing: Biotechnology also revolutionized food processing and preservation. Enzymes and microorganisms derived from biotech processes, have been used to improve food quality, shelf life and safety. Fermentation techniques have been harnessed to create a wide range of food products, from yogurt to bread (Cao et al., 2021).

6. Challenges and Controversies: The adoption of GMOs sparked debates over safety, environmental impacts, and ethical considerations. These controversies continue to shape public perception and regulatory policies regarding biotechnology in agriculture (Hesham et al., 2021).

7. Precision Breeding Techniques: Recent advances in biotechnology have given rise to precision breeding techniques like CRISPR-Cas9, enabling precise gene editing in crops without introducing foreign DNA (El-Mounadi et al., 2020). This technology has the potential to accelerate crop improvement while addressing some concerns associated with GMOs (Arora & Narula, 2017).

8. Sustainability and Climate Change: Biotechnology is increasingly being leveraged to develop crops that are more resilient to climate change, require fewer resources, and reduce the environmental footprint of agriculture (Das et al., 2023).

9. Global Impact: Biotechnology in agriculture has played a vital role in feeding a growing global population, addressing malnutrition, and improving food security. It continues to be a critical tool in meeting the food demands of the future (Khan et al., 2023).

3. Biotechnological techniques: various biotechnological techniques used in food production. Biotechnological techniques encompass a wide array of methods and applications that have transformed food production in numerous ways. Various biotechnological methods used in food production are discussed in detail (Aboul-Maaty & Oraby, 2019) (Niazian, 2019):

3.1 Genetically Modified Organisms (GMOs):

Crop Improvement: GMOs are crops genetic material or DNA of which has been altered through genetic engineering to exhibit specific traits. These traits can include resistance to pests, tolerance to herbicides, increased nutritional content, and improved yield potential. For example, Bt cotton produces a protein toxic to certain insect pests, reducing the need for chemical pesticides (F. Hossain et al., 2004),(Phipps & Park, 2002).

Disease Resistance: Biotechnology has also been used to develop crops with enhanced resistance to diseases, thereby reducing crop losses and improving food security (Brookes & Barfoot, 2017).

Drought Tolerance: Researchers are also working on creating drought-tolerant crops to address water scarcity issues in agriculture (Phipps & Park, 2002).

3.2 Precision Breeding:

CRISPR-Cas9: This revolutionary gene-editing technique allows scientists to make precise modifications to an organism's DNA without introducing foreign genes. In agriculture, CRISPR-Cas9 is used to develop crops with targeted improvements, such as resistance to specific diseases or improved nutritional content (Khan et al., 2023),(Gaj et al., 2013).

3.3 Fermentation and Food Processing :

Enhanced Fermentation: Biotechnology has improved the fermentation process for various food products like yogurt, cheese, and bread, leading to better taste, texture, and nutritional profiles (Galimberti et al., 2021).

Bio-Preservation: Beneficial microorganisms are used to inhibit the growth of spoilage and pathogenic bacteria in food, extending its shelf life and reducing food waste(Nurye Gebeyehu, 2023).

3.4 Food Safety :

Molecular Diagnostics: Biotechnological techniques are employed for the rapid and accurate detection of foodborne pathogens and contaminants. Polymerase chain reaction (PCR) and DNA-based tests are examples of these methods (Vågsholm et al., 2020).

Traceability: DNA barcoding and molecular markers help trace the origin and authenticity of food products, enhancing food safety and quality control (Zhao et al., 2020).

3.5 Nutrigenomics :

Personalized Nutrition: Nutrigenomics studies how an individual's genetic makeup influences their response to dietary components. Biotechnology allows for personalized dietary recommendations based on genetic profiles, improving health outcomes (Adetunji et al., 2023).

3.6 Aquaculture :

Selective Breeding: Biotechnology is used to selectively breed fish and shellfish for desirable traits like growth rate, disease resistance, and meat quality, contributing to sustainable aquaculture (Pradeepkiran, 2019).

3.7 Vertical Farming and Controlled Environment Agriculture :

Biotech for Crop Optimization: In controlled environments like vertical farms, biotechnological tools are employed to optimize growing conditions, nutrient delivery, and crop genetics, resulting in higher yields and resource efficiency (Shewry et al., 2008).

3.8 Reducing Post-Harvest Losses :

Biodegradable Packaging : Biotechnology has led to the development of biodegradable and edible packaging materials that extend the shelf life of food products and reduce packaging waste (Roy & Rhim, 2022).

3.9 Alternative Protein Sources :

Cultured Meat: Biotechnology plays a pivotal role in the production of cultured or lab-grown meat, offering a sustainable and ethical alternative to traditional livestock farming (Zhao et al., 2020).

3.10 Biofortification :

Enhanced Nutritional Content : Biotechnology is used to enhance the nutritional content of staple crops, such as vitamin A-enriched "Golden Rice" or iron-fortified beans, to address malnutrition in vulnerable populations (Hefferon, 2015).

4.Nutritional enhancement- biotechnology has been used to enhance the nutritional content of food products

Biotechnology has played a pivotal role in nutritional enhancement, revolutionizing the nutritional content of various food products. Through a combination of genetic modification, precision breeding, and innovative biotechnological techniques, it has now become possible to address specific nutrient deficiencies and improve the overall nutritional profile of foods (Hefferon, 2015). One notable example of nutritional enhancement through biotechnology is the development of Golden Rice. This genetically modified rice variety is engineered to produce beta-carotene, a precursor of vitamin A. Vitamin A deficiency is a significant health issue, particularly in regions where rice is a staple food (Paine et al., 2005). Golden Rice offers a solution by providing an additional source of vitamin A in the diet, potentially saving millions of lives and preventing blindness in vulnerable populations (Pérez-Massot et al., 2013),(Al-Babili & Beyer, 2005). Beyond addressing nutrient deficiencies, biotechnology has enabled the creation of crops with improved protein quality. For instance, soybeans, a prominent plant-based protein source, can be genetically modified to contain higher levels of essential amino acids (Robert M. Goodman, n.d.). This enhancement ensures that plant-based diets can offer a completer and more balanced source of protein, meeting the nutritional needs of vegetarians and vegans more effectively (Bawa & Anilakumar, 2013).

Biotechnology also contributes to the reduction of anti-nutrients in certain crops. Anti-nutrients are compounds that interfere with the absorption of essential nutrients in the body. By using biotechnological methods to decrease anti-nutrient levels, the bioavailability of vital nutrients can also be enhanced, ensuring that the nutrients in food are better absorbed and utilized by the body. Another crucial aspect of nutritional fortification involves increasing the nutrient density of staple crops. Nutrient density refers to the concentration of essential nutrients in a given food product. Biotechnology, including genetic modification and gene editing, allows for the development of crops like maize and wheat that contain higher levels of key nutrients (Glenn, 2008),(Napier et al., 2019). This means that individuals can derive more nutritional value from consuming the same quantity of these staple foods. Furthermore, biotechnology has facilitated allergen reduction in food products, making them safer for individuals with allergies. By modifying or removing allergenic proteins, biotechnology minimizes the risk of allergic reactions and broadens the range of safe food options for those with food allergies (Balwan et al., 2021). Biotechnology's ability to enhance the nutritional content of food products represents a significant breakthrough in addressing malnutrition, improving dietary quality, and promoting overall health. By developing crops with increased nutrient levels, better protein quality, reduced anti-nutrients, and allergen-reduced properties, biotechnology contributes to creating a healthier and safer food supply for a growing global population (Farre et al., 2011). Nevertheless, it is crucial to conduct rigorous safety assessments and adhere to regulatory guidelines to ensure that biotechnologically enhanced foods meet the highest standards of safety and quality (Tyczewska et al., 2023).

5. Improved crop traits- how biotechnology enhances crop traits (Pest resistance, drought tolerance).

Biotechnology has revolutionized agriculture by enhancing various crop traits, including pest resistance and drought tolerance. These improvements are essential for increasing agricultural productivity, ensuring food security, and mitigating the impacts of environmental stressors (Legendre & Demirer, 2023).

5.1 Pest Resistance :

Biotechnology has enabled the development of crops that exhibit resistance to pests, reducing the need for chemical pesticides and minimizing crop losses due to insect damage. One of the most well-known examples is Bt cotton, which has been genetically modified to produce a protein from the bacterium *Bacillus thuringiensis* (Bt)(Mubarik et al., 2021). This protein is toxic to certain insect pests, such as cotton bollworms and pink bollworms. When these pests feed on Bt cotton, they ingest the Bt protein and perish, thereby reducing the need for chemical insecticides and increasing crop yields (Carpenter et al., 2002). Another notable example is Bt maize, engineered to resist corn rootworm and European corn borer. By incorporating genes for pest resistance, biotechnology ensures that crops remain robust in the face of insect attacks. This not only benefits farmers by reducing input costs but also has environmental advantages by decreasing the use of chemical pesticides, which can harm non-target species and pollinators (Yang et al., 2023).

5.2 Drought Tolerance :

Biotechnology also contributes to improving crop resilience in water-scarce regions through the development of drought-tolerant varieties. These crops can maintain productivity even in conditions of limited water availability. Various biotechnological approaches are employed for achieving drought tolerance (González, 2023):

5.2.1 Genetic Modification : Genes responsible for drought tolerance, often sourced from drought-resistant plants, can be introduced into crops. These genes may enable better water utilization, reduced water loss through transpiration, or improved stress responses (Carpenter et al., 2002).

5.2.2 Selective Breeding : Traditional breeding techniques, guided by biotechnological tools like molecular markers, help identify and propagate crops with natural drought tolerance. This approach leverages the genetic diversity within crop species to develop resilient varieties (Haque et al., 2023).

5.2.3 Stress-Responsive Traits : Biotechnology allows researchers to identify and manipulate genes associated with stress responses in plants. By enhancing a plant's ability to withstand water scarcity, these traits ensure that crops continue to thrive even in challenging environments (Vennapusa et al., 2023).

One remarkable example is genetically modified maize that expresses genes responsible for improved water use efficiency. This genetically manipulated crop demonstrates enhanced drought tolerance, maintaining crop yields even during dry spells. Such innovations are crucial for regions vulnerable to changing weather patterns and prolonged droughts. Biotechnology has significantly advanced agriculture by enhancing crop traits like pest resistance and drought tolerance(Vennapusa et al., 2023),(Haque et al., 2023),(González, 2023). These innovations not only increase agricultural productivity but also contribute to sustainable farming practices by reducing the environmental impact of chemical pesticides and ensuring crop resilience in the face of climate change-related challenges(Legendre & Demirer, 2023). While biotechnology has immense potential, it is essential to continue rigorous safety assessments and regulatory oversight to ensure the responsible deployment of biotech crops for the benefit of global food security and sustainability (Najafi & Lee, 2014).

6. Environment impact: Environment consequences including biodiversity & soil health.

The environmental impact of biotechnology in agriculture, particularly regarding biodiversity and soil health, is a topic of considerable importance and debate. While biotechnology has brought about significant advancements in crop production, it also raises concerns about its potential consequences on the environment (Venkatesh et al., 2019).

6.1 Biodiversity :

Biotechnology, especially the cultivation of genetically modified (GM) crops, can have both positive and negative effects on biodiversity. On one hand, GM crops engineered for pest resistance can reduce the need for chemical pesticides, which can be harmful to non-target species and the environment. This reduction in pesticide use may contribute to the preservation of beneficial insects and wildlife in and around agricultural areas (Reed et al., 2011). On the other hand, there are concerns about the potential impacts of GM crops on non-target organisms and native plant species. For example, there is a risk that GM crops may unintentionally harm non-target insects, such as pollinators, through the expression of insecticidal proteins. Additionally, the cultivation of GM crops could lead to the displacement of native plant species, affecting local ecosystems and biodiversity (Brookes & Barfoot, 2017).

6.2 Soil Health :

Biotechnology's impact on soil health is a complex and multifaceted issue. While some biotech crops, such as herbicide-tolerant varieties, can reduce the need for tilling and soil disturbance, which can be beneficial for soil structure and microbial communities, other aspects require careful consideration (Kremer, 2017). The widespread cultivation of certain GM crops, particularly those resistant to herbicides like glyphosate, has led to concerns about herbicide-resistant weeds. These "superweeds" can emerge due to the overreliance on specific herbicides, which can negatively impact soil health(Venkatesh et al., 2019). Farmers may need to resort to alternative herbicides or more intensive tillage practices to control superweeds, potentially leading to soil erosion and degradation (Broeren et al., 2017). Moreover, the use of biotechnological techniques like genetic modification can have indirect effects on soil health by influencing crop choices and farming practices. For instance, the adoption of GM crops might lead to monoculture farming systems, which can deplete soil nutrients, disrupt soil microbial diversity, and increase the risk of soil erosion (Balwan et al., 2021).

The environmental impact of biotechnology in agriculture, particularly on biodiversity and soil health, is a complex and context-dependent issue. While biotechnology offers opportunities to reduce pesticide use and minimize soil disturbance, it also poses risks to non-target species and may influence farming practices in ways that can harm soil health (BONCIU, 2023). To address these concerns, it is crucial to conduct thorough risk assessments, implement best practices in agricultural management, and promote sustainable farming systems that consider the long-term impact on the environment. Additionally, ongoing research and monitoring are essential to better understand and mitigate the environmental consequences of biotechnology in agriculture (Broeren et al., 2017).

7. Future trends & Challenges- Future trends & innovation in biotechnology

The future of biotechnology promises to be marked by a host of exciting trends and innovations, poised to transform numerous aspects of our lives. One of the most prominent trends is the continued development and application of gene editing technologies like CRISPR-Cas9. These tools offer unprecedented precision in modifying genes, opening up possibilities for more targeted treatments for genetic diseases, advanced agricultural breeding, and the potential to address environmental challenges (M. A. Hossain & Roslan, 2023),(Schaeffer & Nakata, 2016). Biotechnology is also making significant strides in personalized medicine, where treatments and therapies are

tailored to an individual's genetic makeup. This approach holds immense potential for more effective and less invasive medical interventions, improving patient outcomes and reducing side effects (Moshelion & Altman, 2015). Furthermore, the field of synthetic biology is advancing rapidly, enabling scientists to design and construct new biological systems, from microorganisms that can produce biofuels to custom-designed organisms for medical or environmental purposes. This holds great promise for sustainable agriculture, renewable energy, and environmental remediation (Tait, n.d.). In agriculture, biotechnology is evolving toward the development of crops that are not only high-yielding but also resilient to climate change and capable of thriving in challenging conditions, addressing the global challenge of food security (Tait, n.d.). Vertical farming and controlled environment agriculture are likely to become more prevalent, enabling year-round cultivation in urban settings while minimizing resource use (BONCIU, 2023).

However, along with these promising trends, biotechnology also faces significant challenges. Ethical, legal, and regulatory considerations must keep pace with the rapid advancements, ensuring responsible and equitable use of biotechnological innovations. Questions regarding data privacy, biosecurity, and access to cutting-edge treatments and technologies need to be addressed to ensure broad societal benefits (M. A. Hossain & Roslan, 2023). Additionally, public awareness and understanding of biotechnology's capabilities and limitations will be crucial for informed decision-making and ethical discussions(Geada et al., 2018). Balancing innovation with ethical, environmental, and social considerations will be central to harnessing the full potential of biotechnology in the coming years. Despite these challenges, the future of biotechnology holds great promise for advancing science, medicine, agriculture, and industry, with transformative impacts on our society and the world.

Here's a comparison of future trends and challenges in biotechnology presented in a table :

Aspect	Future Trends & Innovations in Biotechnology	Challenges in Biotechnology	References
Gene Editing Advancements	-Development of precise gene editing technologies like CRISPR-Cas9.	- Ethical and regulatory concerns regarding genetic manipulation.	21,41
Personalized Medicine	-Increasing focus on personalized healthcare tailored to individual genetics.	-Data privacy and security concerns in handling personal genomic data.	25,35.
Synthetic Biology	- Advancements in designing and constructing custom biological systems.	-Ethical considerations and biosecurity in synthetic organism creation.	51,6
Resilient Crops	-Development of climate-resilient crops for improved food security.	- Environmental impact and resource management in agriculture.	66,8
Vertical Farming & Controlled Environment Agriculture	-Growth in urban agriculturewith year-round, resource-efficient crop production.	- Sustainability challenges and energy/resource requirements.	13,17
Ethical and Regulatory Considerations	- Establishment of robust ethical, legal, and regulatory frameworks.	-Ensuring responsible andequitable use of biotechnological innovations.	42,20
Biosecurity	- Secure handling and management of biotechnological materials.	-Preventing misuse and accidental release of potentially harmful organisms.	8,60
Data Privacy	-Addressing concerns relatedto data privacy and security.	- Safeguarding personal genomic data and ensuring secure sharing.	24,36
Access and Equity	- Ensuring equal access to biotechnological treatments and technologies.	-Avoiding disparities in access based on socioeconomic factors.	55,46
Public Awareness and Education	- Promoting public understanding of biotechnology.	-Facilitating informed decision-making and ethical discussions.	45,44
Environmental Impact	- Continuous assessment and mitigation of environmental impacts.	-Balancing benefits with potential environmental consequences.	38,16
Resource Management	-Sustainable resource use in biotechnology-driven agriculture and industry.	- Efficient use of resources like water and land.	65,57
Ethical Considerations	-Navigating ethical dilemmas in genetic modification and biotechnology.	- Addressing concerns about the manipulation of the human genome.	20,19

This table provides a concise overview of both the promising trends and the complex challenges that the field of biotechnology is expected to encounter in the coming years.

Conclusion :

In conclusion, the future of biotechnology holds great promise as it continues to advance and innovate across various sectors, from medicine to agriculture and beyond. The development of precise gene editing tools, personalized medicine, and synthetic biology techniques is poised to revolutionize healthcare, industry, and environmental management (Najafi & Lee, 2014). These innovations have the potential to improve the quality of life for individuals, enhance food security, and address pressing global challenges. However, alongside these transformative trends, biotechnology also faces a set of formidable challenges. Ethical and regulatory considerations are crucial to ensure responsible use and equitable access to biotechnological advancements (Ikegwu et al., 2023). Data privacy and biosecurity concerns demand vigilant safeguards to protect sensitive information and prevent misuse. Moreover, as biotechnology plays an increasingly prominent role in agriculture and industry, the environmental impact and resource management must be carefully monitored and managed to mitigate potential consequences (Traditional et al., 2009)(Azeem et al., 2023). Safeguarding public awareness and understanding of biotechnology will be essential in fostering informed discussions and decisions. In navigating these trends and challenges, the field of biotechnology is at a critical juncture, requiring a balanced and responsible approach to harness its full potential while addressing ethical, environmental, and societal considerations. The future of biotechnology promises to be transformative, but its responsible and equitable application remains a paramount concern in shaping a better tomorrow.

References

1. Aboul-Maaty, N. A.-F., & Oraby, H. A.-S. (2019). Extraction of high-quality genomic DNA from different plant orders applying a modified CTAB-based method. *Bulletin of the National Research Centre*, *43*(1), 1–10. https://doi.org/10.1186/s42269-019-0066-1
2. Adetunji, C. O., Olaniyan, O. T., Rebezov, M., Shariati, M. A., Ijabadeniyi, O. A., Ajayi, O. O., Inobeme, A., Ajiboye, M. D., Dauda, W. P., Ghazanfar, S., Adetunji, J. B., & Odoh, U. E. (2023). Roles of nutrigenomics in drug discovery and development. In *Role of Nutrigenomics in Modern-day Healthcare and Drug Discovery* (pp. 277–299). Elsevier. https://doi.org/10.1016/B978-0-12-824412-8.00016-3
3. Al-Babili, S., & Beyer, P. (2005). Golden Rice - Five years on the road - Five years to go? *Trends in Plant Science*, *10*(12), 565–573. https://doi.org/10.1016/j.tplants.2005.10.006
4. Amiri, S., Aghamirzaei, M., Mostashari, P., Sarbazi, M., Tizchang, S., & Madahi, H. (2021). The impact of biotechnology on dairy industry. In *Microbial Biotechnology in Food and Health* (pp. 53–79). Elsevier. https://doi.org/10.1016/B978-0-12-819813-1.00003-7
5. Arora, L., & Narula, A. (2017). Gene editing and crop improvement using CRISPR-cas9 system. *Frontiers in Plant Science*, *8*(November). https://doi.org/10.3389/fpls.2017.01932
6. Azeem, A., Ul-Allah, S., Sher, A., Ijaz, M., Sattar, A., Ahmad, W., & Qayyum, A. (2023). Biosafety and Biosecurity in Genetically Modified Crops. In *Sustainable Agriculture in the Era of the OMICs Revolution* (pp. 501–510). Springer International Publishing. https://doi.org/10.1007/978-3-031-15568-0_23
7. Balwan, W. K., Saba, N., & Rasool, N. (2021). An overview of climate change and food security in India. *… of the Romanian Society for Cell …*, *22*(1). https://www.annalsofrscb.ro/index.php/jou

rnal/article/view/9066%0Ahttps://www.annalsofrscb.ro/index.php/journal/article/download/9066/6625

8. Barea, J. M. (2015). Future challenges and perspectives for applying microbial biotechnology in sustainable agriculture based on a better understanding of plant-microbiome interactions. *Journal of Soil Science and Plant Nutrition*, *15*(2), 261–282. https://doi.org/10.4067/s0718-95162015005000021
9. Bawa, A. S., & Anilakumar, K. R. (2013). Genetically modified foods: safety, risks and public concerns—a review. *Journal of Food Science and Technology*, *50*(6), 1035–1046. https://doi.org/10.1007/s13197-012-0899-1
10. Benefits, N. (n.d.). Food Biotechnology : Impact of Biotechnology on Food Process Industry : *Application of Biotechnology in Dairying*.
11. BONCIU, E. (2023). GENETIC TRANSFORMATION IN AGRICULTURE: THE REAL CHANCE FOR ENSURING WORLDWIDE SUSTAINABLE FOOD SECURITY. *Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development*, *23*(1).
12. Broeren, M. L. M., Zijp, M. C., Waaijers-van der Loop, S. L., Heugens, E. H. W., Posthuma, L., Worrell, E., & Shen, L. (2017). Environmental assessment of bio-based chemicals in early-stage development: a review of methods and indicators. *Biofuels, Bioproducts and Biorefining*, *11*(4), 701–718. https://doi.org/10.1002/bbb.1772
13. Brookes, G., & Barfoot, P. (2017). Environmental impacts of genetically modified (GM) crop use 1996–2015: Impacts on pesticide use and carbon emissions. *GM Crops & Food*, *8*(2), 117–147. https://doi.org/10.1080/21645698.2017.1309490

International Multidisciplinary Research E-Journal Online Available at http://gater.in/
INTERNATIONAL PEER REVIEWED JOURNAL
OF GLOBAL ASSOCIATION FOR TRAINING, EDUCATION & RESEARCH
(GLOBAL CONSORTIUM OF PROFESSIONALS, TRAINERS, ACADEMICIANS & RESEARCHERS)

The Role of Business Management Schools in Teaching Business Students Professionalism and How To Be Green Entrepreneurs

Manoj Kumar Mishra, Assistant Professor

O. P. Jindal Univesity, Raigarh

Email-id: misramanoj22@gmail.com

Abstract:

India as a developing nation has a good number of Schumpeterian entrepreneurs who have made the country a frontrunner from last one decade. But due to accelerated population this number is not sufficient to satisfy the total requisite of employment. India as a country needs many more young and innovative entrepreneurs to cope-up with this huge employment demand. Realizing it these management institutions have large responsibilities on their soldiers to create an entrepreneurial academic culture which motivates the young graduate to start new ventures in spite looking for the job. To explore this very aspects the paper is an attempt to understand the role of management institution in developing an entrepreneurial aptitude and professionalism among Business Students. For this study a vast survey is conducted using structured questionnaire and find out the different factors responsible for cultivating an entrepreneurial aptitude among Business Students; if not, then why has been also explored. A study of business institutes have been done to find out that whether they are able to inculcate entrepreneurial attributes among students. The above study helps to identify the key areas where work needed to be done for developing green entrepreneurial aptitude.

Key-Words: Entrepreneurs, Green Entrepreneurial aptitude, Management Institutes, Business Graduates

Introduction:

Education is meant to build character, which is important for the growth of the country. Over time, the meaning of education has changed in a big way. The word "education" comes from the Latin word "educare," which
means "to teach." The word "educare" means to bring up, raise, feed, train, or shape *(Bhatt, 2017; Lau, Shaffer, Chan& Man, 2012).* It was an evolving process and a kind of transformation of human mind to create and come up with something that can bring some evolutionary change in the existing social system. It was prevalent that all cannot have same kind of skill set and education. As of their interest and liking they have chosen their fields. Same goes with management education in the country. *(Raab, Stedham, & Neune 2005; Ramana, Raman, & Aryasri, 2009).*

The history of management education in India is not old enough. In the year of 1958 there were 9 management institutes in the country and in 2012 number goes up to 2450. Management education was an effort to create pool of labours which could help industry in getting skilled labour force with great IQ as well as SQ, SQ and
EQ. *(Bowyer, & Vitale, 2018; Lubis, 2014).* initially the demand of labour force was high and supply was less. Gradually it become reverse in order and supply become more and demand reduces because of sophisticated technological intervention. The nature of management education has changed in the country. Different kind of institutions came up with various specializations to cater the need of industry. Generation X and Y of the country largely contributed to the labour force in the industry

(Waraich & Chaturvedi, 2016; Heinonen, & Poikkijoki 2006). The trends among business students have been changing currently. They prefer to be job provider rather job seeker. These trends among business students have been flourishing. They are trying their fate in area of entrepreneurship. The nature of education is still same as it was earlier. Do the management institutions have changed their contents and teaching practices. The answer is yes to some extent. But largely it is same. This study is an effort to identify the role of management institutions in facilitating entrepreneurial attributes among business students *(Vella, 2001; Pathak, & Srivastava, 2010; Kurtkoti, 2016).*

Richard Cantillon came up with the very first theory of entrepreneurship in the year 1725. He has said that entrepreneurs are self-employed people who are willing to take the risk of buying at certain prices and selling at unknown prices (Mekonnin, 2015; Nandamuri, 2013; Varamaki, Joennuu, Tornikoski, and Viljamaa, 2015). Entrepreneurial behavior is usually thought of as a set of actions that lead to a specific entrepreneurial event, like starting a new business or making a new product. These goals are seen as key to understanding the goals of entrepreneurs, which come from both rational and intuitive thinking and are influenced by the entrepreneur's social, political, and economic environment, as well as his or her perceived past, current personality, and abilities (Nwankwo, Marire, Kanu, Balogun and Uhiara, 2012). Entrepreneurship creates jobs and has many other positive effects on the economy. This is because, from an economic point of view, entrepreneurial activity is a mix of taking risks and coming up with new ideas. So, these kinds of activities lead to new businesses with new products and services, which in the long run make a big difference to the growth of the economy (Azhar et. al., 2011; Bennett, 2006; Christina & Thomas Man 2009).

Literature Review :

Successful business owners typically possess a diverse set of talents and experiences that allow them to spot and seize upon market openings. According to the 2006 Results Report from the Global Entrepreneurship Monitor, entrepreneurialism is flourishing in every region of the globe. However, studies conducted in the past have shown that far more people have the potential to become entrepreneurs than do so (Harris, Gibson and Taylor, 2007). Mekonnin (2015) conducted a study to better understand the entrepreneurial motivations of first-year Ethiopian university students. The study's findings suggested that an individual's level of entrepreneurial motivation may be used to foretell whether or not that person would go on to find their own business after graduating from college. Research Council conducted in 2012 by Couetil, Rhoads, and Haghighi found that at least 66 per cent of engineering students were interested in working for large or medium-sized businesses following graduation. As many people believed that learning about entrepreneurship would broaden their employment opportunities. Only 35% of respondents said they had learned anything about entrepreneurship from their engineering studies or teachers. Numerous surveys found that students who had taken entrepreneurship courses had significantly better levels of confidence in their abilities to start and grow a business. Students majoring in electrical and mechanical engineering are more likely to take business courses than their counterparts studying other branches of engineering.

Harris et al. (2007) discovered that the small business institute course significantly influenced students' views on being an entrepreneur. A substantial interaction effect also demonstrated that women's. Attitudes shifted significantly towards the end of the course. This demonstrates how beneficial it is for students to enroll in business courses in order to acquire the skills necessary to become successful business owners. Dutta, Erenda, and Li (2011) identified a lot of evidence suggesting that focusing one's education on entrepreneurship is not sufficient to succeed in the future of business. Instead, a person's ability to generate revenue and

wealth in the future is bolstered by their exposure to a variety of educational opportunities. It demonstrates how studying entrepreneurship may provide one with the business management knowledge and abilities necessary for success. The findings of a study conducted by Nwankwo, Marire, Kanu, Balogun, and Uhiara (2012) revealed that self-efficacy was significantly correlated with entrepreneurship aspirations, and that gender-role orientation aspects differed significantly.

According to Azhar, Javaid, Rehman, and Hyder (2011), the study's primary objective is to investigate the motivations behind the entrepreneurship aspirations of business students in Pakistan. In addition to looking at demographics, the survey also asks participants questions about their own feelings of attraction, their perceptions of social norms, and their assumptions about other people's behaviors. Elmuti, Khoury, and Omran, 2012 There are direct correlations between entrepreneurship education and financial success, as demonstrated by the findings. Successful entrepreneurs typically have a solid foundation in management, social competency, people skills, and basic business operations. They were statistically significant, lending credence to the value placed on entrepreneurial education. Participants in entrepreneurial education and training programs display increased receptivity, self-assurance, and trust, according to the findings. Harris and Gibson's (2014) research report argues that students' prior educational experiences significantly contribute to their future pro-entrepreneurial mindset.

Research Methodology:

This study has been done to identify the role of institutions in developing entrepreneurial attributes among business students. The population of the study was business graduates pursuing their UG and PG courses from management institutions situated in Delhi. The data have been collected from two different private management institutions students. Data have been collected of 230 students of PG and UG courses. But only 105 questionnaires were filled entirely. That is why analysis was done on 105 samples only. This study is descriptive in nature which tries to explore the entrepreneurial attributes among business students. Convenient sampling methods have been used to collect the data from business students. Students have been distributed questionnaire and they have been asked to fill it. For the purpose of this study both primary and secondary sources were used to get data and information. For the collection of data structured questionnaire was used. Analysis of data was done on SPSS software on 20.0 versions. Reliability of the questionnaire was checked and it was found reliable. Sample sufficiency (KMO) was checked and it was found sufficient. Exploratory factor analysis was performed to identify the factors leading to single construct.

Objectives of the Study & Hypothesis:

1. To study the factors affecting green entrepreneurial attitude among business students.
2. To study the impact of gender on green entrepreneurial attribute among students.
3. To study the impact of family background on green entrepreneurial attributes among students.

Ho1: There is significant impact of institute on personality of students.

Ho2: There is significant impact of institute on managerial skill of students.

Ho3: There is significant impact of institute on Professional attitude of students. Ho4: There is significant impact of gender on personality and managerial skills.

Ho5: There is significant impact of family background on personality and managerial skills.

ANALYSIS AND DISCUSSION :

The data has been analyzed to find the factors affecting green entrepreneurial attitude among business students in Delhi.

Demographic Profile of Respondents

Table 1: Family Background of Students

		Frequency	Percent
Valid	*Service*	*30*	28.6
	Business	*72*	68.6
	Any other	*3*	2.9
	Total	105	100.0

(Source: Research Output)

Table 2: Gender of respondents

		Frequency	Percent
Valid	*Male*	*57*	54.3
	Female	*48*	45.7
	Total	105	100.0

(Source: Research Output)

Table: 3 Reliability Statistics

Cronbach's Alpha	N of Items
.774	18

(Source: Research Output)

The above table has shown that the questionnaire used for the purpose of study was reliable.

Table: 4 KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.661
Bartlett's Test of Sphericity	Approx. Chi-Square	689.245
	df	153
	Sig.	.000

(Source: Research Output)

The above table shows that sample size was sufficient for the purpose of study.

Table: 5 Communalities

	Initial	Extraction
Creativity and Innovativeness	1.000	.775
Business Planning	1.000	.507
Self-belief, Hard Work and Disciplined Dedication	1.000	.695
Strong people skills	1.000	.728
Communication	1.000	.772
Management skill	1.000	.771
Behavioural skill	1.000	.631
Technological Skill	1.000	.535
Risk taking ability	1.000	.575
Leadership	1.000	.771
Infrastructure	1.000	.733
Updated curriculum	1.000	.762
Teachers Incapability	1.000	.726
Industry Interface	1.000	.519
Capital	1.000	.690
Corruption	1.000	.649
Educational Background	1.000	.735
Government Policy	1.000	.710

Extraction Method: Principal Component Analysis. (Source: Research Output

Table: 6 Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.448	24.713	24.713	4.448	24.713	24.713	2.553	14.186	14.186
2	2.031	11.282	35.995	2.031	11.282	35.995	2.451	13.616	27.802
3	1.989	11.048	47.043	1.989	11.048	47.043	2.392	13.289	41.091
4	1.486	8.254	55.296	1.486	8.254	55.296	1.906	10.588	51.680
5	1.291	7.170	62.467	1.291	7.170	62.467	1.491	8.283	59.962
6	1.039	5.772	68.239	1.039	5.772	68.239	1.490	8.277	68.239
7	.930	5.167	73.406						
8	.799	4.441	77.847						
9	.718	3.991	81.838						
10	.628	3.491	85.329						
11	.577	3.207	88.536						
12	.474	2.634	91.170						
13	.397	2.203	93.373						
14	.355	1.974	95.348						
15	.259	1.439	96.786						
16	.232	1.290	98.076						
17	.186	1.033	99.109						
18	.160	.891	100.000						

Extraction Method: Principal Component Analysis. (Source: Research Output)

All factors and their related factors from the questionnaire.

These factors have strong influence in developing green entrepreneurial attitude among business students.

Table: 7 Rotated Component Matrix[a]

	Component					
	1	2	3	4	5	6
Infrastructure	.839					
Self-belief, Hard Work and Disciplined Dedication	.712					
Leadership	.705					
Technological Skill	.530					
Educational Background		.793				
Behavioural skill		.687				
Capital		.624				
Risk taking ability		.577				
Teachers Incapability		-.551			.529	
Management skill			.793			
Creativity and Innovativeness			.768			
Government Policy			.571			
Communication				.705		
Updated curriculum				.679		
Strong people skills				.639		
Industry Interface					.698	
Corruption						.785
Business Planning						.614

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. (Source: Research Output)

This highlights the number of factors in each construct in this study.

Table 8: Reliability of Factors

(Source: Research Output)

Factors	Alpha Value
1st factor – Institutional Support (IDV)	α = 0.707
2nd factor – Personality (DV)	α = 0.728
3rd factor – Managerial Skills (DV)	α= 0.665
4th factor – Professional Attitude (DV)	α= 0.679
5th factor – Assistance (Removed)	α= 0.290
6th factor – Barriers (Removed)	α= 0.384

Table: 9 ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
A-R factor score 2 for analysis 1 **(Personality)**	Between Groups	4.150	1	4.150	4.281	***.041***
	Within Groups	99.850	103	.969		Accepted
	Total	104.000	104			
A-R factor score 1 for analysis 1 **(Institutional Support)**	Between Groups	4.292	1	4.292	4.434	***.038***
	Within Groups	99.708	103	.968		
	Total	104.000	104			
A-R factor score 3 for analysis 1 **(Managerial Skill)**	Between Groups	9.227	1	9.227	10.028	***.002 Accepted***
	Within Groups	94.773	103	.920		
	Total	104.000	104			
A-R factor score 4 for analysis 1 **(Professional Attitude)**	Between Groups	1.564	1	1.564	1.572	.213
	Within Groups	102.436	103	.995		
	Total	104.000	104			
A-R factor score 5 for analysis 1 **(Assistance)**	Between Groups	.260	1	.260	.258	.613
	Within Groups	103.740	103	1.007		
	Total	104.000	104			
A-R factor score 6 for analysis 1 **(Barriers)**	Between Groups	2.813	1	2.813	2.864	.094
	Within Groups	101.187	103	.982		
	Total	104.000	104			

(Source: Research Output)

The above table shows the impact of gender on green entrepreneurial attitude among students. The factors two, three and one has significant impact of gender. The alpha values are less than 0.05.

Table: 10 ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
A-R factor score 2 for analysis 1 **(Personality)**	Between Groups	12.104	2	6.052	6.717	***.002***
	Within Groups	91.896	102	.901		Rejected
	Total	104.000	104			
A-R factor score 1 for analysis 1 **(Institutional Support)**	Between Groups	9.000	2	4.500	4.832	***.010***
	Within Groups	95.000	102	.931		
	Total	104.000	104			
A-R factor score 4 for analysis 1 (Professional Attitude)	Between Groups	.700	2	.350	.346	.709
	Within Groups	103.300	102	1.013		
	Total	104.000	104			
A-R factor score 5 for analysis 1 (Assistance)	Between Groups	13.389	2	6.694	7.536	***.001***
	Within Groups	90.611	102	.888		
	Total	104.000	104			
A-R factor score 6 for analysis 1 (Barriers)	Between Groups	1.140	2	.570	.565	.570
	Within Groups	102.860	102	1.008		
	Total	104.000	104			
A-R factor score 3 for analysis 1 **(Managerial Skill)**	Between Groups	.974	2	.487	.482	.619
	Within Groups	103.026	102	1.010		
	Total	104.000	104			

(Source: Research Output)

The above table has shown the impact of family background on entrepreneurial attitude among students. The family background of the students has significant impact on factors 5, 1, 2. Here the alpha values are less than 0.05.

Table 11: Regression Results Using Institutional Support as IDV

Dependent Variable	R-square	Durbin Watson	F-statistics	Sig	Hypotheses
2nd factor – Personality (DV)	0.205	1.766	26.637	0.000	Accepted
3rd factor – Managerial Skills (DV)	0.441	2.230	81.238	0.000	Accepted
4th factor – Professional Attitude (DV)	0.262	2.430	36.477	0.000	Accepted

(Source: Research Output)

The above results show that management institute has significant impact on developing student's managerial skills, professional attitude and personality. These three attributes are considered as core skill set to be an entrepreneur. Therefore it can be stated that yes managements institutes are able to inculcate entrepreneurial attributes among management students.

CONCLUSION:

Bringing green entrepreneurial attitude is a major concern for the management educators. Number of jobs is sinking day to day. The institutions are encouraging students to start their own businesses than to work for others. Still the society carries same kind of attitude as our previous generations has followed. Major chunk of students do believe in doing jobs than to start their own business. In this study it has been identified that what are the different factors contributing or motivating for green entrepreneurial ventures. This also has been studies that for some specific attributes gender play an important role. Likewise, family background also influences some of the green entrepreneurial attitude among business students.

The future scope of this study is that it can be identified how much each factor are contributing to entrepreneurial success for management students. Some other demographic factor can be study to assess the impact of these in developing green entrepreneurial attitude among business students.

References:

1. Bennett, R. (2006). Business lecturers' perceptions of the nature of entrepreneurship. *International Journal of Entrepreneurial Behaviour & Research, 12*(3), 165. Doi http://dx.doi.org/10.1108/13552550610667440
2. Bhatt, D., 2017, what is the etymological meaning of education? https://www.quora.com/What-is-the-etymological-meaning-of-education
3. Bowyer, D., & Vitale, C. (2018). What drives university academics to be entrepreneurial? *E - Journal of Social & Behavioural Research in Business, 9*(1), 10 - 36. Retrieved from https://search.proquest.com/docview/2066562372?accountid=148245
4. Christina W.M. Yu, & Thomas W.Y. Man. (2009). Social interaction and the formation of entrepreneurial characteristics. *Journal of Workplace Learning, 21*(8), 595-613. doi:http://dx.doi.org/10.1108/13665620910996160
5. Dutta, D. K., Li, J., & Merenda, M. (2011).Fostering entrepreneurship: impact of specialization and diversity in education. *International Entrepreneurship and Management Journal*, *7*(2), 163-179.
6. Duval- Couetil, N., Reed-Rhoads, T., & Haghighi, S. (2012). Engineering students and entrepreneurship education: Involvement, attitudes and outcomes. *International Journal of Engineering Education*, *28*(2), 425.
7. Elmuti, D., Khoury, G., & Omran, O. (2012).Does Entrepreneurship Education have A role in Developing Entrepreneurial Skills and Entures'effectiveness? *Journal of Entrepreneurship Education*, *15*, 83.
8. Harris, M. L., Gibson, S. G., & Taylor, S. R. (2007).Examining the impact of small business institute participation on entrepreneurial attitudes. *Journal of Small Business Strategy*, *18*(2), 57-76.
9. Harris, M. L., Gibson, S. G., Taylor, S. R., & Mick, T. D. (2008).Examining the entrepreneurial attitudes of business students: the impact of participation in the Small Business Institute®.In United States Association for Small Business and Entrepreneurship. Conference Proceedings (p. 1471). United States Association for Small Business and Entrepreneurship.
10. Heinonen, J., & Sari-Anne Poikkijoki. (2006). An

entrepreneurial-directed approach to entrepreneurship education: Mission impossible? *The Journal of Management Development, 25*(1), 80-94. Retrieved from https://search.proquest.com/docview/216356786?accountid=148245

11. Hyder, A., Azhar, A., Javaid, A., &Rehman, M. (2011).Entrepreneurial intentions among business students in Pakistan.
12. Kurtkoti, A. S. (2016). Management students' perspective towards leadership.*Sankalpa, 6*(2), 104-108. Retrieved from https://search.proquest.com/docview/1849631365?accountid=148245
13. Lubis, R. L. (2014). Students' entrepreneurial strategy: connecting minds? *International Journal of Arts & Sciences, 7*(3), 545-568. Retrieved from https://search.proquest.com/docview/1644634393?accountid=148245
14. Mekonnin, R. (2015). Determining Entrepreneurial Motivation of Undergraduate Students in Ethiopian Higher Learning Institutions: A Case of Haramaya University. *J. Educ. Res*, (14).
15. Nandamuri, P. P. (2013). Gender differences on select dimensions of entrepreneurship. *IUP Journal of Business Strategy, 10*(1), 7-19. Retrieved from https://search.proquest.com/docview/1400190083?accountid=148245
16. Nwankwo, B. E., Kanu, G. C., Marire, M. I., Balogun, S. K., &Uhiara, A. C. (2012). Gender-role orientation and self-efficacy as correlates of entrepreneurial intention. *European Journal of Business and Social Sciences*, *1*(6), 9-26.
17. Pathak, D., & Srivastava, S. (2010). Variables affecting personal effectiveness: An empirical study on B-school students. *Drishtikon : A Management Journal, 2*(1)
18. Retrieved from https://search.proquest.com/docview/1477996606?accountid=148245
19. Raab, G., Stedham, Y., & Neuner, M. (2005). Entrepreneurial potential: An exploratory study of business students in the U.S. and germany. *Journal of Business and Management, 11*(2), 71-88. Retrieved from https://search.proquest.com/docview/211523827?accountid=148245
20. Ramana, C. V., Raman, K. J., & Aryasri, R. A. (2009). Influence of socio- demographic factors on entrepreneurial attributes and success. *South Asian Journal of Management, 16*(4), 111-126. Retrieved from https://search.proquest.com/docview/222711475?accountid=148245
21. Theresa L.M. Lau, Shaffer, M. A., Chan, K. F., & Yan Man, T. W. (2012). The entrepreneurial behaviour inventory. *International Journal of Entrepreneurial Behaviour & Research, 18*(6), 673-696.doi:http://dx.doi.org/10.1108/13552551211268120
22. Varamäki, E., Joensuu, S., Tornikoski, E., & Viljamaa, A. (2015). The development of entrepreneurial potential among higher education students. *Journal of Small Business and Enterprise Development, 22*(3), 563-589. Retrieved from https://search.proquest.com/docview/1702055379?accountid=148245
23. Vella, N. (2001). *Entrepreneurial attributes in malta* (Order No. 3047748). Available from Abi/Inform Collection. (287904772). Retrieved from https://search.proquest.com/docview/287904772?accountid=148245
24. Waraich, S. B., & Chaturvedi, A. (2016). Entrepreneurship development in business schools: An analysis of initiatives in delhi and NCR dagger]. *South Asian Journal of Management, 23*(1), 189-209. Retrievedbfrom https://search.proquest.com/docview/1829015982?accountid=148245

International Multidisciplinary Research E-Journal Online Available at http://gater.in/
INTERNATIONAL PEER REVIEWED JOURNAL
OF GLOBAL ASSOCIATION FOR TRAINING, EDUCATION & RESEARCH
(GLOBAL CONSORTIUM OF PROFESSIONALS, TRAINERS, ACADEMICIANS & RESEARCHERS)

Socio-Economic Analysis of Triboelectric Nanogenerators for Harvesting Energy in Northeast India

Chandrajita Chakraborty
School of Engineering and Technology, Indira Gandhi National Open University, New Delhi, India
Dr. Shweta Tripathi*
School of Engineering and Technology, Indira Gandhi National Open University, New Delhi, India
**Corresponding author: Email id: Shweta.tripathi@ignou.ac.in*
Mobile no. :9729004303

Abstract : *Energy harvesting technologies are gradually advancing in a manner that benefits the environment as well as harvests highest energy outputs. Triboelectric Nanogenerators [TENG] works by converting mechanical energy into electrical energy and is used in a diverse range of application. The present study studies assess and predicts the feasibility for utilization of this technology in the northeast India, that shows tremendous potential for harvesting renewable energy as well as developing the region under the Smart City Programme (SCM) launched by the Government of India. The results give a promising indication towards set-up of TENG subjected to choosing the right material, and the sectors to be implemented. Moreover, an open-ended survey with locals of northeast also reveals their acceptance and willingness levels that can soar even higher if proper training and awareness is granted by the authorities*

Key words: Triboelectric Nano generators, feasibility analysis, socioeconomic analysis, renewable energy

1. Introduction :

In this century, there has been tremendous development in the energy sector. With a surge in environmental awareness, there has been a lookout for greener alternatives that can serve the energy requirements of the masses. Non-Conventional energy sources or renewable energy sources have been tapped for their inexhaustible, efficient supply of energy. Nevertheless, the distribution and acceptance aren't even yet as there are constraints at various levels of implementation. Developing countries are thus looking for better alternatives that surpass geographical, economic, and technical hurdles while providing clean energy. In India, there have been many programs and initiatives taken by the government to provide equitable access to power but the situation remains grim to this day. Almost 81 million houses do not have access to electricity and 93% of this chunk resides in rural areas [1]. This highlights the need to take drastic steps so that the situation improves and people can get hold of basic energy amenities.

North-eastern India consists of seven states that comprise 3.76% of the total population of country's population [2]. It is a demographically significant area but only 23.5% of the households in this region are connected to the mainstream electricity supply [3]. More than 75% are devoid of their energy requirements. It is an alarming situation and there are several causes behind this lapse. Belligerent and remote territories are a characteristic feature of the terrain of this region [4] which makes it difficult for conventional energy setups to be implemented in these areas. Along with this, lack of income opportunities, literacy rate, and transportation linkage have significantly contributed to the energy involvement of the region. Thus, it is a need of the hour to provide an alternative source of energy that can encompass these barriers with low maintenance, easy to access, clean, and efficient

mode of energy generating device.

Triboelectric Nanogenerators (TENG) have been rising as an efficient energy-generating alternative across the world. It is a low-cost device that generates power from the effect of frictional force. Amalgamating the triboelectric effect and the process of electrical induction of charges, a significant amount of power can be generated from these nanogenerators. Depending on the materials used, changes in the basic design, and large-scale manifesto, these generators have a power density that can reach up to 500 W m^{-2} and competence of conversion of >50% [5]. With four modes of working in vertical contact-separation, lateral sliding, single-electrode, and freestanding structures, these generators have been used to power mobile equipment, High Voltage implementations, and self-powered devices [6]. Moreover, multiunit structures of TENG have been successfully utilized in generating energy from the frictional effect of raindrops [7-8] wind [9-12] sound [13 - 14] and ocean waves [15-18]. The helix-structured TENG can also be used for powering wearable electronics [19]. There has been successful testing of self-repairing hybrid TENG models that can generate solar energy with the effect of raindrops on such materials [20 - 21].

The potential of TENG to serve the power needs of northeast India is still untapped. This paper will try to carry out a feasibility analysis for these devices and understand the possibility of adopting and introducing them as a major power-generating source in areas where electricity has not yet been reached. This is done based on a case study across the rural areas of Tripura, which is one of the northeastern states, through interviews, surveys, and analysis of the grassroots situation in its rural areas. As it will be the first time that the feasibility of TENG will be assessed for this region, it will open up new avenues for future research and put forth a basic standard for the potential implementation of TENG.

1.1 The Principle Behind TENG :

For making this device, two materials are selected with contrasting triboelectric orientation. These materials may or may not contain carbon and consists of a varied range of materials. The interior part of the circuit is utilized to generate a potential by the contact interaction between these materials, which results in transmission of charges. The exterior circuit consists of electrodes that provide a passageway for these electrons to travel and generate electricity. TENGs can be used to harvest energy from all kinds of mechanical energy. The simple yet ubiquitous principle allows it to be implemented both in small and large scale set ups.

2. Methodology :

For conducting this study, a case study was carried out across all eight districts of Tripura, one of the states in northeast India. A survey-based method was undertaken along with interviews from probable stakeholders and officials from various energy organizations. Students pursuing courses related to energy and common people from rural areas were also interviewed. The survey and interview was conducted over the course of six months between the months of August, 2022 to February, 2023. The conversation was kept pliable and the study was conducted for a sample strength of 100 commoners and 50 stakeholders, students and officials from various organizations associated with the energy sector. These individuals were asked questions that tried to verify queries associated with the following categories.

2.1 Climatic Analysis :

Understanding the climatic patterns of Northeast India and aligning it with the operations of TENG to check its feasibility for generating power.

2.2 Market & Stakeholder Analysis :

Understanding the current demand for TENG, awareness about the technology, the current status of energy usage, problems faced, and an acceptance rate of newer technologies through an extensive survey and interview of relevant individuals from the study site. Also, overviewing the willingness of local communities, Government agencies, and business organizations in becoming stakeholders, and

partnership opportunities for such projects after being aware of the nits-and-grits of the principle of TENG.

2.3 Technical Analysis :

The technical specifications shall include checking the efficiency, power, output, performance, and durability of TENG devices.

2.4 Environmental Analysis :

Understanding the regional ecosystem of the rural northeast and assessing the sustainability, waste handling, and pollution combating aspects of TENG, and assessing if this shall be in tandem with the implementation site.

2.5 Cost Analysis :

Predicting the factors that will influence the cost of maintenance, labor costs, costs of installation, implementation costs for greater masses, and strategies to minimize these costs.

These aspects were studied upon for doing an in-depth analysis for checking the feasibility of the device in the study site and extrapolating it for the rest of north-east which has more or less similar conditions. After conducting the survey of common rural people of the study site, these aspects were calculated: The percentage of people who were still under non-electrified area was calculated as:

$$P_E = (N_{PE}/T_{CS})*100 \quad \text{(Eq 1)}$$

P_E is the total number of people who were in non-electrified area, N_{PE} is the total number of people who agreed to living in such areas and T_{CS} is the total number of people surveyed. The percentage of people who faced transportation issues were calculated using the following aspects:

$$P_t = (N_{Pt}/T_{CS})*100 \quad \text{(Eq 2)}$$

Where P_t is the percentage of people who faced problems with transport services, N_{Pt} is the number of people who agreed to facing transportation issues and T_{CS} is the total number of common people surveyed from rural areas. Similarly, the percentage of people utilizing a particular type of fuel is calculated as:

$$P_f = (N_{Pf}/T_{CS})*100 \quad \text{(Eq 3)}$$

Where, N_{Pf} is the percentage of people who use any particular type of fuel, and T_{CS} is the total number of people surveyed. Next, the percentage of willingness in people for changing their existing energy sources was calculated as:

$$P_w = (N_{Pw}/T_{CS})*100 \quad \text{(Eq 4)}$$

Where, N_{Pw} is the number of people who answered a 'Yes' when asked if they were willing to change their existing fuel or energy sources, & T_{CS} is the total number of people surveyed. The issues faced due to energy dearth or lack of access to efficient energy sources was calculated as:

$$P_i = (N_{Pi}/T_{CS})*100 \quad \text{(Eq 5)}$$

Where, N_{Pi} is the total number of people who agreed to facing any particular type of energy issues and T_{CS} is the total number of people surveyed. Next, the percentage of acceptance in people agreeing to utilize TENG technologies are:

$$P_a = (N_{Pa}/T_{CS})*100 \quad \text{(Eq 6)}$$

Where, N_{Pa} is the number of people who answered a 'Yes' when asked if they were willing to utilize TENG technologies if they were implemented locally, & T_{CS} is the total number of people surveyed. Following the survey, data obtained from interviewing probable stakeholders were interpreted using numerical equations. For assessing the awareness of the stakeholders regarding basic concepts involving TENG, responses were divided into three groups: 'No Awareness', 'Partially Aware', and 'Fully Aware' groups. The percentage of people who belonged to each of the groups were calculated as:

$$P_{AWS} = (N_{PAWS}/T_{SH})*100 \quad \text{(Eq 7)}$$

Where, N_{PWS} is the number of people who chose any of the three aforementioned options, T_{SH} is the total number of stakeholders interviewed. To judge the quantitative percentage of willingness of stakeholders to invest in potential future TENG projects were calculated one the basis of two options chosen by them, either 'Urban' or 'Rural'. The percentage (PWS) was calculated as:

$$P_{PWS} = (N_{PWS}/T_{SH})*100 \quad \text{(Eq 8)}$$

Where, N_{PWS} is the number of people who chose any of the aforementioned options, and T_{SH} is the total number of stakeholders interviewed. Lastly, to find

how many of the stakeholders preferred partnership opportunities for such investments was calculated as:

$$P_{PPS} = (N_{PPS}/T_{SH})*100 \quad \text{(Eq 9)}$$

Where, P_{PPS} is the percentage of stakeholders who preferred partnerships, N_{PPS} is the number of people who agreed to prefer partnerships more than individual ventures, and T_{SH} is the total number of stakeholders interviewed.

3. Data Analysis :

Table 1: Aspects considered for feasibility analysis (Source: Literature Review, Interviews & Survey)

S.No	Studied Aspect	TENG Characteristics
1	Climatic	
	Feasibility of Wind Speed	12-18 m/s [22]
	Mean Precipitation	Highly sensitive to raindrops, For a TENG of size 10 cm^2, 0.137 mL/(cm^2 ·s) flow rate of water from raindrops can generate 400 V and 2.5 mA/m^2 and give a power output of 110 mW/m^2 [23]
	Temperature	Up to ~400 °C [24]
	Durability in rough weather	Durable output in rain and wind [25]
2	Market and Stakeholders	
	Awareness of Technology	Very low (Survey)
	Demand	Difficult to determine
	Forecast of market growth	48.55% of CAGR by 2025 [26]
	Potential acceptance rate among the masses	High (Survey)
	Partnership Opportunity	High (Survey)
3	Technical	

	Power Density	Up to 500 W/m^2 [27]
	Conversion Efficiency	>50% [27]
	Charge Density	Up to 430 µC m^{-2} [28]
	Output Voltage & current	Varies. 100-400 V & open current of 2.7-24 µA [29], Upto 600 V [30] peak current may also touch 45 mA at the frequency of ~2.1 kHz [31].
	Life Span	2 Years [32].
4	Environmental	
	Sustainability	Sustainable and Eco-friendly [33], Green and sustainable [34].
	Scope of green innovation	Waste materials can be recycled as raw material for TENGs. Milk cartons can be used for making these devices [35].
	Combat Pollution	Can be used to filter PM 1-2.5 [36].
	Land Usage	Low land usage [37].
	Cultural Impact(locals and heritage sites)	Very less or no chance of affecting vulnerable sites
	Waste Generation	Plastic and chemical waste may be generated if it is not made up of biodegradable substances and also depending upon the types of electropositive and electronegative materials used for making the generator, the disposal may require special attention due to hazardous chemicals being sometimes involved in it.
5	Cost	
	Cost of material	Cost depends upon the materials used but may usually range anywhere between 100 INR to several thousands of INR according to the material used (Survey).
	Cost of Awaring people about the operating system of the generator	INR 500 Per Day on a Daily Work Basis (Survey)
	Cost of Maintenance	Minimum or nil.
	Cost of Transportation	Several thousand INR, Around 1000-10000 INR depending upon the size of installment and type of transportation. (Survey)

4. Result and Discussion :

4.1 Climatic Feasibility :

TENGs can work properly to generate power for wind speeds of 12-18m/s [22]. The average year-long wind speed of the northeastern region of India ranges between 5-20 m/s [38] which means that it is appropriate for generating wind power in the region. However, there is a seasonal fluctuation that is too drastic. Especially during winters, wind speed may drop below 5m/s. Also, monsoon winds of 'Kalbaisakhi' storms may reach far beyond 20 m/s causing damage to the triboelectric materials. In rural hilly areas, due to high altitudes less protection is available from the ravages of northeastern monsoons. To combat it the triboelectric materials should be encased properly in such a way that it is able to harness the power of wind while also protecting themselves. To keep such plants working during low-wind conditions, the plants can be made hybrid by amalgamating photovoltaics or any other form of energy-harnessing units. TENGs can also be combined with piezoelectric generators that help in a cumulative increase in the density of charges and, therefore, the overall electrical output of the system [39]. This combination is highly efficacious and steady in terms of energy acquisition [40].

In terms of precipitation, the region receives an average annual rainfall of around 2000 mm [41]. It provides ample potential to generate power from raindrops. TENGs within an area of 10 cm^2, have been seen to generate power at low flow rates of 0.137 mL/cm^2·s) of up to 400 V and 2.5 mA/m^2 and give a power output of 110 mW/m^2 [23]. Although some parts of northeast India receive high rainfall, it is necessary to consider the hot humid summers and the dry winters as well. During these periods, if such units are made hybrid, as stated above, the plants shall work throughout the year.

The temperature of the northeast may reach an average of 33°C. As TENGs can operate and generate power at temperatures around ~400 °C, therefore it is needless to say that the device can easily operate around the temperatures that sustain in the region. Therefore, it is clear that there are seasonal variations are characteristic of the region's climate along with rough outbursts. In such cases, TENGs have shown high durability when built with a sturdy choice of materials. An example of this is the

combination of MXene/Ecoflex nanocomposite-covered material that has worked efficiently in high rain and winds [42].

4.2 Market and Stakeholder Analysis :

While surveying and assessment of the present demand for a clean alternative of energy, it was found that some participants in the survey had to travel almost 20 km to reach the nearest market and get access to electricity for charging their mobile phones. Fig.1 shows the percentage of people in rural background having access to electricity. It is illustrated in the figure that around 35% of the interviewed common people from rural backgrounds had no access to electricity. The rest of the people were facing issues in the payment of electricity bills as it was difficult to make ends meet due to meager income sources. Families belonging to the BPL class had the most problems regarding their energy access.

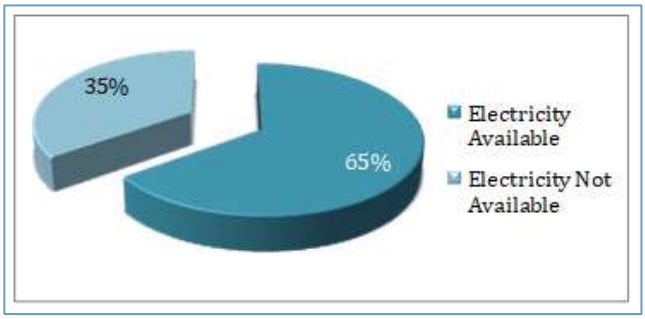


Fig.1- Percentage of people in rural background having access to electricity

Fig.2 illustrates the prevalence of transportation issues in the community. A problem for the hilly communities was transportation issues and 67% of this group reported facing this problem while fetching fuel sources from the main market.

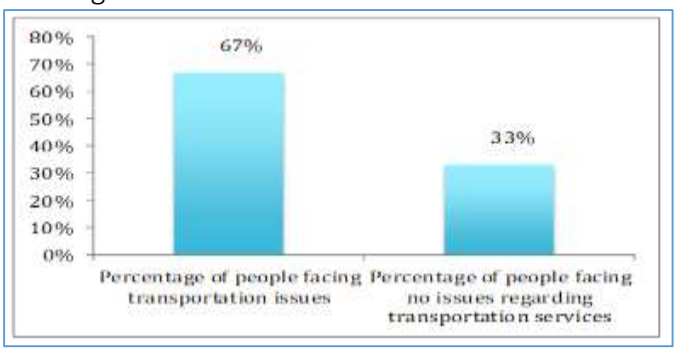


Fig.2- Prevalence of Transportation Issues in surveyed population (Eq 2)

Fig. 3 shows the diversity of fuel sources according to the survey results. Some people chose to bathe and drink unclean water as fuel prices were unaffordable for them and they couldn't afford to waste it just for boiling water. 45% of the people reported using kerosene as fuel (survey), along with 12.5% using natural Gas through pipelines, 24.3% using LPG cylinders, and wood and biomass being used by 18.12% of people which has seen to cause severe respiratory problems [43].

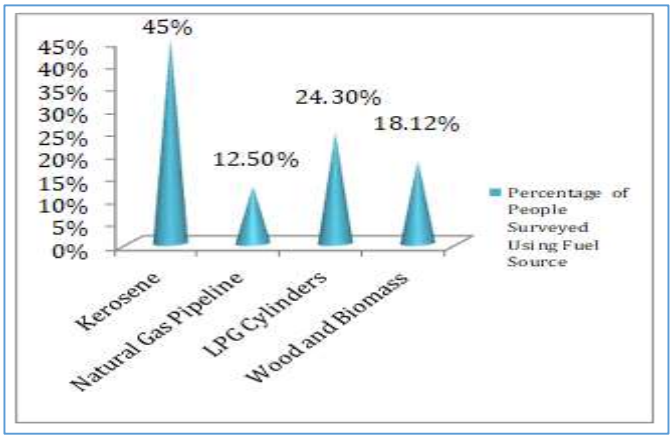


Fig.3- Diversity of Fuel Sources Used by Surveyed Population

The survey also revealed that 57.5% of the individuals wanted a change of energy source and is shown in Fig. 4. It is due to difficulty in access, rising fuel costs, and fewer income sources. The inaccessibility and lack of exposure to these areas were only magnifying the demand for better alternatives.

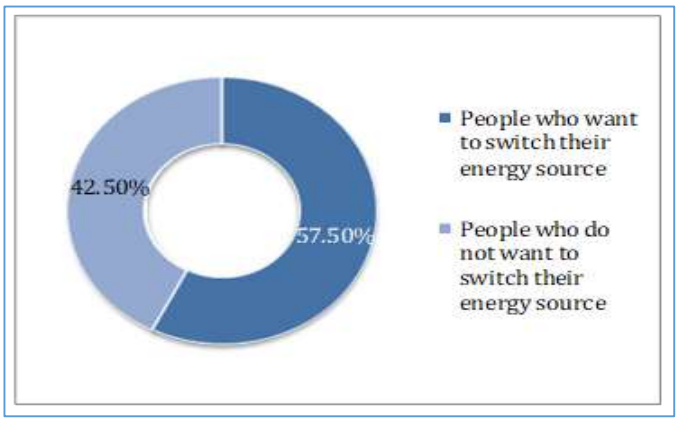


Fig.4- Percentage of surveyed population willing to

change their fuel sources. (Eq 4)

Fig 5 shows the diverse issues faced by surveyed population as a result of inefficient fuel and energy sources. The energy issues, that the surveyed population was facing included, a lack of electrification/illumination, fuel for cooking purposes, charging mobile phones, inability to work after sunset, and protecting their agricultural lands from wild animals like elephants, pests, etc. .

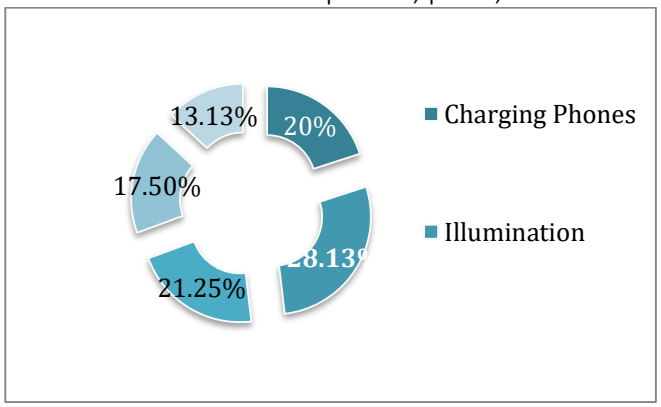


Fig. 5- Diverse issues faced by surveyed population as a result of inefficient fuel and energy sources. (Eq 5)

Fig. 6 shows the probability of acceptance for TENG in surveyed stakeholders. Although there was a lack of awareness, once they were made aware of the basic concepts that surround TENG, almost 55.62% of the individuals showed a positive response in terms of probable installation or potential of using it as a source of energy. They wanted proper instruction and training before handling these and a cost-efficiency consideration from the stakeholder's end.

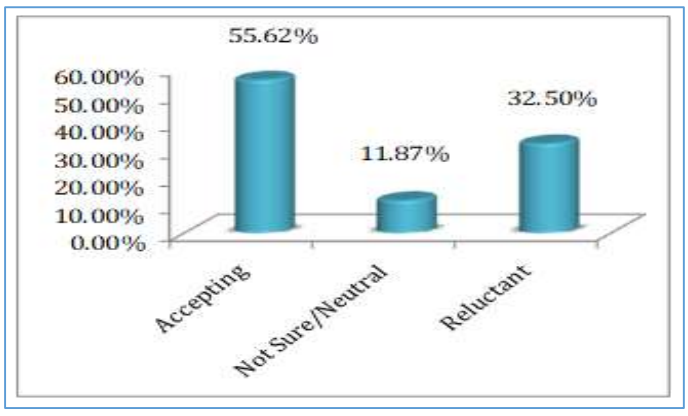


Fig. 6- Probability of Acceptance for TENG in surveyed stakeholders

The awareness of stakeholders regarding TENG is shown in Fig. 7. The survey and interviews of probable stakeholders included organizations along with skilled laborers and students in the energy sector of Tripura. It revealed that only 10% had ever heard of TENG and only 14% had a good knowledge of its working principles along with 76% being fully unaware of the devices and technology .

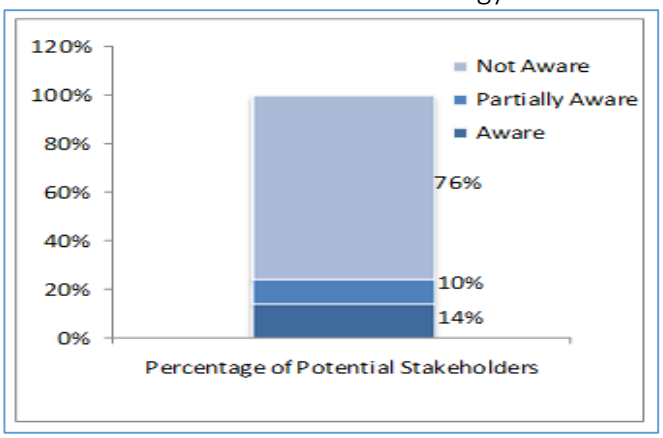


Fig.7- Awareness of stakeholders regarding TENG (Eq 7)

Once they were explained the devices and concepts involved, around 84 % of the corporate stakeholders were open to investing in TENG technologies in the urban frame but only 16% agreed to invest in TENG solely for rural remote areas due to the inaccessibility and hilly terrains of the former, but they agreed to invest in such technologies in the latter with proper funding and potential partnership opportunities with other Governmental and Non-Governmental Organizations. The willingness of potential stakeholders to consider TENG projects based on urban and rural areas is shown in Fig.8. and the willingness for partnerships by the stakeholders is shown in Fig. 9

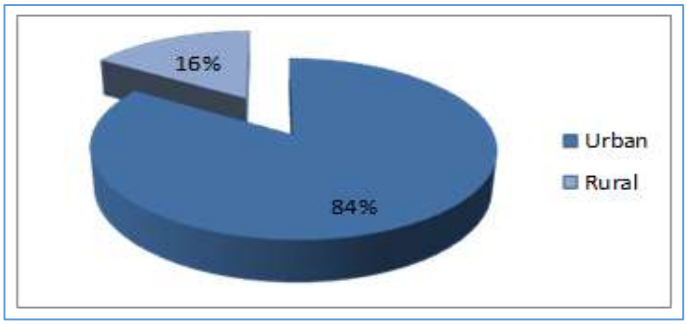


Fig. 8- Willingness of potential stakeholders to consider TENG projects based on urban and rural areas

Fig. 9 illustrates that 76% of the stakeholders preferred partnerships rather than a unitary responsibility.

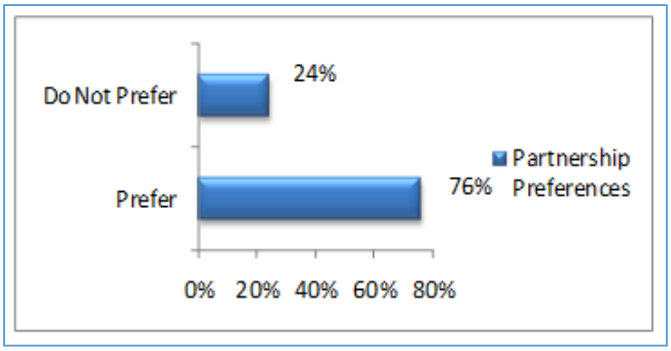


Fig. 9- Willingness for partnerships by stakeholders (Eq 9)

Since its conception in 2012, this technology did not have widespread awareness among people. The students are required to be made aware of such technologies so that they are aware of this untapped avenue of clean energy that they can contribute to holistic development. This revealed an overview of the cost-effective and efficient energy dearth faced by the people. This also showed the willingness of stakeholders to come forth with investment ventures related to TENG, for these areas that will help in solving the mentioned problems to a large extent.

4.3 Technical Analysis :

TENGs can give a power density of up to 500 W/m2 with a conversion efficiency of above 50 percent [27]. It can provide a constant charge of 430 µC m-2 [28]. The output voltage and current can however vary according to the materials involved. A versatile TENG for generating blue energy was seen to generate 100-400 V & open current of 2.7-24 µA [29]. These technical aspects that can be characterized by high voltage and low current outputs can be utilized for several uses.

However, a major drawback of the TENG devices is that they have very short life spans that may extend only up to 2 years [32]. Such a short life span may hinder the availability of these for remote populations while also incurring additional costs. Therefore, despite having a potential for high output, the devices are not durable enough. More research is thus required to combat this drawback. There is also a lack of proper expertise in people working in the energy sector due to it being a comparatively newer technology. This may also bring about hindrances in case some parts do not work as per the expectations.

4.4 Environmental Analysis :

Triboelectric generators are clean energy alternatives that are sustainable and ecologically feasible [33]. There is tremendous scope for innovation by using the principles of reducing, reusing, and recycling materials that would have been otherwise considered garbage. There are instances of making TENG from thrown-out milk cartons [35] that prove that there is a huge scope of research to search for viable materials that can serve for generating power using triboelectricity. Moreover, these nanogenerator units are compact and utilize space most efficiently when compared to large power plants. These can therefore act as catalysts to improve hybrid electricity generation for the masses. For rural populations living in close-knit slums, this can prove to be highly successful. Triboelectric materials can also be used to create biodegradable apparatus like wearable masks that can effectively filter pollutants of size 1-2.5 PM [36]. During this post-pandemic era, it is needless to understand that to prevent harmful pollutants from entering the system, these masks can be equally helpful.

Also, the northeastern states are known for the reverence they have towards natural sites. Sacred groves in Manipur are a well-known example of intact natural heritage that enhances the beauty of this part of the nation [44]. It is necessary to therefore consider the effects of newer technologies so that they do not change the balance of the ecosystem. TENGs being high space effective, form a great option in this case as they do not require large spaces for installation thereby not

risking the vulnerable natural hotspots and the cultural legacy of the region as well.

However, there is a major drawback that needs to be fixed before installing these power-generating devices. The raw materials used for generating triboelectricity can be non-biodegradable and may incur the generation of toxic chemical wastes once their life span is over. Therefore, alternatives to such materials should be researched in this regard.

4.5 Cost Analysis :

The cost of TENGs depends on numerous factors and may be anywhere between 100 INR to several thousand INRs (survey). The type of material, the processes to incur these raw materials, transportation difficulties, and the size of installation can add to additional charges. Moreover, the survey also revealed that the daily skilled labor wages may reach only up to INR 500 per day on a work basis. The skilled laborers are therefore unwilling to come forth for installing small-scale installations due to the uncertainty that shrouds the income source. Moreover, remote communities of the northeast have poor facilities in terms of transportation services [45]. Installing TENGs in inaccessible areas will therefore be a costly process for the stakeholders involved. However, the cost of maintenance, once the handler is aware of the system, is almost nil. The only maintenance required is to keep the triboelectric surfaces clean so that pollutants aren't able to contaminate them and affect their efficiency.

The overall cost can be decreased by community awareness programs where a skilled instructor will teach small rural and/or urban communities regarding the operation of this technology in their day-to-day lives. It will decrease labor costs to a large extent. These programs have to be initiated and conducted by stakeholders including the Government and should include visual demos and usage portfolios. Incentivization for students to come up with innovative low-cost TENG designs may also be an option to decrease future costs significantly while promoting self-reliance on the device. As the goal is to bring down the total cost of introducing this clean alternative of energy, the aforementioned steps shall prove to be a keystone when combined with strategic planning.

4.6 Utilizing Waterlogged Monsoons :

Ecosystems of northeastern parts of India are prone to waterlogging [46] which is worsened by its heavy monsoons. Although waterlogged areas eventually gets cleared out but it takes a long time and all the water is directly drained into local natural reservoirs. TENG can be used to generate significant blue energy from this water before being pumped out of the roads into these reservoirs.

5. Nomenclatures Used :

TENG- Triboelectric Nanogenerators
CAGR- Compound Annual Growth Rate
INR- Indian Rupee
P.M- Particulate Matter
LPG- Liquified Petroleum Gas
BPL- Below Poverty Line

6. Conclusion :

TENGs are efficient energy harvesting equipment that can be utilized in the northeastern part of India for generating useful energy that can be served for solving the energy issues of the region. An extensive case study in Tripura revealed that there is a scope for implementation of this modern alternative of energy generation in the region but it is subject to certain conditions. Due to it being a considerately new technology, there are several drawbacks associated with its technical and environmental aspects. Moreover the approach of usage for TENG devices should also be kept in mind so that it is ensured that the device is able to leave no ecological or cultural fooptprints that notheastern India is known for.

References :

1. Malakar, Y. (2018). Evaluating the role of rural electrification in expanding people's capabilities in India. *Energy Policy*, *114*, 492-498.
2. Dikshit, K. R., & Dikshit, J. K. (2014). *North-east India: Land, people and economy*. Dordrecht: Springer Netherlands.

3. Pattanayak, S., Hauchhum, L., Loha, C., & Sailo, L. (2021). Feasibility study of biomass gasification for power generation in Northeast India. *Biomass Conversion and Biorefinery*, 1-13.
4. Ziipao, R. R. (2020). Roads, tribes, and identity in Northeast India. *Asian Ethnicity*, *21*(1), 1-21.
5. Zi, Y., & Wang, Z. L. (2017). Nanogenerators: An emerging technology towards nanoenergy. *Apl Materials*, *5*(7).
6. Zhou, L., Liu, D., Wang, J., & Wang, Z. L. (2020). Triboelectric nanogenerators: Fundamental physics and potential applications. *Friction*, *8*, 481-506.
7. Zheng, L., Lin, Z. H., Cheng, G., Wu, W., Wen, X., Lee, S., & Wang, Z. L. (2014). Silicon-based hybrid cell for harvesting solar energy and raindrop electrostatic energy. *Nano Energy*, *9*, 291-300.
8. Zhu, H. R., Tang, W., Gao, C. Z., Han, Y., Li, T., Cao, X., & Wang, Z. L. (2015). Self-powered metal surface anti-corrosion protection using energy harvested from rain drops and wind. *Nano Energy*, *14*, 193-200.
9. Yang, Y., Zhu, G., Zhang, H., Chen, J., Zhong, X., Lin, Z. H., ... & Wang, Z. L. (2013). Triboelectric nanogenerator for harvesting wind energy and as self-powered wind vector sensor system. *ACS nano*, *7*(10), 9461-9468.
10. Bae, J., Lee, J., Kim, S., Ha, J., Lee, B. S., Park, Y., ... & Chung, U. I. (2014). Flutter-driven triboelectrification for harvesting wind energy. *Nature communications*, *5*(1), 4929.
11. Wang, J., Ding, W., Pan, L., Wu, C., Yu, H., Yang, L., ... & Wang, Z. L. (2018). Self-powered wind sensor system for detecting wind speed and direction based on a triboelectric nanogenerator. *ACS nano*, *12*(4), 3954-3963.
12. Chen, B., Yang, Y., & Wang, Z. L. (2018). Scavenging wind energy by triboelectric nanogenerators. *Advanced Energy Materials*, *8*(10), 1702649.
13. Xi, Y., Wang, J., Zi, Y., Li, X., Han, C., Cao, X., ... & Wang, Z. (2017). High efficient harvesting of underwater ultrasonic wave energy by triboelectric nanogenerator. *Nano Energy*, *38*, 101-108.
14. Zhao, H., Xiao, X., Xu, P., Zhao, T., Song, L., Pan, X., ... & Wang, Z. L. (2019). Dual-tube helmholtz resonator-based triboelectric nanogenerator for highly efficient harvesting of acoustic energy. *Advanced Energy Materials*, *9*(46), 1902824.
15. Zi, Y., Guo, H., Wen, Z., Yeh, M. H., Hu, C., & Wang, Z. L. (2016). Harvesting low-frequency (< 5 Hz) irregular mechanical energy: a possible killer application of triboelectric nanogenerator. *ACS nano*, *10*(4), 4797-4805.
16. Wen, X., Yang, W., Jing, Q., & Wang, Z. L. (2014). Harvesting broadband kinetic impact energy from mechanical triggering/vibration and water waves. *ACS nano*, *8*(7), 7405-7412.
17. Zhang, L. M., Han, C. B., Jiang, T., Zhou, T., Li, X. H., Zhang, C., & Wang, Z. L. (2016). Multilayer wavy-structured robust triboelectric nanogenerator for harvesting water wave energy. *Nano Energy*, *22*, 87-94.
18. Leung, S. F., Fu, H. C., Zhang, M., Hassan, A. H., Jiang, T., Salama, K. N., ... & He, J. H. (2020). Blue energy fuels: converting ocean wave energy to carbon-based liquid fuels via CO 2 reduction. *Energy & Environmental Science*, *13*(5), 1300-1308.
19. Wang, J., Li, S., Yi, F., Zi, Y., Lin, J., Wang, X., ... & Wang, Z. L. (2016). Sustainably powering wearable electronics solely by biomechanical energy. *Nature communications*, *7*(1), 12744.
20. Ramanarasimhulu K, Prasad BD. Hybrid Energy System Based On Solar Cell and Self-Healing/Self-Cleaning Triboelectric Nanogenerator with Rain Drop Simulation.
21. Yadav, G., Jindal, K., & Tomar, M. (2023). Fabrication of GaN-based MSM droplet triboelectric nanogenerator by the conjunction of photovoltaic and triboelectric effect. *Journal of Alloys and Compounds*, *944*, 169178.
22. McCutcheon, A. (2021). *Triboelectric Energy Generation* (Doctoral dissertation, Worcester Polytechnic Institute).

23. Cheng, B., Niu, S., Xu, Q., Wen, J., Bai, S., & Qin, Y. (2021). Gridding triboelectric nanogenerator for raindrop energy harvesting. *ACS Applied Materials & Interfaces*, *13*(50), 59975-59982.
24. Wang, Z. L. (2020). Triboelectric nanogenerator (TENG)—sparking an energy and sensor revolution. *Advanced Energy Materials*, *10*(17), 2000137.
25. Salauddin, M., Rana, S. S., Sharifuzzaman, M., Rahman, M. T., Park, C., Cho, H., ... & Park, J. Y. (2021). A novel MXene/Ecoflex nanocomposite-coated fabric as a highly negative and stable friction layer for high-output triboelectric nanogenerators. *Advanced Energy Materials*, *11*(1), 2002832.
26. Business Wire (n.d) *$134.11 Million Triboelectric Nanogenerator Markets, 2025 - Market to Grow at a CAGR of 48.55% - ResearchAndMarkets.com*. Retrieved September 14, 2023, from https://www.businesswire.com/news/home/20210302005572/en/134.11-Million-Triboelectric-Nanogenerator-Markets-2025---Market-to-Grow-at-a-CAGR-of-48.55---ResearchAndMarkets.com
27. Zi, Y., & Wang, Z. L. (2017). Nanogenerators: An emerging technology towards nanoenergy. *Apl Materials*, *5*(7).
28.
29. Liu, D., Yin, X., Guo, H., Zhou, L., Li, X., Zhang, C., ... & Wang, Z. L. (2019). A constant current triboelectric nanogenerator arising from electrostatic breakdown. *Science advances*, *5*(4), eaav6437.
30. Xi, Y., Guo, H., Zi, Y., Li, X., Wang, J., Deng, J., ... & Wang, Z. L. (2017). Multifunctional TENG for blue energy scavenging and self-powered wind-speed sensor. *Advanced Energy Materials*, *7*(12), 1602397.
31. Zou, M., Xu, S., Wei, C., Wang, H., & Liu, Z. (2016). A bionic method for the crashworthiness design of thin-walled structures inspired by bamboo. *Thin-Walled Structures*, *101*, 222-230.
32. Geng, F., & Huo, X. (2022). A Self-Powered Sport Sensor Based on Triboelectric Nanogenerator for Fosbury Flop Training. *Journal of Sensors*, *2022*.
33. Ahmed, A., Hassan, I., Ibn-Mohammed, T., Mostafa, H., Reaney, I. M., Koh, L. S., ... & Wang, Z. L. (2017). Environmental life cycle assessment and techno-economic analysis of triboelectric nanogenerators. *Energy & Environmental Science*, *10*(3), 653-671.
34. Wei, Z., Wang, J., Liu, Y., Yuan, J., Liu, T., Du, G., ... & Nie, S. (2022). Sustainable triboelectric materials for smart active sensing systems. *Advanced Functional Materials*, *32*(52), 2208277.
35. Barkas, D. A., Psomopoulos, C. S., Papageorgas, P., Kalkanis, K., Piromalis, D., & Mouratidis, A. (2019). Sustainable energy harvesting through triboelectric nano–generators: a review of current status and applications. *Energy Procedia*, *157*, 999-1010.
36. Li, Y., Zhao, Z., Gao, Y., Li, S., Zhou, L., Wang, J., & Wang, Z. L. (2021). Low-cost, environmentally friendly, and high-performance triboelectric nanogenerator based on a common waste material. *ACS Applied Materials & Interfaces*, *13*(26), 30776-30784.
37. Le, T. T., Curry, E. J., Vinikoor, T., Das, R., Liu, Y., Sheets, D., ... & Nguyen, T. D. (2022). Piezoelectric nanofiber membrane for reusable, stable, and highly functional face mask filter with long-term biodegradability. *Advanced Functional Materials*, *32*(20), 2113040.
38. Li, R., Li, Y., Zhao, Y., Li, Y., & Li, Y. (2018). Harvest of ocean energy by triboelectric generator technology. *Applied Physics Reviews*, *5*(3).
39. Mani, A., Mooley, D. A., & Mooley, D. S. (1983). *Wind energy data for India*. Allied Publishers.
40. Sriphan, S., & Vittayakorn, N. (2022). Hybrid piezoelectric-triboelectric nanogenerators for flexible electronics: Recent advances and perspectives. *Journal of Science: Advanced Materials and Devices*, *7*(3), 100461.
41. Xu, L., Xu, L., Luo, J., Yan, Y., Jia, B. E., Yang, X., ... &

Wang, Z. L. (2020). Hybrid all-in-one power source based on high-performance spherical triboelectric nanogenerators for harvesting environmental energy. *Advanced Energy Materials*, *10*(36), 2001669.

42. Roy, A., Das, S. K., Tripathi, A. K., Singh, N. U., & Barman, H. K. (2015). Biodiversity in North East India and their conservation. *Progressive Agriculture*, *15*(2), 182-189.
43. Salauddin, M., Rana, S. S., Sharifuzzaman, M., Rahman, M. T., Park, C., Cho, H., ... & Park, J. Y. (2021). A novel MXene/Ecoflex nanocomposite-coated fabric as a highly negative and stable friction layer for high-output triboelectric nanogenerators. *Advanced Energy Materials*, *11*(1), 2002832.

International Multidisciplinary Research E-Journal Online Available at http://gater.in/
INTERNATIONAL PEER REVIEWED JOURNAL
OF GLOBAL ASSOCIATION FOR TRAINING, EDUCATION & RESEARCH
(GLOBAL CONSORTIUM OF PROFESSIONALS, TRAINERS, ACADEMICIANS & RESEARCHERS)

Artificial Intelligence and IoT Enabled Waste Management System: A Review

Varun Kumar[1], Om Ji Shukla[2]
Department of Mechanical Engineering, National Institute of Technology Patna, India
E-mail:[1] varunk.ph21.me@nitp.ac.in, [2]omjishukla.me@nitp.ac.in

Abstract:

Rapid increment in population causing uncontrolled generation of waste is becoming a point of concern for various countries. The rise in waste causes health and environmental which forces smart cities to make properly manage it. Segregation and classification with recycling of waste are the focus of municipal corporations of the smart city. Still, there is a large manpower and time required to do it properly. This traditional process is replaced by the modern technique developed by researchers. Internet of Things (IoT) based platforms and deep machine learning are the technologies used to overcome those problems. The purpose of this paper is to review the modern technology used for improvement in waste management in a few years. It also allows determining the issues, algorithm, and approach of the cited research. Various case studies performed using these algorithms and models on smart cities are mentioned properly. This paper discusses the many waste segregation methods, models, and existing technologies that have been proposed, suggested, and developed in the last few years. Also, the paper examines the existing literature pertaining to advancements achieved from an industrial perspective. It also includes the drawbacks of the current systems and algorithms employed by various researchers as the future scope of the study. The review provides us with a lot of possibilities for new information to be generated in the creation of a new waste management system.

Keywords: IoT, Machine learning, Smart waste management.

I-INTRODUCTION

The revolution of Industrial technology improves fundamental processes like supply chain, manufacturing, life cycle management, material usage, etc. The latest version Industry 4.0 integrates the physical world (machines) with the virtual world (computers) which allows industry a much higher degree of control, adaptability, and flexibility than the traditional process. Industry 4.0 was launched by Germany in 2011 as part of H-T Strategy 2020 [1]. The integration of machine learning and IoT (Internet of Things) makes the technology highly flexible and efficient with green, high-quality, and cost-effective production and services [2]. IoT generates data by retrieving information from the internet and providing us the monitoring capabilities [3]. IoT helps the organization in real-time modification as it shares live information. Different layers are used in IoT technology which contains the machine, technology, and functionality of the system. Three-layer IoT architecture is most used by the current industries and research [4]. The integration of these layers provides flexible processing, comprehensive perception, and smart transmission. In every architect, the bottom layer is always utilized for data management and proper coordination between sensing devices. There is a network layer that is responsible for the transmission of information (data) between networks e.g., the Internet, 4G, etc. [5]. Machine learning and Artificial intelligence are processes to handle the huge amount of information generated by the IoT. It contains the storage, processing, and analyzing capability more than the traditional data processing technology. Large data provide a clear insight into the problems which helps the machine to learn properly. A machine that can act like a human is the main aim of artificial intelligence. It can be used for the prediction of upcoming events, classification (using various

techniques), transcribe speech, optimization, etc The utilization of IoT and machine learning in waste management systems helps the organizing committee to predict the quantity of waste, best transportation, segregation, recycling, and real-time updates, etc. The uncontrolled growth of the population becomes the rapid increment in waste which becomes a major problem for various counties. It becomes a large challenge for a fast-growing city to handle a huge amount of waste as they keep following the unchanged plan from the municipal corporation. Proper waste management can save our environment, humans, plants, and our future too [6]. Already in various cities, municipal corporations implemented the new technique and utilize waste as a resource (fuel, recycled items). Worldwide, the rate of increment in the quantity of waste is 1.9 billion tons per annum (35%). Also, there is a huge increment in the rate of waste generated per person per day increasing from 0.2 to 4.5 kg. It is estimated that waste generation per day will increase by 45% and 20 % in low-income and higher-income countries. Various types of waste can be classified for better treatment by municipal corporations. The specific type of waste treatment centre is made in the various cities which helps to recycle and utilize that waste as a resource.

1.1 Type of waste considered for management

These are the types of waste considered in various research-

- Hospital Waste- The waste generated by clinics and hospitals can be very dangerous to normal people if they get in contact with it [7]. There are special companies and procedures required for the treatment of such waste.
- Organic Waste- The waste generated from residences, restaurants, and commercials is food waste. These wastes were highly used for landfilling [8].
- Industrial Waste- Industries and factories are responsible for the generation of these wastes. These are mainly unused, chips and residuals part of the final product which are separated from them during manufacturing. These wastes can be recycled and reusable in the same industries with a proper setup [9].
- Recyclable waste- The type of waste can be recycled and regain its elemental and raw material form. Residences, industries, and factories generate such types of waste. A trained collecting team can be used to separate such waste from the garbage [10].
- Electronic Waste- E-waste is mostly related to electronics and electrical equipment-related waste. They are mainly produced from residences, industries, companies, etc. The unworkable electronics considered E-waste can be recycled by correcting some issues inside it. These wastes are dangerous for human beings because of some radiation emissions from them [11].
- Commercial Waste- Cloths, plastics (toys, appliances), and other old and unusable products come under commercial waste. Mostly these wastes are completely recyclable [12].

1.1 Waste Management Problems in Cities

Waste management is the biggest challenge for a city especially those who are on the way to becoming a smart city. Day by day, the population increases with their living areas expansion. The management plan sectioned by the committee team is always planned for a long time (approx. 10 years). But those plans fail due to unpredictable improvements in population and their uses. As those number increases causes more generation of waste. Still, many cities try to make their plan as per the changes found. These are the points that can be considered as the problems faced by a smart city:

- Ignorant behaviour towards waste management- Lack of knowledge, and awareness regarding waste management and its effect on the environment becomes the biggest problem for a city. The development of

a city always depends upon the thinking of its people. Even in many cities in India, people do not know the importance of the segregation or separation of wastes according to their types (dry, wet, E-waste). Many people burn their waste in the open public area as they think it is the best way to get rid of it. Awareness of the waste producer can solve this problem from the root level.

- **Improper segregation of municipal waste-** The waste management system of the city can understand the importance of the classification of wastes in their respective types. Many large cities like Patna, do not have any proper segregation of waste. They only dispose of city waste for landfills. Also, improper segregation becomes very hazardous and can affect human and animal health [13].
- **Lack of motivation-** Lack of proper motivation decreases the efficiency of the waste management organizer. No one appreciates the rag-picker in our society. It is necessary to participate maximum people in the practices made by these organizers [14].
- **Absence of Technical solution-** Proper execution of new technology is also helping effective way of waste management in a smart city. Mostly various private-public partnership organizer participates in implementing it. Also, IoT-based machine learning helps to make any management smart. Participation of the private sector and the use of this modern technology are found very rare in the current scenario [15].
- **Lack of proper transportation of waste-** Transportation is also an important part of proper waste management in a smart city. In India, for a long time in India, the same old vehicle is used for carrying waste imperfectly. This problem can be solved by optimizing the route (path) of waste transportation [16].

This paper aimed-

- To investigate the advancements achieved through the integration of machine learning, the Internet of Things (IoT), algorithms, and modelling methodologies, with the overarching goal of establishing intelligent and efficient waste management systems.
- To encompass an assessment of advancements attained in waste management from an industrial standpoint.

The introduction part includes the basics of Industry 4.0, IoT, AI, classification of waste, and problems faced during waste management. It also includes the industrial-based improvement in waste management systems from last year. In the end, conclusions and future work are proposed by the authors.

II- LITERATURE REVIEW :

Various models and IoT devices have been developed and suggested for proper waste management by researchers in the last few years. This section includes those models, devices, and existing technology used for the waste management system. In 2011, Hannan et al., Proposed a proper monitoring model of garbage bins and waste collection trucks using cameras, GPS, radio frequency identification, and communication technology. Also, in some studies, different types of garbage bins are placed to keep them properly as per their assigned trucks [25, 26]. The collection of waste records is used to train the model in the waste collection process. Also, the waste disposal system is designed as per the importance and variability of the facility (disposal areas). With proper disposal facility selection, soil nutrients can also be improved. Similarly, in a paper, a solution was proposed for garbage collection problems using intelligent monitoring [27]. A smart M3 platform is used to make the work easy by integrating all different domains of communication and information. Two phases of the complete solution designed: 1st stage includes the monitoring of waste with constant measuring, transmission, and storing of waste in the

compartments. In 2nd, the collected data is optimized for a better waste collection route. In 2017, Morley et al. addressed a dynamic set of infrastructure services on the waste management system for a smart city on IoT [28]. Three phases of planning, transportation, and recycling of waste are described in the set which utilizes sensors, radio frequency identifiers, and actuators. Real-time adaptation to the parameters and plans especially for the capacity of the set makes the system dynamic. A cloud-based smart waste management system (C-SWAM) was developed that provides a real-time update (information) of the different types of waste (plastic, metal, organic) containers [29]. They also proposed a model for best routing and tracing to make the economical movement of waste collection vehicles. In 2016, Ramasami et al. proposed a model to find the best facility for waste disposal (landfilling) [30]. A model which identifies an appropriate location for landfilling in the city which does not affect human health and the environment. Later in 2021, Gondal et al. proposed a real-time multipurpose waste classification model for proper recycling in smart cities [31]. They used a hybrid approach which is two machine learning models to classify the waste into their class. An ML-CNN (multilayer convolutional neural network) and a multilayer perceptron are used in the machine learning model. The ML-CNN structure is made using Python language with Py-Charm IDE. The model consists of a camera, a Raspberry Pi model, a pick-and-place robot, and bins for different classes. There is a large trash bucket from which the robotic arm can pick single trash at a time and put it on a conveyor platform. On the top, a high-definition camera is used to focus on the conveyor belt to capture each trash image. That captured image is passed to the control system of the model where it identifies the trash class and then provides information to the model for further processing. After getting the exact class of the trash, the robot arm picks that trash to the corresponding class of the trash bin (shown in Fig. 1). The model 1st trained with the trash images (around 1241 images) and 349 images for testing purposes throughout the analysis. A total of 5 classes of trash (paper, food, plastic, metal, and general) were provided to train the model. The accuracy of the model was analyzed (99%) and compared with the previous models (91.6%).

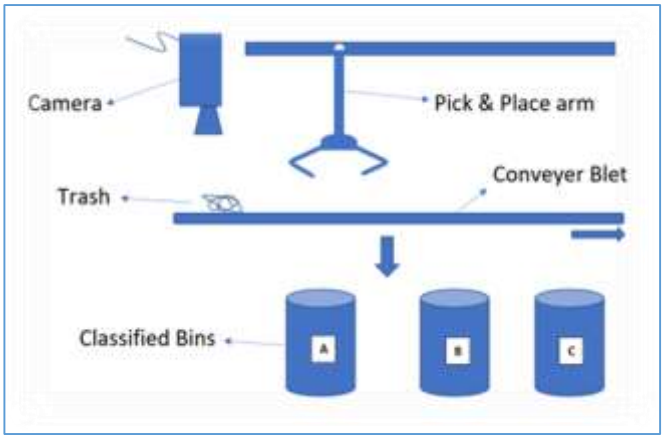


Figure 1 Experimental setup of waste classification [31]

Aswani et al. focused on the E-waste management problems. A machine learning model was fabricated with a camera module (image processing) to identify the E-waste from the mixed trash and separate it for further processing. It is an automated E-waste classification system that can be used for reuse and recycling [32]. In 2020, a systematic review was performed on the modern technology used for the waste management system [33]. They focused on reviewing mainly the automated segregation process performed for waste classification using machine learning papers. It was pointed out that image processing will be a very productive method to analyze and classify waste material. A proper literature review of different equipment, sensors, and systems (Intelligent waste separator, spot garbage, IoT-based waste collection system using infrared sensors, Adaptive and interactive Modelling system, ANN) mentioned for waste management. In comparison, the accuracy of SVM (Support Vector Machine) was found more than CNN (convolutional neural network).

III- INDUSTRIAL-BASED IMPROVEMENT IN THE WASTE MANAGEMENT SYSTEM

Industrial engineers also collaborate in the waste management system of a smart city or country. The proper site for waste disposal, best route, or optimum route, cost-effective, number of vehicles with proper timing, etc. are the improvements provided by Industrial engineers on waste management. They also researched the utilization of waste as a resource that is good for the environment and economic points for a smart city. Various researches are made and ongoing on this improvement along with their valuable suggestion, mentioned below-

Lin et al. focused on the improvement of the vehicle routing problem. The use of inter-arrival time constraints to solve the waste collection problem and its characterization. Bi-level optimization was used on the split delivery vehicle routing problem model. A pair of stages is applied to optimize and solve the problem [17]. Collection points and the number of vehicles used are optimized in these two stages. The model suggested was cost-effective and better in performance observed as it was compared with the existing condition. In 2018, a model for optimization of scheduling and routing of the municipal waste collection was found along with a case study on Surabaya City [18]. An assessment approach with a mathematical model was used to optimize the number of vehicles needed for the collection of waste in the city. It was concluded that the number of vehicles reduced from 37 to 13 as the result of the model and optimization applied to the existing routing of the waste collection of the city. The same work was performed in a model that was suggested to optimize the waste collection truck numbers and scheduling of these vehicles [19]. A binary bat algorithm was used in the research. For comparison purposes, a new model called cyber-physical system in which Industry 4.0 technology is used for optimization with the conventional (existing) waste collection system was analyzed using the mathematical model. In 2020, Rathore et al. focused on the utilization of the collected waste as a resource for thermal power plants. They systematically organized a network between biogas plants to thermal plants from collected waste or municipal corporations [20].

A model of the mixed-integer non-linear program (MINLP) was formulated to optimize the cost during waste management. Total cost (cost of transportation, social cost, penalty cost, functional cost, and hiring cost) was considered in the model to minimize up to some point. Bilaspur City was taken for the case used in this research. Also, the model was applied and compared between existing and proposed conditions. In the proposed scenario, collected waste was transported to the biogas plant where they utilize that waste to generate fuel. Those fuels are finally transmitted to the thermal power plants for working (shown in Fig. 2). This proposed condition gives better utilization of waste compared to disposal at landfill areas. It saves coal and the excess transportation of coal to generate the biogas as fuel. It was calculated that the proposed model can reduce the total cost by around INR 30,462,326 per day compared to the current expense of the waste management system. The reduction of carbon emissions (186.43 tons daily) is also a plus point of the proposed model. A non-linear mathematical model was used to optimize waste-to-energy management strategies [21]. Various facilities are planned where material recovery, proper waste management, incinerators, landfilling, and anaerobic digestion are performed. Low carbon emission, cost-effective, max. Energy recovery and more material recycled were aimed in the proposed model. A fuzzy analytic hierarchy process (AHP) optimizing strategy was applied in the research. It was concluded that 4.2% of energy recovered from the total energy demand in the UAE with 97.6% of carbon footprint reduction from landfilling. Also, the proposed model was found 288% profitable compared to the existing model in the UAE. In 2021, various industrial engineering-based waste management improvements were found during the COVID-19

pandemic in which challenges and practices were proposed and reviewed [22]. Sadeghi et al. designed a sustainable MSW (municipal solid waste) disposal system using a mixed-integer linear programming model. They tried to optimize the recycling centres' location and quantity [24].

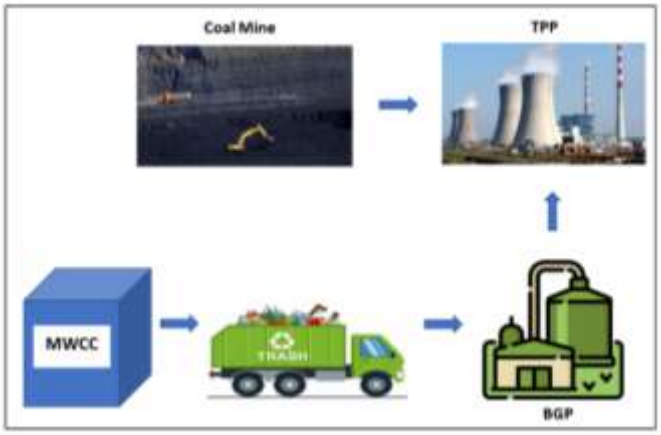


Figure 2 Schematic flow diagram of the optimized model [21]

IV-CONCLUSIONS AND FUTURE SCOPE

Various models, proposals, and steps are carried out in inefficient waste management systems by many researchers. In this review, a proper section of work done for improvement in waste management is mentioned, the theoretical basis model proposed the physical model device used for the processing in waste classification, and its related work, and industrial contribution for the improvement in waste management in environment conservation. From device use and its efficiency, it was concluded that image processing using a camera model is most effective for waste classification. A cost-effective model in which waste was used for fuel generation at biogas plants instead of landfilling was also found excellent work in waste management for a smart city. There is a lot of work required to improve the existing system to make it more efficient and effective management of wastes, In the classification model researchers always focused on a single trash separation at a time. Multiple trash classification and speed improvement are needed in such a fast-running world. There is a lack of a proper efficient method to recycle E-waste found in previous works. The proper implementation of modern technology in a smart city requires. A city like Patna is also analyzed in the waste management sector and found that it needs proper segregation, and recycling waste management plants. Also, the contribution of each citizen is helpful for the proper waste management of a smart city. Recycling and segregation at the household level are also required from the people of the city.

References :

[1] Kagermann, H., Wahlster, W. & Helbig, J.: Recommendations for implementing the strategic initiative INDUSTRIE 4.0: Securing the future of German Manufacturing Industry. Final report of the industry 4.0 Working Group (2013).

[2] Wang, S. et al.: Implementing Smart Factory of Industry 4.0: An Outlook. International Journal of Distributed Sensor Networks, 12(1), 3159805 (2016).

[3] Giusto, D., Antonio I., Giacomo M., & Luigi A.: The internet of things: 20th Tyrrhenian workshop on digital communications. Springer Science & Business Media, (2010).

[4] Mahmoud, R., Tasneem Y., Fadi A., and Imran Z.: "Internet of things (IoT) security: Current status, challenges and prospective measures." In 2015 10th international conference for internet technology and secured transactions (ICITST), pp. 336-341 (2015).

[5] Rak, Richard.: Internet of healthcare: opportunities and legal challenges in Internet of things-enabled telehealth ecosystems. In Proceedings of the 14th International Conference on Theory and Practice of Electronic Governance, pp. 481-484 (2021).

[6] Ayilara, M., Olanrewaju, O., Babalola, O., Odeyemi, O.: Waste management through composting: challenges and potentials. Sustainability, 12(11), 4456 (2020).

[7] Ali, M., Wang, W., Chaudhry, N., & Geng, Y.: Hospital waste management in developing countries: A mini-review. Waste Manag. Res., 35, 581-592 (2017).
[8] Kawai, K., Mai Huong, L.T.: Key parameters for behaviour related to source separation of household organic waste: A case study in Hanoi, Vietnam. Waste Manag. Res., 35, 246–252 (2017).
[9] Zobel, T.: ISO 14001 adoption and industrial waste generation: The case of Swedish manufacturing firms. Waste Manag. Res., 33, 107–113 (2015).
[10] Seyring, N., Dollhofer, M., Weibenbacher, J., Bakas, L., McKinnon, D.: Assessment of collection schemes for packaging and other recyclable waste in European Union-28 Member States and capital cities. Waste Manag. Res., 34, 947–956 (2016).
[11] Babu, B.R., Parande, A.K., Basha, C.A.: Electrical and electronic waste: A global environmental problem. Waste Manag. Res., 25, 307–318 (2007).
[12] Bacot, H., McCoy, B., Plagman-Galvin, J.: Municipal Commercial Recycling Barriers to Success. Am. Rev. Public Adm., 32, 145–165 (2002).
[13] Hoque, R. R. & Balachandran, S.: Handbook of Environmental Materials Management, C. M. Hussain, Ed., Springer, Cham, Switzerland (2019).
[14] Bernstein, J. et al.: Social assessment and public participation in municipal solid waste management. World Bank Working Paper (2004).
[15] Olukanni, D. O. & Nwafor, C. O.: Public-private sector involvement in providing efficient solid waste management services in Nigeria. Recycling, 4 (2), 19 (2019).
[16] Ghose, M. K., Dikshit, A. K., & Sharma, S. K.: A GIS-based transportation model for solid waste disposal- a case study on Asansol municipality. Waste Management, 26 (11), 1287-1293 (2006).
[17] Huang, S. H., & Lin, P. C.: Vehicle routing-scheduling for municipal waste collection system under the "Keep Trash off the Ground" policy. Omerga, 55, 24-37 (2015).
[18] Ramdhani, M. N., Baihaqi, I. & Siswanto, N.: Optimization of municipal waste collection scheduling and routing using vehicle assignment problem (a case study of Surabaya city waste collection). Materials Science and Engineering 337, 012013 (2018).
[19] Banyai, T., Tamas, P., Illes, B., Stankeviciute, Z. & Banyai, A.: Optimization of Municipal Waste Collection Routing: Impact of Industry 4.0 Technologies on Environmental Awareness and Sustainability. International Journal Environmental Research and Public Health, 16, 634 (2019).
[20] Rathore, P., & Sarmah, S. P.: Economic, environmental, and social optimization of solid waste management in the context of circular economy. Computers & Industrial Engineering, 145, 106510 (2020).
[21] Abdallah, M., Hamdan, S., & Shabib, A.: A multi-Objective Model for Strategic Waste Management Master Plans. Journal of Cleaner Production, 124714 (2020).
[22] Das, A. K., Islam, N., Billah, M., & Sarker, A.: COVID-19 pandemic and healthcare solid waste management strategy-A mini-review. Science of the Total Environment, 77, 146220 (2021).
[23] Hantoko, D., Li, X., Pariatamby, A., Yoshikawa, K., Horttaninen, M., & Yan, M.: Challenges and practices on waste management and disposal during COVID-19 pandemic. Journal of Environment Management, 286, 112140 (2021).
[24] Ahangar, S. S., Sadati, A., & Rabbani, M.: Sustainable design of municipal solid waste management system in an integrated closed-loop supply chain network using fuzzy approach: a case study. Journal of Industrial and Production Engineering, 38 (5), 323-340 (2021).
[25] Hannan, M.A., Arebey, M., Begum, R.A., & Basri, H., Radio frequency identification (RFID) and communication technologies for solid waste bin

and truck monitoring system. Waste Manag., 31(12), 2406–2413 (2011).

[26] Anghinolfi, D., Paolucci, M., Robba, M., & Taramasso, A.C., A dynamic optimization model for solid waste recycling. Waste Manag., 33(2), 287–296 (2013).

[27] Catania, V. & Ventura, D.: An Approach for Monitoring and Smart Planning of Urban Solid Waste Management using Smart-M3 Platform. 15th Conference of Open Innovations Association FRUCT, St. Petersburg, Russia, 21–25 April, 24–31 (2014).

[28] Anagnostopoulos, T., Zaslavsky, A., Kolomvatsos, K., Medvedev, A., Amirian, P., Morley, J., & Hadjiefthymiades, S.: Challenges and Opportunities of Waste Management in IoT-enabled Smart Cities: A Survey. IEEE Trans. Sustain. Comput., 2, 275–289 (2017).

[29] Aazam, M., St-Hilaire, M., Lung, C., & Lambadaris,: I. Cloud-based smart waste management for smart cities. In Proceedings of the IEEE Workshop on Computer-Aided Modeling and Design of Communication Links (CAMAD 2016), Toronto, Canada, 23–25 October, 188–193 (2016).

[30] Ramasami, K., & Velumani, B.: Location prediction for solid waste management- A Genetic algorithmic approach. In Proceedings of the 2016 IEEE International Conference on Computational Intelligence and Computing Research (ICCIC), Chennai, India, 15–17 December, 1–5 (2016).

[31] Gondal, A.U., Sadiq, M.I., Ali, T., Irfan, M., Shaf, A., Aamir, M., Shoaib, M., Glowacz, A., Tadeusiewicz, R., & Kantoch, E.: Real-Time Multipurpose Smart Waste Classification Model for Efficient Recycling in Smart Cities Using Multilayer Convolutional Neural Network and Perceptron. Sensors, 21, 4916 (2021).

[32] Aswani, T., Maurya, A., Naik, G., & Perla, M.: Automated E-waste disposal using machine learning. VIVA-Tech Int. Journal for Res. & Inn., 1(4), 91-97 (2021).

[33] Flores, M. G., Tan, & J. B.: Literature Review of Automated Waste Segregation System using Machine Learning: A Comprehensive Analysis. IJSSST, 20 (2), 1473-8031 (2020).

International Multidisciplinary Research E-Journal Online Available at http://gater.in/
INTERNATIONAL PEER REVIEWED JOURNAL
OF GLOBAL ASSOCIATION FOR TRAINING, EDUCATION & RESEARCH
(GLOBAL CONSORTIUM OF PROFESSIONALS, TRAINERS, ACADEMICIANS & RESEARCHERS)

A comprehensive review on performance improvements of various solar Dryer

Lalit Kumar[1], Jyoti Singh Parihar[1], Harish Kumar Ghritlahre[1], Sanjay Agrawal[1,2,*], Sunita S. Singh[3]
[1]Department of Energy and Environmental Engineering, Chhattisgarh Swami Vivekanand Technical University, Bhilai, Chhattisgarh, 491107, India.
[2,*]School of Engineering and Technology, IGNOU, New Delhi-110068
[3]Department of Chemistry, Government VYT PG College, Durg.
E-mail:sanju.aggrawal@gmail.com

Abstract :
Drying is an extremely essential method proposed for agricultural and industrial crops. The removal of moisture from products is accomplished through drying. Bacterial intensification in products is reduced by drying them. As a result, it will be beneficial in terms of preserving products for a long period of time. Among the earliest methods of drying goods, solar drying is the oldest. The system that is used for this operation is called a solar dryer, which uses solar energy for the drying of the product. No need for electricity is required for that purpose. There are different solar drying methods for the drying of agricultural products, such as direct solar drying, indirect solar drying, and mixed-mode solar drying. In this paper, we did a comprehensive review of various solar dryers, like direct solar dryers, indirect solar dryers, and mixed-mode solar dryers, which have been successfully carried out. Forced convection mixed-mode horizontal solar cabinet dryer (FCMHSD) is found to be one of the best solar dryers with respect to drying time as well as moisture removal rate compared to the other two methods.

Keywords : solar energy, solar dryer, direct solar dryer, indirect solar dryer and mixed mode solar dryer.

I - INTRODUCTION :

En ergy is the fundamental basis for the development of any country. In any country, per capita energy consumption is also a symbol of its standard of living. India is a culturally and economically developing country. The population of India is denser and the demand for energy is high, so alternative sources of energy like solar energy, wind energy, biomass energy, nuclear energy, tidal energy, geothermal energy, etc. are being introduced [1]. Solar energy is a renewable source of energy, which is a clean, environmentally friendly, infinite, and economical form of energy. Solar energy is basically used in two ways: either direct conversion into electricity by using photovoltaic solar panels or using solar thermal devices, i.e. solar dryers, solar ponds, solar cookers, solar pumps etc. [2].In developing countries, solar drying is employed as a traditional method for preserving agricultural products and escaping the yearly losses of surplus agricultural products. But this drying produces a lower quality product dependent on weather conditions and contaminated with dirt, dust, insects, rain, pests, etc., so a solar dryer is employed for better removal of moisture content from the agricultural products, which gave the best result as compared to open sun drying [3]. The specific objective of these review papers is to provide a comprehensive review of various solar dryers, like direct solar dryers, indirect solar dryers, and mixed-mode solar dryers.

1.1 Classification of solar dryers

The solar dryer is broadly classified on the basis of the mode of heat transfer as shown in figure 1

- **Direct solar dryer**: In direct solar dryer, the agricultural or food product to be dried is directly exposed to the solar radiation. The movement of air is passing through it and extracts the moisture from the product.
- **Indirect solar dryer**: In Indirect solar dryer, the dryer consist of two elements i.e. solar collector and drying chamber .in solar collector, the solar energy is collected in the form of heat energy then it is connected to the drying chamber

International Multidisciplinary Research E-Journal Online Available at http://gater.in/
INTERNATIONAL PEER REVIEWED JOURNAL
OF GLOBAL ASSOCIATION FOR TRAINING, EDUCATION & RESEARCH
(GLOBAL CONSORTIUM OF PROFESSIONALS, TRAINERS, ACADEMICIANS & RESEARCHERS)

,heated air is passed through it and extraction of moisture is takes place finally the product is to be dried.

- **Mixed mode solar dryer**: Mixed mode solar dryer is a dryer that uses the direct as well as indirect solar radiations by the application of solar air collector. It consists of a reflector, solar collector, and heat exchanger and drying chamber units. In Mixed mode solar dryer the solar energy collection occurs in solar collector and drying chamber both and drying the food product is carried out in only drying chamber. Mixed mode solar dryer is the best option for cloudy days comparing to other dryers.

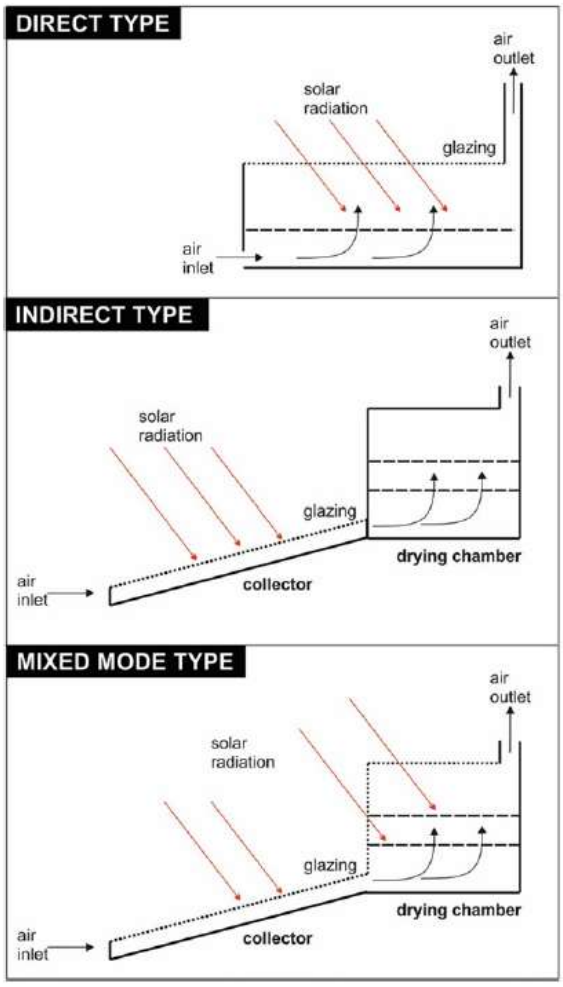


Figure1: Working of solar dryers. [1]

II-**Performance study of solar dryer**:

Solar drying system performance may be assessed by using the following equations as given below ;

Amount of moisture removed

$$M_{evp} = \frac{M_i(mc_i - mc_f)}{(100 - mc_f)} (1)$$

Where, Mevp is amount of moisture removed, Mi is initial mass of the sample, mci is initial moisture content and mcf is moisture content on dry basis.

Drying Rate: It is the rate at which moisture from the crops or vegetables gets evaporated to the surrounding atmosphere. It is given by moisture content at any successive interval of time with respect to time.Where, DR is drying rate, mc_{t+dt} is moisture content at time t+dt and mct is moisture content at time t.

$$DR = \frac{mc_{t+dt} - mc_t}{dt} \times 100 \quad (2)$$

Moisture ratio: It is the comparison of moisture content at any instant of time to the initial moisture content.Where, MR is moisture ratio and mce is equilibrium moisture content.

$$MR = \frac{mc_t - mc_e}{mc_i - mc_e} \quad (3)$$

Drying Efficiency: The ratio of energy or heat supplied for the evaporation of moisture from the sample to the overall energy gained while the experimental procedure is termed as drying efficiency. The drying efficiency can be evaluated for active as well as passive convection.Where, natural and forced convection drying efficiency, hfg is latent heat of vaporization, Asc is area of solar collector, IR is solar intensity, Pex is power supply.

$$?_{ND} = \frac{M_{evp} h_{fg}}{I_R A_{SC}} \quad (4)$$

$$?_{ND} = \frac{M_{evp} h_{fg}}{I_R A_{SC} + P_{ex}} \quad (5)$$

Literature Review :

Hallak et al. [4] designed & describes the direct mode staircase solar dryer for drying various fruits & vegetables(1995).Efficiency of solar collector varies between 0.26 to 0.65. The moisture content is recorded as less than 20 % of initial mass values are 2.5-3.5 days. The average drying period for drying same product in open sun drying is 12 to 15 days.Pangavhane et al. [5] developed a new natural convection solar dryer for drying grapes

(2002). The dryer consists of a solar air heater and a drying chamber. The qualitative analysis is carried out, the drying time for grapes are recorded as 15 days for shade drying & seven days for open sun drying whereas the solar dryer took only 4 days & gave better quality raisins. Average dryer temperature between 50 & 55 °C, The collector efficiency ranges between 0.26 (for 0.0126 kg/sec) and0.65 (for 0.0246kg/sec).Drying time reduced 43 % to the open sun drying.Akachukwu [6] developed a 3 small scale direct mode natural convection solar dryer for drying tomato, okra and carrot (2013).These drying products are sliced in 15mm thickness & investigated in also open sun drying. The system drying efficiency, for drying tomato, carrot &okra are 21.80 %, 19.96 % and 24.95 % respectively followed by in open sun drying, for drying tomato, carrot & okra are 10.59 %, 10.25 % and 15.19 % respectively. The initial moisture content reduced to final moisture content for, drying tomato, carrot & okra are 93-4 %, 88-5 % and 88-4 % respectively. Islam et al. [7] developed & investigated the effect of cover design on moisture removal rate of a cabinet type solar dryer for drying various food product such as Apple, Banana, Pineapple, Guava in different seasons by using three different designs (2018). They successfully analyzed that moisture removal rate in thin tube chimney type chamber is 44.5 %, for attic space type is 33.3 % and for natural draft chamber is 58.9 % in only 6 hrs recorded. Moisture removal rates for Pineapple, guava, apple and bananas are 87 %, 58 %, 84 % and 74 % respectively. Nabnean & Nimnun [8] have designed & constructed a direct forced convection household solar dryer for drying banana(2020). They are constructed a parabolic shape solar dryer& dried banana in 5 batches, each batch having 10kg of banana. They were calculated the dried air temperature in solar dryer ranges 35-60°The initial moisture content of banana is 72% (wb) & the final moisture content is 28%(wb) recorded within 4 days. While in open sun drying, the moisture content is reduced to 40% (wb) at same time period. Saving of drying time is 48% comparing with open sun drying. Dryer payback period is1.1 years.

Madhlopa & Ngwalo [9] have designed, developed & evaluated an indirect type solar dryer with thermal storage and biomass-backup heater for drying pine apple (Ananas Comosus)(2006).The system consist of bio mass burner(with a rectangular duct and flue gas chimney), collector-storage thermal mass and drying chamber (with solar chimney).Dryer was analyzed in three experimental modes such as solar , biomass and solar-biomass. Each batch having 20 kg for drying pine apples in twelve batches. In solar biomass mode moisture content is reduced from 669 % (db) to 11 % (db). The average final moisture pickup efficiency of solar, biomass and solar biomass modes are 15%, 11% and 13 % respectively.Sebii & Shalay [10] designed and fabricated an indirect mode forced convection solar dryer for drying thymus and mint (2013). The system contains a double pass V-corrugated plate solar air heater & blower is attached to a drying chamber. The initial moisture content for drying thymus and mint at an initial temperature of 29 °C is 95 % (wb) and 85 %, respectively. moisture content is achieved after 34 & 5 hrs. resp. In these experiments, 14 mathematical modes of thin layer drying were tested and found that the Midilli Kucuk mode model is beneficial for expressing the drying of mint, whereas the Page and Modified Page models were found to be the best of all for detailing the drying curves of thymus. Musembi et al. [11] designed & fabricated an indirect natural convection a solar dryer for Mid-Latitude region for apple drying (2016). the apples are cut into 2.5 mm thick sliced mass of 886.64 gram having initial moisture content 86 % to final moisture content 8.12 % (wb) within 9 hrs 20 minutes with average irradiation of 534.45 W/M2. The overall drier efficiency was calculated to 17.89 %.Yahya et al. [12] investigated the performance of a solar dryer(SD) and solar assisted heat pump dryer (SAHPD) for cassava chips drying (2016).At temperature 40 & 45 °C,the mass of cassava reduced from 30.8 kg to 17.4 kg in 13 hrs. & 9 hrs for solar dryer & SAHPD resp. Moisture content reduced from 61 %(wb) to 10.5% (wb)at 0.124

kg/sec (mass flow rate).For solar dryer & SAHPD ,average thermal efficiency obtained 25.6 % & 30.9% resp.for solar dryer the average drying rate (DR) & SMER was 1.33 kg/h & 0.38 kg/kwh resp. whereas for SAHPD 1.93kg/h and 0.47 kg/kwh resp .For SD & SAHPD the pickup efficiency varies from 3.9 % to 65.8% & 15.9 % to 70.4 % with average values of 39.3 % & 43.6 % resp. For solar dryer, solar fraction recorded 66.7 % & for SAHPD 44.6% resp .The coefficient of performance of heat pump ranges from 3.23 to 3.47 with corresponding average value 3.38. Essalhi et Al. [13] designed an indirect solar dryer for experimental and theoretical analysis for grapes drying (2018) compare with open sun drying process. The system contains a solar collector, a heat exchanger, a water storage tank and a drying chamber. The time needed for drying grapes starts with initial moisture content of 79.8 %(wb) to 20.2 %(final moisture content) in indirect solar drying120 hrs & open sun drying 201 hrs respectively. Pardhi & Bhagoria [14] developed and evaluate the performance of a mixed mode solar dryer with forced convection for drying grapes by using smooth and roughened plate solar collector (2013). In no load condition the absorber plate attained temperature observed 69.2°C and the same working condition maximum air temperature obtained 64.1°C .The moisture content is reduced from initial 81.4% to final 18.6% within 4 days whereas open sun drying it taken 8 days.

Sekyere et. al [15] designed & constructed a mixed mode natural convection solar dryer with back up heater for drying pineapple (2016).

Sr.No.	Author Name	Year	Type of solar dryer	Product	Time taken	Moisture Content Initial Final
1.	Hallak et al.	1995	Direct mode staircase solar dryer	Fruits and vegetable	2.5 – 3.5 days & 12-15 days for open sun	< 20%
2.	Pangavhane et al.	2002	Natural convection solar dryer	Grapes	15 days ,7 days & 4 days for shade drying, open sun & solar dryer resp.	
3.	Madhlopa et al.	2006	Indirect type natural convection solar dryer	Pineapple (Ananas Comosus)		669% (db) 11%(db)
4.	Eke, B.A.	2013	Natural convection solar dryer	Tomato, okra and carrot.	21.80%, 19.96%&24.95% for tomato, carrot& okra drying respectively.	For tomato,93% 4%(wb) For okra, 88% 4%(wb) For carrot, 88% 5%(wb)
5.	Pardhi et al.	2013	Mixed mode forced convection solar dryer.	Grapes.	4 days & 8 days for open sun drying.	81.4% 18.6%
6.	El-Sebaii et al.	2013	Indirect type Forced convection solar dryer	Thymus & Mint.	34 hrs & 5 hr	Initial 95%(wb) & 85%(wb)
7.	Musembi et al.	2016	Indirect type natural convection solar dryer	Apple	9 hrs 20 minutes	86% % (wb) 8.12% (wb)
8.	Yahya et al.	2016	Solar dryer (SD) & Solar Assisted heat pump Dryer(SAHPD).	Cassava	13hr & 9 hr for SAHPD	61% (wb) 10.5%(wb)
9.	Sekyere et al.	2016	Mixed mode natural convection solar dryer.	Pineapple.	19 hr,10hr,7 hr and 23hrs respectively.	924% (db) 106% (db) 1049% (db) 184% (db) 912% (db) 155% (db) And 1049% (db) 144% (db)
10.	Essalhi et al.	2017	Indirect Solar dryer	Grapes	120 hrs & 201 hrs (open sun)	79.8% 20.2%(wb)
11.	Islam et al.	2018	Cabinet type solar dryer.	Apple, banana, pineapple, guava.	6 hrs.	
12.	Lakshmi et al.	2019	Mixed mode forced convection solar dryer.	Stevia Leaves.	For MFSCD 330 minutes & for open sun drying 870 min.	Final 0.053(db)
13.	Kuhe et al.	2019	Mixed mode active solar crop dryer.	Maize.	6hrs.	Initial (47.16 % - 51.14 %) (d.b.) Final (11.75% – 16.87%) (d.b.)
14.	Nabnean et al.	2020	Forced convection solar dryer.	Banana.	4 days	72%(wb) 28%(wb) For open sun 40%(wb)
15.	Ekka et al.	2020	Forced convection Mixed mode horizontal solar cabinet dryer.	Black ginger	11 hrs, 7 hrs for case II and 13 hrs for open sun drying.	75%(wb) 3.3%(wb) up to 4.3%

The experiment was performed in four drying scenarios in Ghana. They were recorded the final moisture content of pineapple between 106% to 184% (db).they were calculated the moisture content decreased with time in dryer in various operational modes, for solar drying with back up heating mode is 924% to 106 % (db) in 19 hrs, for drying with backup heater is 1049% to184% in 10 hrs., for hybrid solar drying mode is 912 % to 155%(db) in 7 hrs. and solar mode of drying is 1049% to 144% (db) in 23 hrs respectively. The average moisture pickup efficiency for mode 1, 2, 3and mode 4 are 27%,24%,11% and 32% respectively. Lakshmi et.al [16] successfully investigate & analyzed the mixed mode forced convection solar dryer (MFSCD) for drying of Stevia leaves & compared to the open sun drying(OSD)(2019) .During the experiment average solar radiation, ambient temperature & drying air flow rate was observed 567W/m2, 30°C & 0.049kg/sec respectively. The final moisture content for MFSCD is obtained 0.053(db) in 330 minutes & OSD is 870 min. recorded successfully.

Kuhe et.al [17] developed and tested a mixed mode active solar crop dryer for drying of maize with a transpired solar air heater (2019). They were conducted experiment of drying air mass flow rate at five levels within 6 hours. They found moisture content of maize initially from 47.16 % - 51.14 % (d.b.) reduced to a range of 11.75 – 16.87 % (d.b.) at their mass flow rate of 0.038 kg /sec. The collector Efficiency ranges from 65.20 – 71.77 % & drying efficiency ranges 55.3% - 82.2 % at mass flow rate 0.026 kg/sec. & 0.038kg/sec.respectively. Ekka et.al [18] successfully analyzed the performance of a forced convection mixed mode horizontal solar cabinet dryer(FCMHSD) using two successive air mass flow rates for dying of black ginger (Kaempferia parviflora)(2020).In these experiment two successive air mass flow rates are 0.062kg/sec.& 0.018 kg/sec. considered .for case I constant mass flow rate of air is 0.062kg/sec.& the moisture content were reduced from 75%(wb) to 3.3%(wb) in 11 hrs. and 7 hr recorded for case II. The overall efficiency of solar air collector (SAC) is obtained 60% & 49.4% for case I & case II respectively. The average dryer efficiency 6.4%& 10.8% for case I & case II respectively. While in the open sun drying final moisture content reduced up to 4.3% in 13 hrs.

Conclusion :

In this paper, a comprehensive review of direct, indirect and mixed-mode solar dryers is examined in terms of design parameters and performance. In the mixed-mode dryer, the drying rate of the product is increased and the time taken decreases. The mixed-mode solar dryer is the best method as compared to the indirect as well as direct solar dryers. There are fewer moving parts, they are compact in size, and they require less maintenance. An indirect solar dryer gives better results than a direct solar dryer.

References

[1] Sukhatme, S.P., Nayak, J.K. (1996) Solar Energy-Principles of thermal collection and storage. Tata McGraw Hill, New Delhi.

[2] Khan B.H., Non-Conventional ENERGY Resources. Tata McGraw Hill, New Delhi 2009.

[3] Tiwari G.N.: Solar Energy: Fundamentals, Design, Modelling and Applications. Narosa, New Delhi 2004.

[4] Hallak, H., Hillal, J., Hilal, F. and Rahhal, R. (1996). The staircase solar dryer: design and characteristics. Renewable Energy, 7(2), pp.177-183.

[5] Pangavhane, D.R., Sawhney, R.L. and Sarsavadia, P.N., (2002). Design, development and performance testing of a new natural convection solar dryer. Energy, 27(6), pp.579-590.

[6] Eke, B.A. (2013). Development of small scale direct mode natural convection solar dryer for tomato, okra and carrot. International Journal of Engineering and Technology, 3(2), pp.199-204.

[7] Islam, M., Islam, M.I., Tusar, M. and Limon, A.H. (2019). Effect of cover design on moisture removal

rate of a cabinet type solar dryer for food drying application. Energy Procedia, 160, pp.769-776.
[8] Nabnean, S. and Nimnuan, P. (2020). Experimental performance of direct forced convection household solar dryer for drying banana. Case Studies in Thermal Engineering, 22, p.1007-1087.
[9] Madhlopa, A. and Ngwalo, G. (2007). Solar dryer with thermal storage and biomass-backup heater. Solar energy, 81(4), pp.449-462.
[10] El-Sebaii, A.A. and Shalaby, S.M. (2013). Experimental investigation of an indirect-mode forced convection solar dryer for drying thymus and mint. Energy Conversion and Management, 74, pp.109-116.
[11] Musembi, M.N., Kiptoo, K.S. and Yuichi, N. (2016). Design and analysis of solar dryer for mid-latitude region. Energy procedia, 100, pp. 98-110.
[12] Yahya, M., Fudholi, A., Hafizh, H. and Sopian, K. (2016). Comparison of solar dryer and solar-assisted heat pump dryer for cassava. Solar Energy, 136, pp.606-613.
[13] Essalhi, H., Benchrifa, M., Tadili, R. and Bargach, M.N. (2018). Experimental and theoretical analysis of drying grapes under an indirect solar dryer and in open sun. Innovative food science & emerging technologies, 49, pp.58-64.
[14] Pardhi, C.B. and Bhagoria, J.L. (2013). Development and performance evaluation of mixed-mode solar dryer with forced convection. International journal of energy and environmental engineering, 4(1), pp.1-8.
[15] Sekyere, C.K.K., Forson, F.K. and Adam, F.W. (2016). Experimental investigation of the drying characteristics of a mixed mode natural convection solar crop dryer with back up heater. Renewable Energy, 92, pp. 532-542.
[16] Lakshmi, D.V.N., Muthukumar, P., Layek, A. and Nayak, P.K. (2019). Performance analyses of mixed mode forced convection solar dryer for drying of stevia leaves. Solar Energy, 188, pp. 507-518.
[17] Kuhe, A., Ibrahim, J.S., Tuleun, L.T. and Akanji, S.A. (2019). Effect of air mass flow rate on the performance of a mixed-mode active solar crop dryer with a transpired air heater. International Journal of Ambient Energy, pp.1-8.
[18] Ekka, J.P., Bala, K., Muthukumar, P. and Kanaujiya, D.K. (2020). Performance analysis of a forced convection mixed mode horizontal solar cabinet dryer for drying of black ginger (Kaempferia parviflora) using two successive air mass flow rates. Renewable Energy, 152, pp. 55-66.

ıternational Multidisciplinary Research E-Journal Online Available at http://gater.in/
INTERNATIONAL PEER REVIEWED JOURNAL
OF GLOBAL ASSOCIATION FOR TRAINING, EDUCATION & RESEARCH
(GLOBAL CONSORTIUM OF PROFESSIONALS, TRAINERS, ACADEMICIANS & RESEARCHERS)

BLOCKCHAIN SECURED - SURVEILLANCE CAMERA

1st R. KOTHAI
ELECTRICAL AND ELECTRONICS ENGINEERING, SRI SAIRAM ENGINEERING COLLEGE, CHENNAI, INDIA
Email: kothai.eee@sairam.edu.in
2nd LOGESHWARAN B
ELECTRICAL AND ELECTRONICS, ENGINEERING SRI SAIRAM ENGINEERING COLLEGE CHENNAI, INDIA
E-mail: sec21ee033@sairamtap.edu.in
3rd ROHAN C
ELECTRICAL AND ELECTRONICS ENGINEERING, SRI SAIRAM ENGINEERING COLLEGE CHENNAI, INDIA
E-mail: sec21ee043@sairamtap.edu.in
4th PRASANAA J
ELECTRICAL AND ELECTRONICS ENGINEERING SRI SAIRAM ENGINEERING COLLEGE CHENNAI, INDIA
E-Mail: sec21ee101@sairamtap.edu.in
5th ULAGANATHAN A
ELECTRICAL AND ELECTRONICS ENGINEERING, SRI SAIRAM ENGINEERING COLLEGE CHENNAI, INDIA
Email: secl22ee04@sairamtap.edu.in

Abstract :

There are over a billion Surveillance camera (CCTV) cameras observing the world. These cameras capture extensiveAudioandVideo data, whichis typicallyprocessedand stored in centralized cloud servers. However, there are numerous instances that have demonstrated that this conventional method is susceptible to data breaches and privacy violations. As a result, the traditional video surveillance setup struggles to ensure the privacy of individuals captured on CCTV cameras. As an outcome, this work proposes a solution: a safe and private mech-anism for sharing stored surveillance videos among authorized users or nodes.

This mechanism is based on smart contracts, similar to Hyperledger, and it encrypts video frames. The concept of blockchain plays a crucial role in this solution. Functioning as a sequence of interconnected blocks, it acts as a decentralized ledger which is capable of recording transactions across various users and use this information throughout all connected blocks. These blocks are overseen by a peer-to-peer computer network .By encapsulating these ideas, our paper goal is to enhance security and privacy within the data storage of video surveillance while offering a secure approach to use it conventional.

Keywords : Hyperledger, encryption, blockchain

A. INTRODUCTION :

In recent years, the widespread integration of surveillance camera systems has transformed a variety of industries by increasing security, improving operational efficiency, and al-lowing for better decision-making. However, the pervasiveness of these systems has raised serious concerns about data in-tegrity, privacy breaches, and centralized vulnerabilities. Tra-ditional surveillance configurations, which frequently depend on centralized storage and management, are vulnerable to unauthorized access, data manipulation, and single points of failure. Innovative solutions are being sought to address these issues and improve the reliability of surveillance data. The use of blockchain in surveillance cameras ushers in a new paradigm in which every bit of recorded visual data, whether images or videos, is cryptographically hashed and timestamped. These data entries are then encrypted and se-curely stored in blocks on a decentralized blockchain network. These data entries are then securely stored within blocks on a decentralized blockchain network. The immutability of the blockchain guarantees that once data is recorded, any attempt at alteration requires consensus from the network participants, thus fortifying the integrity of the captured information. More-over, the decentralized architecture of blockchain technol-ogy eliminates the vulnerabilities associated with centralized systems. Access control and permissions are governed by smart contracts, enabling granular definition of data accessi-bility. This approach empowers stakeholders with a transpar-ent mechanism for monitoring and controlling data sharing, addressing concerns related to privacy breaches. Throughout this paper, we explore the intricacies of merging blockchain with surveillance cameras, elucidating the technological under-pinnings and benefits of this innovative synergy. Scalability, energy efficiency, and integration complexity are all issues that must be carefully considered when implementing this approach .Finally, the convergence of blockchain technology and surveillance cameras holds enormous promise for ensuring data integrity and privacy within the surveillance ecosystem. This novel approach has the potential to redefine data security standards by leveraging the distributed and tamper-resistant attributes of blockchain, leading to an era of heightened trust and accountability in surveillance data management

B. LITERATURE SURVEY :

[1]This paper proposes a secure method of video surveil-lance for authorized users. Smart contracts, the discrete cosine transform, an advanced encryption standard, and a block shuffling algorithm are at the heart of it. DAB is also used to encrypt video frames. The BC-based solution fosters the development of decentralized, dependable SACs (surveillance analytics centers) and storage sites with secure and privacy-aware sharing of stored surveillance videos between SAC nodes and by law enforcement, police departments, and courts securely connected to the SAC nodes. [2] The paper proposed a distributed platform based on CORBA middleware for high performance Discrete Cosine Transform algorithm execution. DCT, which is ideal for image compression, is a computation-ally intensive task that can be solved efficiently in a network of workstations (NOW). The transform algorithm is divided into a number of independent tasks that are assigned to a group of components that are distributed across a NOW's hosts. Chang-ing the number of image blocks assigned to each of the 17 servers ensures efficient data communication and computation load balancing across the network. The experimental results show that distributed execution of this application significantly speeds

up, and that performance improves with increasing data size, highlighting the importance of distributed algorithms. [3]In this study, they propose employing a local peer network to bridge the gap in order to get around the difficulties of fusing blockchain and loT. By providing a scalable local ledger and preserving peer validation of transactions at both the local and global levels, it reduces the volume of transactions added to the global Blockchain.

I. PREREQUISTIES

Implementing blockchain with surveillance camera required many prerequisties.

A. Privacy and video surveillance systems

To ensure physical security and public safety, governments and private citizens have installed more than a billion surveil-lance cameras throughout urban areas worldwide. To increase security, this surveillance camera is being used in several cities. In the wider cyberspace, where there are almost 4.57 billion active Internet users as of July 2020, or 59% of the world's population, this enormous data set comprising sensi-tive visual information could be exposed. The information leak is commonly attributed to assaults on interception systems as well as the abuse of cameras and recorded video for extortion, cyberstalking, and blackmail. This increases the likelihood of privacy invasions and breaches involving those recorded on CCTV. The best way to construct a video surveillance system that maintains people's privacy in the face of an expanding number of CCTV cameras is to demand that the camera manufacturers incorporate privacy-preserving techniques into its design and suggest secure deployment networks. This vast collection of individually identifiable information Visual data might be broadcast into the larger cyberspace, where as of July 2020, there were about 4.57 billion active Internet users, or 59% of the world's population. Oftentimes, interception attacks and the improper use of cameras and recorded movies for extortion, cyberstalking, or blackmail are to blame for the information leak. This raises the possibility of intru-sions of people caught on CCTV and privacy infractions.

Having camera manufacturers incorporate privacy-preserving techniques into their designs and advising secure deployment networks is the best way to create a video surveillance system that safeguards people's privacy in the midst of the rising proliferation of CCTV cameras.

B. SECURED CHAIN OF BLOCKS(BLOCKCHAIN)

About ten years ago, Bitcoin served as an example of how BC technology might support decentralized trusted computing platforms. The popularity of Bitcoin helped spread awareness of BC technology as a whole. It can now be utilized to carry out secure and reliable transactions over dubious networks without the requirement of a reliable central third party. A block sequence known as the BC contains a list of exhaustive and legitimate transaction records. The parent block of a given block is referred to as its parent block, while the first block is referred to as the genesis block. The BC blocks are connected by a hash value. There is a block header and a block body for every block. The block version, previous block hash, timestamp, 4-byte nonce, body root hash, and target hash are all included in the block header. The validated transactions that took place over a certain amount of time make up the block body. The BC technology can potentially decentralize many applications that rely on a centralized trustworthy body because of these capabilities. Additionally, a lightweight blockchain can be used to guarantee privacy and authorized access in many smart applications, together with the idea of identity-based distributed data custody in multi-cloud storage. However, a public blockchain is not the best option due to worries about privacy and performance difficulties. A private blockchain with only verified member nodes has been proposed as an alternative. Because of this, a thin, closed-group blockchain that can enable decentralized applications like

surveillance and that demands great speed and anonymity might be able to satisfy the needs. Speed is the primary problem. Real-time video surveillance is possible, but the BC does not yet allow it.

C. IoT COMPONENTS(RASPBERRY PI)

The Raspberry Pi Foundation created the Raspberry Pi, a compact, reasonably priced single-board computer. It was developed to advance computer science education and provide a user-friendly platform for testing out hardware and program-ming ideas. Raspberry Pi can run a blockchain node, which participates in a blockchain network's consensus mechanism. This is beneficial in terms of network security and decentral-ization. This can be also used to create a private blockchain network, allowing you to test blockchain technology in a safe environment. This is useful for both learning and testing. Smart contracts can be executed on various blockchain platforms

II. PROPOSED METHODOLOGY

The gathering of surveillance data is the initial step in the proposed system's data flow. The initial stage involves collecting photos or videos using security cameras that have been placed in appropriate locations. The collected data from

Fig. 1: CODE 1

Fig. 2: CODE 2

a wide variety of locations and it was used as the first input in the subsequent process. The information that was collected was encoded within the system . The Raspberry Pi, a central processing unit known for flexibility and computational power, receives the collected data. This transitional phase enables real-time data management and alteration, guaranteeing

that the recorded content is ready for the blockchain connection. The implementation of blockchain technology within the Raspberry Pi is at the heart of the innovation. The captured data is carefully organized into blocks using coded blockchain protocols. These blocks, containing cryptographic hashes and timestamps, form an immutable chain, which ensures data integrity and security. The blockchain is combined with a memory storage device to improve the security of the captured data. This storage device, which is typically a secure and high-capacity storage medium, is in charge of storing the blockchain-secured data. This storage device is blockchain-encrypted data and provides a strong defense against tamper-ing, unauthorized access, and data manipulation. Data integrity is maintained throughout the process, from the moment of capture to the storage device.This comprehensive strategy en-sures that each data instance is securely timestamped, encoded into blockchain blocks, and then stored securely within the memory storage device. By combining surveillance technology with blockchain innovation, this system addresses critical challenges related to data security and integrity, establishing new standards for trustworthy data management within the surveillance domain.

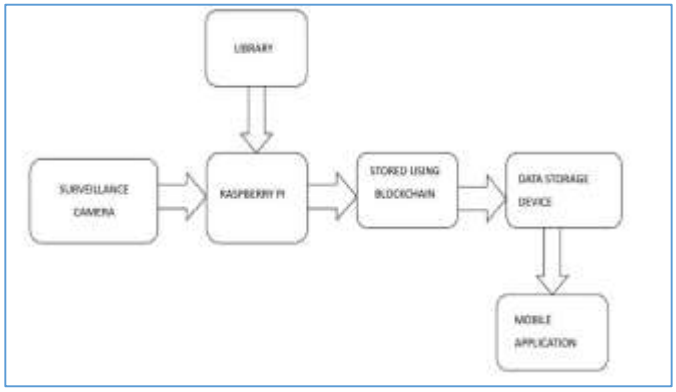


Fig. 3: BLOCK DIAGRAM

III. CONCLUSION

Smart city initiatives and surveillance technology are inti-mately related. The integration of IoT devices with security cameras has become a given. Surveillance cameras with the Internet of Things are being used by more and more sectors nowadays, which could lead to data loss. The question of personal privacy arises with CCTV video surveillance tech-nology. In terms of integrity and security issues, blockchain technology offers a contemporary solution. This application is a good fit for blockchain technology since it guarantees data security and works well for the safe storage of data via a distributed ledger. System performance may be enhanced, data security may be enhanced, and data theft from centralized storage may be prevented using a decentralized system design like this one. In addition, Blockchain transactions are recorded in a chained data structure that is verifiable, traceable, and append-only, as opposed to traditional databases, using con-sensus processes and publicly accessible distributed ledgers. Incorporating Blockchain technology into IoT devices not only fosters trust among participants but also enhances the system's overall effectiveness. Additionally, it guarantees the immutability and auditability of the data itself, as well as its availability, accuracy, and auditability for participants.

REFERENCES :

[1] "A Scalable Blockchain Framework for Secure Transactions in IoT" Authors: Sujit Biswas, Kashif Sharif, Fan Li, Boubakr Nour, and Yu Wang Publication: IEEE Internet of Things Journal 2020

[2] WangPublication: IEEE Internet of Things Journal 2020 [2] "DIS-TRIBUTED IMPLEMENTATION OF DISCRETE COSINE TRANS-FORM ALGORITHM ON A NETWORK OF WORKSTATIONS" J.
A. M. de Rezende, F. C. D. de Oliveira, R. A. R. de Castro, H. R. C. de Oliveira, and M. C. A. da Cunha The paper was published in the journal "IEEE Access" in 2020

[3] Alem Fitwi, Yu Chen "Secure and Privacy-

Preserving Stored Surveil-lance Video Sharing atop Permissioned Blockchain": " 2021 Interna-tional Conference on Computer Communications and Networks

[4] "Blockchain-Based Surveillance System for Smart Cities" by Wang et al. (2020) proposes a blockchain-based surveillance system for smart cities. The system uses blockchain to store and secure surveillance data, which can help to prevent data tampering and ensure the integrity of the data

[5] SURVEILLANCE CAMERA FOR SECURITY MEASURES USING BLOCK CHAIN METHOD" by Kumar et al. (2021) proposes a blockchain-based method for securing surveillance camera

[6] A Blockchain Implementation for the Cataloguing of CCTV Video Evidence" by Kerr et al. (2018) proposes a blockchain implementation for the cataloguing of CCTV video evidence. The implementation uses blockchain to store and secure the metadata of CCTV footage, which can help to prevent tampering and forgeries

[7] "Blockchain-Enabled Smart Surveillance Systemwith Artificial In-telligence" by Zhang et al. (2022) proposes a blockchain-enabled smart surveillance system with artificial intelligence. The system uses blockchain to store and secure surveillance data, and artificial intelli-gence to analyze the data and detect suspicious activity

[8] Smart Buildings Market by Component (Solution (Safety and Security Management, Energy Management, Building Infrastructure Manage-ment, Network Management, IWMS), Services), Building Type (Res-idential, Commercial, Industrial), Region—Global Forecast to 2025. Available online:

[9] D. Jain, P. K. Shukla, and S. Varma, "Energy efficient architecture for mitigating the hot-spot problem in wireless sensor networks," Journal of Ambient Intelligence and Humanized Computing, 2022

[10] Mohamed Rohouti, Kaiqi Xiong, Yufeng Xin,"Secure Software -Defied Networking Communication Systems for Smart Cities; Current Status, Challenges and Trends", IEEE Access 2020

nternational Multidisciplinary Research E-Journal Online Available at http://gater.in/
INTERNATIONAL PEER REVIEWED JOURNAL
OF GLOBAL ASSOCIATION FOR TRAINING, EDUCATION & RESEARCH
(GLOBAL CONSORTIUM OF PROFESSIONALS, TRAINERS, ACADEMICIANS & RESEARCHERS)

CHANGING DYNAMICS OF ENTREPRENEURSHIP IN INDIA

Dr. Kavita Indapurkar* [1]
Amity University Noida
kavitaindapurkar@gmail.com
Dr. Sangeeta Jauhari* [2]
RNT University Bhopal
sangeeta.jauhari.new@gmail.com

Abstract :

Entrepreneurship is accepted to be an engine of growth across the globe and with various policy initiatives over the recent years, India also has accepted this to re-route its growth story. Although we seem to be learning afresh, it is nothing new for India. Culturally, ancient India was predominantly characterised by skill-based entrepreneurship that was our way of life. Our Indian Entrepreneurship has an affluent antiquity. For a long period of time people engaged themselves in production not only to cater market needs but also the non-market needs leading us to be self-sufficient. Knowledge was only considered to be the pre-curser for earning the livelihoods and livelihoods were majorly derived out of skills. For example, all kinds of artisans and handicrafts as well as services like imparting knowledge and health.

However, concept of so called 'formal education' during the colonial era, led us to be more dependent on the so called 'jobs'. The sense of "better quality of life" and to some extent false sense of "security" paved its way into our minds over generations. Even services like imparting education and health became job-based and in this way with rising capitalism, where the capitalists are separated from the actual producers, masses of people in the form of human resource were entrusted with job work. Although the masses were used by the colonial rulers but the practice continued even after independence. Management concepts like division of labour came to be used popularly, further making the human resource vulnerable. The same concept has now come to be employed even in agriculture separating the tillers of land from the owners of land. After independence, this role of production and employing human resource was taken over by the Government and large public sectors emerged and continued to employ masses in similar ways further killing our age-old know-how. Without even realising we marched to perish. Though provincial business enterprises were clamped to the chains of social and cultural grimness, independent India continued to have a variety of political and monetary variables that acted as non-contributing attributes for local businesses. The unpredictable world of politics, absence of good laws, cruel expense approaches led to confining business enterprises in terms of production and distribution, demotivating them to carry out research and development activities. Even the training frameworks at different levels never really helped either the rise of new companies or empowered them to impact the economy of the country. It was only when several other economists pointed out and many countries brought out empirically that entrepreneurship can act as the catalyst for growth, after around sixty years of independence, we started moving in this direction by re-defining and re-enforcing entrepreneurship among the youth, with a hope to bring in change in the coming generations. Today lucrative business environment is being promoted by the Government by working on the factors that would help in ease of doing business on one hand and providing seed capital and other such loans on the other.

Taking experiences from the world, today, the youth are motivated and trained for gaining relevant entrepreneurial competencies. Concepts of incubation centres at higher education institutions are expanded to be included by all

institutions and tinkering labs at school level are also promoted for the same. The grassroot innovations are also promoted on digital platforms of the government and several NGOs are coming up to support them further.

However, with all this in place, even today, social attitude and perception about business and business persons is not very positive when it comes to general public at large. Businesses are believed to be successful only when they use one or more murky ways of dealing and business persons are regarded as having shady character. As a result, there is dearth of social, familial and parental support to the young who show their willingness to start a business. There is a general environment that shows lack of reception to new ideas put forward by them.

The entrepreneur cannot be kept standoffish from the dynamic social qualities, philosophies, new developing advances, natural weights, strict convictions, customer needs. The pioneering action, at any point of time, leads to a perplexing and shifting blend of socio-economic elements. The different social elements practice a solid impact on the character or individual foundation of the people opting for innovations and making the commercial use of the same.

The initiatives like '*AtmaNirbhar Bharat*' and '*Vocal for Local*' sought to create ripple effect in the revival process and more so in post pandemic era. The present chapter brings out the dynamism of entrepreneurship in the present socio-eco-political contexts and draws inferences from the past experiences. It is the educational institutions that take up the responsibility of bringing in changes. The authors through this chapter propose a theoretical model for educational institutions so that entrepreneurship can be nurtured at all levels by them.

Key words: Entrepreneurship, incubation, entrepreneurial competency, *AtmaNirbhar Bharat*, *Vocal for Local*, entrepreneurial willingness.

1. Entrepreneurship in India: A historical perspective

India saw a wonderful blend of business and social arrangement for centuries where people were invigorated by their own instincts to take up work to earn their livings. A specific coordinated social system prevailed in the town local areas then. This development of the Indian business can be followed back to the era of Rig-Veda, when metal painstaking work existed in the general public.

In the recent centuries before getting colonised, this arrangement proved India to emerge as a successful nation in terms of wealth and well-being. Businesses were skill based and included works like carpentry, leather works, metal works, handicrafts and services like Ayurveda, Vastu Shastra, spiritual teachings and many more that proliferated well and were accepted far and wide around the world. These were well supported by the agricultural produce in the country, balancing the two. The well-developed trade routes also confirm the trading partners of the country then and indicated a prosperous India.

It was the state that provided an amicable environment for these businesses to flourish. The businesses were based on innovations and realised the importance of large scale production and developed *'Karkhanas'*. The highly skilled specialists were brought into an affiliation and patronage of the state and this culture of skilled craftsmanship were well appreciated in the social circles.

2. Decline of Entrepreneurship in India -India has an affluent and documented past of about four thousand years dating to Indus valley civilization in Harappa and Mohenjo-Daro. Sea route that was explored in 1498 by Portuguese was used by the Britishers to land in India in 1608 to earn from trade. The British Empire formed special company to trade with the Asian countries and British

merchants and aristocrats held shares in these joint stock companies. There was no other political angle to this move then. Their main aim was to trade in spices, which was an important commodity then that was used to preserve meat. Moreover, cotton, tea, indigo dye and opium were other attractions. Silk was one commodity that attracted the British the most and the sea route was named after this as 'silk route'.

India also wanted to earn and prosper from the new trade links with British. Realising the importance of production, many emperors like Jahangir of Delhi and Vijayanagar-Empire gave permission to the British Company to open factories in their empire. Soon factories were opened in other coastal cities of the country. As part of their business, Britishers also acquired zamindari of certain areas rich in agriculture. In this way they paved their ways in the socio-eco-political nitty-gritties of our country. The city of Calcutta was founded when they acquired zamindari of three villages' kalikata, Suttanati and Govindpur. (https://www.indiatoday.in/education-today/gk-current-affairs/story/when-and-why-british-first-came-to-india-1591166-2019-08-24)

Over a century or so of their trade in India, the British company realised that India is a collection of provincial kingdoms and entering into the political arena will give them more powers to tilt policies for their business benefits. Thus, political economy was invoked and later, Britain as a country that did not even have a written language until 9th Century, that is almost three thousand years after India, eyed to reign our country with an intension to take away our riches, that lasted till off late, that is, 1947.

Lamentably, such a lot of esteemed Indian craftsmanship and service industry along with proliferating trade was destroyed with colonial mind-set with which the South Asian countries grappled for more than a century and a half. Some of the main reasons as opined by the authors can be highlighted and explained here.

The Indian Royal Courts and patronage to the skills disappeared and were replaced by low priced imports produced out of recent industrial revolution there. The then British Government made such policies that led to drain of all the raw materials at cheaper prices to feed their industries and imported all finished products leading to the death of Indian indigenous industries.

Moreover, the Reluctance of the Indian specialists to adjust to the changing tastes and needs of the individuals and adaption to new techniques of production was also a major cause for people to choose the imported finished goods, leading to the fall of indigenous sector of the country.

Even after independence, we as a country continued to follow the processes and the systems that were pushed on us during the British reign. Thus, we continued with almost identical processes and the systems that Britishers left us with, with the only difference that we ourselves chose those to exist.

The commotion that we faced within ourselves about our own practices, and the disapprovals from various sections, drifted us away from our own socio-economic systems and it was assumed to be the state's sole responsibility to create jobs for our youth. The mind-set was established further with the tenacious needs of democratic set up of the country.

3. Entrepreneurship defined- Entrepreneurship is considered to be one of the most important drivers of a country's economic growth (Harper, 2003; Landes et al. 2012; Rideout, Gray, 2013) in order to make possible and preserve a high level of competitiveness, and is also considered to be a catalyst for improving the quality of life and changes in a society (Keat et al. 2011; Ooi, Nasiru, 2015). Entrepreneurship is associated with the creation of new opportunities in uncertain and unknown environments (Neck, Greene, 2011). The importance of entrepreneurship in a rapidly changing world has attracted increasing attention over the last decade (OECD, 2006), with the belief that individuals with entrepreneurial skills and

abilities will create benefits at different levels of society. Worldwide, entrepreneurship has been embraced by all players in the economy as a means for creating new value, ranging from economic growth and increased work satisfaction to increased living standards and improved consumer products and services (European Commission, 2003).

According to Bruyat and Julien (2001), there is a need that the entrepreneurship studies focus on understanding their relationship between the individual and value creation in the course of a process and within an environment that has certain specific features. In turn, Mitchell et al. (2002) argue that entrepreneurship should be understood as the search for economic wealth through creative initiatives undertaken by individuals operating in a given environmental context and constrained by limited resources. Entrepreneurship might also be defined as a dynamic process of creating incremental wealth by individuals who are committed to accepting the risks involved in terms of time, equity, and career (Hisrich et al., 2005).Perceiving what is meant by entrepreneurship is perhaps one of the most complex tasks, given the myriad of existing definitions used to describe the phenomenon (Shane and Venkataraman, 2000). Additionally, several terms are used interchangeably, such as entrepreneur, enterprise, and small business (Henry et al., 2005), that has resulted in a polarization of emergent theory (Matlay, 2005).The heterogeneity and complexity of entrepreneurship through its multiple facets creates a challenge. On the one hand, some researchers (see, e.g. Kirzner, 1973; Drucker, 1985; Volkmann, 2009) argue in favour of models and common definitions as a crucially important basis for the development of the field. On the other hand, other authors (see, e.g. Audretsch, 2012; Bygrave and Hofer, 1991) consider that a single model of Entrepreneurship would be insufficient to meet the requirements of the various Stakeholders. Each entrepreneurial event is unique and the entrepreneurial process is the crystallization of complex variables and contingencies (Jack and Anderson, 1999), which means that entrepreneurship, can be viewed from different angles. In this sense, multidisciplinary entrepreneurship is a positive challenge, because entrepreneurship can be seen not only from a purely economic perspective, but also as a social phenomenon (Steyaert and Katz, 2004). Along this line of thought, Gartner (1990) states that entrepreneurship is a very complex idea and that we must therefore recognize its multiple meanings. The key is to ensure that others know what we are talking about. Entrepreneurship may be defined as an innovative act that creates a new ability to produce wealth (Drucker, 1985) or as the creation of a new organization (Gartner, 1985).For Bygrave (1989), entrepreneurship must be understood as a holistic process of transformation and change, in which the existing stability disappears. Shane and Venkataraman (2000) claim that entrepreneurship concerns the process by which we discover, evaluate, and explore opportunities to create future goods and services. This definition emerges as an important milestone for the study of entrepreneurship because it introduces “opportunities” as a concept of central importance from which several subsequent definitions derive (Gartner, 2001).

The interaction between entrepreneurship, innovation and economic development has become the main theme in policy circles (Looy et al. 2011). This interaction is brought about through a number of various training courses, conferences, the introduction of state-owned and private-capital instruments, which promote the emergence of new businesses and ideas, as well as by the rapid development of the start-up ecosystem. Entrepreneurship development is considered as the priority area in the development policy in many countries. The young entrepreneurs are engaged in varied form of small and medium scale enterprises ranging from paper to electronics,

engineering to electrical, textile to metal and pipe industry, construction to food processing, education to handicrafts, digital platforms and many more.

4. Shift in the Entrepreneurship system in India:

After around 200 hundred years of depending on others we timidly, suspiciously started off with a low self-esteem, self-confidence, self-worth and pride and having almost a deleterious attitude towards our own philosophies, traditions and conduct of societies. A time period of two hundred years is long enough to have changed our mindsets in terms of what are risks, uncertainties, values and so on.

The disillusionment from the mammoth public sector units after around thirty to fourty years of independence, that were believed to be the centres of growth and employment generation coupled with experiences from other countries we started to open our economy again. The policies of liberalisation, privatization and globalization again started to look meaningful for the growth of the country.

Emergence of entrepreneurship driven growth of a few other countries around the world was the first step towards the shift. With privatisation emerging as a first step to mend this, private players were seen more as predators than anybody else and this also reflected in Government's policies and regulations framed for them.

Employment generation remained ineffective for large unskilled masses and the inclusive growth looked far away. Even the 'educated' lot encompassed those who were incapable of taking up any 'job' and the disconnect between education and livelihood became evident.

With service sector picking up for India, demand for and supply of masses to perform widened and this coupled with low or no skill-based education emerged as a major reason for widespread unemployment. Large businesses continued their march towards being more effective and efficient and with India opening up as a market, better technologies led to large scale production further widening the gap between demand and supply of the workforce.

With spill over effects and better exposure to the outside world, we started realising and accepting that 'profits' are not 'evil', rather they are inevitable to carry on with the businesses and businesses are vital for the growth of the country. Governments should not indulge in business activities but should only aim at developing the required regulatory mechanisms and put them in place so that the profits are made out of more sustainable practices and should be well distributed to various factors of production, most vulnerable being the labour.

The Government should realise that entrepreneurial skills are not an innate ability; rather it results out of conducive conditions. To be effective, a business visionary need to stay dynamic and proficient to adapt to the prevailing environment well and use the same to work from his side.

Revelations and spill overs also brought in the sagacity of quality of life and health and well-being closely intertwined with each other, there was a paradigm shift in the way the young educated minds started to harness their skills responding to the efforts made by India to improve upon its ease of doing business rankings, becoming competitive to the world.

5. Developing Entrepreneurial Ecosystem with Policy Interventions:

It was well realised over the decades of planning for growth and more importantly towards inclusive growth, that along with the social blend, technical advancement additionally grants a significant impact in the organizing of an entrepreneurial aptitude and improvement. The era of a magnificent "mechanical age" blended with a superlative degree of growth during the chip era that later dramatically added artificial intelligence gave us a winning edge as a country. But it was realised that this was not inclusive growth and was limited to specific sector.

The technological advancements changed not only the production processes but also the services sectors like health, education and law. And this has been realised well during the Covid times. Not only businesses but governments have also come to realise the importance of disruptive technological advancements and they will be increasingly used as winning strategies.

Realisation of the numerous gaps described in earlier sections have been realised well by the strong political will leading to creation of conducive environment for proliferating entrepreneurship to bring in inclusive sustainable growth. A number of initiatives introduced by the government aim towards developing an entrepreneurial ecosystem and towards harnessing the demographic dividend to achieve growth targets consistently, keeping in view SDG mission 2030. Figure 1 presents the key initiatives taken in India in this regard.

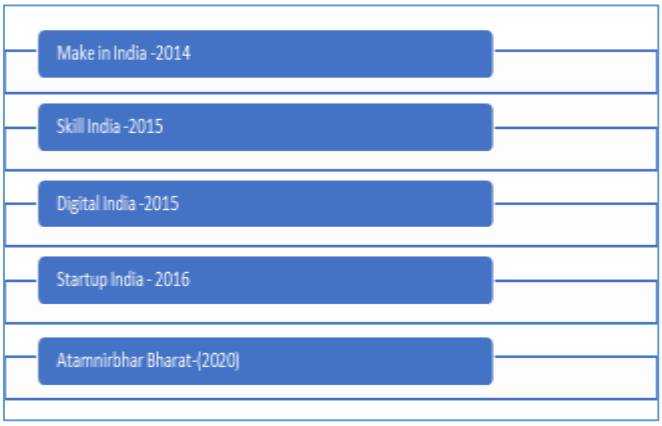


Figure 1: Key Initiatives towards sustainable and inclusive economic growth

Getting into the depth of the numerous initiatives the one common mission that emerges out is the empowerment of not only the demographic dividend but the entire community with respect to information technology, skill, finances and opportunities to innovate. Looking from the perspective of the policy makers the initiatives are for providing base to start the journey of excellence even with the minimal resources and knowledge. The policies under these initiatives are more of participative in their approach rather than giving the guidelines to follow the pathways. Since the year 2014 the dynamism of entrepreneurship in the country has taken a paramount shift and the recent Covid-19 situation provided an opportunity to manifest positive outcomes of the same. The country has now realized the importance of being self-reliant on various fronts and to emerge as a world leader with the enormous potential that lies in the youth. The announcement of *AtmaNirbhar Bharat* gave a message to the entire nation once again to wake up and realise the innate potential that lies in our own philosophies and traditions that enlighten us in various dimensions of public life including entrepreneurship and leadership. The mission of digital India, skill India, Make in India etc. aims to attract the creative ideas so as to transform them into reality. The establishment of advanced incubation centres well equipped with technology and human resources across nation as an outcome of start-up India mission supported by the ministry acts as a linkage between the policy holders and the educational institutions. The thought of establishing Atal Incubation centres, for example, is to develop and revitalise the entrepreneurial ecosystem for the youth and to reach out to the grass root innovations of the society.

6. Grass Root Innovation and Entrepreneurship: A strong leadership during the recent years raised the aspirations of the people in terms of doing societal good along with facilitating one's own self rendered dynamism to entrepreneurship to the country. Doing well on ease of doing business index on one hand and harnessing capabilities of the youth through participative entrepreneurship drive on the other, the country has shown hope towards achieving targets on better living standards, health, education and in turn economic growth. The authors however feel that there is a need to connect these initiatives also to the grass-root innovations to add more dynamism to the entrepreneurship in the country. There is a need to identify and handhold the grassroot innovators.

The grass-root innovations submitted for IGNITE in 2018 awards showed that the children of the age group 12 to 17 came up with innovations like

pothole detector in flooded conditions, washing machines that used recycled soap, stapler like device for stitching buttons, expiry date stamping on eggs, pomegranate de-seeding machine and even the water-car. The story of pad-man presents another example that explicates that grass root innovation actually presents the blend of local traditional and informal knowledge systems with formal knowledge. It indicates intellectual property of the country and the application of the academic knowhow into finding solutions to the problems around. In that sense "necessity is the mother of innovations" holds true.

Structuring the mindset of a grassroot innovator, we may also deduce that the one who is mentally and emotionally invested in the idea will definitely find their way in the mainstream dynamic world. The statistical data may project India as an "unskilled labor abundant" country on the basis of the pre-defined skill measurement indexes but the bubbling of inventions at the grass root level and local households actually define the brilliant skillset of Indian raw talent.

Business offers youngsters a chance to deal with their own abilities and interests and all the while, making their own work. Empowering business venture in youngsters is a significant method of saddling their excitement, energy and desire to add to financial turn of events. It is for the most part acknowledged that business visionaries "make occupations, increment advancement, raise rivalry and are receptive to changing financial chances and patterns. Youthful business people can likewise go about as good examples for their companions and, urge others to follow their models.

These need to join hands with the grass – root innovators of the country to bring in change.

Research shows that bold resource allocation to digital initiatives, including but not limited to advertising initiatives, correlates positively with value creation. (Forbes)

The digitalisation drive that was started post 2014 has helped us tremendously to take measures during pandemic. Most of the government initiatives to support the vulnerable are driven prominently due to the existence of this digital infrastructure in the country.

Digital infrastructure opened the doors to online shopping of groceries to electronic goods. This was directed though towards the rich urban class who are tremendously occupied in their works. However, with pandemic and lock downs this infrastructure was quickly picked up to services like teaching, medical and legal advice. Quickly companies proliferated to teach arts, English speaking, Vedic maths etc. to cater the needs of the parents during the following summers to engage the children.

1. Theoretical Model to Nurture Entrepreneurship:

According to Wu & Wu (2008), education can improve managerial skills of the students so that they can handle the business activities better. Wu & Wu suggested that entrepreneurship education can bring in two important functions. One, the transfer of knowledge and information, and other is capability enhancement. Wu & Wu argued that education can change perception of individuals about their own ability to engage in the deliberate behaviour. Different from general education, entrepreneurship education focuses on enhancing the capabilities of individual entrepreneurial skills. Entrepreneurship education can be delivered in two formats namely teaching theory and practice.

In line with Wu & Wu (2008), Soutaris et al. (2007) from their empirical study concluded that entrepreneurial education influences entrepreneurial intentions of students in three ways: learning, inspiration and resource utilization. The empirical results of Wu & Wu (2008) also found that the level of entrepreneurial education is positively related to the ability of entrepreneurial individuals. For example, US students get a high level of entrepreneurial education, as they get entrepreneurship courses on one hand and also get training on how to start a start-up when they go to college. Thus, their entrepreneurial skills increase due to a combination of the knowledge they learn in the course, with experience gained from the

hands-on training/experiential learning, when they study in schools and when they go to college.

Entrepreneurship has now been increasingly used as a course in various programmes in India also. The results will take sometime to be manifested though.

The findings of Wu & Wu (2008) concludes that the better entrepreneurial ability of students make them more likely take up entrepreneurial roles. Due to the entrepreneurial capabilities gained from entrepreneurial education, US students are found to have higher entrepreneurial intentions, in contrast to students of many other countries.

Although there is a significant increase in the number of courses and programs on entrepreneurial education, it has not been sufficiently integrated into the curriculum from high school to college. In addition, entrepreneurial education is more often applied in business schools than in public schools (Altan, 2015). This is because innovative and viable business ideas are more likely to emerge from technical, scientific and creative studies. There is a need to build interdisciplinary approaches and to make entrepreneurial education accessible to all. This can be done by forming teams that include students from business schools and others and are given to develop and exploit business.

There is always the desire for achievement which acts as an encouragement and motivation to face challenges and to achieve success (Lee, 1997). Indarti & Rostiani (2008) stated that achievements act as personality characteristic of a person that motivates him to take up entrepreneurship. They went on to suggest further that there are three attributes attached to people with high desire to achievement, (a) choosing personal responsibility in making decisions, (b) dare to take risks in accordance with their abilities, and (c) have an interest to always learn from the decisions that have been taken. Similarly, the results of (Scanipello, 1989) showed that a person with a high level of desire for achievement is less likely to accept failure than those with low desire for the same. In other words, the desire for achievement affects success or failure of an entrepreneur to a great extent.

Business in India is certainly not another idea. It has and still is an indispensable piece of our way of life, only we need little backing and motivation to get saddled on our dreams and fly high. The increased self-confidence through self-reliance in these tough times of Covid – 19 will have a long-lasting influence in combining our grass root innovations with the enterprising skills.

To bring in the dynamic and vibrant culture of entrepreneurship back in our country, we have to start from the schools and colleges where the willingness of the probable entrepreneurs should be identified. There are several factors mostly myths that lead to unwillingness. Even those who want to be entrepreneurs shun their idea due to lack of proper knowledge, training and fear of dearth of backing from anyone in case of any unknown failures. But even before identifying the willingness all should be imparted with the knowledge about various schemes of the government, business environment and the handholding that exists in the system. Even the parents may also be invited in few of such events, because we in India even today rely more on the social support system rather than government providing us the same. This may be followed up with storytelling of real life journeys of the start-ups. Later on relevant training modules may be imparted to those who are willing. Figure 2 exhibits the theoretical model that can be implemented in this regard to boost entrepreneurship among the youth in the country.

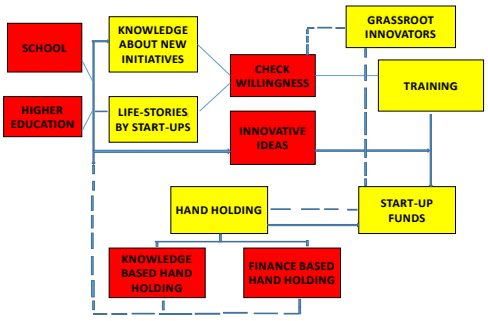


Figure2: Entrepreneurship willingness identification and training in educational institutions

K-WITH model for entrepreneurial education

The model proposed by the authors reflects the real need of identifying the willingness or rather generate the willingness with the help of awareness and experiential learning. To begin with, the model proposes to identify willingness among not only college students but also among the school going children. The willingness is proposed to be checked post interventions of two types that would be universal. One, knowledge series related to new and existing initiatives of the Government to support the entrepreneurs along with knowledge related to market studies and two, interaction with start-up initiators and successful entrepreneurs, particularly with first generation entrepreneurs. The entrepreneurial willingness of the students may be checked somewhere in between this process of knowledge sharing. Parallel to this, the innovative and creative ideas of some of the enthusiastic students should also be given wings by certain support mechanism so that they strengthen their ideas with practical approach.

All such students should be given training in the respective fields and business models/ideas may be developed for them with the help of experts. Selected ideas may be taken forward for start-up funds and continuous knowledge based and finance-based handholding.

Similarly, grassroot innovations should also be picked up regularly by the universities and may be taken to their incubation centres for making it commercially viable. Based on innovators' willingness training and handholding may be extended. Otherwise, the same may be transferred with proper remuneration. However, the authors propose a systematic approach for these grassroot innovators so that they get a conducive environment to develop their ideas further.

With new Government norms and requirements of regulatory authorities for universities, Indian universities have started to develop incubation centres, but we are yet to develop a functional, systematic, integrated and parallel approach for better outcome. There is a need to identify and segregate the first- and second-generation likely entrepreneurs, social entrepreneurs and innovators and give expert advice to these along with handholding.

There is a dire need to adopt a mechanism where we work on the entrepreneurial willingness of the students so that continuous learning, continuous handholding and trials on business models/ideas can give positive results. Along with this there is a definite need to look and improve the societal mindset towards businesspersons.

Further it suggests the handholding at various levels along with the training mechanism. With the technology intervention it becomes easy to reach at the grass root level, however the dire need is to focus three I's -Intent, Inclusion and Innovation

8. Entrepreneurial activities in India during the present pandemic

Necessity is the mother of innovation. Some of the companies that are considered to be 'big' today were started during the crises of 2008History shows that crises are start-up incubators (Riani, 2020).It is proved yet again during this present crisis when a rise in entrepreneurial activities has been witnesses.

There's always a challenge in building a thriving start up, no matter the economic condition (Riani, 2020) the authors therefore are of the strong view that willingness is the most important constituent in the process of entrepreneurship in any economy. Efforts should be made towards nurturing the willingness among the young generation so that they can use their skills in entrepreneurship when time comes. This argument finds roots from the anecdote from Kerala where economic downturn led by pandemic in 2020 resulted into registration of over 400 new companies addressing the solutions to the glaring problems that emerged. (M, 2021).Majority of the companies belongs to the service sector wherein the app based solutions were provided to curb the

recent problem that is the problem to connect. To name few is like Avasarshala, started by couple Ashwathy provides a platform for students to learn about various academic opportunities, Alappuzha-based All about Innovations (AAI) launched WOLF AIRMASK a portable air steriliser for indoor space .These initiatives thus support the thought that in situation of real time crisis solutions emerge out to solve the problems and also gives the support to strengthen the overall system.

As engines of growth, entrepreneurship has been taken up against the job losses during the pandemic, and policy initiatives by the Government of India have also been taken to boost the same. Several NGOs have also come forward to support these entrepreneurs. The start-up eco-system is thus boosted by such measures and ideas. However, Innovative start-up's that shapes the future economic activity are most vulnerable in any economy (Walsh and Cunningham, 2016). Even in calmer times innovative start-ups face liabilities of newness and smallness (Stinchcombe, 1968) that threaten their continued existence. It is therefore important that the enthusiasm to support and nurture entrepreneurs continue over a period of time. This would definitely help to bring in green shoots in our economy post pandemic. Along with the enthusiasm an integrated approach is required to boost the entrepreneurial culture in India, which covers the policy frameworks to support entrepreneurship at one hand, willingness to adopt the developed framework at the other hand and the most important is to educate the masses about the policy interventions and to motivate them to think out of box.

Thus, for new and existing start-ups', thinking long-term but acting short-term means quickly focusing on addressing today's urgent needs while planning for how your solution can evolve (Riani, 2020) over a period of time.

Although it may not be possible to implement all the ideas, continuous generation of ideas is the key and holds solutions to timid issues.

References

1. Business Reform Action Plan 2016 for States/UTs. 2015. Department of Industrial Policy and Promotion: Ministry of Commerce and Industry, Government of India.
2. Chitravanshi, Ruchika. 2015. "States Share Best Ideas to Lift India'
3. Doing Business report series – World Bank Group".
4. Doing Business Comparing Business Regulation in190 Economies2020
5. OECD (2006), Promoting Pro-poor Growth: Private Sector Development, OECD, Paris
6. M, A. (2021, April 22). How Kerala Startup Staying a Float during Pandemic. Thiruvanathapuram, south, India.
7. Riani, A. (2020, Nov 28). Insights about startup opportunities during the pandemic . Forbes .
8. Wu, S. & Wu, L. (2008). The impact of higher education on entrepreneurial intentions of university students in China. *Journal of Small Business and Enterprise Development*, *15*(4), 752-774.
9. Tech & innovation May 25, 2010 / summer 2010 / Issue 59(originally published by Booz & Company)
10. Jacob, M.; Lundqvist, M.; Hellsmark, H. 2003. Entrepreneurial transformations in the Swedish University system: the case of Chalmers
11. Jack, S.L. and Anderson, A.R. (1999), "Entrepreneurship education within the enterprise culture: Producing reflective practitioners", International Journal of Entrepreneurial Behavior & Research, Vol. 5 No. 3, pp. 110-125. https://doi.org/10.1108/13552559910284074
12. University of Technology, Research Policy, 32(9): 1555–1568. https://doi.org/10.1016/S0048-7333(03)00024-6
13. Kalar, B.; Antoncic, B. 2015. The entrepreneurial university, academic activities and technology and knowledge transfer in four European countries, Technovation, 36-37: 1–11. https://doi.org/10.1016/j.technovation.2014.11.002

14. Wong, P. K.; Ho, Y. P.; Autio, E. 2005. Entrepreneurship, Innovation and Economic Growth: Evidence from GEM data, Small Business Economics, 24(3): 335-350. https://doi.org/10.1007/s11187-005-2000-1
15. Kristiansen, S.; Indarti, N. 2004. Entrepreneurial intention among Indonesian and Norwegian students, Journal of Enterprising Culture, 12(01): 55-78. https://doi.org/10.1142/S021849580400004X
16. Volkmann, C., Tokarski, K., Ernst, K. (2012). Background, Characteristics and Context of Social Entrepreneurship. In: Volkmann, C., Tokarski, K., Ernst, K. (eds) Social Entrepreneurship and Social Business. Gabler Verlag. https://doi.org/10.1007/978-3-8349-7093-0_1
17. Chirstian Bruyat, Pierre-André Julien, Defining the field of research in entrepreneurship, Journal of Business Venturing, Volume 16, Issue 2, 2001, Pages 165-180, ISSN 0883-9026, https://doi.org/10.1016/S0883-9026(99)00043-9. (https://www.sciencedirect.com/science/article/pii/S0883902699000439)
18. Krueger, N. F.; Reilly, M. D.; Carsrud, A. L. 2000. Competing models of entrepreneurial intentions, 24. Journal of business venturing, 15(5): 411-432. https://doi.org/10.1016/S0883-9026(98)00033-0
19. Grace S. Walsh and James A. Cunningham (2016), "Business Failure and Entrepreneurship: Emergence, Evolution and Future Research", Foundations and Trends® in Entrepreneurship: Vol. 12: No. 3, pp 163-285. http://dx.doi.org/10.1561/0300000063
20. Indarti and Rostiani : Entrepreneurship Intention of Students: A Comparative Study Between Indonesia, Japan and Norway in the journal of Economics and Business Vol. 23 Number 4 2008
21. M. Bhuyan, P. Pathak, Understanding Entrepreneurial Intention Of University Students In Uttarakhand: An Empirical Study : Indian Journal of Commerce & Management Studies 2012

Websites :

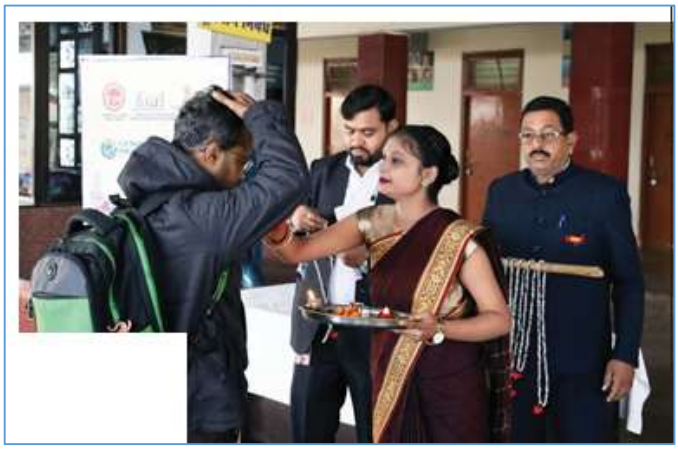
22. https://www.ijemr.net/DOC/AStudyOnEntrepreneurshipDevelopmentInIndia(153-156).pdf
23. http://euroasiapub.org/wp-content/uploads/2016/10/10IMJune-3715.pdf

International Multidisciplinary Research E-Journal Online Available at http://gater.in/
INTERNATIONAL PEER REVIEWED JOURNAL
OF GLOBAL ASSOCIATION FOR TRAINING, EDUCATION & RESEARCH
(GLOBAL CONSORTIUM OF PROFESSIONALS, TRAINERS, ACADEMICIANS & RESEARCHERS)

A Safe Destination for Women Tourists in the state of M.P., India

Dr. Ranjana Mishra, Advisor-MP Tourism Board, Bhopal, MP, India dr.ranjanamishra@gmail.com

'Safe Tourist Destination for Women in Madhya Pradesh' project is forging strategic alliances with communities and local service providers towards the safety of women and girls in a tourism destination.



In order to promote and develop Madhya Pradesh as a safe destination for women tourists, the Madhya Pradesh Tourism Board (MPTB) has launched a pathbreaking

initiative called 'Safe Tourist Destination for Women in Madhya Pradesh'. This project was proposed to the Ministry of Women & Child Development under the 'Nirbhaya Scheme' of the Government of India, for technical and budgetary support to implement the project. After the project was sanctioned, in the first phase, MPTB launched it in 50 major tourist destinations (grouped into 20 clusters) across Madhya Pradesh to make it a safer destination for women tourists. The project has been running successfully for the last 17 months and has received overwhelming support from everyone involved in the travel, tourism and hospitality industries.

With this project, MPTB is transforming tourist destinations across Madhya Pradesh into women- friendly destinations for both international and domestic tourists. By creating an enabling environment and ensuring women-friendly support systems in tourist places, Madhya Pradesh has managed to increase women tourist footfalls in the state.

MPTB was established in 2017 with an objective to promote tourism in the state. The core objectives of the Board are development of tourism sector with public-private-partnership, facilitating large number of investors, skill-development, publicity of tourist destinations nationally and internationally, identification and development of tourism infrastructure, and sustainable and responsible tourism. The 'Safe Tourism Destination for Women in Madhya Pradesh' project is being implemented by MPT Bunder the aegis of the Madhya Pradesh Tourism Department, Government of Madhya Pradesh, in partnership with Women and Child Development Department, Government of Madhya Pradesh and UN Women. UN Women is

providing technical support in designing and implementation of the project, support in monitoring and evaluation, and HR support.

The project is forging strategic alliances with communities and local service providers towards the safety of women and girls in a tourism destination. The project, therefore, works with multiple stakeholders including key stakeholder/ line departments to create safer tourism destinations. The project is also examining the effect on women's perception of safety as a result of enhanced capacity and responsiveness of key line departments, NGOs, CBOs, the community, and other service providers.

KEY OBJECTIVES OF THE PROJECT

The Safe Tourism project is employing a multi- pronged approach in the implementation phase. These are the key objectives of the project:

- Provide safe, secure and women friendly environment in and around tourist destinations.
- Enhance women's confidence and desire to visit tourist destinations without any fear of violence and safety.
- Development of women-friendly spatial design, implementation and maintenance of infrastructural gaps.
- Provide information and advisories about available resources and timely support services using technology.
- Provide self-defence training to women and girls. Promote women workforce participation in tourism activities through orientation and skill enhancement programmes.
- Provide job opportunities to women through employment and self-employment activities in tourist destinations.
- Promote community participation and awareness on women safety.

Formation of legal bodies and federations to organise the local community with the intention of promoting women's safety.

- Strengthening the concept of 'Atithi Devo Bhava'('Guest is Like a God') to build the belief of safety among all women tourists visiting the state.

Women tourists, whether they are travelling solo or in a group, often feel unsafe in tourist destinations, especially after dark. This can be due to several factors, including fewer women working in and around tourist destinations, the lack of clean public toilets, lack of street lighting, lack of public spaces like parks, temples, market areas, and lack of information and support services specifically directed at women. Being in an unknown place, women feel especially vulnerable when travelling. However, after the launch of the Safe Tourism project, they will have a completely different experience in Madhya Pradesh.

F&B training Madhai.

Recognising gender issues within the tourism sector and taking proper action is a core agenda of the Safe Tourism project.

FULFILMENTOFINFRASTRUCTURAL GAPS

MPTB is working on the same line of action which is adopted by the Department of Women and Child Development, Government of Madhya Pradesh, for the safe city programme. Existing infrastructure is being used under this project, like Women Cell, Women Help Desk, Women Help Line, Dial 100 and other emergency numbers, already installed CCTVs, and other existing infrastructure. Apart from this, infrastructural gaps at tourism destinations w.r.t. women's safety are being identified and plugged. The lack of public infrastructure, after all, is a major constraint to women's mobility and safety. For example, toilets that are dark and dirty, with broken doors and no attendants are unsafe. Poorly

lit areas pose a threat to safety. Walking on dark roads and unlit streets are activities most women avoid. Additionally, the lack of street lighting in tourist areas makes it difficult for a woman to visit after dark or work late. Further, lack of efficient and safe public transport can make it difficult for a woman to access tourist places easily.

Measures are being taken to ensure that street lights are installed with their light falling properly on the footpath; high mask lightsare being installed especially at critical junctures;non-working lights are being fixed. Other activities include maintenance of pavements, regulartrimming of trees so that they do not block the lighting onto the pavement, regular maintenance and monitoring of public toilets, installation of CCTV cameras, installation of GPS system & CCTV in all public and commercial vehicles and panic buttons in public transport. The project is integrating a gender-sensitive perspective into infrastructure from the planning and designing phase itself. As for gaps, they are being addressed by convergence with the concerned department and gap funding is being done through the project.

INNOVATIVE USE OF TECHNOLOGY

The project is making innovative use of technology and is offering safety audits, safety apps, and safety information through website and app. Real- time interventions to ensure the safety of women are also proposed like monitoring by CCTV camera, GPS system installation in all cabs, response of emergency cases, etc.

COUNSELLING OF STAKEHOLDERS

A key aspect of the project is counselling and sensitising of stakeholders, that is men and women who are part of the travel and tourism workforce. These include taxi drivers, conductors, front office managers, service staff, cleaners, waiters, guides, shopkeepers, street vendors, etc. Men and women are being brought into the proposed interventions and process so that they can be powerful community advocates for the safety of women. Apart from this, media, the private sector, and research institutions are also considered important project stakeholders.

PROJECT ACTIVITIES

Capacity building, orientation, training, and sensitization: Project implementation requires

International Multidisciplinary Research E-Journal Online Available at http://gater.in/
INTERNATIONAL PEER REVIEWED JOURNAL
OF GLOBAL ASSOCIATION FOR TRAINING, EDUCATION & RESEARCH
(GLOBAL CONSORTIUM OF PROFESSIONALS, TRAINERS, ACADEMICIANS & RESEARCHERS)

Exclusion of Radionuclide from Aqueous Medium through Sustainable Green Approach

Poonam Deshmukh*[1], Santosh Kumar Sar[2]
[1,2] Department of Applied Chemistry, Bhilai Institute of Technology, Durg, 491001, India
Corresponding Author: *Poonam Deshmukh: poonamdeshmukh284@gmail.com

Abstract :
The investigation was employed in a batch system for the extraction of U (VI) from aqueous solution. It tried to use greenly produced magnetic AML towards the metal extraction. The FTIR, XRD, and SEM were used to characterize the sorbent. The ideal process variables were found to be pH 7.00 and 0.05 g of sorbent dose. The maximum removal capacity (q_e) in these scenarios is 21.8 mg/g. The model based on the Langmuir isotherm showed good agreement (r^2 = 0.9738), confirming an optimal fit for the findings of the experiment. The extent of uranium (VI) exclusion is potentially affected by number of operational parameters, including pH, the dosage of magnetic AML, time and the uranium (VI) concentration.
Keywords: Uranyl ion, Sequestration, Green synthesis, Aquatic, Isotherm

1. INTRODUCTION

One of the positive aspects of a healthy society includes having accessibility to clean, safe drinking water. Guidelines for drinking water were provided by the WHO in 1958 [1] and the Bureau of Indian Standards in 1983 [2]. Although there are many areas of science and technology where using uranium is beneficial, doing so additionally generates radioactive waste that may pose hazardous to both the natural world and mankind. They were set up by the scientific community shortly after standards had been released. However, the presence of uranium in water for drinking has not gotten much attention, likely because there are still a few concerns about its impacts on the wellness of humans and animals. There is scant human epidemiological research on uranium intake. Consequently, it contains only subjective uranium limits, despite throughout the fourth Edition of the WHO publication from 2011[3] on water for drinking safety. In accordance with UNSCEAR (2016), uranium is a naturally occurring radioactive element that can be found in varying amounts in all fresh water sources [4]. Different nations have a wide range of allowable uranium levels in drinking water. WHO suggests 30 $\mu g.L^{-1}$. The allowed limit for uranium in Japan is 2$\mu g.L^{-1}$, but in Russia it is 1000 $\mu g.L^{-1}$ [5-6]. For drinking water in India, the Atomic Energy Regulatory Board (AERB) in 2004 suggested a limit of 60$\mu g.L^{-1}$ [7]. It is more chemically poisonous than radiological harmful and less toxic than many other trace elements found in naturally occurring water. Uranium level in earth crust is typically 3 ppm however granitic rocks have higher concentrations [4]. Uranium along with additional elements dissolve in the groundwater it comes in touch with due to natural weathering processes. As a result, longer residence times, temperatures, and other favorable factors expedite natural weathering. Elevated uranium richness may develop in deep groundwater as a result of long residence times and mineral dissolution, which is related to host rock composition and mineral solubility. The host rock-water interaction, runoff water, industrial effluents, phosphate fertilizer, fossil fuels, etc. all affect the uranium content of different water supplies. In order to minimize the impact of radioactive and chemical contamination on the environment, the techniques employed for uranium extraction from water ought to be very selective, affordable, and have an effective rate of uranium extraction. Adsorption is preferred for this purpose, given the favorable characteristics and cons of each of these methods [8]. Before assessing the

performance of sorbents for removal, it is essential to consider the procedure cost-effectiveness. Techniques including the process of reverse osmosis [9] precipitation [10] and sorption by different kinds of synthetic materials [11]; have demonstrated significant efficacy in the elimination of uranium from the contaminated water. The drawbacks of current technologies, such as their high energy consumption, formation of added pollution, and insufficient uranium uptake, make them problematic for widespread public awareness activities. Numerous synthetic sorbents have recently been studied for their ability to remove U (VI) from water and simulated aqueous solutions. Among these are hierarchical bimetallic oxides [12] along with polyacrylamide films [13]. Although they are readily accessible, sustainable, and have a cost-performance ratio, composite as a bio sorbents made from green synthesis have shown to be particularly effective at eliminate U (VI) from water. Numerous studies of pilot-scale investigations have demonstrated that it is a simple and reversible procedure that can be executed to remediate water. All methods for characterization, such as FTIR, SEM/EDS and XRD analysis, were carried out prior to and following bio sorption studies in order to determine the sorption mechanism. Utilizing the isotherm models developed by Langmuir, and Freundlich, experimental results were assessed. Additionally, kinetics: pseudo-first order and pseudo-second order model were employed to evaluate the process. This research will shed light on the studied magnetic bio composite competence and suitability for uranium (VI) elimination as well as its maximal sorption capacity, and it may offer useful information for determining the ideal sorption conditions. The innovative system U (VI)/magnetic bio composite that is being proposed is affordable, efficient to reach equilibrium, and advantageous to the environment.

2. MATERIAL, METHODOLOGY AND INSTRUMENTATION

2.1 Target chemicals

Chemicals of analytical quality were utilized throughout, including Arsenazo III from Sigma-Aldrich and uranyl nitrate hexahydrate, Merck India provided tartaric acid while Loba Chemie Pvt. Ltd. provided DTPE. Sulfate of iron (II) and anhydrous ferric chloride reactants were only of the Analytical Grade (AR) form.

2.2 Preparation and synthesis of magnetic AML as a sorbent

Aegle marmelos leaves (AML) were taken from the surrounding region of Chhattisgarh, thoroughly rinsed under running water to eliminate objectionable particles, and then dried out of the sun to preserve the phytochemical content. After drying, these have been ground into powder. The procedure (co-precipitation) described by Poonam et al. (2022) has been used to produce magnetic AML [14].

2.3 Instrumentation for sorbent

The materials were examined using a number of instruments, including a D8 Advance X-ray diffractometer for XRD and a Fourier transform infrared spectrophotometer (FTIR) in the 4000-400 cm^{-1} range for chemical analysis of magnetic AML. To assess the concentration of U (VI), SEM (JEOL/MP) for surface morphology were utilized.

2.4 Biosorption Procedure

We have identified the operational variables that affect the adsorption of U (VI) on a magnetic AML sorbent, including pH, time of contact, initial metal ion concentration and sorbent dose. We performed the batch adsorption method and then used Arsenazo III to determine the amount of uranium. The equations for the calculation of adsorption capacity and efficiency as used by Poonam et al. (2022) study [15].

3. RESULTS AND DISCUSSION

3.1 Optimum condition

To determine the ideal pH for U (VI) sorption onto the magnetic AMS, the pH was varied from 2 to 10. As the pH increased from 2 to 7, the uranium adsorption process became more effective. At pH 7, the most effective U (VI) removal takes place. Because uranyl carbonate complexes predominate in aqueous solutions with pH ranges between 8 and 10, removal effectiveness is decreased. For U (VI) removal by

magnetically AMS, pH 7 is suitable. Likewise altered was the initial U (VI) concentration, which varied from 10 to 200 mg/L. The initial uranium content increased along with the adsorption effectiveness, increasing (up to 25 mg/L). The highest removal efficiency was reported at an initial uranium content of 25 mg/L. The pH was 7, the dose was 0.05g, and the starting U (VI) concentration was 25 mg/L. While the other variables remained fixed, the sorbent dose was adjusted from 0.01 to 0.3 g. As the sorbent dose is raised (upto certain dose), the removal efficacy increases, most likely due to an increase in the number of active adsorption sites contact periods ranging from 5 to 70 minutes were used in the studies on the U (VI) adsorption onto magnetic AML. The results of the current study have demonstrated that the U (VI) adsorption occurs in two stages. The first stage (0–40 min) moves quite quickly because of the high starting uranium concentration in the aqueous solution and the large number of active sites on the surface of magnetic AML. A decrease in the number of free sites and electrostatic repulsion between the already-bound U (VI) ions on the magnetic AML surface cause the sorption to essentially the conclusion after 45 to 70 minutes.

3.2 Statistical model for sorption investigation

3.2.1 Isotherms study for sorption over magnetic AML

The resulting (Fig. 1a, 1b and Table 1) linear forms of equations were used to fit the experimentally acquired data to the Langmuir and Freundlich adsorption isotherm models [16]

$$\frac{C_e}{Q_e} = \frac{1}{K_L Q_{max}} + \frac{C_e}{Q_{max}} \quad (1)$$

The values of K_L as Langmuir isotherm constant and Q_{max} as maximum sorption capacity were computed using slope and intercept.

Where q_e denotes the quantity adsorbed (mg/g) and C_e the sorbate concentration in the solution (mg/L), as well as at equilibrium is the Langmuir adsorption constant (L/mg). The linear equation for the Freundlich isotherm is as follows.

$$log q_e = log K_F + \frac{1}{n} \log C_e \quad (2)$$

Where K_F denotes as the Freundlich isotherm constant (mg/g)/(mg/L) and n denotes as the adsorption tendency.

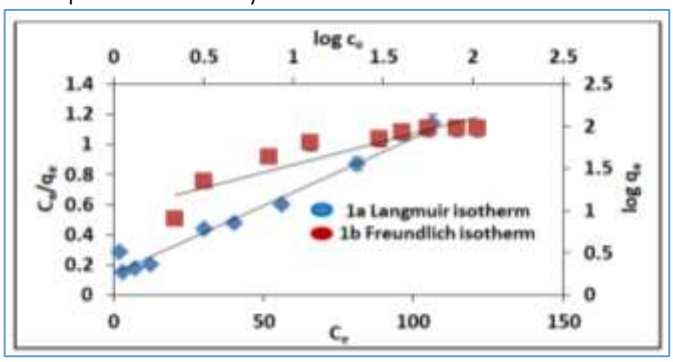


Fig. 1a Langmuir and 1b Freundlich Isotherm model

Table 1 Langmuir and Freundlich Isotherm model for sorption of U (VI) onto magnetic AML

Langmuir constant			Freundlich constant		
K_L (L/mg)	Q_{max} (mg/g)	r^2	K_F (mg/g) / (mg/L)	n	r^2
0.064	111.11	0.9738	9.910	1.816	0.8339

3.2.2 Kinetics study for sorption over magnetic AML

The pseudo-second-order model was used to confirm the adsorption kinetics of U (VI) ions upon magnetically modified AML. Below are the first and second pseudo-order equations respectively.

$$\log(q_e - q_t) = \log q_e - \frac{k_1}{2.303} t \quad (3)$$

$$\frac{t}{q_t} = \frac{1}{k_2 q_{e^2}} + \frac{t}{q_e} \quad (4)$$

q_e and q_t (mg/g) symbolized for equilibrium and any time t adsorption capacity of U(VI) ions, k_1 revealing the first-order constant (min^{-1}). The numerical values of q_e and k_1 can be derived from the intercept and slope, as shown in Fig. 2a while k_2 signifies the pseudo second order constant (g/mg min^{-1}). The slope and intercept decide the values of q_e and k_2 as shown in Fig. 2b. Statistical analysis mentioned in Table 2.

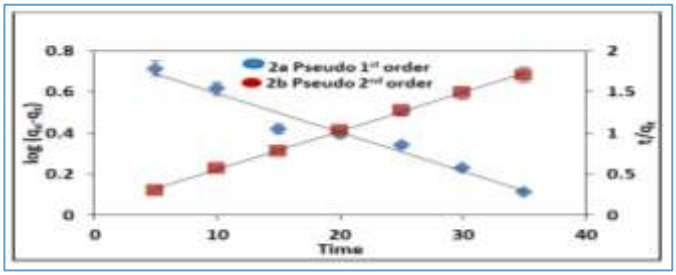


Fig. 2a Pseudo 1st and 2b Pseudo second order kinetics

Table 2 Kinetic parameters for sorption of U (VI) onto magnetic AML

	Pseudo first order kinetics			Pseudo second order kinetics		
q_{exp}	K_1 (1/min)	q_e (mg/g)	r^2	K_2 (g/mg min)	q_e (mg/g)	r^2
21.8	0.0435	6.077	0.9656	0.0258	21.321	0.999

4. ADSORPTION MECHANISM OF TARGET ION ONTO MAGNETIC AML SORBENT

The findings allow us to propose a mechanism for U (VI) sorption onto magnetic AML. The sorption is rapid and happens in two stages, with optimum contact duration of 40 minutes. In light of the presence of Fe-O relates to and the strong affinity of Fe oxides for U (VI), the primary belief is that the method includes chemical adsorption involving complexation and precipitation from the surface. This conclusion is supported by FTIR results (Fig. 3a), which show that carboxyl and hydroxyl groups are the principal uranium-binding groups in the sorbent. This notion is also supported by the O=U=O band at 921 cm^{-1} [17]. SEM (Fig. 3b) investigation revealed changes in the surface influence of the magnetic AML during U (VI) sorption. Langmuir framework was determined to be the best-fitting adsorption isotherm model. The kinetic feature (pseudo-second order model) additionally allows the process is chemisorption. The pattern of diffraction exhibits magnetic AML crystallinity (Fig. 3c), which is closely aligned with a particularly intense peak of Fe_3O_4 [35.4°, (311)c] [18].

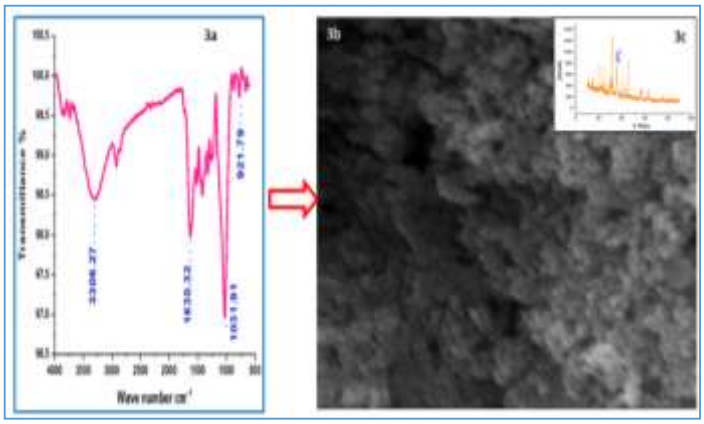


Fig.3a FTIR, 3b SEM morphology and 3c XRD analysis of U (VI) sorption onto magnetic AML

CONCLUSION :

Research on novel uranium sorbent (magnetic AML) with high sorption capacities that are economical and environmentally friendly is undertaken. The ability of sorption of uranium from an aqueous solution was studied using the sorbent. The maximal sorption capacity is satisfactory, according to the Langmuir isotherm model (111.11mg/gm). Given the existence of Fe-O and the great affinity of Fe oxides for U (VI), the prevailing belief is that the method involves chemical adsorption involving association and precipitation from the surface. This conclusion is reinforced by FTIR results, which demonstrate that the sorbent main uranium-binding members are carboxyl and hydroxyl groups. The O=U=O band at 921 cm^{-1} lends support to this idea. SEM investigation demonstrated surface influence modifications.

ACKNOWLEDGEMENTS :

The lab facilities were provided acknowledgments of Principal BIT Durg (C.G.), for which the authors are grateful. The authors are also thankful to the NCNR, Pt.R.S.U. Raipur for providing FTIR facilities.

REFERENCES :

1. World Health Organization, (1963). International standards for drinking-water
2. Indian Standard Specification for Drinking Water, (1983). IS: 10500
3. World Health Organization, (2011). Guidelines for drinking-water quality, WHO Chron 38(4),1–178
4. UNSCEAR. (2016). Sources and effect of ionization radiation, united nation scientific committee on the effect of atomic radiation, Annex D- Biological effects of selected internal emitters- Uranium, United Nations, New York.
5. World Health Organization, (2012). Uranium in drinking water. Background document for development of WHO guidelines for drinking-water quality. WHO, Geneva, 1–21.
6. Sahoo, S.K., Jha. V.N., Patra. A.C., Jha. S.K., Kulkarni. M.S. (2020). Scientifc background and methodology adopted on derivation of regulatory limit for uranium in drinking water–a global perspective. Environ Adv, 2,100020.
7. AERB, (2004). Limits on uranium in drinking water, atomic energy regulatory board of India, Mumbai. AERB/VC/16/2004/80/373
8. He. M., Wang. L., Zhang. Z., Zhang. Y., Zhu. J., Wang. X., Miao. R. and Miao. R. (2020). Stable forward osmosis nanocomposite membrane doped with sulfonated graphene oxide@metal–organic frameworks for heavy metal removal. ACS Appl Mater Interfaces, 12(51),57102– 57116. https://doi.org/10.1021/acsami.0c17405
9. Tapia-Rodriguez. A., Luna-Velasco. A., Field. J.A. and Sierra-Alvarez. R. (2010). Anaerobic bioremediation of hexavalent uranium in groundwater by reductive precipitation with methanogenic granular sludge. Water Res, 44(7),2153–2162. https://doi.org/10.1016/j. watres.2009.12.030
10. Tan. L., Zhang. X., Liu. Q., Jing. X., Liu. J., Song. D., Wang. J., Liu. L. and Wang. J. (2015). Synthesis of Fe_3O_4@TiO_2 core–shell magnetic composites for highly efficient sorption of uranium (VI). Colloids Surf, 469,279–286. https://doi.org/10.1016/j.colsurfa.2015.01. 040
11. Singh. S., Bajwaa. B.S. and Kaur. I. (2021). (Zn/Co)-zeolitic imidazolate frameworks: room temperature synthesis and application as promising U (VI) scavengers—a comparative study. J Ind Eng Chem, 93,351–360. https://doi.org/10.1016/j.jiec.2020.10.012
12. Singh. S., Sharma. S., Bajwaa. B.S. and Kaur. I. (2021). Tungsten disulfde (WS_2) nanosheets: synthesis, characterization, adsorption studies and application for remediation of groundwater samples with high prevalence of uranium from SW-Punjab. J Radioanal Nucl Chem, https://doi.org/10.1007/ s10967-021-07939-x
13. Abou El-Reash, Y.G., Abdelghany. A.M. and Leopold. K. (2017). Solidphase extraction of Cu^{2+} and Pb^{2+} from waters using new thermally treated chitosan/polyacrylamide thin flms; adsorption kinetics and thermodynamics. Int J Environ Anal Chem, 97(10),965–982. https://doi.org/10.1080/03067319.2017.137690
14. Deshmukh. P., Sar. S.K. and Yusan. S.2022. Adsorptive extraction of uranyl ion from aqueous solution by nanocomposite: Synthesis, optimization and characterizatio.Chemical Data Collection,4,1-12 https://doi.org/10.1016/j.cdc.2022.100970.
15. Deshmukh. P., Sar. S.K., Samjecanin. N. Nuhanovic. M. and Lalwani. R. 2022. Magnetically modified waste bark of *Aegle marmelos* tree as promising bio sorbent for uranium (VI) sorption. Radiochemistry, 62(5), 650. DOI: 10.1134/S1066362222050095
16. Deshmukh. P., Sar. S.K. and Ghosh. P.K. 2021. Efficient exclusion of uranyl ion from aqueous medium by a novel magnetic bio adsorbent (*Phyllanthus emblica* bark). Groundwater for Sustainable Development, 14,1-8. https://doi.org/10.1016/j.gsd.2021.100625.
17. Deshmukh. P., Sar. S.K. and Jindal. M.K. 2022. Plant mediated magnetic nano composite as promising scavenger's radionuclides for the efficient remediation in aqueous medium. Chemosphere, 312, 1-9 https://doi.org/10.1016/j.chemosphere.

International Multidisciplinary Research E-Journal Online Available at http://gater.in/
INTERNATIONAL PEER REVIEWED JOURNAL
OF GLOBAL ASSOCIATION FOR TRAINING, EDUCATION & RESEARCH
(GLOBAL CONSORTIUM OF PROFESSIONALS, TRAINERS, ACADEMICIANS & RESEARCHERS)

Concept Note for Skills Based University Course Structure

Dr. Lalit Narayan, AISECT Group, Bhopal M.P.
email : lalitfortunate@gmail.com

Abstract :

Indian education system is undergoing various revolutionary reforms for adopting value based and skill based higher education to contribute effectively in the demand supply of economic and social development. In the light of various guidelines and policies notified by higher and skill education regulators and government authorities, in which National Education Policy (NEP) 2020, National Credit Framework (NCrF), and National Skill Qualification Framework has provided key inputs to shape and plan the implementing direction for skill based higher education. In the present paper it is is attempted to address the need of how to design the course structure of a particularly skills University or any skill based university in the light of NEP 2020, NCrF & NSQF guidelines.

Key Words: Skill Based Education, curriculum design, course structure design,

Introduction:

Course structure of any program is the base of all academic delivery plan. After the notifications of NEP 2020, NCrF, and many other reforms in higher education framework released by bodies like MSDE, MoE, NCVET, UGC, AICTE are now playing great role in shaping the future of institutional operation and delivery.

National Education Policy (NEP) 2020 :

This policy is a developed after a great efforts of many intellectuals to provide a holistic education system in Bharat. The NEP 2020 aims at making "India a global knowledge superpower".

NCrF: National Credit Framework notified in April 2023 which jointly developed by UGC,AICTE, NCVET, DoSEL & DoHE, MoE, MSDE, CBSE, NCERT, NIOS and DGT. This is meta-framework which gives a common standard for all kind of learning processes and also lays a guide to establish path for vertical and horizontal mobility.

NSQF – National Skills Qualification Framework

1st notified in 27th Dec 2013 by UGC. This guideline provides a base guidelines for how skilling in higher education can be adopted and implemented.

Keeping the inputs of NEP 2020, NCrF & NSQF following is the schematic representation of proposed course structure of UG program (one Semester):

Table 1:
Schematic representation of proposed structure for Skill Based course [1]

Proposed Course Structure for UG program									
Odd/Even SEMESTER									
Course Details						Credit Distribution			Total Credits
Course Type	Course Title		Total Marks	Theory	Practical	L	T	P	
Sub – 1	Core Sub I (DSC - Major)	Discipline Specific/ Specialization Subject	100	40	60	2		4	6
Sub- 2	Core Skill Elective (Minor) DSEC	Discipline Specific/ Specialization aligned QP/ NOS mapped level	100	40	60	2		4	6
Sub-3	General Elective Course (GEC	Generic Elective (from same or any faculty)	100	40	60	1		3	4
Sub- 4	Ability Enhancement Course (AEC)	AEC / Foundation Courses	100	40	60	3		1	4
			400	160	240	8		12	20

1. **Disciplinary Core Specific Course DSC: Sub 1**
   A course, which should compulsorily be studied by a candidate as a core/Major requirementis termed as a Core course/Core Skill Course, with practical and immersive sessions/ demonstrational/experiential activities (Not necessary Lab Work).
2. **Disciplinary (Core/specialization) Specific Elective Course DSEC: Sub 2** Generally a course which can be chosen from a pool of courses and which may be veryspecific or specialized or advanced or supportive to the discipline/ subject of study orwhich provides an extended scope or which enables an exposure to some other discipline/subject/domain or nurtures the candidate's proficiency/skill is called anElective Course. **This specialization subject in case of skills based University will bebased on NSQF NOS/Qualification files from relevant sectors of suitable applicablelevel (standard recommendations 1st Year – 4.5, 2nd Year – 5 & 3rd Year – 5.5, 4thYear UG Hon./PG 1st Year -6, PG 2nd year – 6.5) and hours[2].**

Note – As per requirement & special situation the applicable hours or syllabus/NoSs can be distributed preferably in 2 semesters of 1 year session.

3. Generic Elective Course (GEC): Sub 3

An elective course chosen generally from the same or any other faculty/discipline/subject, with an intention to seek exposure is called a Generic Elective.

P.S.: A core course offered in a discipline/subject may be treated as an elective by other discipline/subject and vice versa and such electives may also be referred to asGeneric Elective.

4. Ability Enhancement Courses (AEC)/Competency Improvement Courses/Skill Development Courses/Foundation Course: Sub 4[3]

The Ability Enhancement (AE) Courses may be of two kinds: AE Compulsory Course (AECC) and AE Elective Course (AEEC). "AECC" courses are the courses based upon the content that leads to Knowledge enhancement. They ((i) Environmental Studies, (ii) English/Hindi/Languages, are mandatory for all disciplines. AEEC courses are value- based and/or skill-based and are aimed at providing hands-on-training, competencies, skills, etc.

a. AE Compulsory Course (AECC): Environmental Science, English Communication/Communication skills, Indian Knowledge System & otherrecommended courses.
b. AE Elective Course (AEEC): These courses may be chosen from a pool of courses designed to provide value-based and/or skill-based instruction.

Field Project /Apprenticeship / Internship /Community Engagement work/Dissertation FPAICE: This course is considered as a special course involving application of knowledgein solving / analyzing /exploring a real life situation / difficult problem. A Project/Dissertationwork may be given in lieu of a discipline specific elective paper.

Note: For Non-technical specialization where as such hard-physical labs are not aligned or required this course's lab work can be implemented in the form of immersive sessions/ demonstrational/experiential activities (which may be not necessarily traditional Lab Work nature but it contributes as an experiential learning development and practices).

The below mentioned table will help the Academic Deans for lecture Time Table & class -LabEngagement planning:

Table2:
Credits & Hours distribution for various teaching learning methods [1]

TeachingLearning Method	Details	Credit	Hours
L/T	Lecture/Tutorial	1	15
P	Practical	1	30
FPIACE / Immersive	Field Project, Internship, Apprenticeship, Community Engagement, immersive classes. This type of activity is also considered as practical & hands on learning.	1	40-45

Important Note:

- 600 Hours per semester does not include self-study hours.
- Overall, the structure is attempted and proposed to maintain minimum 60% practical pedagogy & 40% theoretical pedagogy. Which is also not restricted on the delivery nature but tried to encourage hands on experience of learning in all kinds of subjects teaching through Industry- Academia collaborations, immersive activities, sessions by experts or assignments.
- The proposed structure is a kind of suggestive structure and tried to keep as per the standard guidelines of UGC. If any change will happen due to the new policies by NCVET, NCrF, NSQF, UGC, AICTE, or any appropriate body the same will be applicable.

Conclusion :

The presented concept can be considered as a practical interpretation of regulatory guidelines i.e NEP 2020, NCrF & NSQF for embedding skilling in higher education.

References :

1. NSQF Guidelines by UGC (https://nsqf.ugc.ac.in/asset/Support/NSQF%20New%20Guidelines.pdf)

2. NCrF 2023 (https://www.ugc.gov.in/pdfnews/9028476_Report-of-National-Credit-Framework.pdf)

3. Curriculum and credit framework for UG programs by UGC.4. NEP 2020

4. https://www.education.gov.in/sites/upload_files/mhrd/files/NEP_Final_English_0.pdf

International Multidisciplinary Research E-Journal Online Available at http://gater.in/
INTERNATIONAL PEER REVIEWED JOURNAL
OF GLOBAL ASSOCIATION FOR TRAINING, EDUCATION & RESEARCH
(GLOBAL CONSORTIUM OF PROFESSIONALS, TRAINERS, ACADEMICIANS & RESEARCHERS)

Role of Stock Exchanges in Sustainability: In the context of Indian Stock Exchanges

Dr. Ankush G Padle, Assistant Professor, Dept of Commerce, Shri Muktanand College Gangapur, Dist. Sambhajinagar(M.S.) India
E-mail: ank.padle@gmail.com

Abstract:
The economic development of any country mainly depends upon the industrial development. It is assumed as the main agent of economic development and generator of employment. Employment leads to an increase in the income of employee. Indeed, as the income increases, it leads towards better living standards. So, industrialization is the key factor of economic development. Hence, Govt. favors industrialization, for industrialization, every country has investment plans. Companies and governments raise funds through the capital market through public offerings. It is called the capital formation process. But another side of the coin is that, as industrialization grows it negatively impacts on the environment. Hence, as a concern of development, it should be sustainable development. so, that future generations can enjoy, what present generations enjoy. Hence, sustainability has become a significant issue now a day in concern of development. Stock exchanges should have a sustainable fund-raising role and good business practices i.e. environmental, social, and good governance (ESG). The Sustainable Indices and sustainable instruments are the initiatives towards sustainable investment. Hence, Stock Exchanges have to promote good governance in business practices and investment in sustainable development. Hence, in this research study researcher has focused on the initiatives of Stock Exchanges have taken worldwide. As well as the special emphasis given on the Indian Stock Exchanges i.e. NSE and BSE in concern of sustainability.

Keywords: Stock Exchanges, Sustainability, Environment, BRSR, ESG, Sustainability Indices, Sustainable Investment. Sustainable Index/Indices

Introduction:

The industrialization has a significant impact on the environment. Many, Indian Cities as well as world cities have suffocated air. The levels of the suffocating gasses and smog i.e. Green House Gases (GHG) increased in the air. Many environmentalists have given threatening alarm on the increasing level of Pollution. During the time of COVID-19, the air was that much clearer, one was able to see the Himalayan Mountains from sitting in Delhi. Because the human activities were closed due to the lockdown. It is clear that in the name of development everybody running after economic development and for this the nations are running after industrialization. Because the industrialisations are the main means of overall development. huge industrialization leads to pollution on earth and degradation of the environment. So, the Industrialization and conservation of the environment have adverse interests. It is the risky game on the rope that, has to balance walking holding industrial development, and environmental conservation in two hands simultaneously.

To attain Sustainable Economic Development, environmental policies have to be followed strictly. To watch and check on the implementation of various legislative measures, international and national policies there are agencies and authorities. Hence, Economic Development is indeed important, but it is meaningless when, it affects adversely on living things on the earth through environmental degradation.

The key solution for this is sustainability. Every step of the human being should be taken very carefully in concern of conservation of environment. Because, among living things, humans are solely responsible for the pollution on the earth. It is said that humans not only pollute Mother Earth but also encroach on space by launching satellites, missiles, bombing, war, and space research. So, as very responsible living things on the earth, human beings have to accept and take responsibility and initiate to save this universe.

For industrialization, investments in the public and private sectors are called by public offering. Here is the significant role of stack exchanges start. The role of Stock Exchanges in the concern of sustainability has focused on and gained increasing attention in recent years, as more investors and companies are aware of the environmental, social, and governance (ESG) issues that affect their performance and reputation. Stock exchanges can play a vital role in fostering economic growth and sustainable development by facilitating the mobilization of financial resources, promoting good corporate governance, enabling the integration of ESG information in investment decision-making, and developing and enabling new products and services that address ESG risks and opportunities (Boffo, 2020) Boffo, R., and R. Patalano (2020). The stock exchanges can effectively mobilize the capital flow towards green, inclusive, and sustainable investment.

Objectives:

1. To know the role of stock exchanges in sustainability worldwide.
2. To study the efforts taken by the stock exchanges for sustainability.

Research Methodology:

The present study is basically dependent upon the secondary data, which is available on the electronic media i.e. various websites of stock exchanges, SEBI, NSE, BSE, reports, as well the primary data from the online newspapers are the sources of the data. Secondary data is the main source of the data.

Collaborations of Stock Exchanges for Sustainability:

According to a report by the World Federation of Exchanges (WFE) and the United Nations Conference on Trade and Development (UNCTAD), stock exchanges can contribute to sustainability in two main forms: the first is promoting good governance in business practices and the second is promoting investment in sustainable development (Siobhan Cleary & Anthony, 2017). Good governance in the twenty-first century means good practices on ESG issues, what many investors refer to as 'ESG' issues (James Zhan_Director, Investment and Enterprise Division (UNCTAD), 2023). Stock exchanges have traditionally been responsible for helping to form well-regulated markets with transparent, well-governed companies. And today stock exchanges are helping companies adopt best practices on ESG issues (Siobhan Cleary & Anthony, 2017).

Stock exchanges can also promote investment in sustainable development by creating platforms and products that enable investors to access companies that are aligned with their values and preferences. For example, stock exchanges can develop sustainability indices, ratings, and associated products that are useful to investors as they seek to shift to more sustainable investment. Stock exchanges can also facilitate the issuance and listing of green bonds, social bonds, and other instruments that support projects with positive environmental or social impacts. (Cleary, 2015)

Sustainability Indices:

Sustainability indices are created by aggregating various indicators that measure different aspects of economic, social, and environmental mental development in a defined region (Dr. Dong Guo, 2015). The indicators are usually selected based on their relevance, reliability, validity and availability of data. The indicators are then weighted and combined to form a composite index that reflects the overall sustainability performance of the region. Different

sustainability indices may use different methodologies, criteria and data sources to create their indicators and indexes, depending on their purpose, scope and target audience. For example, the Dow Jones Sustainability Indices (DJSI) use a best-in-class approach to select the top 10% of sustainability performers in each industry based on an analysis of corporate governance, risk management, branding, climate change mitigation, supply chain standards and labor practices. The S&P ESG Indices use market-cap-weighted indices that measure the performance of securities meeting sustainability criteria while maintaining similar overall industry group weights as their underlying benchmark. The Bloomberg ESG Indices use R-Factor, an ESG scoring solution developed by State Street Global Advisors, to produce a series of indices focused on the subset of ESG factors most likely to materially impact the financial condition or operating performance of companies in a given industry4 (Dr. Dong Guo, 2015). Sustainability indices can help investors and companies to assess and compare the ESG performance of different securities and sectors. It also facilitates the integration of ESG factors into investment decision-making and portfolio construction.

The S&P ESG Indices, are broad-based, market-cap-weighted indices designed to measure the performance of securities meeting sustainability criteria, while maintaining similar overall industry group weights as their underlying benchmark (www. The United Nations Sustainable Stock Exchanges (SSE) initiative is a partnership between UNCTAD, the UN Global Compact, UNEP FI, and the Principles for Responsible Investment that aims to encourage stock exchanges to promote corporate sustainability in their markets. The SSE initiative has over 20 partner exchanges that have committed to advancing sustainability in their markets. The SSE initiative also maintains a database of fact sheets that detail the sustainability initiatives of more than 50 stock exchanges worldwidehttps://sseinitiative.org/wp-content/uploads/2015/08/Brief-2-Role-of-Stock-Exchanges-in-Promoting-Corporate-Sustainability.pdf (sseinitiative.org, 2015).

- spglobal.com, 2023).
- The Dow Jones Sustainability Indices (DJSI), are a family of best-in-class benchmarks for investors who have recognized that sustainable business practices are critical to generating long-term shareholder value and who wish to reflect their sustainability convictions in their investment portfolios. The DJSI targets the top 10% of sustainability performers in each industryhttps://bing.com/search?q=sustainability+indices (https://en.wikipedia.org, 2023).
- The S&P ESG Dividend Aristocrats Indices, which measure the dividend yield-weighted performance of companies from an underlying index that meets specific sustainability criteria and has followed a managed dividends policy for a specified number of years (www.spglobal.com, 2023).
- The Dow Jones Islamic Market Sustainability Index, which combines Islamic investing principles and sustainability criteria from the DJSI3 (https://en.wikipedia.org, 2023).

These are significant sustainability indices that exist in the market. They can help investors and companies to assess and compare the environmental, social and governance (ESG) performance of different securities and sectors. They can also facilitate the integration of ESG factors into investment decision-making and portfolio construction.

ESG Factors :

- **Environmental factors:** These are related to how a company manages its impact on the natural environment, such as its greenhouse gas emissions, energy efficiency, waste management, water conservation, biodiversity protection, and environmental compliance.
- **Social factors:** These are related to how a company treats its employees, customers, suppliers, and communities, such as its labor standards, human rights, health and safety, customer satisfaction, diversity and inclusion, and social responsibility.

- **Governance factors:** These are related to how a company is run, such as its board structure, executive compensation, shareholder rights, business ethics, anti-corruption policies, and transparency and disclosurehttps://corporatefinanceinstitute.com/resources/esg/esg-environmental-social-governance/ (Peterdy, 2023).

Different investors may use different criteria and methods to evaluate and measure ESG factors for different companies and sectors. Some common sources of ESG data include company reports, third-party ratings and indices, surveys and questionnaires, and public databases (Peterdy, 2023).

Process of Evaluating a company's ESG performance:

Evaluating a company's ESG performance is a process of assessing how well the company manages its environmental, social and governance (ESG) issues, and how prepared it is for future ESG risks and opportunities. There are different methods and frameworks that can be used to measure and compare ESG performance across companies and sectors, depending on the purpose, scope and audience of the evaluation. Some of the common steps involved in evaluating a company's ESG performance are:

- Identify the relevant ESG factors and indicators that are material for the company and its industry, based on the expectations and preferences of the stakeholders, such as investors, customers, regulators, employees and communities. e.g., some of the ESG factors that are often considered are greenhouse gas emissions, energy efficiency, waste management, water conservation, biodiversity protection, labour standards, human rights, health and safety, customer satisfaction, diversity and inclusion, board structure, executive compensation, shareholder rights, business ethics, anti-corruption policies and transparency and disclosure (pwc.com, 2023).
- Collect and analyse the data and information related to the ESG factors and indicators from various sources, such as company reports, third-party ratings and indices, surveys and questionnaires and public databases (Shelley Gilberg, 2023). The data and information should be reliable, consistent, comparable and verifiable. The quality and availability of ESG data may vary depending on the company size, sector and region.
- Apply a scoring or rating system to evaluate the company's ESG performance based on a quantitative or qualitative approach, or a combination of both. A quantitative approach uses numerical values to measure ESG performance based on predefined criteria and standards. A qualitative approach uses descriptive or narrative assessments to evaluate ESG performance based on expert judgment or stakeholder feedback. Different scoring or rating systems may use different methodologies, criteria and weights to create their ESG scores or ratings (Shelley Gilberg, 2023).
- Compare the company's ESG performance with its peers, industry benchmarks, or historical trends to identify its strengths, weaknesses, opportunities, and threats. The comparison should take into account the context and characteristics of the company and its industry. For example, some industries may have higher exposure to certain ESG risks or opportunities than othershttps://www.alva-group.com/blog/how-to-measure-esg-performance/ (Shelley Gilberg, 2023).
- Communicate the results of the ESG evaluation to the relevant stakeholders in a clear, transparent and consistent manner. The communication should highlight the key findings, insights and recommendations of the evaluation. It should also disclose the sources, methods and assumptions used in the evaluation. The communication should be tailored to the needs and interests of different stakeholdergroups https://finscience.com/en/blog/esg/esg-scoring-what-it-is-and-how-to-calculate-it/ (ORECCHIO, 2022).

Role of NSE and BSE in Sustainability Development:

The role of NSE and BSE in sustainability development is to provide a platform for companies and investors to engage in responsible and sustainable business practices and investments. NSE and BSE are the two major stock exchanges in India, regulated by the Securities and Exchange Board of India (SEBI) (BSE, 2023). They offer various products and services that enable the integration of environmental, social and governance (ESG) factors in the capital market.

Some Initiatives taken by NSE and BSE to promote sustainability development are:

- NSE launched the Nifty 100 ESG Index and the Nifty 100 Enhanced ESG Index in 2017, which are based on ESG scores of companies derived from an assessment of their policies, disclosures and performance on ESG parameters. NSE also launched the Nifty 50 ESG Index and the Nifty 50 ESG Sector Leaders Index in 2020, which are designed to reflect the performance of companies within the Nifty 50 index that have positive ESG characteristics (Mr. Avishkar Naik, 2020).
- BSE launched the S&P BSE Carbonex in 2012, which tracks the performance of companies that are committed to mitigating their carbon footprint. BSE also launched the S&P BSE Greenex in 2012, which measures the performance of companies that have low greenhouse gas emissions and high energy efficiency. BSE also participates in the Sustainable Stock Exchanges (SSE) initiative, a partnership between UNCTAD, the UN Global Compact, UNEP FI and the Principles for Responsible Investment that aims to encourage stock exchanges to promote corporate sustainability in their markets (Tandon, 2023).
- Both NSE and BSE facilitate the listing and trading of green bonds, which are debt instruments that raise funds for projects with positive environmental impacts. For example, NSE listed India's first green bond issued by CLP Wind Farms in 2015, while BSE listed India's first municipal green bond issued by Pune Municipal Corporation in 2017.
- Both NSE and BSE have adopted **Business Responsibility and Sustainability Reporting (BRSR)** as a mandatory disclosure requirement for listed entities from FY 2022-23 onwards, as per SEBI's circular dated May 10, 2021. The BRSR framework aims to capture the ESG performance of companies in a comprehensive and comparable manner, covering nine principles and 33 essential indicators.

These are some of the examples of how NSE and BSE play a role in sustainability development.

Business Responsibility and Sustainability Reporting (BRSR):

Business Responsibility and Sustainability Reporting (BRSR) is a new reporting format introduced by the Securities and Exchange Board of India (SEBI) for listed entities in India, which aims to capture their environmental, social and governance (ESG) performance in a comprehensive and comparable manner (SEBI, Business responsibility and sustainability reporting by listed entities, 2021). BRSR is an update on the existing Business Responsibility Reporting (BRR), which was based on the National Voluntary Guidelines on Social, Environmental and Economic Responsibilities of Business (NVGs) (SEBI, 2021). BRSR incorporates the current global practices in sustainability reporting based on the National Guidelines for Responsible Business Conduct (NGRBCs), which are aligned with the United Nations Guiding Principles on Business and Human Rights and the Sustainable Development Goals (ICAI, 2023).

BRSR consists of three sections:

General Disclosures, Management and Process Disclosures, and Performance Disclosures. The General Disclosures section covers basic information about the listed entity, such as its products, services, operations, employees and markets. The Management and Process Disclosures section covers the policies, processes and mechanisms adopted by the listed entity to address the nine principles of the National Guidelines on Responsible Business Conducts (NGRBCs), such as ethics, human rights, environment, stakeholder engagement, consumer protection and

public policy advocacy. The Performance Disclosures section covers the quantitative and qualitative indicators that measure the outcomes and impacts of the listed entity's actions on the nine principles of the NGRBCs (SEBI, 2021).

BRSR is expected to benefit both the listed entities and their stakeholders by enabling them to engage more meaningfully on ESG issues. For the listed entities, BRSR can help them to improve their ESG performance, enhance their reputation, attract responsible investors, reduce risks and costs, and create long-term value. For the stakeholders, BRSR can help them to access reliable and comparable ESG information, make informed decisions, monitor progress and hold accountable the listed entities (SEBI, 2021).

BRSR will be applicable for the top 1000 listed entities by market capitalization for FY 2021-22 voluntarily and for FY 2022-23 onwards on a mandatory basis. SEBI has also issued a guidance note on BRSR to provide clarifications and examples on how to prepare and report on BRSR (SEBI, 2021).

The Nine Principles of NGRBCs are:

- **Principle 1:** Businesses should conduct and govern themselves with integrity, and in a manner that is ethical, transparent, and accountable.
- **Principle 2:** Businesses should provide goods and services in a manner that is sustainable and safe.
- **Principle 3:** Businesses should respect and promote the well-being of all employees, including those in their value chains.
- **Principle 4:** Businesses should respect the interests of and be responsive to all their stakeholders.
- **Principle 5:** Businesses should respect and promote human rights.
- **Principle 6:** Businesses should respect and make efforts to protect and restore the environment.
- **Principle 7:** Businesses, when engaging in influencing public and regulatory policy, should do so in a manner that is responsible and transparent.
- **Principle 8**: Businesses should promote inclusive growth and equitable development.
- **Principle 9:** Businesses should engage with and provide value to their consumers in a responsible manner.

These principles are based on the National Guidelines on Responsible Business Conduct (NGRBC), which are aligned with the United Nations Guiding Principles on Business and Human Rights and the Sustainable Development Goals. The NGRBC provide guidance for businesses to adopt responsible business practices that respect resources and societal expectationshttps://www.undp.org/india/publications/responsible-business-india (Ministry_of_Corporate_Affairs, 2018).

United Nations Guiding Principles on Business and Human Rights (UNGPs). The UNGPs are a set of guidelines for States and companies to prevent, address and remedy to human rights abuses committed in business operations. They were proposed by UN Special Representative on business and human rights John Ruggie, and endorsed by the UN Human Rights Council in June 2011 (wikipedia.org, 2023). The UNGPs are based on three pillars: the State duty to protect human rights, the corporate responsibility to respect human rights, and the need for access to effective remedies for victims of business-related human rights abuse. The UNGPs consist of 31 principles that provide concrete and practical guidance for States and companies on how to implement the three pillars in practice. The UNGPs are the global standard for preventing and addressing the risk of adverse impacts on human rights involving business activity, and they provide the internationally accepted framework for enhancing standards and practices about business and human rights (wikipedia.org, 2023). The UNGPs have been widely recognized and supported by various stakeholders, such as governments, businesses, civil society, investors, international organizations and academia. The UNGPs have also inspired the development of various tools, initiatives and mechanisms to promote and monitor their implementation at different levels (wikipedia.org, 2023).

Sustainable Investment:

Sustainable investing is an investment strategy that considers environmental and social impact in addition to financial returns. It aims to generate positive outcomes for society and the planet, while also achieving competitive returns for investors. Sustainable investing often utilizes environmental, social and governance (ESG) criteria to evaluate and select investments that meet certain standards of sustainability performance (Investor.gov, 2023).

Sustainable investing has become more popular and less expensive in recent years, as more investors and companies are aware of the benefits and opportunities of aligning their values and goals with their investments. According to a report by the Global Sustainable Investment Alliance, sustainable investing assets reached $35.3 trillion in 2020, representing 36% of total assets under management globally. Sustainable investing has also proven to deliver higher returns than conventional investing, as shown by various studies and indices (Harvard_Business_School_HBS_Online, 2023).

Sustainable investing can take different forms and approaches, depending on the objectives, preferences and values of the investors. Some of the common sustainable investing strategies are:

- **Negative/exclusionary screening:** This strategy excludes specific sectors, companies or practices from a fund or portfolio based on ESG criteria. For example, some investors may avoid investing in companies that produce tobacco, weapons, fossil fuels or gambling services.
- **Positive/best-in-class screening:** This strategy selects sectors, companies or projects that have positive ESG performance compared to their peers. For example, some investors may choose to invest in companies that have low carbon emissions, high energy efficiency, good labour standards or strong corporate governance.
- **ESG integration:** This strategy incorporates ESG factors into the financial analysis and valuation of investments. For example, some investors may adjust the expected returns or risks of investments based on their ESG performance or exposure.
- Thematic investing: This strategy focuses on specific themes or issues related to sustainability, such as climate change, renewable energy, water security, health care or education. For example, some investors may invest in funds or companies that support the transition to a low-carbon economy, provide access to clean water or improve health outcomes.
- **Impact investing:** This strategy targets investments that have a measurable positive impact on society or the environment, while also generating financial returns. For example, some investors may invest in social enterprises, green bonds, microfinance institutions or community development projects.

Conclusion :

Stock Exchanges play a very crucial role in the mobilization of capital from the investor. As a market of capital formation, the stock exchanges have taken an initiative to the sustainable investments through sustainable stock indices as well as by launching a green bond and sustainable investment. Between the gap, stock exchanges have great opportunities to take a side of sustainability. They can restrict entry for the company without sustainable activities and green initiatives and investment. Stock exchanges can take guidelines from the governing bodies like in India SEBI. Stock exchanges must be insisted on for good ESG performance as per the policies for climate change in India. it is the National Action Plan for Climate Change. As per the SEBI's guidelines, SEBI has introduced BRSR for the listed companies in India. So, NSE and BSE have insisted on such reporting.

Business Responsibility and Sustainability Reporting (BRSR). BRSR is a new reporting format introduced by the Securities and Exchange Board of India (SEBI) for listed entities in India, which are aligned with the United Nations Guiding Principles on Business and Human Rights and the Sustainable Development Goals.

Stock Exchanges lead reinvestments of the funds, they promote good business practices to achieve ESG and sustainable investment. Stock Exchanges has developed sustainable indices that are promoting more sustainable investments by facilitating green bonds, social bonds and other instruments that support projects with positive environmental or social impact. e.g. The S&P ESG Indices, The Dow Jones Sustainability Indices (DJSI), The S&P ESG Dividend Aristocrats Indices, Dow Jones Islamic Market Sustainability Index, these are significant sustainability indices that exist in the market. They are promoting sustainable investment investors and companies to assess and compare the environmental, social and governance (ESG) performance of different securities and sectors. It is also facilitating the integration of ESG factors into investment decision-making and portfolio construction. The United Nations SSE incentives are encouraging stock exchanges to promote corporate sustainability in their markets.

Where in India NSE has launched the Nifty 100 ESG Index and the Nifty 100 Enhanced ESG Index. BSE launched the S&P BSE Carbonex. Both NSE and BSE facilitate the listing and trading of green bonds, which are debt instruments that raise funds for projects with positive environmental impacts. Both NSE and BSE have adopted Business Responsibility and Sustainability Reporting (BRSR) as a mandatory disclosure requirement for listed entities from FY 2022-23 onwards, as per SEBI's guidelines. The BRSR framework aims to capture the ESG performance of companies in a comprehensive and comparable manner, covering nine principles and 33 essential indicators.

Sustainable investing is an investment strategy that considers environmental and social impact in addition to financial returns. It aims to generate positive outcomes for society and the planet, while also achieving competitive returns for investors. Sustainable investing often utilizes environmental, social and governance (ESG) criteria to evaluate and select investments that meet certain standards of sustainability performance. As well as Sustainable investing has become more popular and less expensive in recent years, as more investors and companies are aware of the benefits and opportunities of aligning their values and goals with their investments.

References:

1. Boffo, R. a. (2020). *ESG Investing: Practices, Progress and Challenges.* Paris: OECD .
2. BSE. (2023, Sept 30). *BSE and Sustainability.* Retrieved from www.bseindia.com: https://www.bseindia.com/static/about/sustainability.aspx?expandable=4
3. Cleary, S. (2015, December). *Stock Exchanges and Sustainability.* Retrieved from Report on Stock Exchanges and Sustainability: https://www.unep.org/resources/report/stock-exchanges-and-sustainability
4. Dr. Dong Guo, K. D. (2015, March). *Assessing Sustainability Frameworks and Indices.* Retrieved from Sustainability Metrics White Paper Series: 3 of 3: https://spm.ei.columbia.edu/sites/default/files/content/Publications/SPM_Metrics_WhitePaper_3.pdf
5. Harvard_Business_School_HBS_Online. (2023, Sept 30). *Business Insights.* Retrieved from /online.hbs.edu: https://online.hbs.edu/blog/post/sustainable-investing
6. https://en.wikipedia.org. (2023, Sept 30). *Dow Jones Sustainability Indices.* Retrieved from https://en.wikipedia.org : https://en.wikipedia.org/wiki/Dow_Jones_Sustainability_Indices
7. ICAI. (2023, Sept). *Certificate Course on Business Responsibility and Sustainability Reporting - Batch - 3.* Retrieved from learning.icai.org: https://learning.icai.org/committee/srs/business-responsibility-and-sustainability-reporting/
8. Investor.gov, U. S. (2023, Sept 30). *Environmental, Social and Governance (ESG) Investing.* Retrieved from Investor.gov: https://www.investor.gov/introduction-

investing/investing-basics/glossary/environmental-social-and-governance-esg-investing#:~:text=%E2%80%9CESG%E2%80%9D%20stands%20for%20environmental%2C%20social%2C%20and%20governance.%20ESG,sustainable%20investing%2C%20

9. Ministry_of_Corporate_Affairs. (2018, Dec). *National Guidelines on responsible Business conduct.* Retrieved from www.mca.gov.in: https://www.mca.gov.in/Ministry/pdf/NationalGuildeline_15032019.pdf
10. Mr. Avishkar Naik, M. Y. (2020, July 11). *ESG Analysis of 50 Listed Companies in India.* Retrieved from static.nseindia.com: https://static.nseindia.com/s3fs-public/inline-files/ESG%2050%20Companies%20NSE%2011Jul2020.pdf
11. ORECCHIO, A. (2022, May 20). *ESG Scoring: what it is and how to calculate it* . Retrieved from finscience.com: https://finscience.com/en/blog/esg/esg-scoring-what-it-is-and-how-to-calculate-it/
12. Peterdy, K. (2023, Sept 30). *ESG (Environmental, Social, & Governance).* Retrieved from corporatefinanceinstitute.com https://corporatefinanceinstitute.com/resources/esg/esg-environmental-social-governance/
13. SEBI. (2021, May). *BUSINESS RESPONSIBILITY & SUSTAINABILITY REPORTING FORMAT.* Retrieved from www.sebi.gov.in: https://www.sebi.gov.in/sebi_data/commondocs/may2021/Business%20responsibility%20and%20sustainability%20reporting%20by%20listed%20entitiesAnnexure1_p.PDF
14. SEBI. (2021, May 10). *Business responsibility and sustainability reporting by listed entities.* Retrieved from www.sebi.gov.in: https://www.sebi.gov.in/legal/circulars/may-2021/business-responsibility-and-sustainability-reporting-by-listed-entities_50096.html
15. Shelley Gilberg, S. O. (2023, Sept 30). *How to measure your ESG performance.* Retrieved from www.pwc.com: https://www.pwc.com/ca/en/today-s-issues/environmental-social-and-governance/measure-esg-performance.html
16. Siobhan Cleary, S. A., & Anthony. (2017, Sep 06). *The Role of Stock Exchanges in Fostering Economic Growth and Sustainable Development*

Call for Papers For 2nd Issue of

GATER International Multidisciplinary Research E-Journal

(January - June 2024)

Theme

Enhancing the Quality of Education"

Email your Abstract / Paper to : office@gater.in

- Date for abstract submission : 31st March 2024
- Date for Full paper submission : 31st April 2024

Paper / Article format (software, font and size) :

The paper will be accepted only in soft copy. The research paper must be saved as type: Microsoft Word 1997-2003, so it can be open in any version of the MS-Word. Papers/articles should be typed in the font "Calibri (Body)" with Font Size: Title: 16', Subtitles: 14' and use 12' size for body text. Line spacing should be at least 1.5 inch.

- **Timeline :** Paper must be sent before timeline given. For any query drop your mail on office@gater.in.
- **Publication Fees (non-refundable) :** (Free of Charge for all GATER Members)

1. For Non - Members : Rs. 1000 /- per Author (Inland)
2. For Non - Member : $15 (Outland)
3. Fee payable to : Global Association for Training Education & Research

(A/c No.- 10165231050, IFSC - IDFB0041382)