annual report-newsletter 2019-2020

faculty of agriculture

Volume 1 | Issue 3

Faculty of Agriculture
Sri Sri University, Bidhyadarpur Arilo
Cuttack 754 006 Odisha

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President’s Message

Dear all,

Over the past 3.5 years, I have seen the growth of Faculty of Agriculture in terms of full recruitment of students and initiation of new program during each academic year. An encouraging progress has been made to build resources, as part of institution building approach, to support the education to ensure the excellence is part of teaching philosophy. The quality and value system, which is being integrated at all levels of the faculty has been recognizable achievements in the formative stages of building a faculty to sustain its education and allied professional activities with a long term goal.

We are driven together to build enabling spaces to achieve excellence in education, research and outreach programs of Faculty of Agriculture. I am glad to recognize the efforts of Prof. S. Kumaraswamy, Dean and Head, Faculty of Agriculture has focused approach to realize excellence through building quality as part of pedagogy and standing as a beacon of inclusion for preparing students for lives well lived beyond classroom and driving them forward. The Faculty members are also constantly striving to contribute to the growth while participating at various levels.

Our pragmatic education approach in a spiritually enabled environment is also directed to provide skills to students to greatly influence the likeable behavior of the students through disruptive life skill programs as part of their learning environment. Our responsibilities have increased over the year to ensure that required resources are built into the faculty and human resources are constantly added to the Faculty of Agriculture

From the beginning, Faculty of Agriculture has been walking on the path of excellence. The faculty has larger vision to build it as an institute in subsequent years with focused programs, research and outreach activities to serve the stakeholders at various levels. We are preparing to be accredited by the Indian Council of Agriculture Research (ICAR), New Delhi.

I am glad that we are determined to make our endeavors to be realized in the context of our ideals and obligations to ensure quality education is provided to students. I place on record, Faculty of Agriculture has made a significant progress in terms of building benchmark for quality education and overall personality development of students. I am deeply impressed by the progress we have seen in building the Faculty of Agriculture and hope to see it evolve as centre of excellence in the coming years. The student centric principles embedded in the university has guided us to promote the excellence and will guide the Faculty of Agriculture, going forward.

I proudly wish success in all future endeavours of Faculty of Agriculture.

Mrs. Rajita Kulkarni
President, Sri Sri University

Vice Chancellor's Message

Dear all,

It gives me an immense delight to have witnessed a significant and admirable excellence achieved in education and allied academic activities by the Faculty of Agriculture. The Faculty has made conscious efforts to build course curriculum with experiential learning as an integral part of teaching-learning process in each semester. Moreover, new courses have been designed and included in the course curriculum to prepare the students in frontier areas of agriculture. For instance, a new course, Biosafety and Bioethics, has been developed and integrated into course curriculum of all the on-going programmes. The course is not taught elsewhere as part of course curriculum in other state agricultural universities. Likewise, focused and innovative courses have been developed to be included in the course curriculum to benefit the students. The courses taught in all the programmes have been modeled as per the Learning Outcome-based Curriculum Framework (LOCF).

The Faculty of Agriculture has larger plan to expand and initiate development of 17 Departments in various disciplines of Agriculture. Likewise, it is planning to be accredited by the Indian Council of Agriculture Research (ICAR), New Delhi.

The Faculty of Agriculture will have new building to support its expansion and create necessary laboratories and also smart classrooms to ensure effective environment for teaching-learning process. The necessary infrastructure is being added to the faculty including faculty members with required discipline expertise and staff. The Faculty has started a new programme B.Sc. (Hons.) Food, Nutrition, and Dietetics from the academic year 2020. Likewise, a 2-year Diploma in Agricultural Technologies and Entrepreneurship is planned from the academic year 2021. Besides, the Faculty also has plan to initiate Master's programme from 2022 besides Ph. D.

The student enrollment for the on-going programmes has been encouraging with fast growing student population in the faculty. The focus of the Faculty of Agriculture has been to ensure quality education and experiential learning are day-to-day part of teaching-learning process. Faculty has employed a pragmatic student centric approach to realize overall personality development of students through student counselling and encouraging students to participate in training/workshop besides extracurricular activities.

I am glad and confident that Faulty of Agriculture will continue to grow and becomes a centre of excellence to provide pragmatic education, conduct problem solving research and implements outreach activities to benefit the target stakeholders.

I wish the student community and also faculty members a pleasant growth to become a centre of excellence in agricultural education, research and outreach activities.

Prof. Ajay Kumar Singh Ph.D.
Vice Chancellor, Sri Sri University

Dean’s Message

Dear all,

It is gratifying feeling to realize that the Faculty of Agriculture has grown to be a large faculty of university within a short time period of 3 years since its inception. The faculty has evolved a teaching philosophy which is student centric with major focus on experiential learning. Moreover, the course curriculum is reviewed to consider learning outcome based course curriculum framework (LOCF) adding new courses.

The enrollment of students is increasing in each academic year. We have been working with pragmatic approach to add necessary infrastructure to facilitate effective teaching-learning process. We will be moving to new building with laboratories in major disciplines of agriculture. Likewise, instruments and field farm facilities will be created under the faculty.

We will also be creating 16 departments in various disciplines to provide a platform to start focused research and outreach activities from the academic year 2021. Likewise, we will be recruiting faculty members to each discipline to ensure that at least each department has 5 regular faculty members. The necessary staff will also be recruited to support the academic activities of the faculty.

We have been practicing student centric approach to teaching-learning process. Student counselling is part of the academic activity on an annual basis to understand the learning limitations of students with redressal mechanisms. We encourage students to participate in training/workshops/internships. Likewise, inspire students to participate in socially relevant activities to learn the life skills from the society.

Currently, we have 4-undergraduate programs. All the program are professional and 4-years duration. We also hope to initiate Master’s programs in various discipline from the academic year 2021.

We are glad our efforts to achieve honest excellence is visible over the last 3 years. We look forward achieve ICAR accreditation by 2021 for our programs. Be part of our journey to achieve excellence in education, research and outreach activities.

We welcome aspiring students with an interest to pursue their education in spiritually enabled environment for overall personality development with required life skills.

We would be glad to invite prospective students to study with us. Hope you would consider us for your higher studies especially with Faculty of Agriculture.

We look forward to welcome you.

Prof. S. Kumaraswamy Ph.D.
Dean and Head, Faculty of Agriculture

faculty of agriculture today and tomorrow

Faculty of Agriculture is expanding its disciplines with new programs. Currently, faculty has successfully integrated on-going programs- B.Sc. (Hons.) Agriculture, B.Sc. (Hons.) Horticulture and B.Sc. (Hons.) Agribusiness. These programs are streamlined now with focused establishment of required infrastructure for education and field scale hands on experiential learning. Besides, B.Sc. (Hons.) Food Nutrition and Dietetics has been initiated from the academic calendar 2020.

Faculty of Agriculture also planning to propose the short-term diploma program of 1 to 2 year, which is in the making to be offered from the academic session 2021. The Faculty of Agriculture has plans to initiate Doctoral program in all the discipline with major focus on problem solving innovative research.

Now, faculty members are being added with specific expertise to strengthen the academic and research program. Faculty of Agriculture has seen a promising growth with several academic and allied initiatives to promote quality education and experiential learning. The course curriculum is developed as Learning Outcome based Course Curriculum Framework (LOCF) with major emphasis on experiential learning opportunity in each courses offered in a semester.

Newer courses are being designed and added to curriculum to integrate inter-disciplinary topics. For example, Biosafety and Bioethics an inter-disciplinary course has been designed and integrated into all the on-going programs. Likewise, the student centric approach is incorporated into informal curricula with counseling sessions to understand the psychological issues relevant to learning process to help students to realize their academic potential. Students are also encouraged to participate in the extra-curricular activities, while they learn the leadership abilities and inter-personal skills to realize overall personality development of students.

Students were provided adequate orientation under Student Ready Program-Rural Agricultural Work Experience (RAWE) with a specific manual and activities. Besides, students have undergone study tour to provide exposure to various institutions involved in research and development with major focus on agriculture.

We also inviting prospective faculty members with various expertise to join us to strengthen and drive the academic plan. We expect to have 50 faculty members by the academic year 2021. We have also approval from the academic council to start 16 departments as per the ICAR guidelines. The faculty is accruing required logistics to apply for ICAR accreditation by the academic year 2021.

Faculty will be moving to new building to establish 16 laboratories and allied facilities to support education, research and outreach activities. The long term vision of the faculty of agriculture is to

build interdisciplinary institute of agriculture and agribusiness modeled as centre of excellence.

publications

1. Palei S, Rout GR and Dash DK 2019. Molecular and morphological assessment of Papaya (Carica papaya), Research Journal of Biotechnology,14 (1) 63-70.

2. Palei S, Dash DK, Rout GR 2019. Standardization of in vitro protocol for plant regeneration of Carica papaya cv. Co8 through indirect organogenesis, Journal of Pharmacognosy and phytochemistry,8 (3):1954-1956

3. Palei S, Dash DK, Rout GR 2019. In vitro mutagenesis in Carica papaya L. using oryzalin as a mutagen, International Journal of chemical studies, 7 (4):1464-1466

4. Palei S, Dash DK, Rout GR 2019, Biology and Biotechnology of Papaya, an important fruit crop of tropics: A Review, International journal of Plant research, 31 (4):1-15

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8. Kumar, M., Kesawat, M.S., Ali, A., Lee, S.C., Gill, S.S. and Kim, H.U. 2019. Integration of Abscisic Acid Signaling with Other Signaling Pathways in Plant Stress Responses and Development. Plants (Basel). 11: 8(12).

9. Kim, S.H., Vieira M., Kim, H.J., Kesawat, M.S., and Park, H.Y. 2019. MS2 Labeling of Endogenous Beta-Actin mRNA Does Not Result in Stabilization of Degradation Intermediates. Molecules and Cells. 42: 189.

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12. Dey, P., Datta, D., Saha, D., Parida, S. and Panda, D. 2019. Plant-Endophyte Interaction and Its Application to Abiotic Stress Management of Crop Plants. International Journal of Current Microbiology and Applied Science. 8(7): 2708-2716.

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14. Sahoo, Tanushree, Verma, M. K. and Ram, K. 2019. Analysis of total flavonoids content in grape genotypes. International Journal of Chemical Studies, 7(1): 1181-84.

15. Sahoo, Tanushree, Verma, M. K., Singh, S. K., Thakre, M., Sethi, S. and Saha, S. 2019. Antioxidant activities and quantification of anthocyanins in some Coloured grape hybrids. Applied Biological Research, 21(1): 58-64.

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31. Kabi M, Baisakh B, Dash M and Tripathy S. K.2020. Study of genetic diversity based on quantitative traits in sesame. The Pharma Innovation Journal.; 9(7): 186-190.

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47. Kar, S., Rout,S., Nayak ,S., Sheera, A and Tripathy, B. 2020. *Eclipta alba* An Immunity Booster Plant- An Overview. In PLANTA- Research Book Series, Deheradun. (Accepted)

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faculty member's participation in conference/workshop/FDP

Dr. Chinmayee Mohapatra

- Participated in Online Webinar on 'Entrepreneurship Opportunities in Mushroom Production' organized by ICAR- RCER, Ranchi geld on 11th August 2020.

- Participated in 'International Web Conference on Ensuring Food Safety, Security and Sustainability through Crop Protection' organized by Bihar Agriculture University held on 5-6 August, 2020.

- Participated in ICAR-NRCB Webinar on 'Integrated Insect Pests and Nematode Management in Banana' held on 4th August, 2020

- Participated in International webinar on 'Climate Smart Agriculture' organized by Center for Advanced Agricultural Science and Technology (CAAST) on 22nd July 2020.

- Participated in XIX International Plant Protection Congress held from 10-14th November, 2019.

Dr. Suvalaxmi Palei

- National Seminar on "Harnessing Science & amp; Technology for a better future" on 21 st Odisha Bigyan 'O' Paribesh Congress organized by Orissa Environmental Society and Siksha 'O' Anusandhan University at SOA, Bhubaneswar, Odisha (23-24 th November, 2019)

- Workshop on "Technology based Entrepreneurship Development Program" organized by Agribusiness Incubation Centre, ICAR- NRRI, Cuttack (18-23rd November, 2019)

- Workshop on "DST Inspire Review Meeting" organized by DST, Government of India at KIIT, Bhubaneswar, Odisha (6-8 th June, 2019)

- 8th Indian Horticulture Congress, 2019. "Shaping Future of Indian Horticulture" organized by The Horticultural Society of India at IGKV, Raipur, Chhattisgarh, India. 17-21 st February, 2019

- Plant growth promoting bacteria from cowdung based biodynamics preparation, In proceeding of National Seminar on "Harnessing Science & Technology for a better future" on 21 st Odisha Bigyan 'O' Paribesh Congress organized by Orissa Environmental Society and Siksha 'O' Anusandhan University at SOA, Bhubaneswar, Odisha, 23-24 th November, 2019

- In vitro mutagenesis in Carica papaya. In proceeding of workshop on DST Inspire Review Meeting" organized by DST, Government of India at KIIT, Bhubaneswar, Odisha, 6-8 th June, 2019

- Brewing waste- A Potential source of bioplastics, In proceeding of 8 th Indian Horticulture Congress "Shaping Future of Indian Horticulture"

organized by The Horticultural Society of India at IGKV, Raipur, Chhattisgarh, India, 17-21 st February, 2019

Ms. Madakini Kabi----------

- Participated in 3 days Faculty Development Program for Student Induction Program for AICTE approved institutions organized by AICTE from 6-8 july,2019.

- Participated in workshop on Technology based Entrepreneurship Development programme organized by ICAR-NRRI from 18-23 November,2019.

- Participated in International conference on “Next Generation Genomics and Integrated Breeding for Crop Improvement (VII-NGGIBCI) on Genomics

  for food, health and nutrition Organized by Center of Excellence in Genomics & Systems Biology (CEGSB) on 14 May, 2020

- Participated in in International Webinar on “Intellectual Property Rights, An Overview: Myth & Realities” organised by the Department of Botany and Department of Commerce & Management, KLE Society’s Science & Commerce College Kalamboli, Navi Mumbai, India on 6 th June, 2020.

Mr. Snehashish Routry----------

- XIX International Plant Protection Congress 2019, 10th to 14th November, 2019, Hyderabad, Telengana

- Routray, S and Mohapatra, C. 2019. RNA Interference (RNAi) technology: a novel tool against insect pests. In proceedings of the conference organised by International Association for the Plant Protection Sciences, Hyderabad, 10-14 November 2019.

Mr. Subrata Kumar Mohanty

- National Seminar on Harnessing Science & Technology for a better future organized by Odisha Bigyan O Paribesh Congress, SOA, November 23-24, 2019.

- National Seminar on Science and Technology: Rural Development organized by Indian Science ongress Association, KIIT, December 13-14, 2019.

- National Symposium on climate smart agriculture for enhancing farm productivity organized by Indian Society of Agronomy, Odisha Chapter, OUAT, January 28-29, 2020.

Dr. Anupama Singh

- Participated in International Webinar on Challenges in Agriculture and Human Health in Emerging Situation organised by Indian Society of

  Genetics, Biotechnology Research and Development, Agra on 22 and 23 June, 2020.

- Participated in the KLE International Webinar on "Intellectual Property Rights, an overview: Myth & Realities" held on June 6, 2020, organised by KLE Society's Science & Commerce College. Kalamboli, Navi Mumbai.

Dr. Mahipal Singh

- Faculty Development Program on How To Be An Effective Online Teacher, conducted by Prof.(Dr.) Ajay Kr. Singh, Vice Chancellor, Sri Sri University on 29.06.2020.

Mr. Prajjal Dey

- National Conference on “Challenges and Innovative Approaches in Agriculture and Allied Science Research”: from February 26 th -27 th

July, 2019 at Regional Sericulture Research Station, Central Silk Board, Govt. of India, Salem, Tamil Nadu.

- Webinar on “From Mendelian Genetics to Modern Genomic” on 11 th July,2020 organized by NAHEP(ICAR)-CAAST IARI.

Dr. Arsha Balakrishnan

- KAU-ISAE Regional Conference on Models for Agricultural Development: The Experiences from Farmer Producer Companies (FPCs), Organised by Kerala Agricultural University, Thrissur, Kerala 2019

Ms. Debanjana Debnath

- National Conference on “Challenges and Innovative Approaches in Agriculture and Allied Science Research”: from February 26th-27th July, 2019 at Regional Sericulture Research Station, Central Silk Board, Govt. of India, Salem, Tamil Nadu

‘Quantitative Methods for Social Sciences’ organized by ICAR-NIAP from June 1 st to June 18 th 2020)

Dr. Vinoda Shankara Naik

- MOOCs Programme on Cyclone Management from 27th July, 2020 to 5th August, 2020 Organized by MANAGE, Hyderabad, India14.

Ms. Shruti Mohapatra

- Mohapatra, S., Mishra, R.K. Climate Change and Sustainable Development concerns in India, national seminar on “Climate Smart Agriculture for Enhancing Farm Profitability” 28th -29th January 2020 in OUAT, Bhubaneswar.

- Mohapatra, S., Priyanka, V., Kaviya and Mishra, R.K. Impact of climate Change on suicidal rates of Agrarian population in India, national seminar on "Agriculture in India: Problems, Policies and prospects" 29th Feb to 1st March, 2020 at BJB Autonomous College, Bhubaneswar.

- Mohapatra, S., Mishra, R.K. and Sarangi, K.K., Bio-ethanol (2nd Generation Ethanol): A Solution to Ever Polluting Gasoline to Climate in India, international conference on "Climate Change and its impact on Global food security and sustainability of Agriculture" 23rd -24th November 2019 at BHU, Varanasi.

Dr. Dhawal K. Dwivedi

- International conference on Soil and Water Resources Management for Climate Smart Agriculture, Global Food and Livelihood security organized by Soil Conservation society of India, World association of Soil and Water Conservation and International Soil Conservation Organization in November 2019 at New Delhi, India.

Mr. Ambika Prasad Misra

- Sorption of fluoride in some soils of varying phosphate status of West Bengal and Meghalaya, National seminar on: "Climate smart Agriculture for enhancing farm profitability" 28-29th Janauary, 2020, OUAT,Bhubanrswar

- Effect of graded dosed on fluoride in red soil of Bhubaneswar, Indian Society of soil science, Bhubaneswar chapter, 2020

Ms. Bidudhi Tripathy

- Participated in "National Webinar on Immuno - Nutrition", Organised by AICRP on Women in Agriculture, Directorate of Research (Agri.), Assam Agricultural University

- Attended webinar on “Economics of Farm Operations”, organized by the School of Engineering, RK University, Rajkot

- Participated in International Webinar on “An Overview of Climate Change Assessment: Global to Regional” Organized by GIET, Bhubaneswar in association with Climate Research, Singapore, Centre for Atmospheric Science, IIT, Delhi

- Attended Webinar on "Desert locust, *Scistocerca gregaria*, and its management" for the course Integrated Pest Management (IPM) through agMOOCs.

- Participated in National Webinar on "Carbon emissions reduction during COVID-19 pandemic and its impact on the climate” organized by GIET, Bhubaneswar

- Oral presentation on “Enhancing the water use efficiency and water productivity through mulching under different crop establishment techniques in wheat” in the National Seminar entitled "Rainfed

  Agriculture: Strategies for a Sustainable Farm Economy" organized by School of Agriculture, GIET University, Gunupur.

- National Seminar entitled "Rainfed Agriculture: Strategies for a Sustainable Farm Economy" organized by School of Agriculture, GIET University, Gunupur.

- National Seminar entitled "Rainfed Agriculture: Strategies for a Sustainable Farm Economy" organized by School of Agriculture, GIET University, Gunupur.

- Participated in International Conference on “Advancement of Biotechnology in Health Care Bio-products and Environmental Research (CABHBE-19)” and published three abstracts as first, second and third author which was organized by Dept. of Biotechnology, GIET University, Gunupur.

- 3rd National Conference on promoting and reinvigorating agri-horti, technological innovations(PRAGATI-2019).

- Participated in Five Day Workshop on “Modern Methodologies in Statistical Data Analysis for Agricultural Research” conducted by University Of Agricultural Sciences, Raichur & ICAR -National Agricultural Higher Education Project, New Delhi

Mr. Brij Bihari Pandey

- National conference on “Technological Innovations in Oilseed Crops for Enhancing Productivity, Profitability and Nutritional Security”, Rajendranagar, Hyderabad, February, 7-8, 2020.

- National conference of plant physiology-2019, at Kerala agriculture university, Thrissur, Kerala, December 19-21, 2019.

Dr. Sandep Rout

- 1-week Short-term Course on IPR, Organized by NIT Jalandhar, 28 Aug -1 Sept 2020.

Ms. Kalyani Pradhan

- “Web Series Programme on COVID-19 Virus” Awareness Programme on (Sunday) organized by Nature Science Foundation, Coimbatore, Tamil Nadu, India. 10th May 2020

- ‘COVID-19 Awareness Program’ organized by D.K.T.E. Society’s Textile and Engineering Institute, Ichalkaranji for the commitment to discharge the service to the nation as a responsible citizen. Dt. 14.5.2020.

- Awareness Campaign on COVID-19 organised by Collector Office, Chandrapur & Z.P. Chandrapur. Dt. 14.5.2020.

- National Level Faculty Development Workshop on ‘LMS- TOOLS FOR EFFECTIVE TEACHING AND LEARNING’ organized by Clara’s College of Commerce, Mumbai in collaboration with EdFly Dt. 25 th may 2020.

- One-day E-FDP on ‘Impact of Literature on Society’ organized by Department of English. Dt. 31.05.2020.

- The e-faculty development program cum work shop on ‘Waste to Bioenergy’ organized by Department of Life Science, School of Basic Sciences and Research, Sharda University, Uttar Pradesh and Department of Agricultural Engineering, Maharastra Institute of Technology, Aurangabad. Dt. 28 th june to 4 th july, 2020.

- National Webinar on ‘Impact of Covid 19 on labour and workforce’ June 10, 2020.

- National Webinar on “How to write and Publish 50,000+ Research & Conference papers Effectively & Efficiently using TYPESET Research Studio” organized by Department of RIT Central Library of Rajarambapu

  Institute of Technology Rajaramnagar, Islampur, Dist. Sangli, Maharashtra, India on 22nd June, 2020.

- International E-Faculty Development Programme on ‘Research Indicators, Resourses, Plagiarism and Academic Integrity’ organised by the knowledge Resource Centre of Patrician College of Arts and Science, Chennai, TamilNadu, India on 22 nd – 26 th june 2020.

Mr. Ningaraja Belagall----------

- Attended National Webinar on `**Management of Biotic and Abiotic Stresses in Protected Agriculture**. Conducted by CSKHPKV Palampur HP. Organized by ICAR on Sept 22 to 24, 2020.

- Attended the webinar on **"Outcome Based Education"** held on 8th and 9th Sept 2020 at Trinity Institute of Professional Studies, Dwarka. A+ Ranked Institution of GGSIPU, Dwarka, New Delhi.

- Attended Webinar on **Organic Farming** – Scope & Business Opportunities in India. Conducted by The SVKM's NMIMS, School of Agricultural Sciences and Technology, Shirapur, MH, India held on 1st August 2020.

- Attending International e- Conference on Sustainable Agriculture conducting by University of Horticultural Sciences, Bagalkot, Karnataka. On 6th to 8th Oct, 2020.

Membership of professional societies

Dr. Chinmayee Mohapatra

- Indian Phytopathological Society

Dr. Suvalaxmi Palei

- Life member in Society for promotion of Horticulture, ICAR-IIHR, Bengaluru, India
- Life member, Society for Biotechnology and Bio-informatics, Bhubaneswar, Odisha,
- Life member in Odisha Horticultural Society, Bhubaneswar, Odisha

Dr. Mahipal Singh

- Editorial Board Member for Advanced Chemicobiology Research

Mr. Prajjal Dey

- Member of Society for Advancement of Agricultural Innovations
- Member of Society for Biotic and Environmental Research

Ms. Debanjana Debnath

- Member of Editorial board of Agri. food magazine e-newsletter

Dr. Dhawal K. Dwivedi

- Life member Association of Agro- meteorologists

Mr. Ambika Prasad Misra

- **Indian Society of Soil Science**
- **Agrobios Newsletter**

Dr. Sandep Rout

- Life Member of Bose Science Society,
- Tamil Nadu Science Organization (TNSO)

Ms. Kalyani Pradhan

- Life member of Odisha Horticulture Society.
- Life member of Society for Scientific Development in Agriculture and Technology
- Life member of Indian Society of Vegetable Science.
- Member of organizing committee 2nd International E-conference on EIABSHWAR, organized by Kalp Laboratory and Society of Plant Promotion, UK.

Collaborations & MoU

Faculty of Agriculture, Sri Sri University and SSIAST, AOL, Bengaluru signed a MoU in 2019 to engage in collaborative activities to share the knowledge, conduct training and workshops. It is envisaged that the Faculty of Agriculture shall act as host for implementing a problem solving developmental research and skill enhancement of farming community and stakeholders.

Dr. Chinmayee Mohapatra, Assistant Professor (Plant Pathology)

Coconut based cropping systems

Coconut (*Cocos nucifera*) is a versatile crop which employs about 5lakh people directly and approximately 10 lakh people are indirectly employed due to coconut plantation. It is called as Kalpavriksha or Tree of Heaven as it provides raw material for various industries such as composting, textile, food industry etc. It has a versatile use and can be used in various ways. Various by products such as Coconut oil, Desiccated coconut, Activated Carbon from coconut shell, and Coir based products produced by coconut is even exported to different countries.

Coconut mono-cropping goes against the practice of efficient utilization of natural resources. It provides very low income to the farmers even with an optimum planting density, as a large area under the plant canopy remains unutilized. Weeds growing in this unused area compete with the palms for moisture and nutrients and as a result of which plant could not produce satisfactory yield. Therefore, coconut-based intercropping systems could be practiced for the efficient utilization of natural resources and getting additional income on a sustainable basis. The intercrops aim at increasing the production and productivity from the given piece of land. During the initial years of coconut cultivation, the sunlight intensity is high and is not utilized completely by the plantation, however, the sunlight and other resources are used efficiently when intercrops are grown. About 4000 to 7000 roots are found in middle-aged palms. Hence, the active root zone is confined to approx.

25% of the available land area and the remaining area can be profitably exploited for raising of intercrops or multi-tier crops.

Mono-cropping is not sustainable

- It provides very low income to the farmers even with an optimum planting density, as a large area under the plant canopy remains unutilized.
- Weeds growing in this unused area compete with the palms for moisture and nutrients and as a result of which plant could not produce satisfactory yield.
- In coconut mono-cropping, it utilizes only 22% of land area in a 7.5m X 7.5m system.
- About 4000 to 7000 roots are found in middle-aged palms. Hence, the active root zone is confined to approx. 25% of the available land area and the remaining area can be profitably exploited for raising of intercrops or multi-tier crops.
- Depending on the spacing undertaken, *i.e.*, 7m X 7m or 10m X 10m, the amount of solar energy under coconut canopy ranges from 43 to 88% of normal sunlight, whereas, the light intensity at the ground level is always higher than 6700lux at all parts of the year.

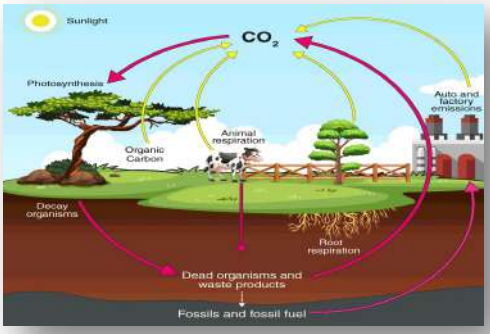
In the diagram given below, there is a schematic representation of available interspace between coconut palms in mono-cropping.

Coconut Based Farming Systems

- Coconut based cropping/farming systems, involving cultivation of compatible crops in the interspaces of coconut and integration with other enterprises like dairy, poultry and aquaculture offer considerable scope for increasing production and enhancing productivity per unit area, time and inputs by more efficient utilization of resources like sunlight, soil, water and labour
- Coconut-based farming system (CBFS) is the most commonly adapted by coconut growing traditional farmers, i.e. it is a multiple cropping

or crop/livestock production system aimed at maximizing and/or complementing the benefits that can be derived from land under coconut.

- CBFS includes growing of compatible crops in interspaces of coconut which offers a great scope for increasing productivity per unit area of land, time and inputs due to efficient utilization of sunlight, soil, water and labour. However, in perennials, the potential to increase the productivity per unit area, time and land is higher as compared to annuals.



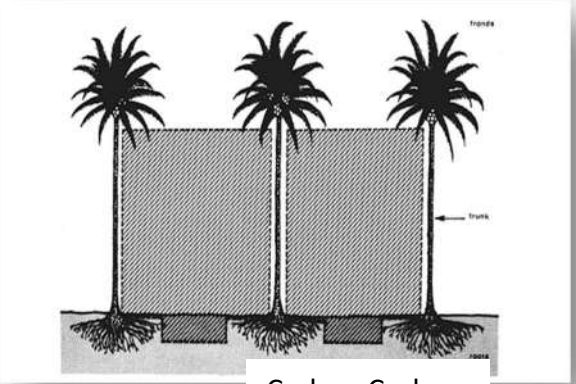
Types of cropping systems in coconut

There are 5 types of cropping systems followed in coconut throughout the country.

- Intercropping System
- Mixed cropping System
- Multi-storeyed cropping System
- High Density Multispecies Cropping System
- Mixed farming

Role of CBFS in soil C sequestration

- Carbon sequestration or carbon dioxide removal is the long-term removal, capture or sequestration of carbon dioxide from the atmosphere to slow or reverse atmospheric CO_2 pollution and to mitigate or reverse global warming.



Carbon Cycle

- In the current situation Soil Organic Carbon (SOC) Sequestration is the most crucial need for a better management practice.

- Increased SOC enhances soil fertility, soil tilth and water holding capacity, eventually increasing the production, promotes sustainability.
- Plants fix atmospheric CO_2 through photosynthesis and convert them as bio mass by storing them in various organs. Plantation crops are perennials that are grown in large scale and are mostly found in mixed species cropping systems.
- Such cropping systems offer a large amount of bio mass production per unit area than mono cropping system. Hence, they act as carbon pools and help in reducing the effect of global warming.
- The total carbon sequestrated was higher in the top 0-15 cm soil layer and lower in 15-30 cm.
- Plantation crops are perennials with large biomass production, and act as 'Natural Sponges' for absorbing CO_2 from atmosphere. Mostly grown in mixed cropping system, these crops form an excellent species in sequestering atmospheric carbon besides providing nutritional security and restoring soil fertility. With global carbon trading becoming reality, emitters unable to meet their own targets could pay of through carbon sequestration in plantations.

By-product utilization in vermicompost

- A lot of biomass is collected in a CBFS; these are mostly thrown away or fed to the cattle. But these biomasses can act as a good source of organic manure, which will maintain the sustainability of the system and enhance the soil as well as the fruit quality.
- Nearly 6-8tonns of coconut wastes in form of leaves, spathes, bunch wastes etc. are obtained from one hectare of a well-managed coconut garden. Along with coconut wastes, biomass from banana, cocoa or any other intercrop can be also utilized for vermicomposting.
- In a mixed farming enterprise, 15 tonnes of FYM, 2 tonnes of poultry manure along with 50,000litres of cow urine can be obtained annually,

which on recycling can easily save 125kg N, 78kg P_2O_5, and 115kg K_2O of chemical fertilizers.

- Vermicompost is loosely packed, granular aggregates of earthworms and associated microbes. These are enzymatically digested organic matter which are in easily available form/ mineralized form.
- It contains around 9.5-17.98% organic Carbon and 0.5-1.5% Nitrogen.

Composted coir pith

- The Coconut coir pith is quite famous in Horticulture field due to its property of being a great growing media.

- But, as it has a wider carbon and nitrogen ratio and lower biodegradability (due to high lignin content), coir pith is not considered as a good carbon source for use in agriculture.
- Hence, Coir pith is composted to reduce the wider C: N ratio, thereby reducing the lignin and cellulose content and also increasing the manorial value of pith.

Composting of coir pith makes it light in weight and converts the plant nutrients to the available form.

Dr. Anupama Singh, Assistant Professor (Genetics and Plant Breeding)

Reverse Breeding: An innovative breeding approach

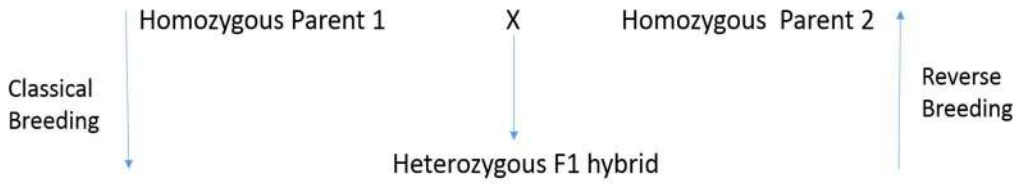
From the ancient time, the goal of plant breeding is to produce the varieties which shows better performance than the previous varieties. Breeders put their continuous efforts for achieving this goal. One of the best way to achieve this goal is production of hybrid varieties by crossing two homozygous parental lines. This hybrid (F1) progeny typically are superior in size, growth characteristics and yield in comparison to their homozygous parents, due to a phenomenon known as heterosis. But the exact mechanism of heterosis/superiority is not known. However, hybrid breeding has always been more or less based on a trial and error approach, since it is difficult to predict which parental lines will give the best progeny. Many pairs of parents then need to be crossed and their progeny tested for the better performance which is time taking process. Aside from the time breeding takes, uncharacterized heterozygotes cannot easily be converted into homozygous parental breeding lines, as desirable allele combinations are lost through recombination during meiosis. Even the performance of hybrid variety is reduced in the further generations as favourable allele combinations of the elite heterozygote are lost in the next generation due to segregation of traits. Because of this difficulty, the development of methods for easy preservation of heterozygous genotypes is one of the greatest challenges in plant breeding.

Reverse breeding as a novel plant breeding technique to directly produce homozygous parental lines from any heterozygous plant was proposed by Dirks et al. in 2009. Reverse breeding, meets the challenge of fixation of complex heterozygous genomes by constructing complementing homozygous lines. This is accomplished by the knockdown of meiotic crossovers and the subsequent fixation of non-recombinant chromosomes in homozygous doubled haploid lines (DHs). The approach not only allows fixation of uncharacterized germplasm but provides breeders with a breeding tool that, when applied to plants of known backgrounds, allows the rapid generation of chromosome substitutions that will facilitate breeding on an individual chromosome level.

Reverse breeding approach comprise of two essential steps-

1) Suppression of crossover recombination in a selected plant.
2) Regeneration of DHs from spores containing non-recombinant chromosomes.

The concept of reverse breeding can be easily understood by the following flow diagram.



Objectives of reverse breeding:

- To maintain the stability of hybrid variety.
- Genetic improvement of parental lines to enhance the hybrid performance.
- To establish the breeding lines/parental lines for uncharacterized heterozygotes.

- To multiply a highly heterozygous plant from a homozygous parental lines easily.

Mechanism involved in reverse breeding:

From a segregating population, a genotypically uncharacterized plant with a favourable combination of traits is selected. Crossing over is suppressed in this plant and achiasmatic gametes are collected, cultured, and used to generate DHs. The DH lines can then be used to reconstitute the superior heterozygote on a commercial scale. So in the whole procedure two mechanisms are involved, one is formation of achiasmatic

gametes through suppression of crossing over and another is production of double haploid lines from achiasmatic gametes.

A) **Formation of achiasmatic gametes**: As, reverse breeding relies on the effective suppression of meiotic crossovers for the formation of achiasmatic gametes. This can be achieved by utilizing various techniques.

B) The first method targets the genes that are essential in crossover formation but leave the chromosome structure intact. The knockdown of gene expression of these genes are essential for RB and that can be achieved by targeting genes using RNA interference (RNAi) or siRNAs, which will result in predominantly post-transcriptional gene silencing (PTGS). Alternatively, dominant-negative mutations of the target gene can be used.

Another method is given for those crops in which stable transformation is difficult to achieve. One of the technique utilized in those plants is Virus-induced gene silencing (VIGS) which is an effective technique for induction of PTGS. In this technique, a plant is infected with a virus that was modified to include a target gene RNA sequence. In a

defence reaction, the plant will break down the viral RNA using siRNA, targeting simultaneously the plants' endogenous mRNA.

Another more recent approach is based on artificial application of chemical which are known to suppress/inhibit the genetic recombination. One of the example of such chemical is 'MIRIN'. Exogenous application of compounds that cause inhibition or omission of recombination during meiosis would speed up the application of reverse breeding.

B) Production of Doubled haploids (DHs): Doubled haploid plants resulting from achiasmatic meiosis can be obtained from unfertilized ovules (gynogenesis) or from microspore and anther cultures (androgenesis), according to well-established protocols that have been developed for a variety of plant species including crops. First, haploid production is achieved and then through chromosome doubling, doubled haploid lines were produced. Genotyping of these double haploids for selection of complementary lines (parents) was done through marker assisted selection.

Applications of Reverse Breeding:

1. Reconstitution of heterozygous germplasm – Crops where the extensive coolection of breeding lines is still a difficult task, reverse breeding can increase the development of the varieties. In these crops, superior heterozygous plants can be propagated/multiplied without prior knowledge of their genetic constitution/parents.

2. Breeding on the single chromosome level: Many interesting characteristics in crops are based on polygenic gene interactions, which are generally located on same chromosome. Breeding of these quantitative traits are therefore not easy. This can be achieved by using chromosome substitution lines which can be obtained when RB is applied to an F1 hybrid of known parents. These homozygous chromosome substitution lines provide novel tools for the study of gene interactions.

3. Reverse breeding and marker assisted breeding: Reverse breeding in combination with marker assisted selection, become a more powerful tool for identification of complementing parents in populations of DHs in early stages through high throughput genotyping by marker assisted selection. The screening of populations that segregate for traits on a single chromosome allow the quick identification of QTLs, when genotyping is combined with –for example- transcriptome or metabolome profiling.

Limitations of Revesre Breeding: This approach is limited to those crops where DH technology is common practice eg. cucumber, onion, broccoli, sugarbeet, maize, pea, and sorghum. There are, some exceptions such as soybean, cotton, lettuce and tomato where doubled haploid plants are rarely formed or not available at all.

The technique is also limited to crops with a haploid chromosome number of 12 or less and in which spores can be regenerated into DHs. In polyploids or species with high chromosome numbers, this technique is not applicable.

Dr. Suvalaxmi Palei, Assistant Professor (Horticulture)

Vitamin C and COVID 19: Myths and Facts

The recognition of vitamin C is associated with a history of an unrelenting search for the cause of the ancient hemorrhagic disease scurvy. Vitamin C protects the immune system, reduces the severity of allergic reactions and helps to fight off infections. It plays an important role in bone formation, wound healing and the maintenance of healthy gums and maintenance of connective tissues. Vitamin C plays an important role in a number of metabolic functions including the activation of the B vitamin, folic acid, the conversion of cholesterol to bile acids and the conversion of the amino acid, tryptophan, to the neurotransmitter, serotonin. It is an antioxidant that protects body from

free radical damage. It is used as therapeutic agent in many diseases and disorders. However, the significance and beneficial effect of vitamin C in respect to human disease such as cancer, atherosclerosis, diabetes, neurodegenerative disease and metal toxicity however remains equivocal. Vitamin C or ascorbic acid was first isolated in 1923 by Hungarian biochemist and Nobel laureate Szent-Gyorgyi and synthesized by Howarth and Hirst. It exists in reduced ascorbate and oxidized forms as dehydroascorbic acid which are easily inter-convertible and biologically active thus it acts as important antioxidant. Thus further continuous uninterrupted efforts may open new vistas to understand its significance in disease management.

Recommended Daily Intake of Vitamin C

The amount of vitamin C you need each day depends on your age. Average daily recommended amounts for different ages are listed below in milligrams (mg). (Source- National Institute of Health, U.S. Department of Health and Human Service, 2020).

Life Stage	Recommended Amount/ Day
Birth to 6 months	40 mg
Infants 7–12 months	50 mg
Children 1–3 years	15 mg
Children 4–8 years	25 mg
Children 9–13 years	45 mg
Teens 14–18 years (boys)	75 mg
Teens 14–18 years (girls)	65 mg
Adults (men)	90 mg
Adults (women)	75 mg
Pregnant teens	80 mg
Pregnant women	85 mg
Breastfeeding teens	115 mg
Breastfeeding women	120 mg

If you smoke, add 35 mg to the above values to calculate your total daily recommended amount.

COVID-19 and Vitamin C?

The World Health Organization (WHO) was informed on December 2019 about a coronavirus pneumonia outbreak in Wuhan, Hubei province (China). Subsequently, on 11th September 2020, **28,056,120** cases and **908,651** deaths were reported.

Coronavirus is an enveloped RNA virus, from the genus *Betacoronavirus*, that is distributed in birds, humans, and other mammals. WHO has named the novel coronavirus disease as COVID-19. More than 80 clinical trials have been launched to test coronavirus treatment, including some drug repurposing or repositioning for COVID-19. This causes severe lung injury that results in Acute Respiratory Distress Syndrome (ARDS), a life-threatening lung disorder. This process prevents the necessary oxygen to enter into the lungs and ultimately causes death. Coronaviruses increase oxidative stress that promotes cellular malfunction and ultimately results in organ failure. It is believed that pulmonary failure (ARDS) is the principal cause of Covid19's action on humans. This helps to increase oxidative stress considerably because of the generation of free radicals and cytokines. This process finally leads to serious cellular injury, organ failure and death. The administration of anti-oxidizing agents along with proven conventional supportive therapies is believed to have an important role in controlling these medical situations. Appropriate vaccines and antiviral drugs for the Covid19 epidemic are not available. So, Vitamin C and other antioxidants are extremely good agents for ARDS. These can be applied clinically. The antiviral properties of Vitamin-C help to reduce symptoms and mortality in children and adults. The principal mechanism of actions of Vitamin-C that helps to make the immune system stronger, reduces the cytokines storm and inhibits oxidative processes.

Although vitamin C has been popularly prescribed for the common cold, research shows that for most people, vitamin C supplements do not reduce the risk of getting the COVID 19. However, people who take vitamin C supplements regularly might have slightly shorter infections or somewhat milder symptoms when they do have a COVID 19. Using vitamin C supplements after COVID 19 symptoms start does not appear to be helpful.

Source and content of vitamin C in fresh fruits and vegetables

Name of Fruits and Vegetables	Content of average Vitamin C in mg per 100 gram of fresh fruit/leaves
Barbadoes Cherry (*Malpighia emarginata*)	**1400.0**
Aonla (*Phyllanthus emblica* L)	**600.0**
Guava (*Psidium guajava*)	**300.0**
Apple (*Malus domestica*)	35.1
Banana (*Musa spp.*)	32.9
Ber (*Zizyphus mauritiana*)	60.0
Grapes (*Vitis vinifera*)	85.3
Litchi (*Litchi chinensis*)	36.6
Mango (*Mangifera indica*)	75.5
Strawberry (*Fragaria ananassa*)	60.00
Papaya (*Carica papaya*)	60.00
Lime (*Citrus aurantifolia*)	25.3
Sweet orange (*Citrus sinensis*)	36.0
Green Mango (*Mangifera indica*)	56.3
Mandarin (*Citrus reticulata*)	15.7
Pineapple (*Ananas comosus*)	35.5
Tamarind (*Tamarindus indica*)	178.9
Drumstick leaves (*Moringa oleifera*)	**220.0**
Coriander leaves (*Coriandrum sativum*)	**135.0**
Chili (*Capsicum annum*)	**111.0**
Tomato (*Solanum lycopersicum*)	28.3
Cauliflower(*Brassica Oleraceae var. botrytis*)	40.0
Garlic (*Allium sativum*)	31.0
Bittergourd (*Momordica charantia*)	55.6

What kinds of vitamin C dietary supplements are available?

Most multivitamins have vitamin C. Vitamin C is also available alone as a dietary supplement or in combination with other nutrients. The vitamin C in

dietary supplements is usually in the form of ascorbic acid, but some supplements have other forms, such as sodium ascorbate, calcium ascorbate, other mineral ascorbates, and ascorbic acid with bioflavonoids. Research has significantly indicated that natural form of Vitamin C is better than the other forms.

Can vitamin C be harmful?

Vitamin C is generally safe and well tolerated, even in large doses. The Institute of Medicine, US set the Tolerable Upper Intake Level for oral vitamin C ingestion at 2 g daily for adults based on gastrointestinal disturbances

(diarrhea, nausea, and stomach cramps) observed in some individuals at higher doses. High amounts of vitamin C intake have been associated with an increased risk of kidney stones, although the evidence is mixed and inconsistent. The current recommendation is to avoid vitamin C supplementation in those susceptible to kidney stone formation. Vitamin C consumed with iron could increase the risk of iron overload in susceptible individuals. Patients with these conditions should not avoid eating fruit and vegetables but limit their intake of iron instead.

The daily upper limits for vitamin C are listed below:

Life Stage	Upper Limit
Birth to 12 months	Not established
Children 1–3 years	400 mg
Children 4–8 years	650 mg
Children 9–18 years	1,200 mg
Teens 14–18 years	1,800 mg
Adults	2,000 mg

Are there any interactions with vitamin C that people should know about?

Vitamin C dietary supplements can interact or interfere with medicines that you take. Here are several examples:

- Vitamin C dietary supplements might interact with cancer treatments, such as chemotherapy and radiation therapy. It is not clear whether vitamin C might have the unwanted effect of protecting tumor cells from cancer treatments or whether it might help protect normal tissues from getting damaged. If you are being treated for cancer, check with your healthcare provider before taking vitamin C or other antioxidant supplements, especially in high doses.
- In one study, vitamin C plus other antioxidants (such as vitamin E, selenium, and beta-carotene) reduced the heart protective effects of two drugs taken in combination (a statin and niacin) to control blood-cholesterol levels. It is not known whether this interaction also occurs with other statins. Health care providers should monitor lipid levels in people taking both statins and antioxidant supplements.

- Therefore, before taking Vitamin C, tell your doctor, pharmacist, and other health care providers about any dietary supplements and medicines you take. They can tell you if those dietary supplements might interact or interfere with your prescription or over-the-counter medicines or if the medicines might interfere with how your body absorbs, uses, or breaks down nutrients

Vitamin C and healthful eating

People should get most of their nutrients from food. Foods contain vitamins, minerals, dietary fiber and other substances that benefit health. In some cases, fortified foods and dietary supplements may provide nutrients that otherwise may be consumed in less-than-recommended amounts.

Mr. Snehashish Routry, Assistant Professor (Entomology)

In the midst of 'sixth mass extinction' of insects

Currently earth is under the phenomena of Holocene extinction *i.e.*, sixth mass extinction process predominantly due to anthropogenic activities (that's why called Anthropocene extinction). A loss of about three quarters of all species in existence across the entire globe over a 'short' geological period of time (less than 2.8 million years) is known as a mass extinction. In previous five mass extinctions earth has lost significant number of species. In the first mass extinction in Ordovician event (440 million years) 85% of all species including marine invertebrates were affected. During the late Devonian period (374 million years) second mass extinction affected 75% of all the species. The largest mass extinction till date occurred during Permian period (250 million years) due to asteroid impact affecting the existence of 95% of all the species. 80% of the earth's species went extinct in Jurassic event (200 million years; forth mass extinction). The latest mass extinction has occurred 145 million years ago (Cretaceous event) leading extinction of 76% of all species. According to a study, 29,400 species of terrestrial vertebrates having fewer than 1000 individuals are in the

verge of extinction. And according to an estimation 42% of 3,623 terrestrial invertebrate species including insects and 25% of 1,306 species of marine invertebrates assessed on the International Union for Conservation of Nature (IUCN) Red List are classified as threatened with extinction.

It has been reported that half of the 1 million animal and plant species on earth facing extinction are insects, and their disappearance could be catastrophic for humankind. More than 40% of insect species are declining and a third are endangered. The rate of extinction is eight times faster than that of mammals, birds and reptiles. The total mass of insects is falling by a precipitous 2.5% a year, according to the best data available, suggesting they could vanish within a century. One of the biggest impacts of insect loss is on the many insectivorous-birds, -reptiles, -amphibians and -fish. Such cascading effects have already been seen in Puerto Rico, where a recent study revealed a 98% fall in ground insects over 35 years. The International Union for the Conservation of Nature (IUCN) Red List of Threatened Species has evaluated only some 8,400 species of insects out of one million known to exist. However, it is likely that insect extinctions since the industrial era are around 5 to 10%, i.e. 250,000 to 500,000 species, based on estimates of 7% extinctions for land snails. In total at least one million species are facing extinction in the coming decades, half of them being insects.

Indian scenario

The similar trends in India also cannot be ignored as many Indian entomologists also agree that India is already witnessing a slump in insect numbers. In many instances such as, disappearance of a leafhopper genus *Gunhilda* in India, diminishing number of sound producing crickets and tettigonids, local disappearance of flea beetles from Botanical garden, GKVK, Bengaluru, loss of population of many beneficial parasitoids such as *Campoletis chlorideae* in chick pea, drastic reduction

of fireflies in Dehradun etc indicate India is not free from such global impact. Amid all these data another challenge is significant percentage of the insect world has not been explored yet. Scientists estimate the number of insect species at about 5.5 million. Only a fifth of them have been identified and named. The number of threatened and extinct insect species is woefully underestimated because so many are rare or undescribed. Nearly 89% of the global insect population has not even been named. Though India one of the mega-biodiversity countries in the world with unique biogeographical locations, diversified climatic conditions and a wide array of ecosystems from deep-sea to high mountain ranges at the Himalayas harboring huge entomofauna (Forest ecosystem- 63,733 species, Himalayas- 25,064 spp., Trans-Himalayas Cold desert- 2,291 spp., Islands-3,572 spp., Desert- 1,577 spp., Semi-Desert- 4,346 spp., mangrove- 1,461, soil- 13,711, agroecosystem- 3,130 spp. and aquatic- 4,976 spp.), all of them have not been identified yet. 'Though the insect diversity of India is comparatively rich and well known, revisionary works on smaller and lesser-known groups are still lacking. There is also a need to write the '*Fauna of India*' on the various families of the economically essential groups, as the '*Fauna of British India*' volumes are comparatively old and outdated. It is also necessary to undertake the studies on DNA barcoding of insects of economic and conservation significance as well as cryptic species', Dr Kailash Chandra, Director, Zoological survey of India.

We depend on these winged invertebrates

Insects contribute to the four main types of ecosystem services i) provisioning services, ii) supporting services, iii) regulating services, and iv) cultural services. This animal group contributes to the structure, fertility, and spatial dynamics of soil, and they are a crucial element for maintaining biodiversity and food webs. A large number of insects provide medical or industrial products and globally, >2000 insect species are consumed as food. Also, in agroecosystems,

insects perform many different functions, such as pollination, nutrient and energy cycling, pest suppression, seed dispersal, and decomposition of organic matter, feces, and carrion. Today, the agricultural sector already actively uses insect antagonists of pests (classical and augmentative biological control) or establishes habitat management practices to promote insects as natural enemies of pests. In this context, as a clear consequence, insect declines can negatively affect the maintenance of food supply and put at risk human well-being.

What hasten such extinction

We can’t ignore intensive agriculture, particularly the heavy use of agrochemicals. Urbanization and climate change are also significant factors. The other drivers are dwindling and degraded habitat, followed by pollutants - especially insecticides - and invasive species. Impact of climate change is also equally responsible.

Possible Measures

Many solutions are now available to support insect populations at sustainable levels, especially through preserving and recovering natural habitats, eliminating deleterious agricultural practices including harmful pesticides, implementing measures for avoiding or eliminating the negative impacts of invasive species, taking aggressive steps to

reduce greenhouse gas emissions, and curbing the deleterious effects of overexploitation of many taxa. According to Indian State of Forest Report (2019), 16 million ha are protected areas (NPs and WLSs) and 24.56% of the geographic areas are under forest and tree cover which need to be expanded. More awareness among all the stakeholders and collaborative efforts can save this upcoming apocalyptic phase.

Ms. Mandakini Kabi, Assistant Professor (Genetics and Plant Breeding)

Nanotechnology: Potential application in agriculture

Currently the increasing challenges of sustainable production and food security are engaging new researcher for search of new technology in the field of agriculture. Among recent significant technological advancements and innovations, nanotechnology has potential to provide effective solutions to the multiple agriculture-related problems. Nanotechnology is the art and science of manipulating of individual atoms and molecules at the nanoscale of less than 100 nanometers which provides a great scientific interest by bridging the gap between bulk materials and atomic or molecular structures. Nanomaterials (NMs) enhance crop productivity through emphasizing its numerous applications in agriculture sectors as follows.

1. Soil enhancement and crop growth

The most important application in agriculture is the use of nanomaterials as fertilizer. Fertilizer plays a pivotal role in increasing the agricultural production. However, the excessive usages of fertilizers irreversibly alter the chemical ecology of soil, further reducing the available area for crop production. Sustainable agriculture entails a minimum use of agrochemicals that can eventually protect the environment and conserve different species from extinction. Notably, nanomaterials enhance the productivity of crops by increasing the efficiency of agricultural inputs to facilitate site-targeted controlled delivery of

nutrients, thereby ensuring the minimal use of agri-inputs. NMs can be applied to the soil as nanostructured fertilizers (nanofertilizers, as Fe, Mn, Zn, Cu, Mo NPs) or can be used as enhanced delivery systems to improve the uptake and the performance of conventional fertilizers

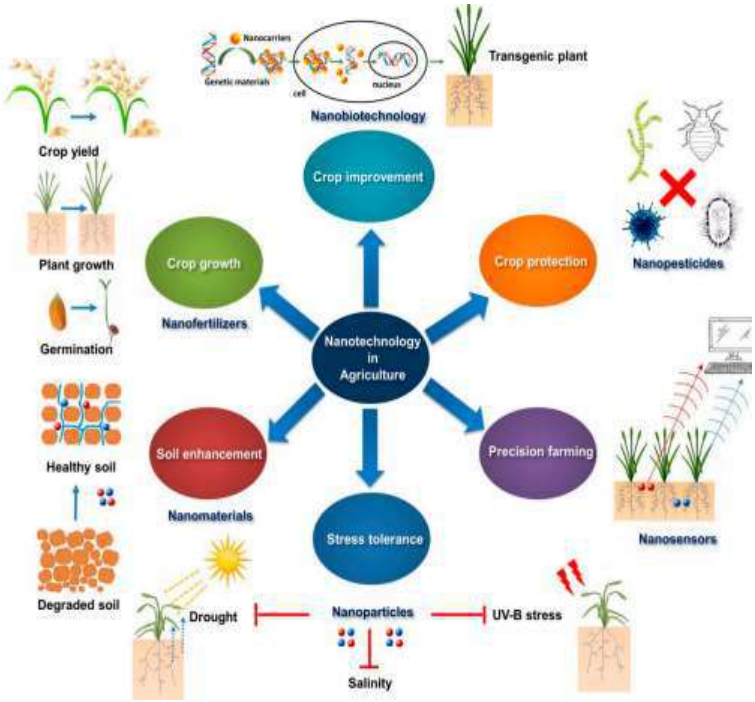
(nutrients and phosphates) which facilitate controlled release of nutrients. Metallic nanoparticles based on Iron oxide, ZnO, TiO_2, and copper have been directly applied as nanofertilizers in soil by irrigation or via foliar applications in different plants, such as mung bean plant, cucumber and rapeseed. Further, micronutrients when applied as nanoparticle boost the nutritional status of plants by suppressing crop disease and stimulate crop growth. For example, foliar sprays of micronutrients containing metallic oxide NPs (Al_2O_3, CuO, FeO, MnO, NiO, and ZnO) increased the yields of tomato and eggplant despite infection of the plants with Fusarium wilt fungus, by reducing disease extent.

2. Crop Protection

The assistance of nanotechnology in plant protection products has exponentially increased, which is considered as an alternative solution for crop protection. Nanomaterials such as copper oxide (CuONPs), zinc oxide (ZnONPs), magnesium hydroxide (MgOHNPs) and magnesium oxide (MgONPs) when used as insecticides effectively control insect and also minimizes the use of environmental-risk substances. It has been reported that nanoparticles of magnesium oxide (MgO) effectively control green peach aphid (GPA).

3. Precision farming

The development and exploitation of nanosensors in precision farming, to measure and monitor crop growth, soil conditions, and diseases have substantially improved the human control of soil and plant heath, quality control and safety assurance contributing much to sustainable agriculture and environmental systems. NMs have been applied to develop biosensors or they have



been used as “sensing materials” in the fields of crop biotechnology, agriculture, and food industry. Different categories of nanosensor types have been tested in plants, includin plasmonic nanosensors, fluorescence resonance energy transfer (FRET)-based nanosensors, carbon based electrochemical nanosensors, nanowire nanosensors and antibody nanosensors. Although the use of nanosensors in plants is at an initial stage, interesting reports have proposed the use of NMs as tools for detection and quantification of plant metabolic flux, residual of pesticides in food and bacteria, viral and fungal pathogens. NMs-based biosensors are very promising as they allow rapid detection and precise quantification of fungi, bacteria and viruses in plants.

4. Crop improvement

The emerging highlight of the intersection of nanotechnology and biotechnology has received increasing attention in crop improvement. For development of transgenic crop, the cell wall represents a barrier to the delivery of exogenous biomolecules in plant cells. To overcome this barrier and achieve plant genetic transformation, different strategies based on Agrobacterium transformation or biolistic methods are worldwide used for DNA delivery in plant cells. Limitations to these approaches rely on narrow host range and plant extensive damages, which often inhibit plant development. Most of the pioneering studies for nanomaterial-based plant genetic engineering have been conducted in plant cell cultures. For example, Silicon Carbide-Mediated Transformation has been reported as a successful approach to deliver DNA in different calli (tobacco, maize, rice, soybean and cotton). Although lagged behind the advancements achieved in animal systems, results reported recently in plants are proving that NMs may overcome the barrier

of the cell wall in adult plants and reduce the drawbacks associated with current transgene delivery systems.

5. Stress tolerance

Abiotic stress, whether in the form of drought, heat, excess salinity, cold, nutrient deficits, chemical toxicity or oxidative stress, is the primary cause of crop loss worldwide and reduces the average yield of most major crop plants by more than 50%. Plants constantly produce ROS in chloroplasts, mitochondria, peroxisomes, and other sites of cell during the metabolic processes such as respiration and photosynthesis. At low level, ROS act as signaling molecules involved in growth, development, and defense. However, over accumulated ROS in plants under stress conditions results in damaged cell membranes, DNA, protein, and other cell components and therefore the inhibition of plant growth occurs. ROS scavenging by plants is mainly performed by antioxidant enzymes, such as superoxide dismutase (SOD), catalase (CAT), ascorbate peroxidase (APX), glutathione reductase (GR), glutathione peroxidase (GPX), and peroxidase (POD), as well as by non-enzymatic low-molecular-weight metabolites (vitamin C, vitamin E, polyphenols). Accordingly, an enhancement of the ability of plants to scavenge ROS, such as by using nanomaterials bearing antioxidant enzyme activities, may improve plant resistance to abiotic stress and thus mitigate yield losses. The over accumulated ROS in plants under abiotic stress can be scavenged by nanoparticles such as CeO_2, C60, and Fe_2O_3 NPs, which have the ability to scavenge ROS. Thus, plants engineered with these NPs showed better performance under stress conditions.

In the field of agriculture, nanotechnology has been used to heighten the crop production with quality enrichment by improving farming systems. The potential of nanomaterials encourages a new green revolution with reduced farming risks. But it is reasonable to argue that the potentiality and the benefits of the application of NMs in plant sciences and agriculture are still not fully exploited, due to some bottlenecks i.e., (i) the need to design and synthesis safe NMs which do not interfere negatively with plant growth and development (ii) the lack of knowledge on the exact mechanisms of NMs uptake and mobilization in plants and (iii) the lack of multidisciplinary approaches, necessary for the design and the implementation of nanotechnology applications in plants.

Therefore, further research is urgently needed to unravel the behavior and fate of nanomaterials as agriculture inputs and their interaction with living systems and environments.

Mr. Subrata Kumar Mohanty, Assistant Professor (Agronomy)

Rice fallows: An option to improve the production of Pulses and oilseeds in Odisha

Rice fallows basically imply to those lowland *kharif* sown rice areas which remain uncropped during *rabi* season due to various reasons such as lack of irrigation, unassured post monsoon rainfall, cultivation of long-duration varieties of rice, early withdrawal of monsoon rains leading to soil moisture stress at planting time of winter crops, waterlogging and excessive moisture in November/December, lack of appropriate varieties of winter crops for late planting, and socio-economic problems like stray cattle, blue bulls etc. India accounts for 79% (11.65 million ha) of the total rice fallows of South Asia (15.0 million ha). Odisha accounts for 10% (12.2 lakh ha) of total rice fallows of India. More than 80% of this lies in the eastern states of Chhatisgarh, Jharkhand, Madhya Pradesh, Odisha, Assam, Bihar and West Bengal.

In order to meet domestic demands of edible oil and pulses, a large quantity is imported which leads to huge drain of foreign exchange. Bringing fallow land under cultivation offer good scope for area expansion of these crops and crop intensification. Their productive utilization can overcome many social and economic problems of the region like unemployment, labour migration, malnutrition and low income. Development and popularization of improved varieties of pulses and

oilseeds suiting to rice fallows of different agro-ecological regions coupled with improved agro-technology will boost production, and thus improve income and livelihood security of farming community. Moreover,

introduction of legumes can provide a sustainable production base to the continued rice mono-cropped system leading to decline in total factor productivity and also provide much needed nutritional security.

Rice fallow ecology

Rice fallows are distributed in eastern plains, central region, coastal peninsula and north-east hills. In Odisha, rice is cultivated on wide range of soils and lands. *Kharif* paddy coverage in the state (medium and low land) is 30.74 lakh ha (15.8 +14.94 lakh ha) out of which *rabi* pulse area is 14.03 lakh ha. Other crops after rice are grown in 4.51 lakh ha and rice fallow is 12.2 lakh ha. The climate of the state is hot sub humid with hot summer and mild winter. The mean annual temperature of the state is about 27.5^0 C. The mean winter temperature of the state is 21.8 ^{0}C. Mean maximum for these months is 29.1^0 C and mean minimum is 14.4^0 C. Mean annual rainfall of the state is 1421 mm and is received in 63 rainy days. Average winter rainfall is 40 mm, which is received in 2 rainy days. Rain in October is about 124 mm received in 5 rainy days which is helpful for sowing *rabi* pulses under residual soil moisture.

Technological interventions and choice of crop varieties:

Depending upon winter temperature, soil texture and moisture, selection of crops should be made. The residual moisture left in the soil at the time of rice harvest is often sufficient to raise short-duration pulses and oilseed crops and rice fallows can be converted into productive lands. Introduction of pulses such as lentil, mungbean, urdbean, lathyrus, field peas and oilseeds such as mustard, groundnut, linseed, niger, safflower and sesame etc. in rice fallows can augment the domestic availability pulses and oilseeds, which are in short supply and will also help in restoration the soil health. The varieties should be short duration, drought tolerance, disease and pest resistance.

Planting strategy:

In rice fallows, planting is generally delayed. Under relay/*paira* planting, seeds should be broadcast 7-10 days before harvest of rice. Zero-till seed-cum fertilizer drill should be used wherever feasible when planting is done after harvest of rice. It is necessary to use short to medium maturing varieties of rice for timely planting of *rabi* crops. **Seed priming and optimum seed rate:** Overnight soaking of seeds, referred as seed priming, hastens seed germination and establishment under relay cropping. Since all broadcast seeds do not establish good contact with soil, the seed germination is low. Therefore, adoption of 20-25% higher seed rate over the recommended rate ensures desired plant stand.

Foliar nutrition: Since application of fertilizers under relay cropping is not feasible, seed pelleting and foliar application of nutrients should be practiced. Foliar application of 2% urea at flowering and pod formation significantly improved yields of chickpea under rainfed conditions by increasing leaf N content and making them photosynthetically more active. Seed pelleting with micronutrients like Zn and Mo is also recommended as a part of nutrient management strategy in rice fallows. It was reported that the foliar spraying of NAA@40ppm with 0.5% chelated micronutrient (Zn, Fe, B and Mo) and 2% DAP along with recommended dose of fertilizer produced the highest pods/plant and grain yield in as compared to application of the above macro or micro nutrients alone.

Management of terminal moisture stress: Application of mulch reduces the evaporation from the soil surface due to the physical barrier over the soil which ultimately increases the available soil moisture to plant. Mulching with paddy straw and legume straw mulch produced significantly higher grain yield over no mulch (Singh *et al.*, 2014). Provision of

protective irrigation increases the crop yield of pulses and oilseeds, as these crops are grown mostly on the residual soil moisture condition in rainfed situation. Application of light irrigation at the time of flowering increases the grain yield by more than 36% in greengram and groundnut.

Solar water pumping for irrigation: Scarcity of electricity coupled with the increasing unreliability of monsoon rains and prevalent costly diesel pumping systems pose an economic risk to small and marginal farmers. This leads to use of solar water pumping systems as a cost effective alternative to irrigation pump sets that run on grid electricity or diesel. Solar PV water pumping for irrigation is a suitable option in areas where ample availability of surface and ground water and sufficient solar radiation conducive for solar PV water pumping are ensured

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Plant protection: Post-emergence application of imazethapyr @ 50 g/ha(Dinamaz 10 % EC @1000 ml/ha)) has been found quite effective against seasonal grassy weeds in crops like groundnut, urdbean and mungbean. It should be applied at 3-4 leaf stage. Similarly, quizalofop ethyl @50 g/ha(Targa super 5 % EC @1000 ml/ha) can be used to check ratooning of rice stubbles which cause substantial moisture loss. Insect-pests and diseases should be promptly controlled. Seed dressing with fungicides like carbendazim should be done. Efforts should be made to choose disease-resistant varieties.

It is expected that nearly 3.0 million hectare area of rice fallows can be brought under cultivation in India, which can provide about 1.5-2.0 million tonnes of additional food grain production. In Odisha, about 5 lakh ha rice fallow area can be brought under cultivation. Selection of suitable varieties having shorter maturity duration, improved crop stands establishment methods and adoption of improved agro-techniques like foliar spraying of nutrients, weed, disease and pest management and

protective irrigation can make breakthrough in production of oilseeds and pulse in rice fallows.

Dr. Mahipal Singh, Assistant Professor (Genetics and Plant Breeding)

Plant derived vaccine: A new cure for infectious diseases

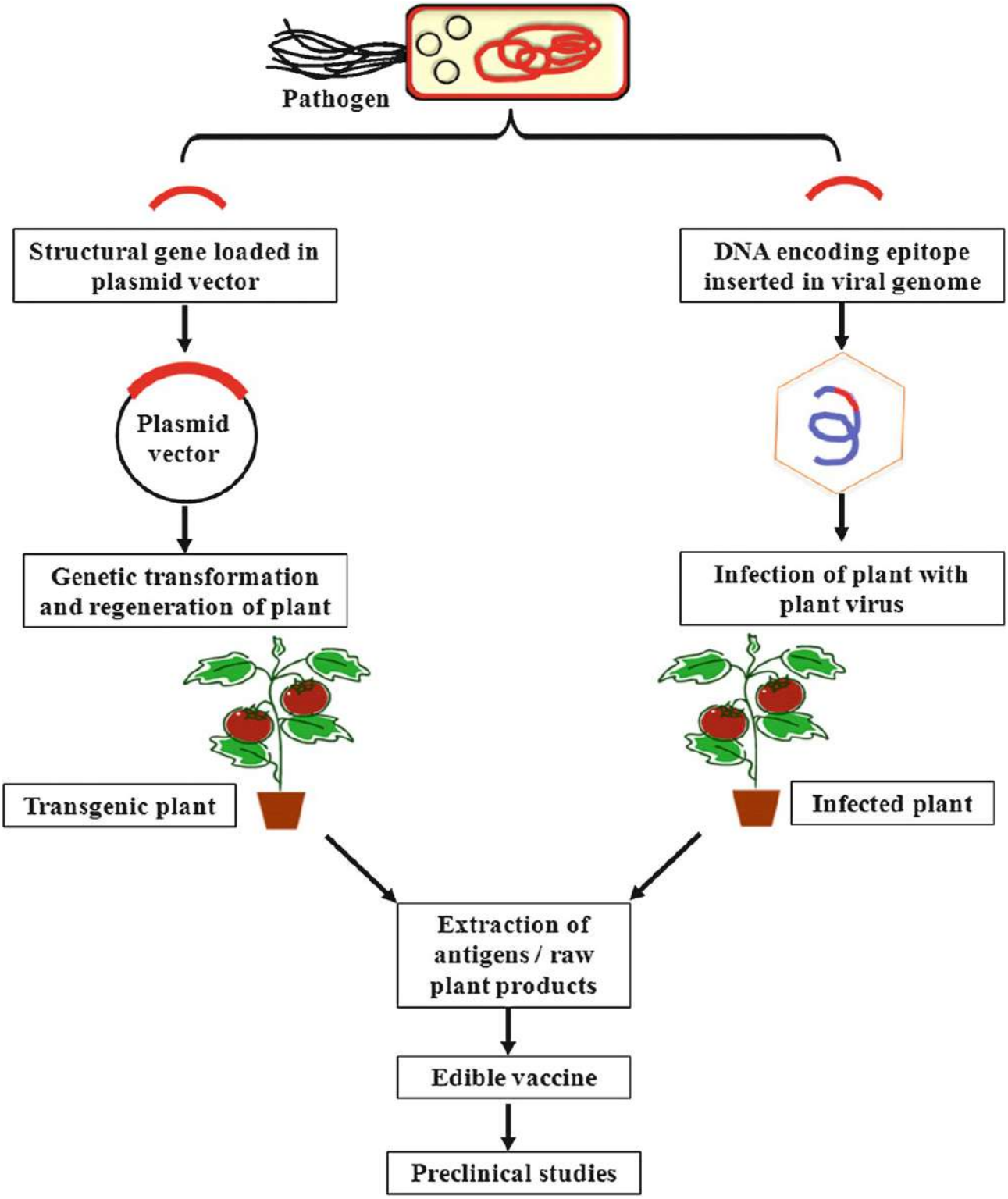
Since the ancient times, microbial diseases remain to be one of the leading causes of mortality worldwide. The major health's problem in developing countries drives from poor nutrition, inadequate water supply and sanitation. This results in a high level of diseases, such as hookworm, hepatitis and chronic dysentery. By the late 1990s, an international campaign to immunization for whole world's children against devastating diseases. However, the 20 per cent of infants still missed the six vaccines including diphtheria, pertussis, polio, measles, tetanus, and tuberculosis account for about two million unnecessary deaths each year, especially in the most remote and impoverished part of the globe. For a long time, vaccines have been one of the most powerful and fundamental defense and disease prevention tools against numerous bacterial, viral, and parasitic diseases. The major drawback until now has been the production and purification process makes them expensive and unaffordable to many developing nations. Recently, plant derived vaccines has attracted global attention, gave a new hope to the mankind to fight microbial infections in effective ways and also owing to its several advantages over conventional vaccines including ease of production, storable, cost-effectiveness, and easy application (oral). Further, it's also eliminates the need for needles and syringes which require highly trained immunization staff.

Plant vaccines are the edible vaccines that are the antigen of pathogen produced through transgenic edible plants, which produce immunogenic response when delivered orally. Plants are being genetically modified with genes from disease causing virus and bacteria that code for the

proteins (known as antigen) that stimulates a protective immune response. The genetically modified plant could be used as an edible vaccine in near future. Transgenic plant products could be delivered in their native form or could be the starting material for the production of processed edible vaccines. These could be administered as dried formulation, such as capsules and powder, adds to milk or other liquids. Finally, through the availability of suitable, efficient, promoter sets and expression cassettes for tissue specific or inducible expression, further efforts should be concentrated on fruits that are inexpensive to produce, grown in (sub) tropical regions, consumed raw, quick to transform, regenerate and easy to evaluate. Sub species of the Solanaceae family can be propagated vegetatively or by seeds at low costs and are ready for evaluation in clinical trials with shorter time than others.

Production of Plant Vaccines

There are different methods for the production of plant vaccines such as expression of antigens in plants using agrobacterium mediated transformation, delivery of vaccine epitopes using plant viruses and synthesis of vaccines in transformed chloroplasts. The production of plant derived vaccines involves the integration of selected gene from the microbes encoding the antigen for specific disease into the plant genome with plant vector by agrobacterium mediated transformation. In another method, appropriate plant virus is genetically modified to produce the desired proteins. This genetically engineered virus is then mobilized into the plant, which enables it to generate large number of transgenic plants from which chimeric proteins are extracted and purified. The consequential edible plant vaccine or dried formulation can then be used for immunological applications. To date, various plants species have been used to express foreign antigens in their edible parts and 9 vaccines are now in human clinical trials.



Methods for the production of plant derived edible vaccines.

Potential plant derived vaccines for diseases in human clinical trials.

Disease	Host plant
Hepatitis B	Lettuce
	Potato
Cholera	Rice
Influenza	*Nicotina benthamiana*
	Nicotina benthamiana
	Nicotina benthamiana
Rabies	Spinach
Enterotoxigenic Escherichia coli infection (ETEC)	Potato
	Maize

Constraints in development of plant-derived vaccines

I) Regulatory challenges

II) Technical challenges

1. Survival in gut
2. Elicitation of immune system and achieving sufficient level of expression

III) Financial challenges

IV) Developmental challenges

Future prospects:

Plant derived vaccines are the emerging type of vaccines which is easy to produce, much safer and inexpensive alternatives to conventional vaccines. As any plant based vaccine can easily grow and scaling up. Further, plant derived vaccines have a higher therapeutic value to treat numerous human and animal diseases worldwide. The time is not so far when edible vaccines available in the developing countries in near future. However, there are also few bioethical concerns from the production of plant derived vaccines such as the risk of transferring allergens from transgenic plants to human.

It is expected that regulatory approval will be allowed eventually to help in the eradicated many major diseases such as hepatitis B. Therefore, plant derived vaccines provide a greater opportunity in the near future when no longer injectable vaccines be used but millions of lives can be saved by simply eating a fruit.

Mr. Prajjal Dey, Assistant Professor (Crop Physiology)

To swerve or crash: online and offline mode of education

Before the pandemic had arrived, I have firmly believed in the notion "Physical reality is a reflection of what we believe and reality will not change if we do not change first". However, the pandemic, we all are living now, have shifted my paradigm. The crisis has taught me a basic lesson: "Physical reality is actually real" (at least in classrooms) as it actively enhances the learning atmosphere in stimulating collaborative learning. In the classroom, it is possible to directly engage with students through "communication gaze" (eye contact while lecturing). This method not only improves keen learning but also develops emotional friendliness. A plethora of information has been given on it and to cite recently reported that students experience on perception and teachers gaze is positively correlated. As there was a sudden lockout, because of COVID 19, almost all colleges were forced to launch live online classes with the primary goal of providing students with knowledge and study material. In the context of video guides, lectures and texts, online teaching integrated the use of the Internet to provide learning content to students.

Learning is the crux of how humans sustain and develop. That can sound trite but the fact is pandemic has impacted on the way students learn. The teaching landscape has swerved abruptly. Consequently, to cut the corners, all the institutions have turned into online teaching-learning. Teachers in various institutions, quite suddenly, are working through technologies to redistribute, benefit and empower students. The

accelerating force of digitization has created a disruptive online phenomenon across institutions and learning spaces around. So, has such a huge, drastic transition of online teaching-learning “saved the day”?

Surely, no one should ignore the fact that online classes, at one level, are binding students amidst to pandemic. It has provided learning resources and offered a lot of versatility in terms of time, document lectures, flexibility, comfortable environment and personal space. However, due to abrupt transition, it has limited collaborative learning due to network difficulties, technical issues and teacher-student interaction. Furthermore, during online lectures, most students lack active academic involvement and are less attentive compared to offline lectures.

Though being a forerunner of technology, the Karnataka government has prohibited online education (up to the fifth standard) by stating that online classes may impact mental health students. Reacting to the scenario, teachers have raised their question over" How does a responsible government prohibit any sort of online or offline learning? They also suggested that the authority should concentrate more on teacher training and access to digital communication.

So, within these circumstances, what could the proper course of action be? Are we saying that in the middle of a pandemic, students should remain unlettered or we should do our best under adverse circumstances? We all may wish to get a concrete solution but the answer is ambiguous. Under present conditions, there are endless angles to condemn the new digitization of education. Maybe it would have been better if it had evolved any other way, but perhaps a carefully conceived course of action would not have been able to stop all the problems. Reality can bite and bite hard. Oddly enough, a big lesson from the current viral epidemic sheds light on how to transform online education into a more interactive, agile and holistic learning environment for every student with compassion and care.

Dr. Tanushree Sahoo, Assistant Professor (Horticulture)

Barbados cherry: the richest source of ascorbic acid

Barbados cherry is basically a subtropical fruit, but it grows well in tropical and semi-arid conditions too. The rainfall requirement is both medium and low, and it can tolerate long periods of drought. Trees of Barbados cherry are seen wild as well under cultivation throughout the north-eastern Brazil (Taylor, 2005). Large scale plantations are noticed in Jamaica, Puerto Rico, Florida, Cuba, Venezuela, Guatemala, Ghana, India, the Philippines, Australia, and Israel (Morton, 1987). In India, the tree has been grown in tropical areas such as; Tamil Nadu, Kerala and it has also become popular in Port Blair and other regions (Singh, 2006).

The tree grows well on well-drained soil with pH ranging from 5.5 to 6.5. If the soil is acidic, the reclamation with lime is needed before planting in order to overcome calcium deficiency (Saroj & Awasthi, 2006). The mature plants can survive upto 28^{0}F, if the exposure is for a short period, whereas young plants are killed when the temperature goes below 30^{0}F.

Scientific name: *Malpighia punicifolia* L.
Family: Malpighiaceae
Origin: Lesser Antilles from St. Croix to Trinidad
Chromosome number: 2n = 20

The fruit of the Barbados cherry resemble the European cherry. The common name of this fruit crop are the Antilles cherry, Puerto Rican cherry,

West Indian cherry, native cherry, health tree, garden cherry and French cherry (Ghosh, 2015). The flowering occurs round the year. Bees are the main pollinating agents for this fruit. Fruits are mainly produced in the leaf axils either singly or in 2 – 3 in number. Fruits are oblate to round and 3 lobed. Fruit diameter is 1 – 3 cm and weighing 3 – 5 g. The fruit resemble the true cherry but it is a three carpellate drupe, bright red and orange colored, peel is thin and glossy.

Fruit is very juicy and having soft pulp with a pleasant, tart flavor and acid to sub-acid (Orwa, 2009). It takes around 3 weeks from anthesis to maturity of the fruits (Nakasone *et al*., 1968). Seeds are 3 in number, small, rounded, each having 2 large and 1 small fluted wings looking like 3 triangular, yellowish, leathery coated, corrugated inedible 'stones'.

Nutritional importance

- Barbados cherry is reported to be the richest source of Vitamin C up to 1000 - 4000 mg per 100g of edible portion. The green immature fruits normally contain higher amount of vitamin C i.e. nearly twice than that of mature fruits.
- The fruits not only provide higher vitamin C than oranges, but also supply nearly twice amount of magnesium, potassium and pantothenic acid than that of oranges.
- The fruits contain remarkable amount of vitamin A ranging from 4300-12,500 IU/100g.
- Thiamin, riboflavin and niacin are also present in considerable amount in it.
- In West Indies and South America, jam and jellies made out of Barbados cherry fruits are very famous and consumed as fresh very widely.
- It is also reservoir of various minerals including iron, calcium and phosphorous.

- The fruits are also proven as powerful antioxidant rich and fight against many chronic diseases.
- The fresh juice of this fruit prevents darkening of banana slices.

Medicinal properties

- Being the richest source of vitamin C, it boosts metabolism of human body system, thus very good for our health.
- The fruits are also having anti-fungal activity.
- The free radical scavenging activity of fruits help to prevent aging process and abnormal cellular growth.
- The mineral salts present in this fruits help to hydrate and condition the skin.
- It is also a good remedy against diarrhea, digestive disorders, dysentery, colds, fever, infections *etc*.
- It is very useful to cure hepatitis and liver pains, stomachaches, and tooth decay.
- Barbados cherry is also used to treat breast pain and postmenopausal disorders.

Barbados cherry is a very nutritious fruit hence its cultivation is to be promoted in commercial plantation as well as in kitchen garden. Mass multiplication of vegetative planting material needs to be encouraged for qualitative and higher yield of the crop. Various value added products can be made to provide its health benefits to the consumers.

Ms. Meenakshi Badu, Assistant Professor (Horticulture)

Drumstick: A multi-utility-nutritional tree species

The drumstick is an extremely well-known vegetable, cultivated in several regions of India. Common name in English West Indian ben, ben-

oil-tree, Benzoil Tree, moringa, drumstick tree, Ben tree, Behn tree, Behen tree, Benzolive tree (USA), Horseradish tree, Coatli, Indian-mulberry, Maranga, Moringo, Oil of ben tree, in Hindi- Muranka and Sajgan Shinga, Kannada-Moringa and Nuggekai, Marathi- Shevga chi seeng and Shevaga, Tamil-Murungai and Murugaikkai, Gujarati- Seeng ni phalli and Sargavani shing, Malayalam-Sigru and Muringakka, Telugu-sajana and Munagakayalu, Bengali-Sajna and Sajane Dauta, in Odia- Munigha, Sajana, Saijna, Sajina, Shajna, Soandal, Sujuna, Sajan and Chhuin, in Punjabi-Savonjna . It has got excellent therapeutic values and high nutrition content. It is cultivated in several other countries of world, yet mainly it is cultivated in India. The drumstick is popular, mostly because of its gentle and sensitive pods. It has got numerous extraordinary benefits, like being an anti-bacterial and detoxifier.

Moringa or Drumstick as it is popularly called is native to India, southern foot hills of Himalayas. It is cultivated in North India and South India as well. It is grown in tropical and sub-tropical areas. India is the largest producer of Moringa with Andhra Pradesh as the largest producer among the states, followed by Karnataka and Tamilnadu in both area and production. In Tamilnadu varieties of this has been developed. It is also grown in neighboring countries, Pakistan and Afghanistan. Generally, Moringa is grown in sunny areas and it is drought resistant, though it gives more produce if water is available for irrigation. But it cannot withstand cold and frost.

The drumstick tree is slim and medium sized tree, which grows upright, features a big canopy of branches, and produces arcs. Its edible part is green pod and leaves having chromosome number 2n=2X=28. It is originated in North West India. It is a deciduous, tropical plant and used as multipurpose tree. Moringaceae is a monogeneric family. It got fruits that appears like drumsticks (therefore its title), and in addition white or creamy white flowers (Inflorescence-panicle). Seeds contain an oil is called “behen/ben oil”. Seed oil percentage: 38-40%. Drumstick oil cake is used as organic substitute for water purifying chemicals such as aluminium sulphate (alum). Oil used for illumination,

soap industry and highly priced for lubricating watches and computers. Highly cross pollinated crop due to heteromorphism and is entomophilous, honeybees being pollinators. The leaves are spherical in shape which are also edible. Drumsticks are often prepared in the same manner as beans, yet feature a somewhat distinct flavour, just like the flavour of asparagus.

Perennial types of drumstick is propagated by limb cutting and annual types by seeds. Growing of the plant isn't so complicated however this tree stems is extremely weak and simply broken due to excessive quantity of gum in branches. One important things is that, we need to keep watering the plant right until its full grown to 8-9 feet.

Health Benefits of Drumsticks

It's really a 'yard stick' for health, as it is known to be very therapeutic for the human health in one way or another. It provides 42 Kcal for 1 cup (118 g). This particular vegetable offers all type of nutritional advantages and in addition cures numerous health conditions. Drumstick, from the stems, leaves and seeds are recognized to have got therapeutic qualities. Here are some health advantages of drumsticks:

1. Fights cold and flu

Drumsticks are recognized to have a great content of Vitamin C. If we're experiencing low because of cold as well as sore throat, have drumstick soup to get comfort immediately. Drumstick leaves are commonly known to get therapeutic qualities and is also beneficial in dealing with asthma, wheezing and other respiratory system difficulties.

2. For strong bones

The green vegetable features large quantities of iron, vitamins and calcium. Drumsticks are recognized to offer healthy and strong bones and are also believed to purify the blood. Drumstick pods and leaves

particularly are said to be the blood purifier. For better outcomes have smashed drumstick leaves along with milk.

3. Pregnancy and Lactation

Using this tonic on a regular basis by pregnant women will supply them with essential calcium, iron and vitamins.

4. Avoids infection

Drumsticks have a superior content of anti-bacterial qualities and are also valuable in avoiding infections within the throat, chest, as well as skin. Drumstick pods, leaves and also flowers are utilized in preparing soups since they are anti-biotic naturally. It may also be utilized in dealing with fungal skin ailment.

5. Digestive Disorders

Drumstick is additionally useful for digestive complaints. A teaspoonful of fresh leaf juice, combined with honey plus a glassful of tender coconut water is offered 2 or 3 times like a herbal medicine throughout the management of cholera, dysentery, diarrhoea, colitis and jaundice.

6. Lung problems

7. Excellent iron tonic

8. Glowing skin

The juice of drumstick pods is extremely useful in improving the glow as well as shine of the face. Usually, it is combined together with lime juice and is particularly quite effective in getting rid of acne, blackheads, pimples and other skin diseases.

9. Impotency

The powdered type of this excellent vegetable is utilized to prevent impotency.

10. Tonic for Children

The leaves function as a tonic for babies as well as growing kids. For better results, juice needs to be obtained from leaves, filtered and combined with milk. This mix becomes a fantastic tonic for strong and healthy bones as well as for cleansing bloodstream.

11. Urinary Disorders

A tablespoonful of coagulated fresh leaf juice, combined with a glass of fresh juice of cucumber or carrot, is an efficient medication for scanty urination as well as continuous burning in urethra because of higher acidity of urine. A teaspoonful of the juice along with 10 g of rock salt once daily is utilized for stopping extreme urination of non-diabetics.

12. Increases Bone Density

After consuming drumstick regularly for just two months it’s been proven that it raises density of bones. This is extremely great for growing up kids.

13. Reduces Cancer Level

Constant ingesting of drumstick and its leaves decreases the probability of creating cancer by 80% and it has been proven females who are victim of breast cancer recover fast out of this sickness.

14. Reduces Intestine Tumor or Ulcer

Intestine tumor or even ulcer could be decreased and lots of tests have been carried out in past that was optimistic in lessening size of ulcer just by offering drumstick extract.

15. Improves Vision of Eye and Retina

It enhances the vision of eye additionally clears the toxins through the retina that boosts the lifetime of retina.

16. Uterus Fibroid

It lowers the size of cist on uterus; therefore, it will help in lessening the pain underneath the naval in ladies. In certain villages still this method is utilized by middle aged women to cut back the pain sensation in abdomen.

17. Asthma, Bronchitis, Tuberculosis

Person needs to prepare the soup from leaves of Drumstick twice daily as well as take in fresh soup. This helps to make lungs powerful eliminates the toxin through the lungs that are settled due to smoking cigarettes or even heavy industry air pollution.

18. Beneficial for Brain Injury

Drumstick and its leaves are extremely helpful for all those kind of head injury. Even doctors suggest patients to get this after going through operation on brain.

19. Improves Digestion problem

After consuming the leaves and drumstick for specific time period, it will help interior organ to operate effectively. As kidney, liver function enhances, it will help intestine to boost the quality of gastric juice. It will help in Digestion problem.

20. Reduces Diabetic Level

In 1982 few experiments were carried out in Tamil Nadu on 36 diabetics. Out of which 30 individuals demonstrated optimistic outcome of decreasing sugar level within blood.

21. Makes Gall Bladder Healthy

It will help in enhancing the function of gall bladder, which really helps diabetes individuals to decrease the sugar score. Those who are not diabetic it assists them to keep their gall bladder healthy and balanced.

22. High acidic Urine (Dysuria)

Eliminate the extract from drumstick leaves or even best practice to grind leaves in carrot juice and also take in 300 ml each 6 to 10 hours. Also start the toxin free process to eliminate bacteria or even virus through the body. It provides excellent result. In couple of days' time acid in urine minimizes.

23. Improves Nervous and Immune system

It has been demonstrated in past continues ingesting of drumstick assist person enhance the defense mechanisms and in addition observed that individual is quite healthy with no cold or even viral fever. Somewhat boost in blood haemoglobin have been also documented recently.

Dr. Arsha Balakrishanan, Assistant Professor (Agricultural Economics)

Artificial Intelligence (AI) in Indian Agriculture

Agricultural sector is the backbone of the Indian economy. In India a vast majority of the population depends on agriculture and allied activities for their livelihood. Indian agriculture has been traditionally rainfed and extremely dependent on climatic factors, which has made farmers vulnerable to crop loss. The Indian farm sector growth has become stagnant due to low productivity, fragmented landholding, market-asymmetry, absence of good agricultural practices, lack of reforms in agricultural marketing etc. These issues were long persisted, which demands intervention of technology to bring about a change.

Insights coming out of the use of technology over the agriculture life cycle should be useful in reducing risks and uncertainty in agriculture operations. Artificial Intelligence in agriculture is an inter-disciplinary domain comprising of computer science, statistics, plant breeding and genetics, biology and related disciplines. With the use of

AI in agriculture and allied sectors the lives of crores of farmers could be transformed drastically in India and world over.

Key Contributions of AI in Agriculture

Following are the key areas where Artificial Intelligence (AI) could bring innovations in the agricultural and allied sectors.

1. **AI-based precision agriculture:** Deep learning (Artificial Neural Network) algorithms can give insights into sowing time, irrigation, fertilization etc. that lead to increase in the productivity, efficiency of equipments and people in agriculture.

   Precision farming is in nascent state in many countries like India. Thus, proactive support from the public and private sectors is necessary for its rapid adoption. With successful adoption, it requires at least three phases in implementation namely exploration, analysis and execution. Precision agriculture is capable of addressing economic and environmental issues that affects the agriculture and allied sectors currently. In the present India where growth of agriculture is a key to progress of the nation, there should be a full fleshed effort to make use of the latest technologies such as AI to transform the Green Revolution as an Evergreen Revolution.

2. **Smart sensors and Internet of Things**: Sensors are the fundamental components of the agricultural Internet of Things (IoT). Sensors collect various parameters including soil humidity, soil temperature, air temperature etc. Such a database so created can be used along with artificial intelligence technology to improve the utilization rate of such information.

In India, the major problem in agriculture is the shortage of agriculture labourers and lack of interest of farmers in farming due to realization of less profit. Certain Indian states make use of the latest agricultural technologies to compensate the labour problem. This helps in improving the profit margin of famers. The use of IoT in agriculture can be helpful for the betterment of the lives of Indian farmers. IoT can be used for the Automation which helps in reducing the manual labour. It also helps in controlling the financial loss incurred due to improper execution.

IoT systems provide the famers with adequate information on the right kind and quantity of pesticides. The wastage of various agricultural inputs such as seeds, fertilizers etc in godown is reduced by using proposed model of intelligent input storages. The losses incurred in FCI godowns due to high moisture content and pest attacks can be minimized to a large extent by the use of IoT. In the future, there is a vast scope for IoT to enhance the profit margin of Indian farmers.

3. **Agricultural robotics and automation equipment**: An agricultural robot is an automatic or semi-automatic equipment to be programmed on the go. It can make use of agricultural products or information as the operating object, along with the partial human information perception and limb movement ability.

   The use of latest technologies such as Robot Automation Systems (RAS) can revolutionise the agricultural and allied sectors in the country. The application and use of these technologies differs across various sectors, i.e. crops, livestock and pisciculture. There are numerous ways that robots could contribute across these sectors, economically (such as efficient growing and harvesting in an economic way), ecologically (such as less use of harmful chemicals to maintain soil and human health) and ethically (such

as better animal welfare through timely monitoring and intervention). Moreover, robotics may help automation in the maintenance of livestock and pisciculture or alternative growing systems, for instance, vertical farming and agro- forestry systems.

4. **Intelligent systems for animal health care**: This kind of systems covers technological means like data processing and remote monitoring to take care of the animal health accurately and monitor the necessary parameters in real time.

   By the use of relevant knowledge of problems, in the context of animal welfare, faced by the physician, AI programs (expert systems) are crafted to behave like consultants. Those systems have the ability to expand on the practitioner's expertise. Expert systems are computer programs that make use of interpretations from large quantities of data for making decisions about a specific problem, such as a specific area of medicine.

5. **Expert systems in agriculture**: Such systems effectively make use of management's input into agricultural production systems by the processing of all available knowledge pertinent to the specific task under consideration. These expert systems are used in Crop and Livestock Management Advisors, Planning Systems, Pest Control Systems, and various Diagnostic Systems.

6. **Crop Phenotyping and analysis**: The straight-forward in the study of crop breeding is finding out the relationship between phenotypes, genes and the environment. To perform this, it requires large data acquisition, management, interpretation and modelling of the data, integration and applications.

   Performing field Phenotyping manually demands lots of labour and time, many a times destructive and not objective. Furthermore, the

complexity and variability of crops under field conditions demand precise data and application of filtering.

7. **Remote sensing in agriculture**: Remote sensing is a very important application for resource feature space analysis. Such processes give out qualitative and quantitative positioning data. Presently it is used in computing the yield of crops, monitoring of crop growth, surveys of land, monitoring of agricultural-ecological environment, pest monitoring and natural disasters.

   Overall, agricultural remote sensing has the following requirements from big data technology for further progress:

   a. Reliable remote sensing data
   b. Ability to process data at global, national, regional and farm scales
   c. Tools for extraction of agricultural remote sensing info
   d. Visual information extraction of agricultural remote sensing info

8. **AI technology in aquaculture**: Aquaculture pond monitoring processes are currently not efficient enough as per the experience of breeders. This results in consumption of more time and costs in terms of resources. The major issues faced in aquaculture are the occurrences of diseases, unreliable quality of water, high operational costs and waste. AI makes it possible to model a distributed system for aquaculture water quality care by the utilization of remote monitoring of dissolved oxygen, pH and water temperature. Such a distributed system for monitoring is known as the Internet of Things to monitor water quality in aquaculture ponds.

9. **AI in food engineering**: AI is useful in many aspects of the food industry, from sorting products and packages till food safety compliance, also from better cleanliness to development of product and marketing. Big data collected from user generated content gives out huge opportunities over the dimensions of insights with respect to the consumers, markets, products, advertising at various location and time points etc.

AI techniques have enabled us to retrieve the finest details of every complex situation and provide the best solution that is fit for a particular problem. Application of AI in agriculture is a way in which humanity becomes capable of addressing several challenges it faces in

finding a sustainable future. With the successful application of AI techniques, the traditional agricultural lifestyle can look forward to significant changes. It is seen that the AI systems are in production and operation in India and over several parts of the world, to assist the agricultural experts for better solutions.

Ms. Debanjana Debnath, Assistant Professor (Plant Pathology)

Chitosan: Multi-utility organic polysaccharide from nature

Chitin (N-acetylglucosamine) polymer is the second most abundant polysaccharide in the world after cellulose on earth which found in crabs, insect and fungi. Mainly this crystalline or semi-crystalline hard polysaccharide compound make protective barrier in the cell wall or cuticle which protect the organism from harsh environment and sometimes from other parasites. Chitosan a polysaccharide that can be derived from deacetylation of chitin and can be easily extracted from fungal cell wall and crustacean shells is the topic of the discussion of this article. Here we will be able to know that how a protective compound of

fungus cell or some other organism can become curse to fungus and some other pathogen themselves only. This heteropolysaccharide chitosan mainly composed of beta-1,4-2deoxy-2-amino-D-glucopyranose and beta-1,4-2-deoxy-2 acetamido-D-glucopyranose glycosidic linkage. This chitin derivative compound, chitosan is a unique magical compound which is not only biocompatible and biodegradable but also very efficient in plant disease control by its different action among which some are direct action and others are in indirect way. Different mode of action has been described below;

1. Direct antimicrobial activity

An antimicrobial compound is such type of compound that kills or inhibits the growth of micro-organism.Chitosan has high antimicrobial activity

against a wide range of fungi,bacteria and viruses. As an example *Botrytis cinerea, Alternaria alternata, Colletotrichum gleosporoides* and *Rhizopus stolonifer* can be controlled by the use of chitosan through inhibiting the mycellial growth, sporulation and spore viability. Chitosan prevents the growth of different bacteria like *Xanthomonas, Pseudomonas syringae, Agrobacterium tumefaciens* and *Erwinia carotovora* and is also inactivate the replication of virus and viroids. chitosan particles tightly bind with nucleic acids and inactivate the synthesis of essential mRNA which is important for infectious process of the virus or viroid.

2. Physical barrier to pathogen

Chitosan after applying in the host tissue generally accumulated there and it inhibit the further mycelium growth and pathogen invasion and also activate the hypersensitive reaction which causes the necrotic cell death and along with that accelerate the signalling pathway regarding defense mechanism.

3. Nutrient shortage to pathogen

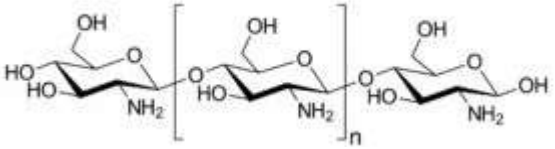
Chelation of nutrient is an important mode of action by which chitosan can make the important nutrient to be unavailable form for the pathogen by this way they can restrict the pathogen growth by inhibiting the metabolic process of the different micro-organism.

4. Mycotoxin binder activity

Chitosan can bind different mycotoxin released by the pathogen, which can affect the host plant growth in various way and make them inaccessible for the plant and reduce the disease severity.

6. Activation of plant defense

Chitosan activate the plant defence in many ways with vast activity by regulating plants own defence mechanism.The activation of defence mechanism happens not only in the locally but also systemically by initiating early signaling events and accumulation of defense-related compound like phytoalexin and PR protein.Not only that chitosan reported to acts as a potent biotic elicitor, by activating different pathways through activating many enzymes related to defence mechanisms like phenylalanine ammonia-lyase [PAL], polyphenol-oxidases [PPOs] andperoxidases such as guaiacol-peroxidase (G-POD) and ascorbate peroxidase [APX that increase the crop resistance to diseases. Use of chitosan in soybeans (Glycine max L.) induce the mechanism of programmed cell death. Treatments of tobacco plants with 0.1% chitosan reduces the spread of the necrosis virus by inducing callose deposition, micro-oxidative bursts and micro-hypersensitive responses.



Methods of use of chitosan

1. Chitosan used for seed treatment

Seed is known as the only living input of agriculture and it very tender and prone to attack by different soil and seed borne pathogen. the treatment of seed by creating coating or dressing on seed by using chitosan can act as first line of defense. It can protect in the very critical stage of germination and also there after the seedling development when the emerging tender plant remains very prone to pathogen infection. Chitosan not only protect the seed from pathogen invasion but also improve the plant growth and development. Chitosan coating on seeds with or without some essential of thyme and tea tree oil has showed well efficiency in controlling disease and also reduce the chances of pathogen attack. Seed-chitosan interaction through seed treatment protect the seed or seedling by direct pathogen attack and on the other hand improves the plants physiological condition by increasing seed germination index, reducing the mean germination time and increasing plant biomass by increasing shoot-root length and growth vigour. chitosan proves itself

very efficient in activating local or systemic defense against pathogen by induce plant defence related compound like PAL, PPO, peroxidases, chitinase, phenolic and phytoalexin content in pre and post emergence of seedling. chitosan increases the lignin accumulation in seed which acts as first barrier to soil borne pathogen by check the primary invasion.

2. Chitosan used as soil amendment

The efficiency of chitosan as soil treatment has been proved against a range of noxious soil pathogen like *Fusurium,Alternaria,Aspergillus* etc. Chitosan in soil can cause detrimental effect on soil microbiota community and also like seed treatment it elicite the plants systemic immunity by activating different defense related biomolecules. This

biomolecule accumulation in plant cell immune the plant by inner side and helps to check local and systemic infection. For an example, the plant defense activity induction was observed to increase in micropropagated kiwi plants after using chitosan mixed growth medium.

3. Chitosan applied as foliar treatment

Just like seed and soil treatment Faoro et al,2008; showed that chitosan foliar spray on barley is very efficient to control the infection by powdery mildew pathogen *Blumeria graminis f. sp. Hordei*.Moreover chitosan can act as anti-transpirant and preserve water upto 26-43% without changing considerable yield in pepper plant. This can be great step towards 'more crop per drop' movement in today's world where the whole world is facing water scarcity.

The concept of chitosan is not that much of old but within very short time the chitosan is getting very popularity for its multidirectional efficiency along with environment safe nature, ease of application and some other new opportunistic function which makes us another step close towards organic and sustainable farming. But this fact also can't be denying that we need more and more research about the chitosan-host-pathogen interaction and also about the formulation and quantity to be used. Other than that the awareness should be increased among farmer community about the benefits of use of new molecule like chitosan which can act as pillar of modern but safe agriculture in near future.

Dr. Vinoda Shankara Naik, Assistant Professor (Agricultural Extension)

Public-Private-Partnership (PPP) in Agriculture

Partnerships are an important component of institutional innovation for agricultural growth and poverty alleviation. All partnership efforts for agricultural transformation should ultimately lead to economic prosperity of the farmer. Innovation is one thing and reaching of the technology to the farmer is another. Both are very important. All along in the agriculture concerns have been on Food Security and Nutrition Security for the nation. To achieve these goals, partnerships at various levels with different objectives have to be developed amongst various stakeholders, which shall bring prosperity to the nation through the prosperity of the main stakeholder, the farmer. For the success of the partnership with Public Institutions and Private Organizations, identifying the strengths of the partner and the areas of complementarities are very important.

Public-Private-Partnership (PPP)

Public- Private Partnership (PPP) can be defined as any collaborative effort between public and private sectors in which each sector contributes to the planning, resources, knowledge and capacities needed to accomplish mutual objectives. PPP is a risk sharing relationship between the public and private sectors which is developed to bring about a desired public policy outcome.

Importance of PPP

Public investment in productivity-enhancing agricultural R&D has been declining in most of the world outside China. Private investments and capability, on the other hand, continue to grow. These trends open up the need and opportunities for R & D partnerships that pool assets

to farmers' benefit. The public sector provides strength in crop improvement; private organizations contribute expertise in plant sciences, genomics, bioinformatics, and the marketing and delivery of products and services.

The PPPs providing advisory services involve the government, universities, NGOs, and commercial partners. The spread of knowledge is achieved through farmer workshops, village-level interactions and technology demonstrations in the farmers' own fields. PPP can enhance the process of development because of higher investment by the two sectors.

Possible areas of PPP in agriculture in India

The 'common space' for PPP in agriculture in India is best visualized in the context of agricultural innovation for increasing food security and rural incomes. Some areas with sufficient common space for designing effective PPP are:

i. Agricultural biotechnology research (for major food and fibre crops)
ii. Energy farming in rainfed areas
iii. Dairy, livestock and poultry products
iv. Natural resource management

Other areas of PPP application may be:

a. Transport (road, rail, ports, airports)
b. Fixed links (bridges, tunnels)
c. Water resources (filtration plants, irrigation, sewage, treatment, pipelines)
d. Health (hospitals and specialized health services)
e. Educational facilities (schools, libraries)
f. Social (housing) etc.

In India, the draft Policy Framework for Agricultural Extension affirms that the policy environment will promote private and company driven extension to operate competitively. Private sector, NGOs and farmer based organizations are encouraged to take up extension activities. The public sector may still need to play an important role in providing agricultural extension services due to its “public good” nature. The public private partnership in agricultural extension in Madhya Pradesh is the most ambitious effort.

Public- Private Partnerships (PPPs) are generally found at the community level where the strengths of the public and private sectors complement each other in providing information and advisory services that address the needs of farmers and rural communities. The public sector’s mandate for provision of information and services can be best achieved through harnessing the potential of the private sector to add local context in a commercial environment. However, there are key obstacles that must be overcome, including clarifying public/private sector roles, developing solutions to poor infrastructure and generating sufficient awareness of services among farmers.

Ms. Shruti Mohaptra, Assistant Professor (Agricultural Economics)

Impact of Corona Virus (Covid 19) on Indian Economy

Newly discovered infectious disease called Corona virus disease (Covid 19) has made the world wide scenario as pandemic which has made the infected people experiencing moderate respiratory illness that is in need of urgent special treatments, targeting mostly older people and people with medical problems like diabetes, cancer, chronic respiratory diseases and cardiovascular disease there by developing serious illness. Covid-19 which is caused by novel corona virus has been declared by the

world health organization as pandemic that is 5th one happened in last 100 years as a result of which unprecedented lock down has been imposed in cities of various countries to stop the further spread of it. But it has made the markets worldwide be crashed.

There has been far reaching consequences of 2019-20 novel coronavirus beyond the outspreading of this disease as a result of which so many efforts are being done to quarantine it. The worldwide diffusion of this pandemic situation has developed many concerns which have now shifted from supply side production problems to issues regarding declined business especially in the service sector. There have been widespread reports of supply shortages of pharmaceuticals, with many areas seeing panic buying and consequent shortages of food and other essential grocery items. Morgan Stanley says that “the viral outbreak has been seen to pose a major destabilizing threat to the global economy”. There has been some estimation by the eminent economists and analysts that the economic decline of the global growth due to this pandemic could surmount that of SARS outbreak.

According to Organization for Economic Cooperation and Development (OECD), the Covid 19 outbreak could make the global economy grow at its slowest rate this year if compared since 2009. As per recent news, travel limitations have made in more than 100 countries because of coronavirus causing to hardest hit to travel industry. Wuhan, the financial hub of central china, has played a significant role in trade centre and transportation as well as hosting the headquarters of major vehicle and local steel makers. Recently the recorded monetary development has shown that the GDP growth of the country China was 7.8% in 2019 (South China morning post 2020) as against the national average of 6.1 per cent. But recent outbreak of this virus has made numerous firms being evacuated expecting to make ripple effects throughout China. Among all the industrial sectors considered the retail, tourism and hospitality

sectors are most likely to be affected. During the period of 2002-03, the outbreak of SARS-CoV in China affected the global economy with a

loss of around $40 billion. Comparing to that period presently China economy has been expanded 8 to 9 times. Hence taking this scenario in to consideration the experts have believed that the overall impact on world economy could be quite huge. IMF has estimated that the only country China has contributed 39% of the economic growth of the world in 2019 (IMF 2020). Hence any kind of slowdown in the economy of China could likely pass those waves across the global economy (CNBC 2020). Taking in to consideration the above situation a literature has been reviewed on its impact on global economy.

India Economy Pre-Covid 19

As far concern Indian economy was going on and keeps progressing before Corona Pandemics, India was seen as Super Power in terms of Economy. GDP statics goes on and world was looking on India. Our late president Mr. APJ Abdul kalam has dream of India 2020 where India is going to achieve targets shown by Kalam sir, Our Present Prime Minister Narendra Modi, Man of Wisdom also taking higher step to step on Indian economy and taken many revolutionary steps to boost up India. But Due to Covid 19 epidemics just break the ling of progress, not for India but across globe is fighting to stand by economy. Our vision of India 2020 slow down but Government is pushing up to stat up industries and country to be on and business to be run as it was before Covid 19.

Impact of Covid 19 in India:

As we have already acknowledged that India is a developing economy, it is stated as an economy passing through demand depression and high unemployment, with 21-day lockdown announced by Prime Minister Narendra

Modi on March 23, 2020, it would slowdown the supply-side, accelerating the slowdown further and jeopardizing the economic wellbeing of millions.

With an increasing number of coronavirus cases, the government has locked down transport services, closed all public and private offices, factories and restricted mobilization. Based on recent studies, some economists have said that there is a job loss of 40 million people (MRD report) in the country, mostly in the unorganized sectors. In this scenario, they are predicting that India would go into recession affecting the unorganized sector and semiskilled jobholders losing their employment. It may also likely surface that at this time of eroding trust within and between countries – with national leadership under pressure from growing societal unrest and economic confrontations between major powers if we refer to the times of Ebola crisis in Africa. The labour sector under the MGNREGA, 2005 are worst impacted as they are not provided jobs due to lockdown, most of the labour sectors are associated with the construction companies and daily wage earners. Travel restrictions and quarantines affecting hundreds of millions of people have left Indian factories short of labour and parts, just-in-time supply chains and triggering sales warnings across technology, automotive, consumer goods, pharmaceutical and other industries. If we refer to the recent measures announced by the government and the RBI to mitigate the impact of the pandemic, as said by the RBI governor, these are only for short term and may not deliver the desired results as the problem is severe and has been further aggravated by the lockdown. The quarterly GDP growth has consistently fallen.

National Statistical Office (NSO) revised its data on August 31, 2020, drastically cutting down growth rates in the quarter April to June is worst contraction in decades with record 23.9 % comparison to last Year. Referring to the recent happenings and data, the unorganized sector excluding this likely to suffer a great downfall in the coming days as the job generation is going down in an alarming rate with the prolonged

lockdown and weak GDP. With the commencement of 2020-21 financial years the effects of coronavirus have affected the stability of the economy of 150 countries - jeopardizing their lifestyle, economy, impacting business and assumption of common wellbeing which we had taken for

granted. The lockdown has adversely have affected service sector like banks, restaurants, food vendors, and food delivery providers at par with providing health safety and medical sustenance, we should also have to think about the health of the sickening economy by mobilizing the resources and make plans of job creation and job continuity.

Impact on Economy of India:

There is a big shift in the world economic market and the share market has witnessed crashes day by day. Factories, Restaurants, Pubs, Markets, Flights, Super Markets, Malls, Universities and Colleges etc. were shut down. Fear of corona virus has limited the movement of the individuals. People were not even going to buy the daily essentials and these all were somewhere impacting the economy of the world as a whole. The Organization for Economic Co-operation and Development (OECD) reveals that they have cut their expectation for global growth to 2.4% from 2.9%, and warns that it could fall as low as 1.5%. India faces a huge decline in government revenues and growth of the income for at least two quarters as the coronavirus hits economic activity of the country as a whole. A fall in investor sentiment impacts privatization plans, government and industry. The lockdown in India will have a sizeable impact on the economy mainly on consumption which is the biggest component of GDP. India’s total electronic imports is equal to 45% that of China. Around one-third of machinery and almost two-fifths of organic chemicals that India purchases come from China. For automotive parts and fertilizers China’s share in India’s import is more than 25%. Around 65 to 70% of active pharmaceutical ingredients and around 90% of certain mobile phones come from China to India.

Impact on Agriculture

The pandemic outbreak of COVID 19 has made consumers to make tough choices regarding food, online groceries and overall expenditures due to the growing levels of restrictions like social distancing, avoiding

closures and crowds for slowing down the effect of corona virus. Dairy is prominently featured in out-of-home eating, and there may be some disruptions in food service sales. This will likely have an impact on markets and prices. The impact on the food sector has also been very significant especially in case of perishable commodities. Current market situation has portrayed that prices of agricultural commodities like vegetables, grapes and sugar have fallen 15 to 20 per cent due to bulk demand of consumers especially hotels and restaurants. The farm gate prices have fallen due to the fear of this covid 19. There has been huge uncertainty regarding the export and import of food items. The expected steep decrease in demand due to sudden ceasing of export and import along with reduction in domestic sales due to closure of malls and retail showrooms has made a situation expecting unprecedented and severe losses by the industry which will be in need of immediate financial relief for mitigation of this crisis. There was a report from the online delivery services and Supermarkets that there has been a huge growth in demand among consumers for stockpiling the goods like rice, toilet paper and orange juice due to escalating effect of this pandemic situation.

Impact on Energy Sector

The arrival of such a pandemic situation (Covid-19 outbreak) has made an impact on downstream oil industry such that within a very short period of time there has been a declining trend found in price of crude oil and billions of stock prices which have been contributed by several major gas and oil companies will result a huge loss to them. China, who is the largest energy consuming country of world, can be taken as an example

where due to outbreak of this virus attack demand of the oil and fuel products has declined as a result of which supply of those products have risen suddenly which has given rise to rise in prices. Consequently, the scenario has been so worsening that there has been oil price war which has already begun due to decrease in both demand and supply of the products in countries. There has been developed a fear among the investors that world wise spread of this virus will make a hit further

to the demand for oil as well as global economy because the oil price between OPEC, the group of oil producers and Russia had already been affected by rest of the world and this corona virus has driven the price down further.

Impact on financial markets:

Economic disturbances in association with the covid 19 pandemic has a wide ranging impact on financial markets along with commodity markets, bonds and stocks. There has been an expected estimation done by the UNDP that there will be a reduction of around US$220 billion in revenue generation of the developing countries and this economic impact could last for years. This pandemic crash led to clear instability in the markets during February which effected investors around the world to losses in trillions of US dollars.

Impact on industrial sector

Most of the countries around the world for uncertain period of time has been put in the mode of lock down as a result of which people of concerned countries have preferred to work from home or else not working there by discretionary expenditure of consumers have found to be collapsed. There has been much delay in numerous sectors like cancellations of sporting events, bans on travel and restrictions on social gatherings. Public transport and public spaces such as restaurants, shopping centres and

museums have not been used and avoided since last 3 months as a result of which service sector along with industrial business sectors have been affected much. But when gone in details it has been seen that the distribution of the consequences of covid 19 has not been uniform affecting several sectors disproportionately and even beneficial to some sectors as a well-known story of business of mask, sanitizer, hand wash etc.

Detailed scenario has shown that the global travel industry such as airlines, cruise companies, casino hotels have got their activity declined to even more than 90 per cent which could be proved a great loss to the industrial sector as well as financial sector. Apart from this the tourist destinations have been deserted and there have been cancellations in airline grounding fleets and firing staffs, trade fairs and cruises including international and national hotels and casinos. There are some other business also relying on tourism will be suffered with spillover effects because the companies related to tourism have cancelled travel and meetings and also the border has been closed by the government.

Coronavirus recession is sudden economic recession that caused during the 1st quarter of 2020 which will be more loss to the world economy than the estimated budget of the Quarter 1st. When the loss of commerce, trade, tourism, and major impacts on global supply chains are taken into consideration, the economic impacts of the outbreak will be vast both within China and globally. Apart from the deteriorating global health situation, there have been so many negative impacts on energy sector, food sector as well as the overall economy of world. Many economists have forseen that the countries have to pay more if they neglect this ongoing spreading. Almost 234 countries have been infected by the coronavirus and many of them are under lockdown inorder to stop the spreading. Some capital economists estimated that if urgent global actions could not be taken to curtail this outbreak of corona virus then

within very short period of time there could be around $280 billion of loss globally in the first quarter of the year and it may go on increasing year by year. The economic decline due to this pandemic shock is continuing and it is very difficuly to predict the next scenario but there has been clear indications that the developing countries will get their economy be worser befor they could be better. Hence the government as well as the advanced research labs should pay much of their attention to cure over this situation so that the targets of economic growth which was estimated could reach little far towards the target.

Dr. Dhawal K. Dwevedi, Assistant Professor (Agricultural Engineering)

Rooftop rainwater harvesting using remote sensing and GIS

Water is one of the most essential gifts of nature and must be safeguarded and valued as the very existence of living beings depends on water. Unfortunately, there is lack of awareness about the rainwater harvesting potential so enough emphasis is not laid on planning and development of rainwater conservation. With the increasing population and escalating concerns about water security, it is now imperative to adopt roof water harvesting not only to fulfil drinking water requirements but to provide the additional water sought for small-scale irrigation of household agriculture. If the rainwater is polluted, then it may not be the preferred source for drinking, but it is still acceptable for agricultural use. Climate change has further augmented the erratic pattern of rainfall in India resulting in highly unpredictable and uneven spatial and temporal rainfall distribution. Due to such high variability in the rainfall amount, it is advisable to adopt a simple yet effective technique of roof water harvesting.

In India, groundwater is extensively used for drinking and irrigation purposes and overexploitation of groundwater has resulted in its

considerable reduction. Inadequate rainfall, exceptionally high demands versus limited supply owing to rise in population, urbanization and rise in industries have caused depletion in groundwater level. According to the Central Ground Water Board (CGWB), excess extraction of groundwater caused 61% decline in groundwater level in wells in India between 2007 and 2017. As a consequence of urban development, the natural terrain is replaced by pavements and hard surfaces having insignificant infiltration capacity and when the rainfall water reaches these surfaces almost 80% of this water flows in form of runoff to the waste-water disposal system or rivers and only 20% soaks into the soil. Every drop

of rainfall should be utilized to cater the demand of an ever increasing population as the present system of water supply may not be sufficient in future.

The utilization of rainwater is one of the best ways of achieving sustainable urban development and it is the only cost effective solution to minimize the demand-supply gap by augmenting the existing water supply. It is necessary to adopt rainwater harvesting methods in places where the conventional water supply has failed to meet the peak period demand of the people for drinking water and to contribute to the irrigation demand of a kitchen garden.

Roof water harvesting is a process of collecting runoff occurring due to rainfall from impermeable terrace on top of the house and conserving it in a tank. This method is comparatively easier and reliable and provides good quality water for drinking. The collected rainwater can either be used as the principal or as a supplementary source of water. The stored water could be used for drinking as well as other domestic purposes like cooking, washing and bathing and agriculture purposes like watering land, feeding cattle etc. Roof water harvesting is a proven approach towards conserving water effectively and economically. The roof water harvesting method has been used since ancient times for providing

water for drinking and small scale irrigation during water shortage. The roof water harvesting concept varies from small and basic arrangement, such as attachment of a pipe draining into an underground tank, to large and complex, such as those to collect water from many hectares serving a large number of people.

Remote sensing and Geographical Information System (GIS) techniques has made it possible to continuously monitor land use/cover changes and it provides useful information regarding impact of human development on the natural resources. Application of remotely sensed data has made it possible to study the changes in land cover in less time, at low cost and with better accuracy. The roof areas in an urban region can be

identified from satellite imageries and they can be analyzed using an appropriate GIS tool. The paved and impermeable surfaces in satellite imagery can be classified from other features due to the difference in spectral reflectance of such surfaces.

For smaller regions, the roof area can be directly identified in google earth engine which uses the data of Landsat satellite. The built up area can be classified using freely available application like remap which is user friendly and efficient. Remap uses the power of the Google Earth Engine, allowing directly access of satellite data archives and state-of-the-art remote sensing methods. Remap uses NASA's Landsat imagery (30 m spatial resolution) into different land use and land cover classes and from the classification, the built up areas can be isolated. To achieve the lowest error rate and highest classification accuracy, it should be ensured that the training points are at least greater than 20 and accurately located for each class. The satellite imagery may give similar spectral reflectance for roof area, compounds made of concrete, pavements, roads and other hard impermeable surfaces. Therefore, ground truth data should also be obtained to validate the results of the GIS software.

The total amount of water received in the form of rainfall over an area is called the rainwater endowment of that area and the amount that can be harvested is called the water harvesting potential.

The following information is required to estimate the rainwater harvesting potential.

1. Mean Rainfall depth
2. Catchment area characteristics
3. Runoff and its coefficient

$$\boldsymbol{Area\ of\ catchment}\ (\boldsymbol{m^2}) \times \boldsymbol{Rainfall\ deth}\ (\boldsymbol{m}) \times \boldsymbol{Runoff\ Coefficient} = \boldsymbol{Volume\ of\ water\ received}\ (\boldsymbol{m^3})$$

Runoff depends upon the area and type of the catchment over which it falls as well as surface features. To obtain the volume of the rain water harvested, the depth of rainfall was multiplied with the catchment area and runoff coefficient. The effective area of roof used for computing volume of water is called roof foot print. The runoff coefficient is the value that represents the ratio of the volume of water that runs off a surface to the volume of rainfall that falls on the surface There are many parts of the hydrologic cycle that affect the runoff coefficient. Thus run-off coefficient for roof depends on roof type, slope, degree of imperviousness and surface roughness.

The roof water harvesting potential of some of the buildings at Sri Sri University using google earth pro is illustrated in this article. The roof areas of the building in the university were calculated using the polygon tool of the google earth.

Roof area of some of the buildings located at Sri Sri University, Cuttack

Roof water harvesting potential of various buildings at Sri Sri University for average rainfall

Name of the Building	Area (m^2)	For 50 % of average rainfall, Rainwater harvesting potential (m^3)	Considering 10 % storage, Volume (m^3)	Number of Tanks	Tank capacity (L)
Shruti	3411	2046.6	204.66	2	102330
Kriti	2496	1497.6	149.76	2	74880
Shivaji Bhawan	1258	754.8	75.48	1	37740
Aravalli	1105	663	66.3	1	33150

The average rainfall of Cuttack is 1515 mm. In the calculations of rainwater harvesting potential, only 50 % of the average rainfall has been considered. The runoff coefficient in the calculations is taken as 0.8 as supported by the previous studies of runoff coefficient on a

concrete roof. It may not be economical to store all the available water and therefore, only 10% is considered for storage. The stored water can be used for drinking purpose as well as for small scale irrigation of a terrace garden. This example shows that google earth can be used for calculating the area of roof and estimating the water harvesting potential if the average rainfall data is available. Using google earth for calculating roof areas in a larger area can be an arduous task. In that case, remap software can be used.

Roof area

Example of Roof area classification in an urban area using remap software

For a large urban area, the remap software can be useful in classifying the roof area quickly once the training points are selected appropriately. However, as the spectral reflectance's of certain surfaces are similar, minor error might be encountered in the classification. The area under roads and other compacted areas can be identified and roof area can thus be isolated. Once the roof area is calculated using remap software, the same procedure as described in the example can be used for estimating the roof water harvesting potential. Planning for roof water harvesting can be done based on the irrigation requirement of kitchen gardens, water requirement of people, the

availability of space for construction of storage structures, possible effects of pollution on collected rainwater and cost.

Financial assistance was given by the government of Odisha to the people for encouraging rooftop rainwater harvesting systems. Government of Odisha had unveiled a rooftop rainwater harvesting scheme of 100 crores in the year 2015. 16,955 buildings were adopted for rooftop rainwater harvesting in Bhuneshwar, Berhampur, Titlagarh, Jharsuguda and Branjrajnagar towns. Use of remote sensing and GIS can definitely help in effective planning and implementation of such rainwater harvesting schemes.

Mr. Ambika Prasad Misra, Assistant Professor (Soil Science)

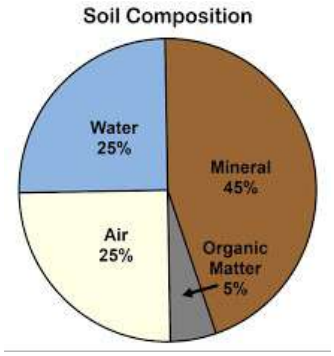
Soil Health– Importance, Assessment and Management

The terms ‘soil health’ and ‘soil quality’ are becoming increasingly familiar worldwide. A modern consensus definition of soil health is the continued capacity of the soil to function as a vital living ecosystem that sustains plants, animals and humans (Natural Resources Conservation Service – USDA-NRCS, 2012; Soil Renaissance, 2014)

Soil: Soil is defined by the Soil Science Society of America (SSSA) as the unconsolidated mineral or organic material on the immediate surface of the earth that serves as a natural medium for the growth of land plants.

Soil Health: The state of the soil being in sound physical, chemical, and biological condition, having the capability to sustain the growth and development of land plants.

Soil health invokes the idea that soil is an ecosystem full of life that needs to be carefully managed to regain and maintain our soil's ability to function optimally. The term 'soil health' has been generally preferred by farmers, while scientists have generally preferred 'soil quality'.



Important soil functions related to crop production and environmental quality include:

- Retaining and cycling nutrients
- Supporting plant growth
- Sequestering carbon
- Allow infiltration, and facilitate storage and filtration of water
- Suppressing pests, diseases, and weeds
- Detoxifying harmful chemicals
- Supporting the production of food, feed, fibre and fuel

When the soil is not functioning to its full capacity, sustainable productivity, environmental quality, and net farmer profits are jeopardized over the long term.

Impaired function may result from constraints to specific and interacting soil processes. Several effective mangement pratices are included to enhances the soil health condition of the soil. Basically they are catagorized into physical, chemical & biological section which all in together enhance and alter the improvement of soil health. The Soil

physical properties are mainly overruled by the soil matrix. Soil texture is a constant property that can't be easily changed. Texture influences many soil functions, infiltration rate, water holding capacity of the soil, and how fertile the soil will be. A high percentage of clay soil will drain water slowly compared to soils with a high sand percentage. Bulk density, which is a measure of how closely the soil particles are packed together. It is an indicator of soil compaction and soil health. It affects infiltration, rooting depth/restrictions, available water capacity, soil porosity, plant nutrient availability, and soil microorganism activity, which influence key soil processes and productivity. A compacted soil inhibits plant rooting and water movement in the soil as well as percolation of water to inner depth. Soil structure will affect water movement, resistance to erosion, and nutrient cycling. Soil chemical conditions that affect crops include soil pH, salinity, and the sodium adsorption ratio (SAR) also plays an important role in maintain soil health.

The biological component of the soil is perhaps the most intriguing attribute because it comprises both the living organisms and the dead organic materials they feed upon. Bacteria, fungi, and many other living organisms in the soil, in association with living plants and dead organic matter, are the key drivers that maintain and even regenerate healthy soil functions. Organic materials in agricultural soils play a vital role in exciting the soil health. A soil rich in organic matter tends to develop a good soil health in due course of time. Most soil microorganisms are found near the plant roots in a region called the rhizosphere. Microbes are so abundant in rhizospheres due to the simple carbohydrates in root exudates that the plants produce, which microbes can use as food. That is why the presence of living roots is essential for maintaining good soil health.

Why Should We Care About Soil Health?

Soil is one of the natural resources that support human civilization since time immemorial. Without a productive and healthy soil, producing enough food to feed an ever-increasing human population is next to impossible. Many degraded soils across the globe that are no longer productive and can only be regenerated to a fruitful state by applying various soil health principles. Another reason we should care about soil health is the environmental, economic, and public health consequences arising from degraded and unhealthy soils. Poorly managed soils can also lead to the contamination of surface water and groundwater due to agrichemicals attached to the dust and soil.

How Do We Manage Soil Health?

- Reduce soil disturbance (farmlands and rangelands)
- Crop rotation practices (farmlands)
- Cover cropping practices to promote plant diversity and living roots (farmlands)
- Diversify production systems (farmlands and rangelands)
- Add soil organic amendments (farmlands and rangelands)
- Integrate livestock into cropping systems (farmlands)
- Promote diverse plant species with different rooting depths (rangelands)
- Sustainable animal grazing practices (rangelands)

Mr. Ningaraj Belagall, Assistant Professor (Entomology)

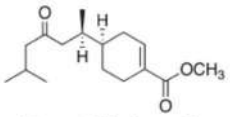
Insect hormones as green insecticide

Green labeled pesticides are those chemical molecules which are with LD 50 dose of more than 5000 according to the pesticides labeling. Since from discovery of insecticidal property of DDT, organochlorines, organophosphate and carbamate insecticides every one exploited as pesticide umbrella on insect pests that lead to environmental pollution and resulted in loss of so many bird species. This environmental negative consequence was studied by Rachel Carson and

written book, entitled with Silent Spring in 1962. From this date onwards, scientists started their work on green labeled pesticides i.e third generation pesticides as insect hormones as pesticides. As we well known that insect's growth and development is punctuated by instars or stages. The development of the insect from egg to adult is regulated by hormones, including pro-thoracicotropic hormones (PTTHs), juvenile hormones (JHs) and molting hormones. These three are the important hormones synthesized within in insect body by different organs like brain, corpora allata and prothoracic glands respectively. PTTH synthesized in the insect brain and triggers corpora allata to release juvenile hormone as well as molting hormone from the pro-thoracic glands. Juvenile hormone is the sesquiterpene exists in at least six different forms. JH III is the most common type and is present in most insects, whereas JH I and II are the principal ones in Lepidoptera. The insect molting hormone, 20-hydroxyecdysone (20E), is secreted as ecdysone by a pair of endocrine glands that are located in the prothorax of lepidoptera and other insects respectively. Ecdysone manifests its action of molt-inducing by which larvae molts to pupae, pupae to adults and thereby completes total life cycle as regular phenomena in nature.

Story of discovery of insect hormones as potential green insecticides

The use of insect hormones as pesticides goes back to the accidental discovery of Juvabione"The Paper Factor". Karel Sláma brought the fire bug, *Pyr-rhocoris apterus* Linnaeus, from (the then) Czechoslovakia to the late Carroll Williams laboratory at Harvard University in the United States (US). There was difficulty in maintenance of this insect culture in the US although it had been easily cultured in Czechoslovakia. It was observed that instead of developing into normal adults, the nymphs developed into nymphal-adult intermediates termed *adultoids*, or extra instar nymphs were obtained. While ana-lyzing the causes, it was inferred that the molting deformities were due to the "paper factor," the newspaper strips used in rearing jars. The American newspapers made from the balsam fir (*A. balsamea*) contained the juvabione, whereas the trees in Czechoslo-vakia did not. Several years later, William S. Bowers isolated and characterized the active factor, which he named *juvabione*. This accidental discovery leads to the development of insect growth regulators (IGR) as third generation pesticides in the market.



Juvabione – "The Paper Factor"

Insect hormones as pesticides

1. Juvenile Hormone Analogues

The historical backdrop of juvenoids started with the arrangement of the unrefined concentrate of the male Cecropia moths, *Hyalophora cecropia*. The concentrates when infused into pupae or when applied on the outside of pupal body caused maintenance of pupal characters. A large number of sesquiterpenoid juvenoids were prepared and screened for their JH activity against insects (Bowers, 1971). In addition to these exacerbates, a specific kind of the non-cyclic isoprenoid juvenoid, methoprene (created by Zoecon Corp. in 1972) demonstrated extraordinary JH movement against creepy insects and was the principal first insect IGR (enrolled under the brand name Altosid™) for insect control (Henrick et al., 1973). Next a significant achievement in the JHA was the improvement of fenoxycarb with wide range action and higher photostability than the prior JHAs (Grenier and Grenier, 1993). The following outstanding disclosure was of pyriproxyfen, viewed likely as the most intense JHA accessible today (Hatakoshi, 2012) with its expansive range movement against a wide scope of insect pests (see Figure 1 for JHA).

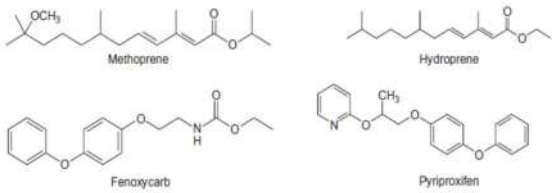


FIGURE 1 Juvenile hormone analogues widely used for pest control.

Chitin Synthesis Inhibitors

The first chitin synthesis inhibitor, diflubenzuron, having a place with the benzoylphenyl urea class of science, was found fortunately by Philips-Duphar Company during the 1970s. This disclosure started the exploration on benzoylphenyl urea as another class of insecticide sprays prompting the

improvement of various BPU subordinates as effective chitin amalgamation inhibitors. There are two types of Chitin Synthesis Inhibitors (CSH).

a) **Benzoylphenyl Ureases**: have a focal urea moiety, with the vast majority of the unpredictable replacements happening on the phenyl end leaving the benzoyl part to remain moderately straightforward. It was guessed that this end was simply the one that appended to the unidentified receptor bringing about restraint of chitin union.

b) **Non-benzoylphenyl Urea Compounds as CSI**

Among the CSIs not identified with the benzoylphenyl urea class of mixes, buprofezin, etoxazole, cyromazine, and dicyclanil have been generally utilized for insect control in agriculture and general wellbeing the executive's frameworks. Buprofezin having a place with the gathering of thiadiazines is discovered effective against the homop-terans, for example, mealybugs, scale creepy crawlies, and whiteflies. Its activities on creepy crawlies incorporate inhibition of cuticle deposition and chitin biosynthesis in the earthy colored planthopper, *Nilaparvata lugens* (Stål) (Uchida et al., 1985); counteraction of arrangement of a lamellate fingernail skin in fairies of green-house whitefly, *Trialeurodes vaporariorum* Westwood (De Cock and Degheele, 1991); and inhibition of cholinesterase movement in insects.

Ecdysone Agonists

There are numerous common phytoecdysteroids and zooecdysteroids present in plants and creatures. The principal non-steroidal EA having a place with the bis-acylhydrazine (BAH) class of science was created by Rohm and Haas Co. These compounds mainly act on the ecdysone or molting hormone producing prothorasic glands. So that insect never moults from larvae to pupae and to adult. The compound RH-5849 incited an untimely however fruitless shed by meddling with ordinary fingernail skin arrangement prompting passing of insects. In spite of the fact that RH-5849 was not marketed because of low power, the improved subordinates of BAH, for example, tebufenozide, methoxyfenozide, and halofenozide were delivered for business use against insect control.

Management of insect pests by insect hormonal analogues

IGR Group	Trade Names	Target Pests
JH Analogue		
Methoprene	Altosid®, Aquaprene®,	*Rhyzopertha dominica* *Phlebotomus papatasi*
Hydroprene	Altozar®, Gencor®, Mator®,	*Plodia interpunctella*
Kinoprene	Enstar® AQ, Enstar® II	*Bemisia argentifolii*
Pyriproxyfen	Aciprox®, Adeal®, Admiral®,	*Locusta migratoria,* desert locust, *Schistocerca gregaria*
Fenoxycarb	Insegar®, Logic®, Pictyl®,	German cockroach, *Blattella germanica* Scale insects, *Phenacoccus pergandei*
Chitin Synthesis Inhibitor		
A) BPU derivatives		
Diflubenzuron	Dimilin, Adept, Bi-Larv	*Helicoverpa armigera*
Lufenuron	Match®, Luster®,Manyi®	*H. armigera, Musca domestica*
Novaluron	Rimon®, Diamond®, Pedestal®	Codling moth, *Cydia pomonella*, and the oriental fruit moth, *Grapholita molesta*
Flucycloxuron	Andalin®	Oriental armyworm, *Mythimna separata*
B) Non-BPU derivatives		
Buprofezin	Applaud®,Courier®, Maestro®,	Brown planthopper, *Nilaparvata Lugens and Amrasca biguttula biguttula*
Etoxazole	Barok®, Baroque®, Borneo®	Red spider mite, *Tetranychus urticae*
Cyromazine	Trigard®,Larvadex®,	Stable flies, *Stomoxys calcitrans*

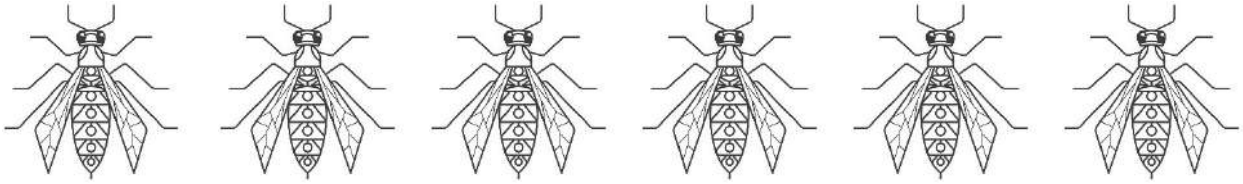
	Ecdysone Agonists	
Tebufenozide	Confirm®, Mimic®, Conidan®	*S. exempta, Spodoptera exigua, S. littoralis*
Methoxyfenozide	Falcon®, Intrepid®, Integro®,	*H. armigera*
Chromafenozide	ANS-118, Virtu®, Phares®, Killat®,	Common cutworm, *S. litura*, the beet armyworm, *S. exigua*

Management of Stored Product Pests by insect hormones

Alongside insecticidal chemicals, JHAs have been evaluated for their role in control of stored product pests. Some of the JHAs including methoprene, hydroprene, diflubenzuron, fenoxycarb, and pyriproxyfen have been found effective as surface treatments against the stored product pests. Methoprene is found effective against some stored product insects, like lesser grain borer, *Rhyzopertha dominica* Fabricius. Fenoxycarb was found to be effective against storage mites.

Management of Public Health and Urban Pests

IGR compounds play a major role in managing the insect pests associated with human health. Because of specificity in their mode of action and safety to non-target organisms and the environment, these IGR-based insecticides are more preferred than other synthetic insecticides. Most of the IGRs have high potency against mosquitoes, other pests and vector species. The IGRs such as diflubenzuron, lufenuron, triflumuron, novaluron, and methoprene are being used to manage insect vectors of human diseases.



Ms. Bidudhi Tripathy, Assistant Professor (Agronomy)

Biological weed control: A tool in climate smart agriculture

The increasing population of the world has intensified the problem of food crisis and at the same time has threatened the world agriculture due to natural resource degradation and climate change. The changing climatic conditions has affected negatively the Production stability, agricultural productivity, income and food security. Weeds are the biggest nuisance in crop cultivation and causes huge economic losses to the agriculture production system. Farmers adopt various control measures viz. physical, cultural, mechanical and chemical measures to maintain the weeds population below the threshold level. These methods have a good control efficiency but at the same time they are either not feasible in the Modern context as well as cause harm to the crop ecosystem. Development of climate resilient agriculture is the need of the hour for achieving future food security and climate change goals. The agricultural system can be stepped back from damage and recover quickly by adapting mitigation strategies. Mitigation strategies reduce the contribution of agriculture system to greenhouse gas emission, and adaptation strategies provide agriculture production under changing scenarios. Therefore, weed control using insects, plant pathogens and other living organisms or their products can be taken as eco-friendly and sustainable alternative to the management of weeds and a tool for climate smart agriculture. Biological control is especially useful in natural areas, forests, rangelands and aquatic water bodies, where very high specificity, low costs and permanent control are needed to reduce populations of an invasive exotic weed without harming the native species. First unintentional biological control in the world happened in India where cochineal insect, *Dactylopius ceylonicus* was introduced from

Brazil unknowingly in place of *D. cacti* for preparing dye from *Opuntia vulgaris* during 1795. With time it started achieving control over *Opuntia*, which led to the foundation of biological control of weeds in future.

Systematic biological control research in India started in 1957 with the establishment of Commonwealth Institute of Biological Control (CIBC) at Bangalore and followed by establishment of All India Coordinated Research Project on Biological Control of Crop Pest and Weeds (AICRP-BC&W) in 1977. Directorate of Weed Research (DWR) earlier named as National Research Centre for Weed Science (NRCWS) came into being in 1989 at Jabalpur deals with weed management techniques including biological control of weeds in India. Under classical biological control, exotic natural enemies are introduced against inadvertently introduced alien organisms, which have become pests in the lack of natural checks. In India till now 31 exotic biological control agents have been introduced against weeds, 22 of which were recovered and established, 6 could not be released in the field while 4 could not be recovered after release. 7 of these established bioagents are providing excellent control, 4 substantial and 9 partial controls. It was recorded that under classical biological control in India, highest degree of success was achieved in biological control of aquatic weeds (55.5%) followed by homopterous pest (46.7%) of crop pest and terrestrial weeds (23.8%). Some examples of successful biological weed control are listed as

Exotic natural enemy	Country/year of introduction and weed
Dactylopius ceylonicus	Brazil, 1795, against *Opuntia vulgaris*
Dactylopius opuntiae	USA via Srilanka via Australia, 1926, against *Opuntia stricta*
Zygogramma bicolorata	Mexico, 1983, against *Parthenium hysterophorus*
Neochetina bruchi and *Neochetina eichorniae*	Argentina via USA, 1983, against *Eichornia Crassipes*
Crocidosema lantana	Hawaii, 1902, against *Lantana camara*
Cyrtobagous salviniae	*Salvinia molesta*

Stem segment of *Opuntia stricta* damaged by *Dactylopius opuntiae*

Eichornia crassipes infested by *Neochetina bruchi* in a pond

Advances in biological weed control in India

- Development of bio-herbicides: Bioherbicides are the liquid formulation of microbes like fungi, bacteria, viruses and virus that are sprayed on weed population in similar manner as of chemical herbicides. Among them fungi are the most widely used, the isolates of fungal propagules are known as mycoherbicides. The work on microbial approaches in India is mainly limited to *Parthenium* and aquatic weeds.

- Phytotoxins from plants: Plants produce an incredible diversity of low molecular weight organic compounds known as secondary metabolites or allelochemicals. The phenomena of allelopathy can be practically utilized for weed control in the form of crop rotations, intercropping, allelopathic mulches and spray of allelopathic plant water extracts. Application of sorghum and sunflower extracts reduced weed biomass by 33-53% and increased wheat yield by 7-14%. Number of synthetic herbicides is derived from these phytotoxins such as herbicide mesotrione is derived from leptospermone, a compound isolated from bottle brush plant and used for killing of weeds in maize crop.

- Phytotoxic metabolites from microbes: Plant pathogenic fungi and bacteria produce a wide array of metabolites including alkaloids, glycosides,

peptides, phenolics, terpenoids with wide range of ecological and industrial utility. These metabolites can be exploited for their use as weed control and offers best alternative to chemical herbicides. Fungal species like Alternaria, Penicillium and Fusarium biosynthesizes more than 130 bioactive compounds. A few companies in India claim the successful formulation of the product from the isolates of fungi against Parthenium and water hyacinth, but large scale field application is still awaited.

- Amalgamation of biological methods with chemical measures- Utilization of biological measures alone for controlling the weeds require a very long time. However, if it is performed in conjunction with chemical measures, the knockdown timings are reduced effectively. Like, biological control of water hyacinth using Neochetina spp. Alone take considerable long time ranging from two to three years, however chemical and biological integration may significantly reduce the time of control.

Mr. Mr. Brij Bihari Pandey, Assistant Professor (Crop Physiology)

Water conservation: A cooperative campaign

Water is a critical input into agriculture in nearly all its aspects having a determining effect on the eventual yield. India accounts for about 17% of the world’s population but only 4% of the world's freshwater resources. Distribution of these water resources across the vast expanse of the country is also uneven. The increasing demands on water resources by India’s huge population and diminishing quality of existing water resources due to water pollution have led to a situation where the consumption of water is rapidly increasing while the supply of freshwater remains more or less constant. Additionally, water overuse can cause water shortage, often occurs in areas of irrigation agriculture, and harms the environment in several ways including increased salinity, nutrient pollution, and the degradation and loss of flood plains and wetlands. Indian agriculture accounts for 90% of water use due to fast

track groundwater depletion and poor irrigation systems. Besides, the lack of monsoons in some parts of India will result in water shortages that lead to occurrence of severe drought incidence. The latest findings suggest that while there have been alternate dry and wet spells over the past three decades, the frequency of occurrence of drought years has significantly increased in India. Along with that, frequent and prolonged droughts spell across the country have severe impacts on the economy, society, ultimately leading to severe loss to human life. The water shortages are already acute: nearly half the country's population faces high-to-extreme water stress and about 200,000 die each year due to inadequate access to safe water.

An innovative approach: Save water, earn money

The state Madhya Pradesh, promoted as 'The Heart of India' by the state's tourism board is aptly named so because of its central location. The incidence of severe drought in Madhya Pradesh is very common and farmers are facing its worst agricultural crisis in recent years. The frequent dry spells and irregularities in monsoon affect the lives of several farmers in the state and farmers have no option but to migrate to cities to earn and support their families. Though the government and other bodies have been instrumental in bringing some initiatives and plan to fight the issue, the dent they are trying to fill is still very big. Even if the government resolves the problem at a very creamy upper layer, and the ground-level reconstruction is still at premature stage that is also very crucial to mitigate all the damage.

In this looming situations, people in Madhya Pradesh's Dewas district are building farm ponds, and the initiative turn lives of thousands of farmers in Dewas, Seoni, and Chhindwara district of Madhya Pradesh for the better in the last 10 years, courtesy an idea of farmland introduced in 2006-07 by the then collector of Dewas 'Umakant Umrao'. Today, the

idea very popular in the country and known as ‘Pani Bachao Dhan Kamao’ (save water, earn money) campaign. The initiative started when ‘umrao’

visited the farmer’s field in Dewas district to access the loss due to hailstone and there he observed that the villagers don’t cultivate *rabi* crops due to water scarcity. He suggests the farmers dig out the one-tenth area of their land and turn it into farm ponds. These ponds store rainwater during monsoon seasons that lasted through the season till the next rain in most years. The approach soon turned into ‘Pani Bachao, Laabh Kamao’ (Save water, earn profit) initiative that resulted in rainwater harvesting and conservation.

During the initiative, Umrao along with other agriculture officials convinced almost 40 big landholding farmers to dig a pond in their fields. The pond is 10-12 feet deep and digging of a small pond (minimum half a bigha) takes about Rs 1.5 lakh or Rs 2 lakh. As it was an expensive affair, large farm holding farmers roped to avail themselves into it. Moreover, in some areas, farmers group up together and dig an unfertile land which will provide a bigger farm pond and can irrigate large number of plots together.

The district Dewas has black cotton soil which runs up to 10 feet deep; followed by a 15-20 feet layer of yellow soil (pili ghumat in Hindi) and then sandy loam. This allows almost nil percolation of water, best to harvest and retain rainwater. Moreover, the small area of the farm pond can be filled within a couple of rainy days and can last through the dry spells. Together the soil conditions and smaller ponds are the major reasons for success.

After the success of farmers belongs to Dewas district the farmers from other districts also start implementing the same idea. In the first year, the self-financing campaign was named as ‘Bhagirath Krishi Abhiyaan’ and the farmer who dug a pond would be called ‘Bhagirath Krishak’ (named

after the mythological water hero Bhagirath who brought down the Ganges to the earth) while their ponds were called ‘Rewa Sagar’ (another name of Narmada river, the lifeline of Madhya Pradesh).

The farm pond under the in the Dewas district

After two years later, the government started a subsidy scheme; the subsidy amount was Rs 16,350 with a requirement of a minimum depth of 12 feet. The amount was later increased to Rs 80,000 to Rs 1 lakh and then the scheme was called ‘Balram Talab’. Today there are more than 1,000 irrigational ponds out of which 564 ones, which are known as Rewa Sagar, were made without any aid from the government. Rewa Sagar’ is when farmers put in 100 % of their own money. The United Nations had selected Dewas district’s community water management works in the best three water management practices in the world under the category of ‘Best Water Management Practices’ for year 2011-2012.

These structures have been quite beneficial for the farmers as they do not take up much space and they store water till the *rabi* season.

Also, with the availability of water from a farm pond, which meant assured irrigation, farmers started getting winter crops too. And now, after 10 years, it is not just the additional crop that farmers can grow due to the pond, but assured water has improved the quality

too. Also, in ponds water remains till the end of the second cropping season thus, wheat and gram are also cultivated along with other *rabi* crops. Due to the construction of these farm ponds the cropping intensity (ratio of the number of crops harvested in a given land each year) for Dewas district has gone up from 118 % to 180 % from 2006 onwards to date. After the implementation of the campaign the farming community those who were struggled to meet the ends now incoming a huge margin of profit and changing their lives.

After the success of the initiative, the farmers from Dewas and some other districts become businessmen, different farmers heir their tractor, and hired a tractor to dig or deepen the pond and earn income every year. They work from 4 am to 11 pm and earn Rs. 250 per work hour. Some of the farmers who dig a big pond and have leftover water after their consumption they supply it to a neighbor or needed farmer and consume 20% of their farm output. Farmers also now able to practices pisciculture in these ponds and can earn an extra Rs. 30-32,000 rupees per year. This has doubled the income to around Rs. 60,000 in the span of just a few years. From an environmental point of view, these ponds retain water for the majority part of the year, as soil moisture helped maintain ecological balance, Dewas has seen an increase in biodiversity, rather it is all coming back, especially the agriculture friendly insects and birds.

Dr. Revanasiddappa Bhawar, Assistant Professor (Agricultural Economics)

Risk Management in Agriculture: An overview

Agricultural activities are subject to a wide range of risks due to the various economic, climatic and social factors associated with the environment in which farming is practiced. Some of these risks are common to other industries while many are specific to agriculture. Their presence affects production choices with implications on the overall economic efficiency of agricultural production. The realization of the risks not only leads to falls in farm incomes but adversely affect the economic welfare of those involved in agriculture. It has the potential to curtail the investment and growth of farm businesses. It is important to understand the effect of risks on farming and how can risk be mitigated by adopting different techniques.

Risk and uncertainty in agriculture

Risk is a situation where all possible outcomes are known for a given management decision and the probability associated with each possible outcome is also known. Risk refers to variability or outcomes which are measurable in an empirical or quantitative manner. Risk is insurable.

Uncertainty exists when one or both of two situations exist for a management decision. Either all possible outcomes are unknown, the probability of the outcomes is unknown or neither the outcomes nor the probabilities are known. Uncertainty refers to future events where the parameters of probability distribution (mean yield or price, the variance, range or dispersion and the skew and kurtosis) cannot be determined empirically. Uncertainty is not insurable.

Types of risk

1) **Production Risk:** Agriculture is often characterized by high variability of production outcomes. Unlike most other entrepreneurs, farmers are not able to predict with certainty the amount of output that the production process will yield due to external factors such as weather, pests and diseases. Farmers can also be hindered by adverse events during harvesting or threshing that may result in production loss. Development and adoption of innovations though offer possibilities of better return but also add to production risk in agriculture. In India, more than 63 per cent of land is vulnerable to droughts. Droughts lead to economic losses resulting low agricultural production, loss of animal wealth, reduced nutrition and loss of health of workers.

2) **Market risk:** Agri-commodities markets are characterized by risk and uncertainty such as changes in the prices of inputs or outputs. Factors like fluctuations in the prices of inputs and outputs, outside competition, changing supply and demand, market imperfections, changing consumer preferences, etc result in market risk. Sale of farm produce under distress may take place due to lack of post-harvest processing and lack of infrastructure storage facilities.

3) **Financial and Credit Risk:** Many agricultural production cycles stretch over long periods of time and farmers have to make expenses all through this period. This leads to cash flow problems which further intensified due to lack of access to insurance services, credit and the high cost of borrowing informal sources. This also creates an obligation to repay debt. Rising interest rates, the prospect of loans being called by lenders, and restricted credit availability to the farmers lead to financial risks.

4) **Institutional Risk:** Another Important source of uncertainty for farmers is risk institutional, generated by unexpected changes in regulations that influence farmers' activities. Changes in legal policies, regulations, financial services, level of price or income support payments and subsidies can significantly alter the profitability of farming activities.

5) **Personal Risk:** This risk refers to factors such as problems with human health or personal relationships that can affect the agriculture. Agricultural households, as any other economic entrepreneur, are exposed to personal risks affecting the life and the wellbeing of people who work on the farm.

6) **Resource Risk:** The resource risks include uncertain supply or non-availability of labour (skilled labour), credit, irrigation water and timely supply of desired inputs like seed, fertilizer and plant protection chemicals. Supply of spurious seeds and plant protection chemicals pose a great risk to the producers. Failure of crops due to sub-standard seed or spurious plant protection chemicals causes drain of resources of the farmer. It inflicts considerable damage not only to value but also on the psyche of the farmer.

7) **Assets Risks:** When all other measures fail, farmers have no option but to sell their assets (like livestock) or to migrate out to regions with better work opportunities. Small farmers are exposed to this risk, the most.

8) **Technology Risk:** Like most other entrepreneurs, farmers are responsible for all the consequences of their activities. Adoption of new technologies like genetically modified crops, investment and associated credit access, exposes farmer to high degree of risk.

Why to manage the risk in agriculture?

Efficient and effective management of risk will help in making farming a profitable enterprise. Management of risk in agriculture is one of the major concerns of the decision makers and policy planners as risk in farming is considered as one of the major cause of low level of farm investments and diversification towards high-risk high-return enterprises. Both, in turn, have implications for growth in agriculture. In order to develop mechanisms and strategies to mitigate risk in agriculture, it is imperative to know the sources and magnitude of different kind of risks associated with agriculture. Farmers are exposed to wide range of risks like rainfall variability, market price

fluctuations, credit uncertainty and adoption of new technology. The diversities in the sources of risks require a variety of instruments offering protection for offering protection to farmers from such risks.

Benefits to farmers

Farmers have to take decisions on crops to be planted, application of seed rates, fertilizer levels and other inputs early in the cropping season. Risk associated with agriculture for various factors like climate, availability of inputs and services bring in an element of uncertainly in all farm management decisions. If everything is known with certainty, decision would be relatively easy. However, in the real world, more successful manager is the ones with the ability to make the best possible decisions within an environment of risk and uncertainty. Therefore, understanding various risk and strategies to manage them will help the farmers to take an appropriate decision leading to optimal output.

Strategies for reducing risk

The various methods which can be used to reduce risk are discussed as below-

1) **Diversification:** Production of two or more commodities on the farm may reduce income variability as; in general, all prices and yields are not low or high at the same time.
2) **Stable enterprises:** Irrigation will provide more stable crop yields than dry land farming. Production risk can be reduced by careful selection of the enterprises with low yield variability. This is particularly important in areas of low rainfall and unstable climate.
3) **Crop and livestock insurance:** For events that can be insured, the risk of loss can be covered by availing appropriate insurance policy. This way chance of large loss can be converted into certain cost.
4) **Flexibility:** Diversification is mainly a method of preventing large losses. Flexibility is a method of preventing the sacrifice of large gains. Flexibility allows for changing plans as time passes, additional information is obtained and ability to predict the future improves.
5) **Spreading sales:** Instead of selling the entire crop output at one time, farmers may sell the output in part at different times. Spreading sales helps in managing intra-year price variation.
6) **Hedging:** It is a technical procedure that involves trading in a commodity futures contracts through a commodity broker. This tool may help in managing price risk.
7) **Contract sales:** Producers of some crops like gherkins, vegetables, etc often sign a contract with a buyer or processor before planting

season. A contract of this type removes the price risk at planting time itself.

8) **Minimum support price:** The government purchases the selected farm commodity from the farmers at MSP if the market price falls below defined price.

Risk Management Steps

i. **Risk identification:** Identification of risk relevant for a specific farm is highly important for instance, livestock farmers will face different risks than arable farms, producers of wheat will be exposed to different risks than producers of sugar beets. Likewise, conventional farms will have different risks than organic farms.

ii. **Risk assessment:** Once the risk has been identified, equally important is to assess the frequency and severity of occurrence of risk. This will help in defining appropriate strategy for risk management. It is important to assess the incident rate i.e. the probability of occurrence of a specific risk. In some cases, information is available that makes it possible to quantify the rates of occurrence of risk. This is true, for instance, in the case of weather risks, for which longer-term records are available. In other cases, farmers need to develop subjective assessments of incident rates, taking into account, prior experiences with occurrence of such risks. Another important aspect is to assess the potential loss. It is an assessment of possible financial loss if a risk, such as an animal disease or a hail storm, occurs.

iii. **Risk management:** After relevant risks have been identified and assessed, farmers have to work out a strategy to cope-up with these risks. In general, farmers have four options for managing a risk:

   a. Risk avoidance – avoid risk or an event of risk to occur if a risk can have catastrophic consequences

b. Transfer of risks to third parties like insurance companies or financial investors in futures markets

c. Risk reduction through longer-term contracts or diversifying farm activities

d. Risk acceptance - a strategy used mainly where incident rates and loss potentials are low

iv. **Risk control includes internal design of the risk management process:** Providing decision-makers with relevant information on regular basis on topics such as new risks, changing incident rates and loss potentials and critical control of the effectiveness of the risk management strategy applied, i.e. its potential to reduce risks to an acceptable level. If any need for a critical review of a farm's risk management strategy occurs, the whole risk management process has to be re-run.

Farmers in are exposed to the uncertainties of weather, prices and diseases. Many farmers live on the edge of extreme uncertainty, sometimes rising just above the threshold level of survival. Risk is considered as a major cause of low level of farm investment and income generation in agriculture. Therefore, management of risk in agriculture is one of the major concerns. The diversities in the sources of risks require a variety of instruments for protecting the farmers against such risks. Farmers need to understand risk and risk management skills for efficient and effective management of risk in farming.

Dr. Sandep Rout, Assistant Professor (Forestry)

Sal (*Shorea robusta*): a timber tree species

Sal is a large timber species in India, distributed over 12 million ha. From plains up to 900-1700 m altitude covering parts of North, East and Central India, 13.3 percent of the total forest area in the region. It

stretches from Punjab, Himachal Pradesh to Haryana states in the north via the sub Himalayan tracts, to Assam and Tripura states covering the hills of Garo, Khasi and Jaintia in the outer Himalayas. It is spread from western Bengal to the east. In the South and across most of South Eastern Madhya Pradesh up to Chindawara and Hoshangabad districts in the West, Odisha up to Vishakhapatanam. It is also distributed in Bhutan and Nepal. Sal is known as a holy tree by most of India's tribal people. Sal is one of the most gregarious Indian trees and appears to regenerate in masses under favourable conditions and grow in more or less even- aged crops of varying degrees in which it is either pure or the bulk of the stock is produced in mixture with other species. Sal belongs to the Magnoliopsida taxonomic group and the Dipterocarpaceae family. It is called Shorea robusta in Latin.

Botanical Description

Shorea robusta is a large deciduous tree with a height of up to 50 m and a thickness of 5 m; these are extraordinary sizes and, under normal conditions, S. Robusta trees are approximately 18-32 m tall and 1.5-2 m girths; bole is clean, straight and cylindrical, but also with epicormic branches; spreading and spherical crowns. Bark-brown and dark, 2.5 cm. Thick, with deep vertical furrows, thicker and fairly rough bark of old or matured trees with deeper furrows and greyish, reddish brown to dark brown, offers efficient fire protection. At a very young age, the tree grows a long taproot. A white liquid and oleo-resin that turns brown upon drying exudes upon tapping the trees. Cross-grained, pale brown to dark reddish brown Heartwood Coarse. Easy, glossy, glabrous leaves, about 10-25 cm long and about 10-25 cm wide, stout, leathery, glossy, alternate, small, oval at the base, apex tapering to a long point; reddish new leaves, soon becoming delicate green. Pale yellow or cream-coloured flowers, lax, terminal or axillary panicles, pubescent velvet. The fruit is 1-1.5 cm long, ovoid, reddish to pale yellowish green, slightly fleshy, indehiscent, with wings like permanent sepals, 5-7 cm long, 10-nerved, obtuse, linear wings. Ovoid, seed one. In March, the

plant bears young foliage and flower-fruiting starts in April during the summer season. Flowers are usually in March and fruits are in June·

Vernacular Names:

Assami: Sal, Dieng-blei, Hal-orang,Bolsal
Bengali: Shaalgaach, Sal, Shal, Sakher,Sakhu,Sakhua,Sakoh, Sala, Salwa,
Gujerati: Shaalvriksh, Ral.
Kannad: Saal, Kabba, Baelabobu
Malayalam: Saalvriksham, Malappumarutu, Karimaruthu
Marathi: Shaalvriksh, Raalechaavriksha, Sala, Guggilu, Rala, Sajara
Odiya: Shaaluaagachha, Sal, Shalua,
Punjabi: Shala, Sal
Tamil: Saalam, Kungiliyam,Talura,Kungiliyam
Telegu: Guggilam, Sarjakamu, Guggilamu, Jalarichettu, Gugal,Guggilamu, Saluva, Sarjakarna, Sarjamu Urdu: Ral

Habitat:

Sal is mainly found from Punjab to the hills of Garo, Khasi and Jaintia, West Bengal, Bihar, Odisha, Andhra Pradesh, and Madhya Pradesh along the sub-Himalayan tract. It can also be seen in hills of up to 1,700 m in the tropical Himalayas, Northeast and Central India and West Bengal·

Uses

Medicinal Properties

The resin obtained from the plant is known as an astringent and a detergent and is used in dysentery and bleeding piles and also for fumigating ill people's rooms with honey or sugar. It is also administered for gonorrhoea and poor digestion. The decoction of the bark is used as drops for ear problems and as fruit for diarrhoea. Dammar

Rein of India-*Shorea robusta*. In the form of a gum resin, it exudes from the fissure created in the bark of the tree. In European pharmacopoeia, it is a useful medicine. It consists of two forms, white and red, which are used as frankincense for fumigation and are soluble in alcohol. Sulphur blended. It is used as an ointment for sources of wounds, etc. And it is used as plaster for wounds, combined with wax. It's salty, heartbreaking, and nauseating. It is recommended by traditional physicians for venereal complaints including gonorrhoea, gout, etc.

Mixed with boiled milk, cough, piles, bronchitis, and leucorrhoea are a useful treatment. It will consume all of the morbid fluid from the system. In many Hindu homes, temples, sick quarters, the resin is also used for increased use. The powdered stem bark or bark paste is used among the tribal inhabitants of southern Bihar & the Kondhs of southwestern Odisha to avoid bleeding and facilitate cure of cuts.

Resins

When tapped once a month in the manner mentioned above, at each tapping, a fully productive tree was recorded to yield about 4 kg of damar, i.e. about 48 kg/year. However, variation in yields is considered to be genotypic (tree-to-tree) and some trees can only be tapped every 3 months due to low yields. In other situations, if the resin is not collected from a good-yielding tree for 6 months, the hole in the tree (10-15 cm wide and deep) will be fully filled. The production of resin is reported to decrease dramatically when the tree is flowering and fruiting, and reaches previous levels only a year later.

Leaf Plate

The fresh leaves are used for serving small snacks such as boiled lentils, and the sun-dried leaves are stitched together to create leaf plates (khali) and leaf bowls (dona) using grass stem sticks or sewing

machines. During domestic and ceremonial occasions, leaf plates are used for serving meals. The mahaprasad is served to the devotees in Anand Bazar's sal leaf plates in the temple of Lord Jagannath situated at Puri, Odisha. For the goats and cattle wandering in the streets, the used plates act as a meal. The leaf cups are routinely used at roadside eateries to serve prasadam to the devotees in temples; and also pani puri, chat, and ragda pattice. Since the Odisha salt forest occupies about 30 percent of India's total salt forests, it is one of the income-generating activities for the landless, marginal, and forest-dependent tribal people living in the Odisha districts of Sundargarh, Mayurbhanj, Kendujhar, Kandhmal, Debagarh, Nayagarh, Balasore, and Sambalpur. Due to the lack of legal constraints, the abundance of leaves throughout the year, and the presence of traditional expertise in leaf plate making, this occupation was adopted by the local people as a source of income. The final product, i.e. machine pressed plates, is exported via railways and roadways to the states of Andhra Pradesh, Bihar, West Bengal, Telangana, Madhya Pradesh, Karnataka, Maharashtra, and Gujarat.

Seed Oil

Since salt seed is a forest commodity, it has been difficult to access procurement directly. Therefore, from some of the outlets of Odisha Forest Development Corporation in Bhubaneswar, the extracted salt seed oil that was in butter form was procured. As far as energy security and environmental aspects are concerned, biodiesel has huge prospects in India. The challenges of realizing the 20 percent blending goal, however, are also very intriguing. Exploration of fresh and underused non-edible seed oils is of vital importance in this context. A small step in the right direction is the initiative taken in the current research work to investigate Sal or Shorea Robust as a biodiesel feedstock. In the present research, the production of biodiesel from salt seed oil was carried out through a transesterification process and then a detailed physico-chemical characterization was performed.

Wood

One of the hardwood timbers is Sal wood. It comes with grain that is rugged and coarse. In appearance, it is very light and turns into a dark brown colour with extended sunlight exposure. For furniture and other wood items, it was the chosen timber.

It can be concluded from the study that Sal as an effective ethno medicinal tree species curing numerous diseases and wound healing capacity. It is evident from the information it is a potential biodiesel tree. The literature regarding NTFPs Sal leave is a potential biodegradable leaf plate. Sal resin and wood also preferred for furniture are potential sources of economy. So its conservation and regeneration is of high priority.

Ms. Kalyani Pradhan, Assistant Professor (Horticulture)

Taro *(Colocasia esculenta* L. Schott*)*: An Underutilized Vegetable

The species of Colocasia is an ancient crop used worldwide, in Africa, Asia, the West Indies and South America. It is grown in the tropical tropics all over. Traditionally, its edible corms and leaves are used for liver related ailments. C. Esculenta is a member of the Araceae family and is commonly known as Taro. The plant's leaf juice is both stimulant and rube-facient and styptic. In internal otalgia, adenitis, haemorrhages and bubos, it is also useful. For hundreds of years, true taros have been grown in the South Pacific, and are available in the tropical area between India and Indonesia. Likewise, leaves are used as vegetables. The plant is herb with long heart clusters or arrow heads of haped leaves pointing towards the earth. It comprises erect stems that, as well as a few metres long, can be green, red, black or variegated. A variety of phytochemicals, such as vitamin C, thiamine, sapotoxin, oxalic acid, calcium oxalate, niacin, and riboflavin, are

present in plants. There are amino acids and proteins in the tubers. The corms contain 3-rhamnoside cyaniding, 3-glucoside cyaniding and 3-glucoside anthocyaninsperlargonidin. It is traditionally used to treat swelling of the stomach and pain and fever. It is also used to treat the big green leaves known as 'elephant ear' and 1-2 m tall on infected sores. The primary edible component of the crop is the tuberous root. Taro, a common name for the corms and tubers of various genera of the Araceae family, is a source of edible corms of C. The leaf juice is also used in snake bite as well as food poisoning in plant origin as conventional medicines. Uh. Esculenta. It is most commonly cultivated by several common names, such as Arbi, Arvi and Eddoe, in Southeast Asia. Rubefacient, stimulant, styptic, the juice of the plant leaf is effective in internal haemorrhages, adenitis, otalgia and buboes. Corm juice is demulcent, anodyne, and laxative. Antihelminthic, anti-diabetic and anti-inflammatory behaviours have been found in the leaves of the plant.

Colocasia esculenta is a perennial, tropical plant primarily grown as a root vegetable for its edible, starchy corm. The plant has rhizomes of different shapes and sizes. Leaves are up to 40 cm × 24.8 cm (15 3/4 in × 9 3/4 in) and sprout from the rhizome. They are dark green above and light green beneath. They are triangular-ovate, sub-rounded and mucronate at the apex, with the tip of the basal lobes rounded or sub-rounded. The petiole is 0.8–1.2 m (2 ft 7 in–3 ft 11 in) high. The path may have a length of up to 25 cm (10 in). The spadix is approximately three fifths as long as the spathe, with flowering parts up to a diameter of 8 mm (5/16 in). The female portion is intermixed with sterile white ones on the fertile ovaries. Neuters grow above the females, with six or eight cells, and are lobed rhomboid or irregular orium. Shorter than the male portion is the appendage.

Uses

Medicinal uses

C. Esculenta has many medicinal uses. All the pieces of the plant, viz. Leaves, stems and tubers exhibit different medicinal properties. Antimicrobial, antihepatotoxic, anti-diabetic, anti-lipid peroxidative action, anti-metastatic, antifungal, anti-inflammatory and several more are some of the properties. Taro corm was historically used by people of the Munda tribe as a cure for body ache. In alopecia, cetacean juice derived from the corm of a plant is used as an expectorant, stimulant, appetiser and astringent. The vegetable contains mucilage when cooked and has been found to be an important nervous tonic.The antidiabetic function of the extract of ethanol. *C esculenta* (EECE) leaves were carried out using an alloxan-induced model of diabetes in rats. EECE (100, 200 and 400 mg/kg) and metformin (450 mg/kg) were administered orally in diabetic-induced rats with alloxan (120 mg/kg, i.p.). The onset of blood glucose reduction was observed at 4 h (96 mg/dl), the peak at 6 h (120 mg/dl) but the anti-hyperglycaemic effect decreased at 24 h. Maximum blood glucose reduction (174.34 mg/dl) was observed in the subacute sample at a dose of 400 mg/kg on the 14th day. The findings indicated that in alloxan-induced diabetic rats, EECE (400 mg/kg) exhibits antihyperglycaemic activity. It has been stated to have the free radical scavenging property of esculenta whole leaf juice. By using a rat liver slice model, the in vitro free radical scavenging effect was studied on liver cells.

Genetic diversity in Taro

Taro is arguably one of the oldest crops in the world. Archaeological studies show its use in the Solomon Islands as early as 28,000 years ago. The highest clonal diversity indices were obtained in Asian and Pacific countries. Among these nations, sexual reproduction seems more likely to be the means by which taro has been genetically diversified.

Many cultivars flower naturally in the Pacific, where all cultivars are diploids, insect pollinators are very involved, and natural hybridization occurs regularly between cultivars. Mace and Godwin identified taro chromosomes with diploids (2n=2x=28) and triploids (2n=3x=42) when researching diversity using basic cytological methods (Mace et al., 2002). In India, the number of Taro chromosomes is 2n=14, 28, and 42 and 2n=36 and 48 and indicated that genetic instability may be due to long-term cultivation in the diversity centre area (Dastidar *et al.,* 2009). Quero-Garcıa *et al.,* 2006 reported that taro is a highly polymorphic, allogamous and protogynous species.

Improved Varieties

It has a number of varieties grown in different parts of India like Satamukhi, Kakakachu, Sreerashmi, Sree Pallavi, White Gauriya, Panchamukhi, NDC 1, NDC2 NDC3, Kadma, Muktakeshi, Jhankhri etc.

Nutraceuticals benefits of Taro

Taros have a high level of β-carotene in the corm, which will give the body vitamin A and antioxidant properties. β-carotene only varies quite slightly in structure terms. They are very popular carotenoids, antioxidants and have other possible health benefits. Taro tubers are rich in starch, and anthocyanins, cyanidin 3-glucoside, are found in the tubers. Linked anthocyanins are reputed to promote blood circulation in comparison with flavonoids by reducing capillary fragility to boost eyesight, act as potent antioxidants, act as anti-inflammatory agents, and prevent the growth of human cancer cells. The presence of oxalates that impart acrid flavour or cause discomfort when raw or unprocessed foods are eaten from them is one major limiting factor in the use of taro. The needle-like calcium oxalate crystals that can penetrate soft skin are responsible for this acridity (Bradbury et al., 1998). Cancer is the world's leading cause of death and it is often attributed to poor

eating habits and lifestyles. It is critical that the dietary components present in plant foods find ways to minimize and prevent the risk of cancer. Cancer is a condition of a multi-stage disease and tapping at any initial stage will help reduce the condition of the disease. In many types of carcinoma cell lineages and animal models, root and tuber phytochemicals have shown anticancer effects (Huang *et al.*, 2004).

Package and practices

Climate & Soil: With plenty of moisture, Taro needs a mild climate. Even in the colder temperate regions, it can also be grown. Taro grows well in all kinds of soils, deeply well drained, friable, particularly alluvial, the ideal kind.

Planting season: May-June (rainfed), any time (for irrigated).

Spacing: Optimum spacing for taro is 60x45cm.

Fertilizer requirement: 12.5 t/h, NPK: 80:25:100

Planting method: For planting, various kinds of land preparation are used, such as pit forming, ridges, and follow-up techniques. Due to improved preservation of soil moisture, the following approach is superior to the others.

Depth of Planting: 5-7 cm

Planting material: Both mother corm and cormel can be used as planting materials. If corms are used, it should be cut to small sets of 150-200 gm, and for cormels, whole tubers of 50-80 gm size are ideal.

Planting materials requirement: 1800-2500 kg corms or 600 to 100 kg cormels are required.

De-suckering: By de-sucking the unhealthy suckers and maintaining only the safe suckers, the tuber yield and size of good quality tuber per plant can be increased. Maximum yield is achieved when the growth of three healthy suckers is allowed.

Mulching: Application of mulch soon after planting is beneficial for Taro, as it conserves soil moisture and regulates soil temperature. Green leaf mulching enhances yield significantly in taro.

Weeding & Earthing up: Two times of weeding & earthing up should be done. 1st weeding & earthing up will be after 45 days of plantation with the full dose of P and split dozes of fertilizer (half dose of N & K) and another weeding & earthling up after one month with remaining half dose of N & K.

Irrigation: Under moist conditions, Taro performed well. If rainfall is not adequate, supplementary irrigation must be provided to maintain soil moisture near field capacity. More frequent irrigation at 10-day intervals was necessary for summer crops.

Harvesting: When the majority of the leaves begin to turn yellow, Taro is ready. Crop length varies according to cultivation methods and cultivation methods. Taro will be ready for harvest in around 5-7 months in India.

Pests and diseases of taro

Armyworm (*Spodoptera litura*)

It is an Asian and Pacific pest with a wide host range. Eggs are laid in masses and covered by scales of hair from the tip of the female moth's abdomen. Masses of eggs are typically creamy to golden-brown. The colour of the larvae is variable: the young larvae are light green, while the stars are dark green to brown later on. Bright yellow stripes are typical of Spodopteralitura larvae along the dorsal surface. The adult is grey-brown with a heavily variegated pattern and paler lines along the veins. The forewings are grey to reddish-brown. The hind wings are greyish-white with the edges being grey. At first, the early larval stages remain together, radiating out from the egg mass later, stripping the surface of the interveinal leaf and skeletonizing the leaves as they progress. Both parts of the leaf, including the petioles, are eaten in later phases.

White spotted flea beetle (*Monoleptasignata*)

Minute eggs are laid around the host plant 's base in soil cracks. In the soil, minute worm-like larvae live and feed on tiny plant roots and root hair. With two yellowish markings, the hard forewings are black, one in front and the other behind the middle. In older beetles, the head, thorax and abdomen are reddish brown, and in younger beetles, they are much lighter. Beetles with long antennas are approximately 3–3.8 mm long. By feeding leftover tissues, adults develop large holes in leaves. Adults on leaves are prominent and frequently found.

Whitefly (*Bemisia tabaci*)

Adults are fly-like, soft-bodied, yellowish, dusted with white waxy powder and 1.0-1.5 mm in length. The females often lay eggs on the underside of leaves near the veins. In order to lay more larvae, they prefer hairy leaf surfaces. Upon hatching, the first nymph moves to find an acceptable feeding site on the leaf surface. Powdery wax coats the wings and the body is light yellow in colour. Both adults and nymphs suck the sap of the plant and decrease the plant's vigour. They secrete large amounts of honeydew when populations are high, which favours the growth of sooty mould.

Cotton aphids (*Aphis gossypii*)

The eggs are yellow, but soon the colour becomes glossy black. Nymphs range from tan to grey or green in colour. The adult body ranges from light green to dark green, but white, yellow, pale green, and dark green shapes are also present. On the underside of the leaves, or at the rising tip of the veins, cotton aphids feed, sucking nutrients from the plant. The leaves will become chlorotic and prematurely die. Their feeding also causes a great deal of distortion and curling of the leaves, hindering the plant's photosynthetic potential.

Leaf blight

It is caused by *Phytophthora colocasiae*, a fungus. About a century ago, it was first recorded in Java and has since spread to various parts of Asia and the Pacific.

The disease starts out on the leaf as purple-brown water-soaked lesions. The lesions ooze a bright yellow liquid. Then, in 10-20 days, these lesions enlarge, bind together and gradually kill the whole lamina. In addition to high temperatures and high humidity, free water collection on older leaves is conducive to the onset and spread of the disease and the germination of spores. The disease can be transmitted by wind and splashing rain from plant to plant. For three or more weeks, spores survive in the planting material. Thus, one common means of spreading the disease over long distances and from season to season is contaminated planting material. *Alocasia macrorrhiza*, a common aroid crop in the Pacific region, is also affected by the illness, but the symptoms and loss of yield are less extreme.

Yield losses of 30-50 percent can be caused by the disease and the quality of the reduced crop is reduced. In affected areas, taro leaves are also scarce for human consumption. The majority of countries where the disease has been identified are strictly isolated by quarantine.

C. Esculenta has a lot of variety in both the pharmaceutical and research industries. One of the staple root and tuber crops cultivated for various purposes is Taro. A variety of beneficial nutritional and health benefits

are offered by its tubers, such as anticancer activity, phenolic acid, phytochemicals. In many developing countries, taro is used as a staple food or subsistence food by millions of people. Therefore, this plant should be explored in order to make full use of its medicinal and pharmaceutical properties.

Dr. Darshan, Assistant Professor (Agricultural Extension)

Leveraging farmer producer organizations

Agriculture is rightly said to be the backbone of the Indian economy as it contributes to 13.7 per cent of Gross Domestic Product (GDP) and provides employment to 58 per cent of population of our country. With the advent of the green revolution, there has been a significant four-fold increase in food grain production during the last five decades. The production trend has projected to a laudable state of self-sufficiency from a meagre 51 million tonnes in 1950-51 to record production of 284.8 million tonnes of food grains by the end of 2018. This provides strong evidence for the fact that the Indian farmers are good producers.

However, the increase in agricultural production has not resulted in an increase in income of cultivators. In the present Indian context of rapid changes, the agricultural sector is facing severe challenges like declining per capita agricultural land availability (due to increased fragmentation of land holdings), declining natural resource base, increasing demand for land for non-agricultural purposes due to urbanisation and industrialisation, breaking of joint to nuclear families, disinterest or disenchantment of youth towards agriculture i.e. more than 40 per cent of rural youth want to quit farming, absence of a vibrant model to organise farmers and link with the market (NSSO, 2011). According to the agriculture census 2015-16, 86.21 per cent of Indian farmers come under the small and marginal category. The per capita agricultural land availability in India, at present, is 0.13 ha.

Problems faced by Indian small farmers are multi-fold. They produce fruits and vegetables in rural areas but they are highly demanded and highly priced in urban areas. For this, they need to sell the produce in cities but unfortunately, rural India lacks transportation facilities and storage facilities which would otherwise have helped farmers to store their perishable produce for a longer time period and sell it at a later

time when the market prices are favourable. More than 45 per cent of fruits and vegetables and 30 per cent cereals are wasted due to lack of storage and processing facilities. Post-harvest losses of food grains in India account to 10 per cent of total production, i.e. 20 million tonnes which is equivalent to the total annual food grains production of Australia. (TACSA Report on Secondary Agriculture, 2013). Processing and value-addition can secure better prices for the farmers' produce but the farmers lack the needed amount of money and infrastructure required for processing. Access to the latest information and technology and recent market trends and prices are also not available to the farmers. This lands the farmers in a position of ignorance and low bargaining power, which makes them vulnerable to exploitation by middlemen. As a result of all this, the farmers suffer distress sale and ultimately, sell their produce at throwaway prices. This reveals the glaring fact that Indian farmers are poor marketers. They do not get remunerative prices for their produce. The share of the producer in consumer's rupee, at present, is 10 to 23 per cent only in India against a remarkable 64 to 81 per cent in developed countries. Another emerging challenge before the small scale farmers is the present trend of globalisation and liberalisation. This has further complicated the situation by throwing small-scale producers to fight large commercial producers from all around the world. Thus, fragmented and dispersed in remote areas, small producers face a number of challenges which cannot be tackled individually.

Traditional agriculture will not be able to sustain the farmer's interest. In this context, if agriculture has to survive, we have to explore ways and means to make it more profitable (increase income obtained per unit of time & land), and more employment opportunities in agriculture need to be created. In this modern era of cut-throat competition, agriculture will be only successful if it will move from culture (a way of life) to a dynamic entity of agribusiness.

Research increasingly shows that smallholders would be able to substantially increase their incomes from agriculture and allied activities if they participate in markets. As a result, the focus of development has shifted from the enhancement of production to market connectivity. One of the potential alternatives for efficient marketing is mobilising farmers for group action, for arranging inputs and collective marketing so as to benefit from economies of scale. Keeping this in mind, mobilisation of farmers into "Farmers' Organisations (FOs)" for group activities is very much imperative.

Farmers' organisations are groups of rural producers coming together to form organisations, in order to pursue specific common interests of their members developing technical and economic activities that benefit their members and maintaining relations with partners operating in their economic and institutional environment.

Farmers' organisations are essential institutions for the empowerment, poverty alleviation and advancement of farmers and the rural poor. NCF, 2006 stated that "FOs should be promoted to combine the advantages of decentralised production and centralised services, post-harvest management, value addition, and marketing.

International Fund for Agricultural Development-2004 (IFAD) opined, in rural areas, FOs are the nearest and often, only institutions providing essential goods and services to the rural poor and helping them to break out from the poverty cycle. FOs reduces the risk - individual farmers face during seasonal shocks. FOs also helps to mobilise capital and contribute to the growth of the local economy.

A Producer Organisation (PO) is a generic name that represents different forms of community organisations such as large cooperatives, Primary Agricultural Cooperative Societies (PACS), Self-Help Groups (SHGs),

Federation of SHGs, Commodity Interest Groups (CIGs), Joint Liability Groups (JLGs), Farmers Club (FCs), and Producer Companies (PCs).

Farmers Organisations can take one of the many possible forms, like Farmer Interest Groups (FIG), CIGs, Cooperatives, SHGs, Farmers' Associations, Producer Organisations, Federations, and Unions. Whatever be the form of the organisation, there are some characteristics which hold farmer organisations together– a common interest, mandatory membership, rules, regulations and discipline, adherence to quality standards in production and shared roles and responsibilities on a rotation basis.

The basic idea is that farmers' organisations will strengthen the farmers' negotiation position in relation to the buyers, reducing transaction costs and production risks faced by the farmers. This will bring farmers closer to the market, enable them to benefit from comparative advantages and maybe even to connect them to the international market. The purpose of establishing FOs is to internalise extension services for its members and provide backward linkages (input, credit, and technology) and forward linkages (production facilities, market and value addition).

Farmer organisations can be grouped into two types: one is the community-based and resource-orientated organisation; the other is the commodity-based and market-orientated organisation. Community-based, resource-orientated FOs could be present at village level consists of more diversified clients in terms of crops and commodities. They focus on dealing with inputs needed by the members, to enhance the productivity of their businesses based on land, water, or animals. These organisations are generally small, have well-defined geographical areas, and are predominantly concerned about inputs. These organisations can generate income from the sale of inputs and outputs. The income can be used back to spend on extension, data generation, business planning, and

administration. Examples of such organisations are agriculture cooperative societies, farmer's clubs, SHGs, FIGs, etc.

Whereas commodity-based, market-oriented FOs focus on a single commodity and choose for value-added products which have expanded markets. They are designated as output-dominated groups. Not specific to any single community, they can obtain members from among the regional growers of that commodity who are interested in investing some share capital to acquire the most recent processing technology and professional manpower. These FOs are generally not small and have to operate in a competitive environment. Research, input supply, extension, credit, collection of produce, processing, and marketing are all integrated to maximise the returns on the investments of the members who invested in the collective enterprise. Some of such organisations are Anand milk and other dairy FOs, jackfruit growers association, grape growers association, onion growers association, etc.

At present, there have been an increasing number of attempts to organise farmers in India. Agriculture Technology Management Agency (ATMA) organises farmers into groups (FIGs and CIGs), Innovation in Technology Dissemination (ITD) and National Agricultural Technology Project (NATP) evaluated success stories and tried replicating the models, Non-Governmental Organisations (NGOs) and Panchayat Raj Institutions (PRIs) organise farmers groups, National Bank for Agricultural and Rural Development (NABARD) organises farmers into SHGs and farmers clubs, line departments form producer groups through different commodity boards, State Agricultural Universities (SAUs) also facilitate formation of farmer groups through support of Krishi Vigyan Kendras (KVKs). The role of extension in promotion of FOs (Chamala, 1990) includes (1) empowerment role (2) community-organising role (3) human resource development role and (4) problem-solving and education Role.

Small Farmers Agribusiness Consortium (SFAC), through FPOs, intends to work closely in support of the Department of Agriculture & Cooperation

and the various state governments to enhance production, productivity, and profitability of small farmers in the country. Farmers will be organised in small neighbour-hood informal groups which would be supported under the program to form associations/organisations relevant to their context including confederating them into FPOs for improved input and output market access and negotiating power,

Farmers Producer organizations can help in bringing prosperity to the lives of small and marginal holder farmers by means of collective action and resultant economies of scale, bargaining power and collective decision making. FPOs can give training to members on good agricultural practices based location specific farming system approach and low-cost and environmental friendly inputs. It provides uninterrupted advisory services to its member farmers, ability to compete with business organizations, professional management aspects, entering into contract to reduce input and marketing risks, procuring firm orders from market and government programs, creating effective value chain to the farm produce locally and generate employment for rural people, help in improving the export potential of agricultural produce and help the farmers to reap full advantages of various schemes meant to help them. In the initial stages the support from government, resource institutions, and financial institutions may be required mainly because these are collectives of resource poor farmers, who may not be able to mobilize the required working capital and also might be lacking in managerial abilities.

Dr. S. Kumaraswamy, Professor (Soil Ecology)

Biodiversity banking: An economic tool in conservation strategies

Biodiversity banking is a market driven instrument designed to ensure biodiversity offsets are implemented consistently and strategically

where natural resources are used sustainably to conserve the biodiversity for their value. The banking mechanism does not imply absolute trading of the biodiversity rather it is an incentive based conservation initiative by way of attaching value to the life-forms of the nature. The success of the mechanism depends on the stakeholder's knowledge on the biodiversity reserves, degradation pattern and dynamics at landscape to regional scale. Believably, the stakeholders with highest level of resource biology knowledge tend to respond positively towards the initiative. However, inevitable heterogeneity within the population due to difference in socio-economic factors, attitudes, values and perceptions must be defined to realize meaningful implementation of the mechanism. Hierarchically, bio- diversity banking is a last resort unlike various environmental conservation activities. However, biodiversity banking is appealing to the stakeholder as it is linked to incentive schemes for the willingness to comply with the conservation activities.

Biodiversity banking process allows accumulation of 'tradable biodiversity credits to derive monetary benefits by the stakeholder if they commit to enhance the biodiversity value of the land. However, the guidelines for trading the credits need to be established with clear definition on criterion for fixation of price for the biodiversity in terms of its rarity and services it provides to the immediate stakeholders with its larger cumulative benefits to the region. The incentive based and/or mutual trading of biodiversity and their services is yet to be realized. The traders and buyer community can be either the actual beneficiaries who share the mutual benefits by way of conserving the location specific biodiversity and/or through an offset mechanism by bio-bankers. There is need for the development of defined guidelines for the bio-bankers and local governments to realize effective implementation of biobanking process to maintain the biodiversity and its services linked to social and economic considerations of the stakeholders.

Biodiversity offset mechanism, with positive outcome to qualify for the biodiversity banking process, is one of the inclusive options in the hierarchy of environment restoration and management. The offsets schemes can be on-site, off-site, off-site through third party and/or voluntary. The offset mechanisms might operate in terms of (i) bilaterally developed offset (land owner as offset provider and developer); (ii) offset developed between a landowner and group of developers; and (iii) independent development of offset irrespective of earning bilaterally tradable credits. These offset mechanisms require a critical view on designing the stakeholder friendly strategic schemes for securing private land to conserve and improve the biodiversity value. It can be achieved by providing compensation to the willing private land owners for participating in the biobanking process. The compensation can be in terms of rebate on tax, premium price tags for marketable services, funds allocation for the restoration and option to sell credits irrespective of the market price.

While developing biodiversity offset mechanism, land has to be classified as (i) high biodiversity value; (ii) medium biodiversity value; and (iii) low biodiversity value to design suitable strategies to implement the partnership based biodiversity banking in each of the identified zones. Such a classification will minimize the project initiation costs and improves the assessment to ensure maintenance of onsite biodiversity with due consideration to the principles of restoration ecology. It requires highly reliable and scientifically robust database on components of biodiversity at micro-to-macro-scale. Hence, scientifically robust attempt in offset mechanism to derive incentives under biobanking has relevance to ensure success in conservation approach.

Need for strategic considerations

Biodiversity banking may not have instant economic pull needed to justify the startup funding to initiate the concept. Predictably, the concept development and success of implementation will be expected to be higher where resources are abundant and stake- holders with clear knowledge on biodiversity. In this direction, an altruistic partnership and understanding of biodiversity issues at various levels is the key to design the biodiversity- banks. Further, biobanking process also requires establishment of implementable conceptual frameworks. The framework must include precise clarity on multi-lateral or bilateral agreements, good governance criterion, legislative framework and law enforcement, consideration to regional economy, scientific research needs, traditional knowledge available on local biodiversity, intellectual property rights (community owned), traditional resource rights (inextricable link between culture and biodiversity) or uniqueness/rare/endangered biodiversity.

Biodiversity banking and offsets may be delivered in alternative mode of 'like for like' swap system. For example, the Shell Foundation negotiated an offset supporting the Smithsonian Institute's initiative of assessment of biodiversity and monitoring rather investing on land. Likewise, 'Potsdam Initiative—biological diversity 2010' mooted by G8 countries acts as testimony for the government commitments to influence financial institutions to include biodiversity into their decision-making process. However, demonstrated credibility of institute and organization is critical in persuading the lending institutions like corporate sector and public banking institutions. Admittedly, there is lack of guidelines in biodiversity offset mechanism to ensure the success of biobanking process, which has been a hurdle at this juncture. Further, skeptic views of government agencies to trade the biodiversity at various scales need persuasive approach.

Current knowledge on biodiversity offset process is limited due to subjective approach in estimation and contextual complications of broader social and economic change. The risk of failure of the mechanism can be buffered through network reciprocity and co-evolution to build competition among the cooperators and defectors. Further, issuance of monetary bond as insurance by prospective funding agencies can assure success of the biodiversity offsets. Moreover, the concept with promise needs forthcoming consideration from responsible stakeholders, willingness of business ventures from corporate houses, financial institutions and government commitments to train and monitor the process. Most of the time investment in conservational initiative suffers from the focus on risks rather than exploring the business opportunities with larger societal benefits. Public–private-partnership model can be a proactive step in this direction to manage the risks and look up for new emerging opportunities. Nevertheless, a strategic approach with long-term projections identifying the risk factors will help draft the criterion and indicators for biodiversity banking process in business partnership ventures. There exists plethora of biodiversity repositories for the application of the concept and exploring the development of biodiversity- banks with mutual and/or equitable sharing of services and monetary benefits. Environ- mental certification for such biodiversity-banks (public-private-partnership model) can be yet another tool to enhance the vigor, sustenance and incorporation of technological advances for scientific conservation approach.

Criterion	Indicators	Remarks
Policy (local to regional scale)	Must address issues of relevance for policy making (market, incentive, institutional mechanism, potential financial partners-stakeholder interface).	Wider applicability, comply with international policy issues, facilitate the international trading mechanisms and funds for development of biodiversity- banks at

		local to regional scale.
Validation of analytical reliability and biodiversity value index of biodiversity-banks (commercial ventures)	Views of researcher, stakeholders, immediate rural beneficiaries and consumers of services. Each may legitimately contribute differently. A valid indicator must therefore be able to reconcile the need for plausible scientific analysis with a requirement to be recognized as legitimate by other non-scientist, stakeholders.	Equitable benefits sharing is a driver for mutual ventures as profitable business yet with conservational in approach Stakeholder own a major share of profits for contributing to the traditional knowledge and skills to improve valuation of biodiversity.
Accessibility to uses at an appropriate scale (flexible offset mechanisms)	An indicator may have policy relevance at only a particular scale and thus selection must match an indicator to the scale that is appropriate to those decision-makers who will use it.	Gross root communities as decision-makers, elimination of gender bias, improved participation of women in the decision-making process is must.
Measurability (robust database)	In the context of an immediate need for indicators to monitor policy impact, the key question is the availability or easy acquisition of data.	Validation of traditional knowledge, conservational methods, priority need based biodiversity conservation of high economic value and wider usability. Common value index to compare biodiversity-banks performance in terms of profits (normalization, weighting and aggregation, sustainability indices).

Majority of biodiversity banking stewardship can be exploited from the developing and resource poor countries. Such a stewardship in these countries require establishment of suitably defined funds allocation mechanisms to pay for stewardship services, especially for the biodiversity whose benefits are too diffuse to market mechanisms. Further, definition on property rights in stewardship is essential to exercise adequate control while managing the biodiversity-banks. Admittedly, revising property right legislation can be a lengthy

process. However, ownership issues and consensus on property right can be defined in a mutualistic manner by the conservation advocating institutions, which require support from local, national and international stakeholders. Likewise, financial institutions in association with local groups can help improve the interpretation on the legal pluralism of the land rights to design mutually benefiting rules. Further, biodiversity banking mechanism must include local people as an integral part of decision-making process to utilize their knowledge on conservation skills, consideration to their dedication and creativity as non-monetary resources.

A streamlined institutional arrangement in biodiversity banking is a requirement to overcome the concerns of stakeholders. A strategic strengthening of the partnerships with institutions of similar mandate between NGOs and CBOs is critical for the biobanking process. There are also several debatable considerations to refine the public–private-partnership in biodiversity banking process. These points act as guiding principles while defining the process and refine them suitably for the local and regional governance mechanism. The partnership can also be extendable to pricing and marketing mechanisms negotiable between the user groups and service providers mediated by government and conservation advocating institution inclusive of CBOs and NGOs. Indicatively, a well-defined institutional arrangement is pre-requisite in biodiversity banking stewardship, when the agreements involve culturally diverse communities. The trust building is another important consideration to win over the confidence of skeptic communities with least knowledge on biodiversity and its services. Under such situations, community institutions can play a vital link to educate, negotiate and resolve the conflict of interests. It requires a committed and persuasive campaign by the local CBOs and national and international NGOs to analyze the community attitude towards the conservational initiative linked to business and also to establish the basis for negotiations in the partnership.

Some biodiversity repositories of importance suitable for biobanking stewardship

Repository type	Stakeholders	Business avenues/mechanisms
Sacred groves	Culturally diverse groups, temple management, quasi-government affiliation of temple	Ecotourism, NTFPs, pharmaceutical, organic dyes, handicrafts
CCA, common lands with unique biodiversity	Communities, villagers, panchayat	Reserve biodiversity– tenurial ownership by corporate, eco-taxes payable to stakeholders, partnership based business ventures
National parks/ sanctuaries/ wetlands	State and central government, wildlife authority, MoEF & CC, parks authority	Internationally tradable bi-lateral agreement with government and biodiversity authority of international status (CBD, IUCN)
Private reserves	Royal families, business houses	Sharing the ecosystem services with immediate beneficiaries as social responsibility, nominal levies use the resources of commons, ecotourism
Corporate lands	All corporate house, industrial groups	Tradable to local government to claim the social responsibility share, urban biodiversity enhancement for aesthetic and regulatory services value, Schemes to comply with environment protection, implement scientifically feasible offsets
Urban fringe landscape/traffic islands/aesthetic land area	State government, municipal councils	Non-tradable common property but maintained by corporate sector under social responsibility rules
Cemetery/burial grounds/ memorial parks	Land of Commons	Reserve biodiversity, tradable carbon credits, medicinal plant parks
Watersheds	Farmers, revenue department, forest department	Private bankers, CDM traders, NTFPs business parks, medicinal parks, ecotourism
Sacred heritage sites	Government, quasi-government, royal families, hospitality/hoteliers	Rare and endangered species conservation, business venture on partnership basis

		for multiplication, ecotourism
Avenue biodiversity	Government, common man	Reserves of commons, tradable carbon credits, amenities business plans, voluntary public participation
Recreational/ educational parks/research and educational institute biodiversity reserves	Government, quasi-government, private, trust/foundation	Tradable biodiversity-banks of biodiversity for corporate house—manage and save eco-tax, act as sites for long term scientific research
Kitchen gardens	Common man, households	Household/cottage industries, processed Products Incentives for community owned for biodiversity of economic value
Agro-biodiversity/ farmlands	Farmers, progressive farmers, technologically improved farming systems, not an open access system	Communities owned organic products business, corporate partnership on lease basis, traditional seed multiplication and marketing, gene banks
Wastelands and degraded lands/ waste dump sites	Government, individuals with sound business plan for biodiversity offsets, service providers, CBOs, industry partnership with village communities	Land value improvement, subsequent transformation to allied activities of high economic returns, vegetation cover enhancement.

In this initiative it is vital to issue stewardship permits and/or contracts with defined enforceable terms, while developing the agreement clauses. The agreements must define poverty alleviation through the promotion of individual stewardship. It requires concerted efforts from government, civil society and NGOs to evolve complementary policy reforms and enforcement of norms. Indeed, the initiative is of national and international interest to promote the responsible conservation of dwindling biodiversity. However, the process must emphasize creation of livelihood support systems to the stakeholder

inclusive of resource poor communities for equitable profit sharing and recognize their traditional rights.

Currently, the funding for the initiative is a prominent hurdle in the absence of defined rules and guidelines for stewardship. The existing developmental research funds provided by the government and quasi-government institutions limit to basic and environmental improvement projects with minimal activity to evolve objective valuation of various facets of biodiversity and its services. There is need for policy reforms to aggregate funds for targeted research on biodiversity conservation linked to business avenues with win–win options to make biobanking process a success. Worldwide, there is growing interest to harness the economic benefits from biodiversity banking as a responsible business venture and also source of additional livelihood support system to economically poor stakeholder community. It calls for concerted effort to develop mutualistic biobanking stewardship to sustain the ecological integrity for the benefit of civil society as part of biodiversity conservation initiatives. The policy reforms to implement incentive based innovative conservation initiative like biobanking provides an opportunistic avenue to create win–win situation for public–private partnership, which is essentially governed by norms of national and international authorities. Thus, biobanking process will assist the developing and economically poor countries to effectively implement the biodiversity conservation initiatives with the duality of enhanced livelihood support system as identified in the millennium development goals.

Student-mind-tree

Mr. Ankit Kumar Keshari | B.Sc. (Hons.) Agriculture Year 4

Diversified organic farming

The marketing of agricultural produce is an important activity as it needs to balance the affordability and availability of feed for consumers with sustained improved income to farmers. But with this, several challenges have been identified in agricultural marketing which adversely affects the farmers. Continuous increase in the cost of cultivation with a tremendous fluctuation in market price is one of the biggest reasons that adversely affect the income of the farmers due to instability in demand and supply of the farm produce during various seasons. This issue can be addressed with a pronged approach by modifying the cropping system as well as the quality of agricultural produces i.e. Multi-storey cropping system + Organic farming. This practice is meant to enhance farm productivity with a limited area by efficient utilization of available natural resources i.e. air, water, light, space, and nutrients. The introduction of the multi-storied cropping system or multiple cropping in organic farming ensures the best combination of crop-tree intercropping with the production of healthy crops that enables

farmers to earn regular income throughout the year in different seasons which ultimately address the price fluctuation in the market.

In the future, the availability of land for cultivation will be a major impendent due to the rapid increase in urbanization, and also there will be degradation of fertile land due to soil erosion with the rapid use of chemical inputs to increase the yield per unit area to feed the demand of people. Under this situation, effective utilization of the available land with the proper diversified cropping system for production of field and horticultural crops is the only approach to achieve nutritional security for the growing population and sustainable income for the farmer community.

Introduction of diversified cropping system along with organic farming into traditional farming system could be one of the solutions to realize sustainable productivity and maximum income per unit area besides maintaining soil fertility by the recycling of natural resources. A multi-storied approach is an alternative farming system specifically for small and marginal farmers to provide greater economic return per unit area. This new hybrid approach has been executed by an innovative farmer of Maharashtra.

Path breaking success of farmer:

It is a very well-known fact the farmers of the Marathwada region in Maharashtra are suffering and continuously facing a tough situation of drought, unseasoned rain, hailstorm, and government apathy towards farmers and fallen prices of agricultural produce from last few years. There are shreds of evidence that farmers are committing suicide due to financial distress, lack of timely help, crop failure, and poor prices for their crops. When many farmers are discarding themselves from farming due to such natural calamities and uncertainty in net income. The only person Shri Ajay Prakash Rao Jadav has come forward to demonstrate sustainable organic farming.

He is having only 10 acres of land in the village of ‘Kheda’ in Kannad tehsil of Aurangabad district devoted his life with new experiments in farming. Before going to start a new experiment in the traditional farming first he studied the market infrastructure of his region to better understand the supply and demand of the agricultural produce in the local market.

Based on his survey he got to know, in his locality people are unaware of the importance of organic produce, so selling of organic produce in the local market may not be a profitable approach, so for getting a better price of the produce and to avoid losses due to middleman, he contacted with wholesalers. And there was a greater demand of organic produces from all wholesalers, so to produce the organic crops in bulk quantities, he developed a farmer association with the local farmers and shown the path of success by practicing organic farming with a cluster approach. Ajay Jadhav focused on using natural ways to enhance the quality of soil and cultivated crops by following diversified organic agriculture. This lessened the cost of the product and got a good price for organic produce.

Organic Methodology:

He started the new experiment of diversified organic farming in his 10 acres of land where first he divided the whole land into small patches to maintain the diversity of different crops. His primary objective was to utilize the limited available area to earn maximum output. In 5 acres of land he introduced multi-storied farming by growing different fruit crops (mango, guava, jackfruit, grapes, etc.), plantation crops (coconut, arecanut, etc.), spices and some vegetable crops which yield in different seasons throughout the year that address the of price fluctuation in the market.

On the other hand, in 2 acre of land he cultivates more than 120 types of vegetables with two different species each for seed production to

earn better income per unit land area. Remaining 3 acres of land is utilized for Apiculture, Poultry, and Dairy farming. There is a demand of quality honey in the market, but Bee Venom which is a poison release from the body of honeybees while stinging that used in apitherapy (natural treatment of illness) and has a greater demand in the market than the honey i.e. Rs. 10,000/gm. So, from apiculture unit instead of collecting only honey, he uses electrical stimulator to collect the bee venom produce from honey bee. To enhance the soil health instead of using various chemicals Ajay Jadhav uses Trichoderma, Verticillium, Paecilomyces, Pseudomonas as useful bacterial inoculums to enhance the soil.

By practicing diversified farming, he found that he was increasing the health of soil and keeping nature and human health unharmed. He found the best way to enhance the health of soil and of humans.

Successful Marketing:

Though Ajay Jadhav succeed in producing organic produce in bulk quantities, but selling these produces was a big challenge for him. Generally, consumers are in search of low-price produce and avoid purchasing such organic produce by paying more. However, regular awareness could help him develop a good business through ICT networks. When people started eating hygienic organic food, they get good results of healthy eating. Seeing believes the neighbours of his customers have also started demanding the organic produce now for various health reasons. By practicing diversified farming, he found that he was increasing the health of soil and keeping nature and human health unharmed. He found the best way to enhance the health of soil and of humans. Now with the 10 acres of land Sri Ajay Jadav is earning Rs.19

lakhs per annum. Ajay Jadhav has become a real inspiration for the youth to empower in sustainable agricultural practices.

In our country majority of farmers belong to small and marginal categories. And most of the farmers cultivate seasonal crops. Hence after a certain time interval, they have the scope to earn. Organic diversified farming may be an alternate approach to earn whole round the year as well as there is less risk of complete crop failure.

Ms. Satya Ranjita Singh | B.Sc. (Hons.) Agriculture Year 4

Bamboo shoot: The cheapest immune booster

Bamboos belonging to family Poaceae are considered as one of the most versatile multi-utility forest tree grasses. Though distribution of bamboos is worldwide with over 1250 species, their presence is mainly found in Southeast Asia. They are known to have more than 1500 uses and are considered as one of the most economically important plants in the world. The bamboo is used in paper, handicraft industry, house construction, and making furniture, water pipes, storage vessels and other important household items. Bamboos in addition to their multiple applications have another important usage in utilizing their juvenile shoots as popular food items.

Bamboo shoot and its nutrient composition

Bamboo shoots have immense potential of being used as important health food as they contain high proteins, amino acids, carbohydrates, many important minerals, and vitamins. Freshly collected bamboo shoots have

good amount of thiamine, niacin, vitamin A, vitamin B6, and vitamin E. the diets are rich source of dietary fibres and phytosterols and less cholesterol contents which make them one of the popular natural health foods. Bamboo shoots contain generally tyrosine, arginine histidine, and

leucine as amino acids. Out of 17 amino acids reported in bamboo shoots, 8 amino acids were essential for human body. The presence of tyrosine facilitates biochemical metabolism of our body as it is a major constituent of adrenals which are precursors for adrenaline, necessary for active body metabolic activities. It also plays important role in function of thyroid and pituitary glands which are involved in producing and regulating hormones in human body. Presence of high fibre and phytosterols in bamboo shoot reduces fat and cholesterol levels of blood. The dietary fibre possesses number of health benefits as it controls blood pressure, hypertension, and obesity and also protects our body from coronary diseases and potential carcinogens.

Global market and Indian scenario

The present global market of bamboo shoots is around $1,700 million. More than 3million tonnes of bamboo shoots are consumed across the earth annually, but the shoot production and consumption in India are confided to north eastern states in this corona situation also is working at its best. Bamboo has been a key ingredient in new antimicrobial soaps and hand mists developed by Filipino scientists to fight against novel corona virus.

Way forward

According to the National Bamboo Mission, India has the highest area (13.96 million hectares) under bamboo and is the second richest country after China in terms of bamboo diversity with 136 species. The annual production of bamboo in India is 14.6 million tones and the bamboo-rattan industry in the country was worth ₹ 28,005 crores in 2017. So a little change in production method, awareness and postharvest management can enhance the export and diversification of food product.

'World Bamboo Day' is celebrated on September 18 every year. This year countries discussed about the medicinal property of bamboo. The theme of this year is 'bamboo now, 'the bamboo is growing'. so let's help bamboo and our country to grow.

Mr. Satyabrata Basantia | B.Sc. (Hons.) Agriculture Year 4

Transforming agriculture through artificial intelligence

The agriculture and allied sectors are considered as the bedrock of India's economy. The traditional agricultural practices we have been following have always tried to maintain the balance between farming and nature, and as a result, the great Indian civilization prospered with a rich culture of agriculture and allied industries. It is the principal livelihood for over 58% of the rural households. As per Food and Agriculture Organization of the United Nations (FAO), by 2050, the world's population will reach 9.1 billion . Our next generation will need 50% more food which will be more calorie intensive with the lesser agricultural lands available along with the growing problem of climate change. To overcome this upcoming crisis agriculture sector must evolve. Humanity has come a long way over the millennia in how we farm and grow crops with the introduction of various technologies. Artificial

Intelligence (AI), along with other digital technologies, will play a key role in modernizing agricultural activities and achieving the goal of producing more food on lesser land. AI is intelligence shown by machines which comes through analysis of data. It stimulates the intelligent behaviour of human beings like thinking and reacting, and achieves human-like performance in all cognitive tasks using purely logical reasoning. AI continuously learns and observes and keeps upgrading itself to work more efficiently. With the use of powerful algorithms, it analyzes huge amount of data and with recent advancement in computing power and cloud technology it has begun dawn of a new era in agriculture. AI simply amplifies human intelligence and takes better decisions for the crop.

AI can be used in various fields of Agriculture sector;

Soil & Crop Monitoring: Soil and crop monitoring performed via image recognition and deep learning models can be used to take corrective measures to restore soil and crop health. Remote sensing (RS) techniques along with hyper spectral imaging and 3D laser scanning are effective to construct crop matrix over thousands of acres of cultivable land
Disease Detection: It can warn us about the pest and disease infestations by monitoring crop status through remotely sensed data.

Smart Irrigation: It can automate the irrigation process by analyzing the moisture of soil and the climate condition. Water usage in agricultural land can be optimized by using thermal imaging cameras that continuously monitor if crops are getting sufficient amount of water.

Drones and UAVS: Unmanned aerial vehicles (UAV) are remote sensing autonomous vehicles which help in capturing images and collecting data about a particular scene by creating detailed 3D maps of the terrain.

Robotics: Robots are adding a new dimension to modern agriculture by doing various tasks like harvesting, packing etc through machine learning.

Supply Chain Management: A better price realization for farmers is possible through an effective price discovery model. Predictive modelling using AI can be instrumental in presenting more accurate demand-supply information and predicting demand for agricultural produce to farmers.

Weather Forecasting: AI can predict the weather in advance and warns farmer about upcoming natural calamities.

Challenges:

Though technologies like AI can modernize Indian agriculture, it still faces various challenges in wide adaptations. Mainly a lot of data is needed in AI system to train machines and to make precise predictions. In the Indian context, this is also a huge challenge to get the relevant data at a farmer's level. In India adopting the AI in agriculture becomes more cost expensive due to small land holdings of farmers and simultaneously it promotes unemployment of daily labours.

AI surely can help the farmers to increase the capacity of production and reduce the cost of production. It has both non-biological and human aspects embedded in it. In the times of open trades, turning to newer technologies and methods to increase production and quality is one of the few effective measures Indian farmers can take. With the diffusion of AI in field applications, it will bring a new revolution in Indian agriculture.

In the end we can say that it us who makes a technology a blessing or a curse. AI is such a gift of science and all of us can use it to rise

against the problem of world hunger and provide a promising and better future for our next generations.

Mr. Soumya Ranjan Sahu | B.Sc. (Hons.) Agriculture Year 4

Local honey for human allergies

Eating local honey to prevent the springtime sniffles seems like it should work: local bees collect pollen, pollen gets into the honey, we get exposed to the allergens, and our body learns we're safe. The belief that this work is so widespread that a group of scientists decided it was worth testing. They started with an open-label trial. That's the technical, jargon-y term for a study where participants know whether they're getting the real treatment or a placebo. Volunteers with seasonal allergies showed up and were told either to eat a tablespoon of honey every day or to eat corn syrup flavored with artificial honey. Those eating the honey reported statistically significantly lowered symptoms- it was so promising that the researchers decided they really did need to see whether honey could help with allergies.

So they progressed to a double blind trial, where no one knew what they were getting. Participants this time got divided into three groups: one got local honey, one a national pasteurized honey, and one the flavored corn syrup. They ate a full tablespoon every day. If this sounds thoroughly gross to us, we are not alone. Out of 36 initial volunteers, 13 dropped out because the regimen was too sweet for them. Those who survived eating a tablespoon of honey everyday for 30 weeks mailed in journals regularly tracking their perceived allergy symptoms. By the end of the study, those who ate the honey were doing no better with their allergies than those who ate the corn syrup (though their blood sugar might have been in better shape).

It’s possible, of course, that the participants simply weren’t eating enough honey. The scientists note in their paper that oral consumption of allergens has historically been shown to be an effective way to train the immune system not to overreact. It follows that the allergens in honey should help train people’s bodies. If that’s the case, though, we’re still out of luck. Not many people will be able to tolerate eating multiple tablespoons of honey every day.

Like all naturopathic remedies, we may genuinely feel better taking honey. These studies prove that the results we see are most likely the placebo effect, but the placebo effect can be helpful. If we believe the honey helps, then the honey helps. All that matters in the end is that we feel better, and if eating a tablespoon of honey is what enables us to spend summer days outside in the grass, we should go for it. Honey is delicious. Worst case scenario, we are consuming a natural sweetener

that’s less of a blood sugar rush than table sugar. Best case scenario, we help our allergies. It’s no surprise this particular remedy has a lot of buzz.

Mr. Soumyakanta Mohapatra | B.Sc. (Hons.) Agriculture Year 4

Cordyceps militaris: A medicinal mushroom

Studies on medicinal mushrooms become a very important topic because of their potent pharmacological uses and huge global markets. An entomopathogenic fungus, Cordyceps sp., in the family Clavicipitaceae in the class Pyrenomycetes of the order Hypocreales, has been known to have numerous pharmacological and therapeutic implications, especially,in terms of human health, making it a suitable

candidate for ethno-pharmacological use. The species is considered as the most fascinating and unique species of the Himalayas for its morphological structure and ethno-medicinal value. Cordyceps have been used as anti-tumour, immune modulating,and antioxidant agent.

The name Cordyceps has been derived from two latin words, i.e.cord and ceps meaning club and head, respectively. *Cordyceps militaris* belongs to the phylum Ascomycota classified in the order Hypocreales, as spores are produced internally inside a sac, called ascus. It is an entomopathogenic fungus having an annual appearance which often grows parasitically on lepidopteran larvae and pupae of insects and spiders. It normally inhabits on the surface of insects pupae in winters and leading to the formation of fruiting body in summers. So it is also known as ***"winter-worm summer-grass"***. In India, it is prominently found in subalpine regions of grassy lands of Himalayas commonly known as "Keera Ghas"or "Keeda jadi". This herb is also referred as "Himalayan Gold" due to its broad clinical and commercial value.

Commercial product

Cordyceps that includes about 400 species worldwide but only two are of medicinal value,*Cordyceps militaris* and *Cordyceps sinensis*.Cordyceps requires specific set of conditions for its growth and has small size; therefore, the large-scale collection of this mushroom is a daunting task. However, people within the age group 15–65 years including men, women, young boys and girls are the main collectors of this fungus and price per 1 kg of wild-collected mushroom in the market of India is about rupees 1,50,000 . In past years have seen tremendous exploitation of Cordyceps which has significantly reduced its wild occurrence . Efforts have been made to artificially cultivate this mushroom by surface and submerged fermentation

techniques. Pournami Agritech, an agritech start up in Kerala, has successfully harvested the first of tissue culture and commercial cultivation of *C.militaris*.A variety of commercial *C.militaris* products are available in various forms, such as powders, capsules, soup and tea.They are produced from fruiting body of *C.militaris*.In manufacturing terms the simplest types consist of drying of fruiting bodies grind to powder and then processed to 'capsule' form.

Nutritional value

In Cordyceps, there occurs a wide range of nutritionally important components including various types of essential amino acids, vitamins like B1, B2, B12 and K, different kinds of carbohydrates such as monosaccharide, oligosaccharides and various medicinally important polysaccharides, proteins, sterols, nucleosides, and other trace elements. In the fruiting body and in the corpus of *C. militaris*, the reported total free amino acid content is 69.32 and 14.03 mg/g, respectively. The fruiting body harbors many abundant amino acids such as lysine, glutamic acid, proline and threonine as well. The fruiting

body is also rich in unsaturated fatty acids (e.g. linoleic acid), which comprises of about 70 % of the total fatty acids. There are differences in adenosine and cordycepin contents between the fruiting body and the corpus of *C. militaris*.The adenosine concentration are 0.18% in the fruiting body and 0.06% in the corpus. The cordycepin concentration are 0.97% in the fruiting body and 0.36% in the corpus. The adenosine and cordycepin concentration in the fruiting body is approximately 3 fold higher than in the corpus. The adenosine concentration is lower than the concentration of cordycepin.

Pharmacological and therapeutic effects;

- **Cancer**- anti-cancer, anti-angiogensis, anti-mutagenic.

- **Infection**- insecticidal, larvical, antimalarial, antifungal, antibacterial, anti-viral, anti-inflammatory.
- **Systemic effect**- anti-fatigue, cardiovascular benefits etc.

Ms. Supriya Verma| B.Sc. (Hons.) Agriculture Year 4

Urban area and farming

Resources include a number of things fulfilling our daily needs. So is the land considered as a most important resource among the list of all. A land used for various activities can alternatively be managed to derive benefits.

With day-to-day urbanization farmers involved in agriculture wants to get his child placed in a good industry but not in farming sector. Does urbanization ever mean the ignorance of agriculture sector?

Every single person wants to consume pure/organic veggies/fruits etc. Having a luxurious life, a big house, a big lawn area and terrace they can afford everything that is available in market on the name of organic

but “is it really safe” And does the word organic really makes it that pure.

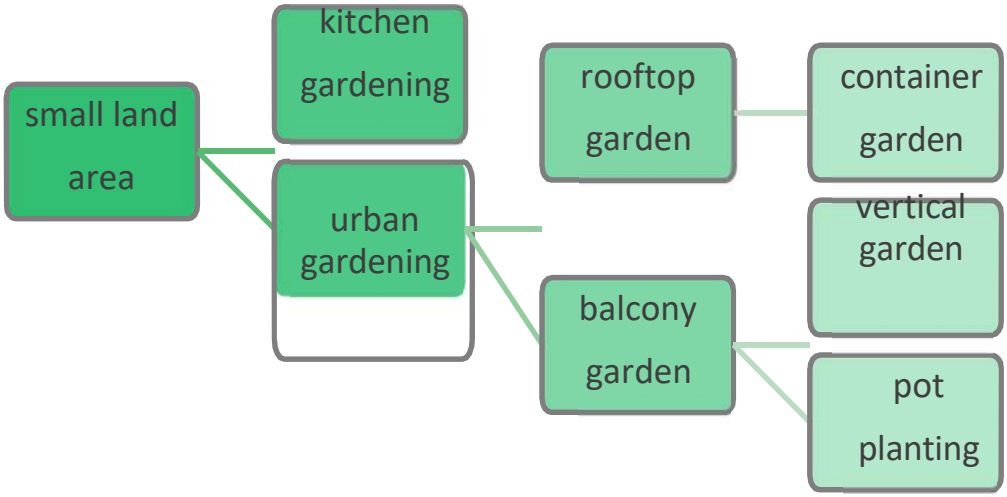
Why alternatives

AGRICULTURE SECTOR PRIORITY IS DECREASING: growing a crop and fulfilling our needs farmers have always done their best but never been prioritized.

SCARCITY OF RESOURCES: resources like sunlight, air, water its free to most of us but we don’t utilize it now and on a long run it will become scarce.

QUALITY OF THE PRODUCE HAS DECREASED: the word organic has turned out to be a business now. No product available in market has remained pure.

- THE ECONOMIC CONDITION WILL IMPROVE.
- IT WILL HELP US AVOID PROBLEMS BEFORE IT BECOMES A SERIOUS SUBJECT.
- MAKE US AWARE ABOUT REAL THINGS.



Types of utilization of urban area

Kitchen gardening

Kitchen gardening is the cultivation of vegetables in the available space for the daily needs. This improves the physical, mental and spiritual health.

We can grow 100% organic, new, and nutritious vegetables for your whole family with kitchen garden. Kitchen garden will certainly improve your home and backyard air quality. Your health will also improve over time by inhaling this fresh and clean air.

Urban gardening

Urban gardening is the practice of growing plants in an urban environment. You may be surprised to know that urban gardening has a positive impact on the economy, the environment and food security.

Terrace / Rooftop Gardening – one of the unique urban ideas, for growing plants on terrace. Also called as roof garden. It is a garden where flowers, fruits and vegetables are grown on terrace, roofs or in balconies.

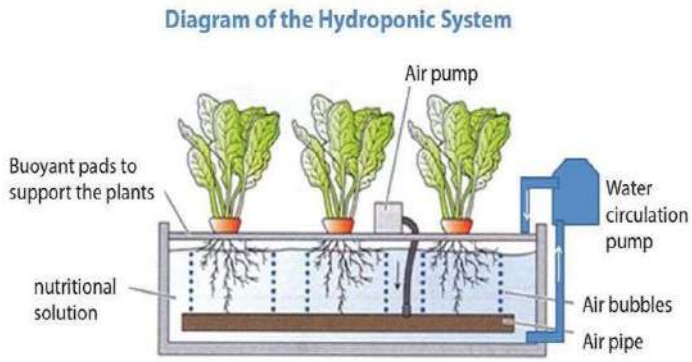
Container gardening - There are many advantages to growing plants in containers, namely: Less risk of soil-borne disease. Virtually eliminate weed problems. Mobile plants give more control over moisture, sunlight & temperature.

Balcony gardening

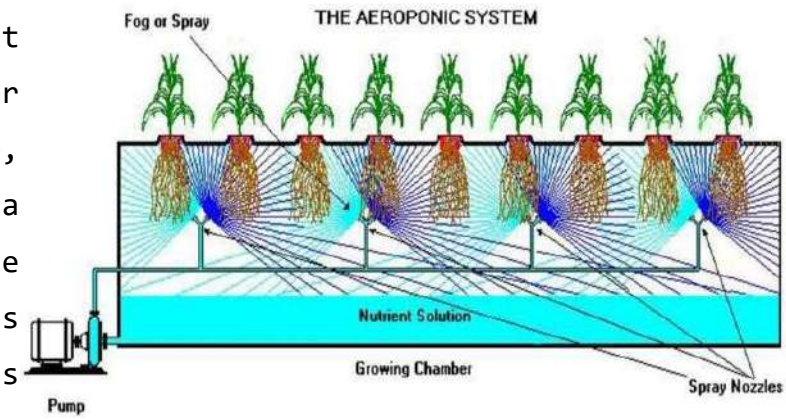
Vertical Gardening: Using various structures like Trellis, netting, or fence, Wire or wooden cages, Teepees and tripods, A-frames, Poles and posts. Pole beans, peas and tomatoes are commonly grown this way. But other vining crops such as cucumbers, squashes—both summer and winter, and melons can also be grown vertically.

Hydroponic gardening: takes place when a liquid nutrient solution is used in growing plants. Simply put, hydroponic gardening involves growing plants without soil. Plants are grown using a nutrient solution instead of using soil. Hydroponics is that it can be practiced indoors.

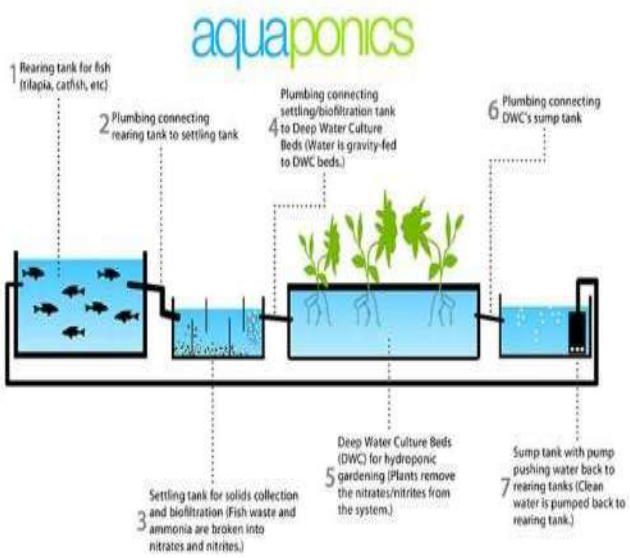
- Water can be recycled
- Less fertilizers used
- Fewer problem of pest and disease attacking
- The best advantage of



Aeroponics*:* It involves the suspension of plants in a semi-closed or closed environment and then spraying the roots of the plant with a nutrient-rich water solution. With this technique, the plant is suspended in a container where the root of the plant is hung below. At this point, nutrient-rich water is misted through a tubing system onto the roots of the plant. This provides nutrients, life, and nourishment through the root to the entire plant without the need to be underground.



Aquaponics gardening: system combines both aquatic and agricultural life. Aquaponics is taking fish/water based animals and land plants to create an independent and controlled environment where fish, proteins, and vegetables can be harvested. A great source of nutrient in this gardening system is gotten from the waste materials coming from the fish.



This nutrient is sufficient enough to make plants grow healthy and survivable.

Utilizing resources is not only required for environment it will also help us add better things to our daily routine. Farming is not just a labour job it’s a profession and will always remain backbone of our country, this 2020 pandemic (Covid19) has made us realize importance of agriculture and farmers.

Lastly I would like to end up by making a conclusion that every small step can lead to a positive change in environment.

Mr. Subham Ghose | B.Sc. (Hons.) Agriculture Year 3

Looking upon the bygones at the eleventh hour

By and large it is said we should move ahead or just march on leaving the defunct but sometimes we need to look upon it as it can be a potent strand to proffer the much needed exuberance. So can be seen about the

current situation which can be referenced to a foregone one regardless of the fountain heads since we are undergoing a more or less similar version of stich.

Agriculture, the source of livelihood for around more than half of India’s population, making it the primary source of employment for the country. Much vaster in the rural areas it contributes a substantial number to the country’s GDP together through its allied sectors.

Currently the nation’s agriculture sector is having several challenges at hand which are in terms of food security, employment for the rural people and sustainable development ensuring natural resource management, conservation and protection along with development of the rural areas.

Along with this if we are going to shed some light on the brighter side of things taking shape, that would include the effectuating of the e-NAM, the electronic market, increment in the sale of tractors in the country, tea & coffee exports standing at US$ 1451.35 million in FY20. And also the long term goals like doubling farm income by 2022, increased investment in agricultural infrastructure such as irrigation facilities, warehousing and cold storage, self-sufficiency in pulses in the coming few years, the agri-export reaching to US$60 billion by the year 2022 and several others on the go.

But the situation at hand or better to be referred as a plight has paralyzed the whole regimen for the sector's revival which has come to a halt giving rise to a mass exodus of migrant labour back to rural hometowns, harvesting process thrown completely off balance, processing plants are understaffed, movement across state borders has been heavily restricted, etc. Though we are amidst a great predicament we as a system together are giving it a whirl for keeping everything unmutilated.

The Indian agriculture has witnessed a lot of transformational changes in the last several decades and continuing to do so as well. Many of such refashioning have marked the passing of milestones of the green

revolution, the blue revolution, the white revolution and the yellow revolution. So let us retrospect the whereabouts of the sector during the nation's independence epoch.

It is a well-known fact that two-third of the country depends on farming. But before independence, the economy was 95% relying on agriculture and the revenues grossed from it. It is worthwhile to mention that around 85% of the population kept only to the villages, and the only means of subsistence was farming. As to agriculture, the situation of the Indian economy on the eve of independence was disheartening. Agriculture being

the most important sector, was facing economic retrogression and stagnation in the economy.

If the country testimonies of low rainfall in a month, then the resulting impact will be low output levels and high rate of crop failure. Low Productivity levels were witnessed, and levels of output declined irrespective of a large area for cultivation.

Further factors leading to the stativity of the sector can be the adverse effects of the Zamindari system, the practice of making farmers work and collect rent as tax irrespective of the situation, scarcity of agricultural resources helps in creating stagnancy in agriculture, the commercialization of agriculture meant moving from growing goods for their consumption to growing for the market. The quiddity of middleman prevented the development of the economic condition of the farmers, which caused motionlessness in the agriculture sector.

So these constituents viz., small & fragmented land holdings, outdated technology, dependence on rainfall, low level of production, subsistence farming, wedge between owners & tillers of soil and the portion of the nation shoving off with a great socio-economic ramification.

If we look into the briefings of the factors they are the incitement behind agricultural activities shifted from self-sustainability to

commercialization focused upon the increase of profits of colonials. As a corollary, there was an increase in the yield of cash crops, but it helped the farmers in no way. Farmers were now mass producing cash crops instead of food crops, which were sooner or later used for the benefit of British industries. These cash crops include cotton, jute, oilseeds, sugarcane, tobacco etc.

Additionally, at the time of partition, a large portion of fertile and highly irrigated land made way to Pakistan, especially the jute producing areas that went with East Pakistan (now Bangladesh). Hence, the jute industry received a heavy setback. By and large, the Bruisers further added to the plight of Indian agricultural system and left with an enormous task ahead of us.

But then also we strived for our nation and triumphed to reach self – sufficiency in many neck of the woods such as cultivated crops along with a plenty of technological modernization and much more socio-economic advancements. Likewise, we will get the better off with the ongoing quandary and locomote further polishing off our own cup of holy grail.

Mr. Bhudev Acharya| B.Sc. (Hons.) Horticulture Year 2

Immortal agriculture sector in the aftermath of pandemic

The Indian economy has taken a huge hit from the coronavirus pandemic and resultant lockdowns. The International Monetary Fund expects the global output to contract by 4.9 per cent in 2020 and India's GDP to contract as much as 4.5 per cent. But the agriculture sector is the silver lining in the year 2020-21, said the monthly economic report for July published by the department of economic affairs. The monsoon this year is forecasted to be 102 per cent of long-period average. A normal monsoon augurs well for India, as a considerable part of the rural workforce in employed in the agricultural sector.

While most economic activity came to a standstill in April-May 2020 due to Covid 19-induced lockdown, farming activities were exempted from the nationwide lockdown to facilitate uninterrupted harvesting of rabi crops and sowing of kharif crops. This was a major enabling factor for the smooth flow of agricultural commodities throughout the lockdown period and across both, rural and urban areas, the report pointed out.

Agriculture and its related activities have always held a significant share in our national income. In recent years, the share of contribution has declined gradually with the growth of other industrialized sectors in the country. But the agriculture share in India still remains very high as compared to many developed countries of the world. Both the Central and State Governments of the country earn significant revenues from the agriculture sector. The rising land revenue contributes towards a substantial income. There are also other sectors like railways and roadways that derive a good part of their income from the movement of agricultural goods.

Over two-thirds of the working population in India is engaged directly in the agricultural sector. As per estimate, about 57 per cent of the working population is engaged in agriculture. There are several important industries in India such as cotton and jute textiles, sugar manufacturing, edible oils, plantation industries (tea, coffee, rubber) and many agro-based cottage industries that depend on the agricultural sector for the supply of their raw materials. These agro-based industries generate about 50 per cent of income in the manufacturing sector, thus, agriculture helps in the industrial development of this country.

The Indian agricultural sector has seen considerable progress been made in the field of agricultural implements over the past decades. From using various hand tools like spades, pick axes, crowbars and sickles, Indian farmers have now graduated to using modern agricultural implements such as combine harvesters, rice trans-planters, power tillers, threshers, tractors, pumping sets, etc.

The Indian market has several leading tool manufacturing companies who produce the highest quality of agricultural implements. Their distribution channels are having the largest share. Consumers can also buy agriculture tools online from various e-commerce platforms.

The agricultural implements market in India has been categorized on the basis of product type including tractors, rotavators, threshers and power tillers. Agricultural tractors dominate this market. The Indian tractor industry is the largest in the world and accounts for one-third of the global tractor production. As mechanization in this sector continues to rise, tool manufacturing companies are now offering their agriculture tools online on e-commerce sites. This ensures that even the smallest fraction of farmers can buy required tools and equipment's on their will. This crisis taught us the importance of those sectors that are ought to be necessary at all costs. There were a number of sectors but just 3 of them have come out as inevitable, they are the health sector, the digital or IT sector and the most important the agriculture sector. This realization has brought about new changes in the thoughts of those people who used to undermine the agriculture sector. The farming sector is being visible as the sole King of all sectors.

The Central Government has also declared a number of bills for the upliftment of agriculture sector and those people related to this. The Krishi bill by the Central Government along with the Atmanirbhar Bharat campaign is being introduced to encourage startups and enterprises related to agriculture. The State Government of Odisha has also looked for the betterment of farmers and agriculturists through its BALRAM and KALIA scheme. This country is moving towards a new direction that is ruralization and no more urbanization.

We have to realize that Agriculture is the most important sector and the inevitable one as well. As rightly said by Mahatma Gandhi ‘the real India lives in the village.’ And farming is one of the most divine occupations and this country will grow only if the farmers and villages grow hand

in hand. This is the only sector that brings forth development of this country and help India becoming a superpower.

Ms. Dipti Abha Dash| B.Sc. (Hons.) Horticulture Year 2

Farmer suicide: a worry of India

India is an agriculture based country, which has 159.7 m ha arable land. so farmers have been an important part of our country. we depend highly on our farmers. however unfortunately the case is that farmer suicides are a common issue in our country. due to a number of reasons there are arriving a lot of cases per year. the govt. of India should take some steps to protect the farmers from this misery as they are the ones who feed us.

There are a lot of reasons as to why this happen in our country. The national crime records bureau of India reported that a total 296, 458 Indians reported that a total 296, 458 Indian farmers had committed suicides since 1995 of 60,750 farmers had committed suicides were in the state of Maharastra since 1995. With the remnant amount spread out in Odisha, Telengana, Andrapradesh, Mandyapradesh, Gujurat, and Chhatishgarh. All states with loose financial and entry regulation.

There are lots of reasons as to why farmers suicide happens in our country. One of the main reason is drought, when the crops do not get enough rainfall they do not yield much produce and this in turn poses a great loss to farmers as their money get wastes and they became more-poorer. area that have frequent drought have higher cases of farmer suicide.

Similarly, another big reason is when the farmers were caught in the debt when the farmers take loan for agriculture and after selling when the farmers were not able to pay their loan they fall in dept and they

were forced to give up their precious things like house, gold, etc. and hence make suicide because of this failure. Moreover, capitalization is

a very big reason for farmer suicide. These big firms capitalize on the crops and sell them using marketing strategies.

Another reason is during any flood, the crop of the farmer gets washed away or erode away and hence at last they do not get any product and at that time there is nothing to eat also and furthermore, the high debt which the farmers have to pay is another major factor, and hence being incapable of bearing these failures they commit suicide.

The govt. must take measures to tackle this issue at the earliest. It must set up some agricultural zones that allow agricultural activities. More ever the govt. should launch some programs that teach the farmers about modern techniques related to farming and will keep in enhancing production. Furthermore, irrigation facilities should be provided in addition to that there must be genuine crop insurance policies that must cover the loss of the farmers, so that they won’t go into debt along with these the weather risk management system should be provided so that farmers can be told beforehand about the upcoming extreme weather condition, as this will make them cautions and also minimize the loss to great extent. The govt. must also ensure that farmers should learn new skills which will help them get some additional income in to the family and by this way, they won’t be solely dependent on their crops and will have a backup with them.

At last it can be inferenced that can amalgamation of factors has led to a picture of large scale farmer suicide. In India the farmer suicide is a large scale and it account for 10.5% while in the whole world it is 11.6%. but now in the present situation it is observed that the farmer’s suicide in India is declining but the declination is in a marginal rate according to NCRB. But we being the citizen of the country should also try to protect them as are the one who gives us food.

Mr. Jhasketan Mahanta | B.Sc. (Hons.) Horticulture Year 2

Modern farming: A necessary evil for the farmer

The three basic needs of human are food, dress and shelter (home). To gets all the basic needs together the first practice which was done by the human beings was farming. Farming gives food and dress directly and shelter indirectly. Therefore, it can be said that "the farming makes a person self-dependent". So, the farming is the backbone of our society and whole world and hence our country India is known as the agriculture based country. If we think deeply, we will come to the conclusion that one who feed our society is a farmer. But, today's farming is going to become a necessary evil for the farmers.

Today's farming involves;

- Use of various technology instead of manual practice
- Application of various chemical fertilizers instead of organic materials.
- Planting of unseasonal crops.
- Deep borwell for irrigation. Etc.
- Applications of various insecticide and pesticides along with various nematocide.

WHY NECESSARY?

The involvements in today's farming are needed for high production of crops.

- Now a day there is a labour problem means nobody wants to do work on field. Therefore, the involvement of various technology is done.

- Various chemical fertilizers are used to supply the additional nutrients to the plants.
- Production of same crops in its favourable season is more, so there is a chance of wastage of products and lowering of market value. So production of the crops during its off season give a good market value with no loss. Therefore, production of unseasonal crop is important.
- For the irrigation of a large farming area a deep borwell is needed.
- Now a day the loss in agriculture due to insect's attack is a major loss. So to avoid the insect attack various insecticides are used.

WHY EVIL?

- Ancient farming and classical farming was being done by manual process. Ploughing was being done by plough with help of bullock, but today it is done by power tiller, tractor etc. At that time the dung of bullocks was used as manure, but today's farming excreta of tractors and power tillers are the oils (petro, diesel) which are harmful for soil and are destroy the fertility of soil. Again these technologies can transmit various disease and weeds.
- Many farmers have a misconception that if they apply more fertilizer then they will get more production .so they use more fertilizers than needed which is dangerous for soil health. So in future it produces a soil with nonproductive soil.
- Planting of unseasonal crop is done in protective structure with application of various synthetic hormone for production of flower and fruit in off season. Which may alter the genetic structure of that crop.

- Now a day there is a scarcity of water in many farming reason. in that area the deep borwell is needed. But deep borwell is

  drying the upper layer of soil and also going to decrease the underground water.
- Application of various insecticides to get rid from insect attack is also going to alter the genetic structure of various crop and also production of various resistant insects. Which is more harmful for crop?
- After production of crop in above difficulties also farmers can't get proper value for the yield. Only the dealers and merchants are getting benefits.
- Poor farmers are also no getting the proper help from govt. only rich farmers are getting all the programs.
- That is why the farming is going to be a necessary evil for the farmers.

The only solution for this problem is to transfer from inorganic farming to organic farming with proper maintained market price and educating the farmer to adopt natural farming systems.

Ms. Lopamudra Das | B.Sc. (Hons.) Horticulture Year 2

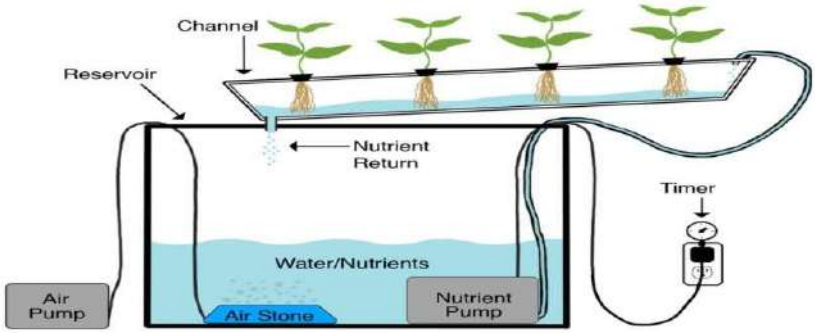
Hydroponics: An alternate farming system in urban areas

In the year 600B.C.E. the climate was arid and dry along the Euphrates River in Western Asia, but there were lush gardens climbing up the walls of the metropolis, Babylon. It is believed that Hanging Gardens of Babylon were surviving through a pulley system of water from the river, a technique of agricultural that today is known as hydroponics.

More specifically, hydroponics is the method of farming where plants can be grown in nutrient fortified water, instead of in soil. Given concerns of feeding a growing human population in a changing climate, scientist believe hydroponic technology may be able to mitigate impending food shortages.

The concept behind hydroponics is quite simple. The plants grow in a soilless medium, such as Rockwool, Shale or hydrocorn. Hydrocorn is a light medium based on clay, while Rockwool is a mix of volcanic rock and limestone capable of absorbing 10 times more water than soil. Other mediums include perlite, coconut coir, vermiculite and sterile sand. Whatever medium is chosen, make sure it doesn’t have a high salt contents that is damaging to plants.

All nutrients and fertilizer required for plant growth are mixed into water, which passes through the medium several times a day. An active hydroponics system uses a pump to move water, while passive system rely on wick or the medium’s ability to absorb water.



Hydroponic advocates note plant grown in soilless environments grow up to 50% faster than plants exposed to the same nutrients in the soil. Crop yield appear to be greater than with traditional gardening. The plants expand less energy finding food, as the nutrients are delivered directly through to the roots with water.

Because of the constant reuse of water and nutrients, a hydroponic garden uses less water than traditional plant beds. Plants produced hydroponically also reduce rates of soil erosion and they have fewer problems with disease and bugs.

Closed water circuits may prove problematic in hydroponics. While the plants will be free from soil disease and insect infestation, harmful microbes that grow in water can be a serious threat. Water in this type of cultivation usually circulates the entire system and reaches every plant. Accordingly, it is likely that if the pathogens is present in water it will infect all plants.

Establishing a new cultivation requires therefore its employees to acquire more specialized skills. Commercial hydroponic systems are mostly automatized, so the vast majority of farming practices are eliminated. Therefore, the labor demand in the plant growing process is significantly reduced.

Processes atomization also means costs association with the supply of electricity. The disadvantage of hydroponics is certainly their considerable initial cost.

Given the need for more sustainable agriculture, there has been a rise in eco-friendly startup companies around the world that are using

hydroponic technology to produce crops on a large scale with a technique known as “vertical farming”.

Vertical farms are buildings filled with countless levels of hydroponic systems, growing different crops in an indoor, controlled temperature environment. The largest vertical farm is being built in DUBAI, covering

1,30,000 sq. feet of lands and aiming to produce 6,000 pounds of food per day, “using 1/2500th the amount of water as an equivalent soil operation.” For a city that imports 85% of their food, this will greatly revolutionize the way the city eats.

While vertical farms hold a lot of promise, they are expensive to implement, technically difficult on large scale, and the food produced from these systems is generally more expensive than equivalent soil grown food because of the high energy costs of maintaining the systems. Even so, the Associated press, estimates that food produced by hydroponic technology in 2019 is worth $32 billion USD, and this is projected to grow at a rate of 5% per year until 2025.

While hydroponic technology may never replace conventional farming, it is breaking the paradigm of food production; we may see a new generation

of modern farmers building green walls inside their houses or community centers to feed families with fresh produce grown all year round.

Mr. Manoj Mahali | B.Sc. (Hons.) Horticulture Year 2

Modernizing agriculture in India

About 50 to 60% of Indian population depends on agriculture and it currently contributes to 16% of the GDP. Till date, the primary occupation of a majority of villagers in the country is farming. But still, it is disheartening to see that people lack the basic knowledge about agriculture equipments in India. They are still unaware of new and improved ways to increase the yield of their crops. While a majority of the citizens indulge in farming, still the country is not self-sufficient in producing enough food to feed the population. Each year, tons of food grains are imported from other developed countries to feed the Indian population. So, *where are we lacking? What are we doing wrong?* There are few reasons that cause the backwardness of agriculture in the country. These are:

- Each year, the yield of the crops is affected due to uncertainty and irregularity of monsoon.
- Due to increasing population of the country, more and more land is getting acquired leaving very little space for farming.
- There is an unavailability of canal irrigation which means that farmers are dependent on the rainy season for a fruitful yield.The only solution to tackle these problems is to modernize the agriculture scenario in

- India. *But how are we going to modernize the agriculture in India?* Embracing the internet will help the farmers to uncover new ways that have been unknown for years. It will give them a chance to alleviate the challenges that hinder crops growth and increase the agriculture yield. Here are few ways that will help to modernize the agriculture scenario in the country.

Which crops grow best where?

It is important to be well versed with the fact that every crop requires a different land and atmospheric conditions to grow; however, finding the right soil for a crop is a tricky thing. How can a farmer potentially

find out the right growing conditions for the crops? How can he decide which land is suitable for the growth of which crop? This is when conducting a survey on the agriculture land can help.
Irrigate the fields in a smart way

Crops require a right quantity of water at the right time for its optimal growth. Therefore, it is important to manage the irrigation of the field. While it can be a challenging task, owing to shortage of water, it should be kept at priority.

Buying agriculture equipment in India such as humidity sensors and water monitoring system can make irrigation a simple task. Humidity sensors are used to measure the moisture content in the soil and based on this data, the water valves supply water to the field automatically without any

supervision. Also, it makes it easy to identify any leakage in the water pipe.

Use the right equipment

Instead of doing farming with the help of animals, farmers must get their hands on the right equipment. Introduction of the latest agriculture equipment such as tractors, front-end loaders, backhoe and more will help farmers to increase their productivity. Apart from the equipment, taking care of the crops is also important. Instead of relying on animals such as oxen, buffalo, and camels the farmers should opt mechanized farm equipments that will produce great results and help the farmer to use less manual power. Instead of manually seeding, opting for seed drillcan reduce work load while increasing efficiency.

Evaluate the performance of the product

Despite having optimal weather condition, right irrigation facility, modernized equipment, and the right pest management in place, there may be some chances when the plant refuses to grow well. Therefore, it is important to constantly measure and evaluate the performance of the produce. This is when smart technology can help and make it convenient to evaluate different parameters with sensors.

To check humidity, pressure, soil and air temperature, and various other issues, you will need remote sensors in place. Getting his hands on the above-listed data will help a farmer to take the necessary steps and plan his moves accordingly. When breeding of the plants is done in an

optimal environment, it will definitely yield better crop quality and increase the production.

Control the Pests

Healthy crops often fall prey to pests and thus farmers have to suffer great loss. Therefore, it is important in the crop production cycle to find out when the pests are more likely to attack and what measures need to be taken.

Here you can install pest sensors to monitor the pest's behavior, their population and analyze different parameters that attract pests. Based on the collected data, the sensor will automatically spray pesticide in the fields whenever it is required and in the right quantity.

Apart from the above-listed points, the farmers need to be educated. One of the major difficulties faced by Indian farmers is the lack of education. While people in developed countries such as the USA and the UK go to study agriculture in Universities, Indian farmers even lack the basic education. Till date, they are using old-fashioned and outdated farming practices which results in depletion of valuable resources, high rate of crop damage and over farming.

Farmers need to know more about agricultural machinery manufacturers in the country. They need to gain access to knowledge about farming implements in India that can help them increase their workload yet make it easy to increase crop growth. There are several farming equipment

manufacturers in the country that are helping farmers ease their workload. The need of the hour is to use updated equipment, gain knowledge about modern techniques and move forward.

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Ms. Priyanka Pradhan | B.Sc. (Hons.) Horticulture Year 2

Role of vermicomposting in organic agriculture

Vermicomposting is a new concept in the modern agriculture. It was first described by a Michigan biology teacher Mary Appelhop, when she wanted to continue composting in winter months despite living in Northern climate. It is gaining popularity in both industrial and domestic settings as it degrades the organic waste quickly. But it is still not known worldwide.

Organic agriculture in today's society is the alternative to the conventional system which aids in the environmental protection. It is mainly restricting the use of agrochemicals and genetically modified organisms. The agricultural practices like organic manure (compost, vermicompost, green manures and animal manure), crop rotation spacing

and biological control of pest to maintain the productivity. The main component of organic agriculture is organic fertilizers. These are largely or entirely composed from organic materials which are derived from plants and animals that have been through a technical process.

Nowadays people are so dependent on the benefits that they tend to forget the main aim of the agriculture. Chemical fertilizers may be helpful in combating the harmful pathogens but it also affects the useful microbes and also degrade to soil quality in long run ultimately harming the crop quality. But as the saying goes by everything has its pros and cons.

Vermitechnology is a system in which the earthworms are utilized for the bio conversion of organic waste into vermicompost. It can also be defined as a green technology that converts organic waste into plant available nutrient rich organic fertilizer. Vermicompost contains water soluble nutrients and is an excellent, nutrient rich organic fertilizer and soil conditioner. It has wide applications in organic waste management and has been proven to be an efficient method to manage organic waste material with diminutive complexity and economic feasibility. The most important aspect in vermicomposting is the usage of various species of worms, usually red wigglers, white worms and other earthworms to create a mixture of decomposing vegetable or food waste, bedding material and vermicast. Vermicast is the final outcome of the disintegration of organic matter by earthworms. These castings have low level of contaminants and higher saturation of nutrients than the organic materials before vermicomposting. Vermicomposting is ready for harvest when it contains few to know scrap of uneaten or bedding.

The two components of vermicomposting are:

1. **Organic waste:** like leftover fruits and vegetables, their peels and ends, Coffee grounds, Teabags, bread, and cereal, Eggshells, Newspapers, Dairy cow or pig manure, Sewage sludge, Cotton mill waste, Agricultural waste, Food processing and grocery waste etc…&

2. **Suitable earthworm species:***Eiseniafetida, Lumbricusrubellus, Eiseniaeugenia etc.*

Vermicompost has different properties like it is rich in many nutrients then other composting material. It significantly decreases the concentration of ammonium-nitrogen nitrogen, which cannot be taken by the plants directly. It is rich in microbial life which converts nutrients into plant available forms. It reduces the heavy metal concentration in higher amount than normal composed and thus it is environmental friendly method to reduce the toxicity issue.

It has a positive impact on the physiochemical as well as biological conditions of the soil. It helps to improve soil aggregation, stability, pH, EC, bulk density, water holding capacity, aeration, organic matter, micro- and macro- nutrients. It enhances the structural stability of the soil making it less vulnerable to soil erosion. It helps in the reduction of leaching and runoff at highest quantity. It helps to reduces the toxicity and enhances plant growth. It decreases the concentration of heavy metals like cadmium, lead, copper, zinc etc. in metal contaminated soil. Microbial population and its activities in soil are enhanced by the addition of vermicompost. Enzymes such as dehydrogenase, urease, cellulase etc… activities in soil is increased with its application. The plant hormone such as auxins and gibberellic acid is also enriched in the soil.

It has positive effect on early as well as late stages of plants life cycle. It gives higher germination, plant height, leaf biomass and leaf area. It increases the crop productivity and quality in wide range of crops such as tomato, lettuce, cabbage etc. It also shortens the number of days for flowering. The nutrients such as vitamin c, total sugar etc. are found to present in higher ratios in the plant. It also improves the root growth and structure.

Vermicomposting also impact the economic & environmental health. It reduces waste flow to landfills. It eliminates the bio-waste from the waste stream reducing contamination of other recyclables collected in a single bin. It creates low skilled jobs at local level. It involves low capital investment and requires simple technologies for making vermicompost for less developed agricultural regions. It decreases the waste released from our houses or industries send to our dump sites. It reduces the greenhouse gas emissions such as methane and nitric oxide as the waste materials break down very slowly and without the presence of oxygen. It was the need for chemical fertilizers and pesticides in the field. So ultimately it reduces the pollution such as land pollution, air pollution and water pollution.

Vermicomposting has some disadvantages like it is more expensive to setup than regular compost piles. It requires special materials to start such as plastic or metal containers and red worms. It takes nearly about six months for the earthworms to digest the waste material and turn it into a compost. In contrast, the normal compost takes only 3 months to turn into organic matter. It is very important to maintain the conditions inside the vermicompost bins. If there is inadequate ventilation for the worms, overfeeding the worms& even using too many wet foods can create offensive odor. It means it requires high maintenance for its proper decomposition. Vermicompost bins must have cool temperature to support earthworm life. So it may harbor many pathogens, weed seeds and other problematic substances. While harvesting the resulting soil amendment, it is required to take out the worms from the bins. This can be time consuming, depending on the size of the vermicompost bin and how many worms were used.

Future perspective of vermicomposting is it highlights the critical beneficial role of earthworms for plant and soil health and their important role in organic waste management. It presents in-depth discussion of earthworm biogeography, diversity, taxonomy and

systematics. It provides full coverage of feeding behavior food preferences dietary requirements and the interaction between earthworms and microbial communities. It includes information on impacts of climate human activities soil properties predation disease and parasitism and competition upon Earthworm ecology. It also helps to control soil as well as environmental pollution. Earthworm effectively harness the beneficial soil microflora, destroy pathogen and convert organic waste into vitamins, enzymes, antibiotics, PGH and other organic compounds. It offers new prospective on vermicomposting research.

In conclusion it is verified that vermicompost can be used as an organic fertilizer alternative to inorganics as it gives different benefits to the crop, soil as well as environment. However, its efficiency greatly depends on the temperature and the raw materials which may have an alternative effect on the earthworms as well as the compost. It might not be cost effective as well for a farmer. From this article, it is known that earthworm very important for the formation of organic matter in the soil. So it is very important to protect them and utilize them in different ways. Overall vermicomposting is a blessing to organic farming.


ECO

Student achievements

Activity	Date
Study Tour	15-09-2019 to 22-09-2019
Display Agri. models	19-09-2019 to 20-09-2019
NRRI Internship	Group 1: 1-09-2019 to 7-09-2019 Group 2: 24-09-2019 to 1-10-2019 Group 3: 16-12-2019 to 21-12-2019
Annual Sports Day (Athelta 2.0)	06-11-2019
International Plant protection congress(IPPC)	10-11-2019 to 14-11-2019
Student Counselling	30-12-2019
Contadino 3.0	04-01-2020
No Mobile phone day	10-01-2020
Krushi Odisha-Inter University Competition	15-01-2020 to 19-01-2020
Visit to ICAR-National Rice Research Institute, Cuttack	25-01-2020
Visit to ICAR-National Rice Research Institute, Cuttack	18-02-2020
Field Trip Central Horticulture Experimental Station	28-02-2020
Anveshan- Inter-University Competition	12-2-2020 to 13-02-2020
Picnic	29-2-2020
Department Volleyball 2019	2019
East Zone all India cricket tournament university level	2019
Attendance in Utkala university Webinar	2020
Attendance in Agrovision E-conclave	2020
Department Sports(Kho Kho)	2019
Attendance in Locust and Man webinar	2020

extra-mindfulness

Upscaling the waste materials with innovative idea/s: Students were initiated into recycling of waste material generated on daily basis. Talented students participated actively and produced creative handmade decorative products. A generic educational awareness on how recycling of certain products can minimize the littering of living environment to imbibe responsible behaviour to maintain the environmental sustainability.

The program was conducted on August 1, 2019

Social tree plantation on campus: Tree plantation has been student initiation program to the campus. Social tree plantation activity is being held during each admission session. As part of social tree plantation activity, students of various programs of Faculty of Agriculture actively participated in tree

planting on the premises of SSU campus. All faculty members guided through the planning, logistics and successful planting of tree samplings. About forty diverse fruit and forest tree were planted in the SSU campus.

The program was conducted on July 19, 2019

Community service and social responsibility: As part of outreach activity, students were initiated into sharing resources with less privileged people in the society. Students were guided to organize a donation campaign in slum dweller community in Cuttack. Donation in terms of cloths, food and token amount of funds to support the initiatives of the slum dwellers community. Community leader of slum dwellers shared the experience and insights on the day-today life, hardships and initiatives on health and hygiene programs and functioning of SGHs to the students. Over 60 students along with faculty members participated and guided to students to imbibe kindness and social responsibility sharing and caring for under privileged in the society.

The program was conducted on August 4, 2019

Cultural get-together and celebration of festivities: Students celebrated Deepavali through cultural activities. It has been tradition to celebrate the festivals on every year. The advocacy to participate in group cultural activity has been useful build robust comradery among the students. Students planned and celebrated Deepavali festival of the season through cultural activities.

The program was conducted on October 27, 2019.

Impact of outreach program: The activities conducted so far has positively impacted the volunteering attitude of student's, learning by participation, sharing the resources and organization skills. Informal exposure to various of facets of life as part of community and social responsibility initiatives is useful to students in teaching-learning process. Moreover, it has also provided insights on steps involved in organizing an activity, logistic planning and inter-personal communication skills. All the programs are initiated and implemented as part of Farmers' Club.

Annual Sports and cultural event: Annual sports event was conducted involving the students of all the batches of various program.

Krushi Odisha 2020: We hosted the Krushi Odisha 2020 competition involving 6 universities. Our students were adjudged 1 and 3 in the completion of fine art and debate.

Anveshan: Students were adjudged winners of 1 and 2 prize in east zone anveshan 2020 conducted by Association of Indian Universities (AIU) in the category of innovation entrepreneurial ideas.

Students participated in Anveshan March 13, 2020

Field visits: Students visited Central Horticultural Experimental Station to learn about the crop improvement research activities.

Students visited the field on February 28, 2020

Likewise, students also visited the central sophisticated instrumentation facility at OUAT, Bhubaneswar.

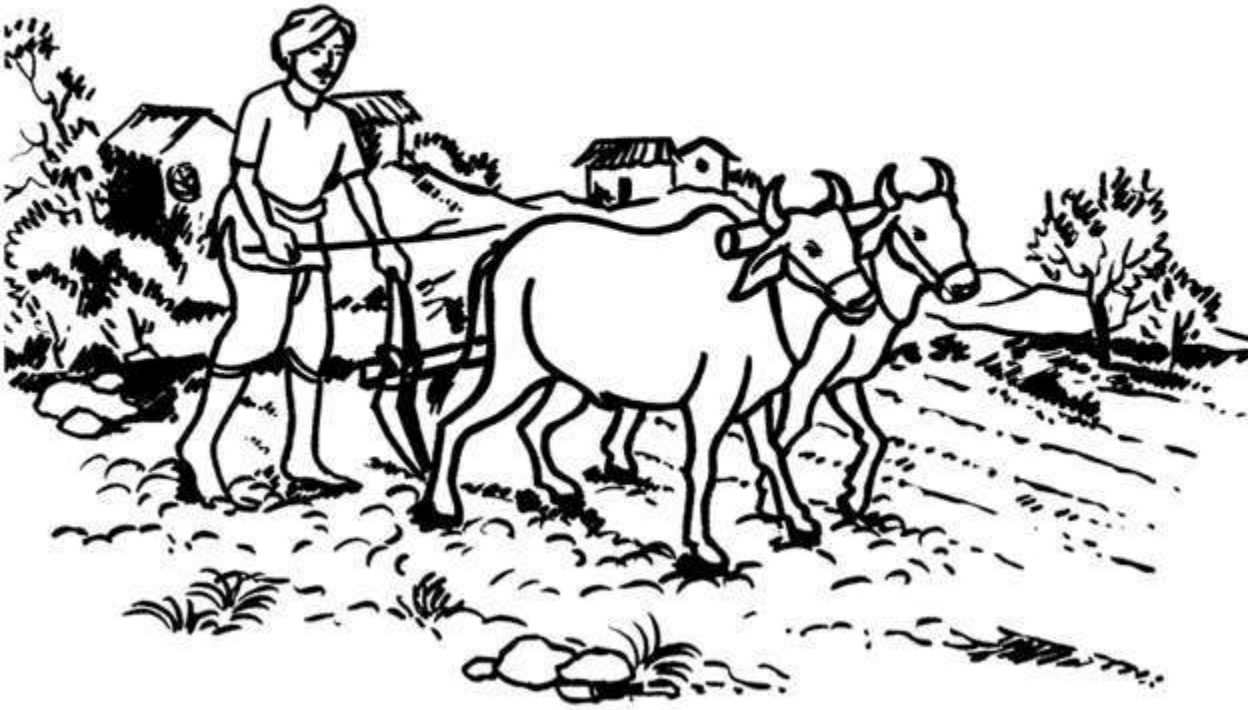
Students were taken to study tour of 10 days within Odisha state. During the period students visited various research institutes involved in research and crop improvement programs.

Student Ready Program: Rural Agricultural Work Experience (RAWE)

Students participated in Rural Agriculture Work Experience (RAWE) for 45 days as part of Student Ready Program. Students were attached with farmers to learn farming practices, grassroots entrepreneurs and share scientific knowledge through extension principles.

the team

Sl. No.	Faculty Member	Designation	Discipline
1	Mr. Subrata Kumar Mohanty	Assist. Professor	Agronomy
2	Ms. Bidudhi Tripathy	Assist. Professor	Agronomy
3	Dr. Anupama Singh	Assist. Professor	Genetics and Plant Breeding
4	Ms. Mandakini Kabi	Assist. Professor	Genetics and Plant Breeding
5	Dr. Mahipal Singh	Assist. Professor	Genetics and Plant Breeding
6	Dr. Chinmayee Mohapatra	Assist. Professor	Plant Pathology
7	Ms. Debanjana Debnath	Assist. Professor	Plant Pathology
8	Mr. Snehashish Routray	Assist. Professor	Entomology
9	Mr. Ningaraj Belagall	Assist. Professor	Entomology
10	Mr. Prajjal Dey	Assist. Professor	Crop Physiology
11	Mr. Brij Bihari Pandey	Assist. Professor	Crop Physiology
12	Dr. Arsha Balakrishnan	Assist. Professor	Agricultural Economics
13	Ms. Shruti Mohapatra	Assist. Professor	Agricultural Economics
14	Dr. Revanasiddappa Bhawar	Assist. Professor	Agricultural Economics
15	Dr. Dhawal K. Dwivedi	Assist. Professor	Agricultural Engineering
16	Dr. Sandep Rout	Assist. Professor	Forestry
17	Dr. Vinoda Shankara Naik	Assist. Professor	Agricultural Extension
18	Dr. Darshan	Assist. Professor	Agricultural Extension
19	Dr. Suvalaxmi Palei	Assist. Professor	Horticulture
20	Dr. Tanushree Sahoo	Assist. Professor	Horticulture
21	Ms. Meenakshi Badu	Assist. Professor	Horticulture
22	Ms. Kalyani Pradhan	Assist. Professor	Horticulture
23	Mr. Ambika Prasad Misra	Assist. Professor	Soil Science & Agri. Chemistry
24	Dr. S. Kumaraswamy	Professor	Soil Ecology
	Guest Faculty		
1	Dr. Sharda Acharya		English
2	Dr. Hari Krishnan		English
3	Dr. Anjala Devi		Yoga Science
	Visiting Faculty		
1	Mr. Subrata Mohapatra	Visiting Faculty	Statistics
2	Mr. Debaprasad Mohapatra	Visiting Faculty	Animal Science
	Staff Members		
1	Mrs. Lipsa Mohanty	Acad. Assistant	
2	Mr. Rasmi Ranjan Patra	Lab. Assistant	
3	Mr. Bijaya Kumar Mohanty	Helper	



Faculty of Agriculture

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