



4TH ORGANIC ASIA
CONGRESS 2021

PROCEEDINGS



4TH ORGANIC ASIA CONGRESS 2021

**ASIA GO ORGANIC
FOR A HEALTHIER PLANET!**

22 - 27 November 2021

HOST :



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Program Schedule and Details



“Asia Go Organic for a Healthier Planet!”

(November 25th - 27th, 2021, Jakarta Indonesia)

Opening Ceremony	
09:00 – 11:30 Indonesia Standard Time	
Moderator: Febriana Tambunan (Indonesia Organic Alliance)	
09:00 – 10:00	Opening Remarks
	Introduction of the VIPs
	Welcome Address <ul style="list-style-type: none">• Emilia Tri Setyowati, President of Indonesia Organic Alliance
	Congratulatory Messages <ul style="list-style-type: none">• Mathew John, President of IFOAM-Organics Asia• Karen Mapusua, President of IFOAM-Organics International• Syahrul Yasin Limpo, Ministry of Agriculture, Indonesia• Sutan Riska Tuanku Kerajaan, Chairman of APKASI (Association of Indonesian District Governments), Regent of Dharmasraya, West Sumatra.• Hendrar Prihadi, Mayor of Semarang City• Dr Bayu Krisnamurti, MS, CPC Chairman of Bina Swadaya Foundation• Riki Frindos, Executive Director of KEHATI
	Keynote Speech <ul style="list-style-type: none">• "Promoting Indonesia's Organic product to the World" Mr. Muhammad Lutfi, Minister of Trade, Republic of Indonesia

10:00 - 10:45	<p>Launching of the ALGOA Indonesia Forum</p> <p>Introductory Speech</p> <ul style="list-style-type: none"> • H. Soekirman, Ambassador of ALGOA and Former Regent of Serdang Bedagai
	<p>Declaration of ALGOA Indonesia Forum</p> <ul style="list-style-type: none"> • H. Umar Zunaidi Hasibuan, Mayor of Tebing Tinggi, Indonesia & ALGOA Member
	<p>Congratulatory Speeches</p> <ul style="list-style-type: none"> • Mayor Lee Cha Young, President of ALGOA • Salvatore Basile, Co-President of Global Alliance for Organic Districts • Mayor Rommel Arnado, President of the League of Organic Agriculture Municipalities, Cities and Provinces in the Philippines (LOAMCP-Ph) • Andreas Paru, Regent of Ngada District, Indonesia & ALGOA member
10:45 – 11:30	<p>Launching of the Women in Organic Agriculture in Asia (WOAA)</p> <p>Keynote Speeches</p> <ul style="list-style-type: none"> • Zhao Yuqi, Qimei, President of Qimei Organic, China • Mama Loreta, Organic Woman Farmer from Indonesia
	<p>WOAA Progress Report</p> <ul style="list-style-type: none"> • Jennifer Chang, Executive Director of IFOAM-Organics Asia
	<p>Messages from Organic Women around the World</p> <ul style="list-style-type: none"> • Support Messages, highlighting the role of women
	<p>Congratulatory Speeches</p> <ul style="list-style-type: none"> • Louise Luttikholt, Executive Director of IFOAM-Organics International • Vice Mayor Lucia Estorga, Daram, Samar, Philippines
	<p>Group Photo</p>
11:30 – 12:30	Lunch
<p>The 4th Organic Asia Congress DAY 1</p>	
<p>SESSION 1</p>	
12:30 – 12:35	<p>Topic 1: Organic Agriculture and Social Inclusivity</p> <p>Moderator: Miyoshi Satoko, Board Member of IFOAM-Organics International</p>

12:35 – 12:50	“Emancipating Marginal Farmers Through Collective Organic Farming Within a Water Commune” by D. Thangapandian, India
12:50 – 13:05	“Sundarban Organic Women Dairy Cooperative: Driving Sustainable Food System in India” by Roy Sabyasachi, India
13:05 – 13:20	“Promoting Entrepreneurship Among Farm Women Via Organic Value Chains” by Dr. Bodapati B. Subrahmanyeswari, India
13:20 – 13:35	“Attitude level of Organic Basmati Growers cum Dairy Farmers towards Organic Dairy Farming in Subtropics of Jammu Region of India” by Dr. Pranav Kumar and P. S. Slathia, India
13:35 – 13:50	Question and Answer
13:50 – 14:05	Topic 2: Government Policies in promoting the adoption of Organic Agriculture Moderator: Victoriano Ihong Tagupa, Executive Director of the League of Organic Agriculture Municipalities, Cities and Provinces of the Philippines (LOAMCP-Ph)
14:05 – 14:20	“A Paradigm Shift in Promoting the Adoption of Organic Agriculture” by Pablito Villegas and Dr. Teodoro Mendoza, Philippines
14:20 – 14:35	“1000 Organic Village Program of Indonesia: Progress and Future Development” by Ardi Praptono, SP, Magr, Indonesia
14:35 – 14:50	“Organic Agro-Tourism in Nepal: Policy Implications at Local Levels” by Dr. Sangam Sherpa, Nepal
14:50 – 15:05	Question and Answer
15:05 – 15:20	Topic 3: The Role of Organic Agriculture for the Rural Revitalization Moderator: Dr. Shaikh Tanveer Hossain, Senior Program Officer, Asian Productivity Office
15:20 – 15:35	“Models and Effectiveness of Poverty Alleviation through Development of Organic Agriculture” by Zhang Hui, Zhao Jiankun Xia Zhaogang, Liu Qiang, Li Xianjun, Shen Guanghong, Zhao Qian, China
15:35 – 15:50	“Supply Chain Support to Rural Small Organic Producers using Solidarity Economic Approach” by Dr Benjamin Quinones, ASEC Philippines
15:50 – 16:05	“Poverty Alleviation, Inclusive Development, And Empowering Communities: Revealing the True Potential of Organic Agriculture Through Corporate Social Responsibility in India” by Srijan Kishore, India

16:05 – 16:20	“Socio-economic Empowerment of Small Organic Farmers in Rural Areas surrounding Mount Merapi, Indonesia” by Untung Wijanarko, Indonesia
16:20 – 16:35	Question and Answer
SESSION 2	
16:35 – 16:40	Biodiversity and Natural Resources Management under Organic Agriculture Systems Moderator: Dr. Agr. Wahyudi David, Faculty Member of Food Science and Tech Univ Bakrie
16:40 – 16:55	“Biodiversity and Natural Resources Management Through Organic Farming: An Experience from The Western Ghats, Kerala, India” by Thomas J and Jacob Jose, India
16:55 – 17:10	“Agro-Biodiversity Beyond Organic for Pandemic Resilient Future” by Manisha Kairaly, India
17:10 – 17:25	“Participation of Farmers in Habitat Creation Operations: A Case Study of the Paddy Fields of Nan-an Indigenous Community” by Miao-Fei Lin, Taiwan
17:25 – 17:40	“Building an Integrated Biodiversity Index for the Assessment of the environmental performance of Organic Farming practices and Agroecosystems” by Xu Xi and Ada Qin, China
17:40 – 17:55	Question and Answer
END OF DAY 1	

The 4th Organic Asia Congress DAY 2 PLENARY	
10:00 – 10:05	Session 1: Organic Agriculture in Indonesia Moderator: Representative from Kehati
10:05 – 10:20	“Local Government Policy and Program to encourage Urban Organic Farming” by Hendrar Prihadi, Mayor of Semarang
10:20 – 10:35	“Integrated Organic Farming Models for Small Holder Farmers” by Dippos Naloanro, Mega Inovasi Organik (MIO)
10:35 – 10:50	“Improving Sustainable Coffee Governance through Strengthening Farmer and Traceability Institutions in Sumatra and Manggarai Raya, NTT” by Rony Megawanto
10:50 – 11:05	Question and Answer

11:20 – 11:25	PARALLEL SESSION 1: New Trends in Organic Agriculture Moderator: Li Feng, IFOAM-Organics Asia China Office Director
11:25 – 11:40	“Organic Livestock Production in India: The Emerging Opportunity” by Dr. Mahesh Chander, India
11:40 – 11:55	TBC, Dr. Wang Yungang
11:55 – 12:10	Organic Ecotourism: Experience from Brenjonk, Seloliman, East Java, Indonesia by Slamet
12:10 – 12:25	Question and Answer
12:30 – 13:30	Lunch

11:20 – 11:25	PARALLEL SESSION 2: Current Studies on Organic Rice Moderator: Teodoro C. Mendoza, Professor (Retired), Institute of Crop Science, College of Agriculture and Food Sciences, University of the Philippines Los Baños
11:25 – 11:40	“Organic Rice Cultivars Breeding with Small Farmers: Experience AB2T1” by Prof. Dr. Ir. Dwi Andreas Santoso, MS
11:40 – 11:55	“True, Full, and Fair Costs Accounting of Rice: The Staple Food of the Filipinos and Half the People of the World” by Teodoro C. Mendoza, May Soe Oo and Taghavia S.M, Philippines
11:55 – 12:10	“Golden Rice: Background, Current Status, Questionable Claims and Lies about Golden Rice” by Dr. Chito Medina, Philippines.
12:10 – 12:25	“Farmers, Consumers Assertion against GMO Rice” by Cristino Panerio, Philippines
12:25 – 12:40	“An Analysis of Economic Benefits of Rice-duck Farming in Ecological Farm” by ZHAO Jianshe, YANG Qiaoyun, XIE Kaiquan, WU Chao, JIANG Gaoming, LI Xiaofang, HU Bo, GUO Liyue, China
12:40 – 12:55	Question and Answer
12:55 – 13:55	Lunch
13:55 – 14:00	AFTERNOON SESSION Moderator: Moderator: Prof. Qiao Yuhui, IFOAM-Organics Asia Board Member
14:00 – 14:15	“Efficacy of Botanicals to Control Virus Diseases Transmitted by Aphids In Organic Potato Production” by Dr. Mohammad Khurshid Alam, Sahana Parvin, Bangladesh

14:15 – 14:30	“Intervention of Inhana Rational Farming Technology For Climate Resilient Organic Seed Development” by Dr. P. Das Biswas, Dr. K. Mukhopadhyay, India
14:30 – 14:45	“The Role and Prospect of Organic Bio-Fertilizer on Supporting Organic Farming, By Dr.rer.nat. Sarjiya Antonius, LIPI Scientist
14:45 – 15:00	“Increasing The Added Value of Bamboo Tabah for Food, Soil Health and Climate Resilience” by Dr Diah Kencana, Udayana University Scientist
15:00 – 15:15	Question and Answer
END OF DAY 2	

The 4th Organic Asia Congress DAY 3 PLENARY	
10:00 – 10:05	Session 1: The Adoption of Organic Agriculture and Climate Change Moderator: Dr. Rico Tabal, Dean, College of Agriculture, Western Mindanao State University, Zamboanga City, Philippines
10:05 – 10:20	“The Planetary Health Diet: Advancing Human Nutrition and Safeguarding the Environment in the Anthropocene” by Renzo Guinto, MD, DrPH, Philippines
10:20 – 10:35	“Comparative Carbon Sequestration of Nine Agroforestry Systems (AFSs) and Pristine Forest in Zamboanga City, Philippines” by Dr. Rico Tabal and Ted Mendoza, Philippines
10:35 – 10:50	“Geo-Spatial Technologies for The Adoption of Organic Farming: A Policy Implication” by Md. Jashim Uddin and Shaikh Tanveer Hossain, Bangladesh
10:50 – 11:05	“Climate Change Adaptation Strategies for Small Holder Farmers” by Prof. dra. Yunita Winarto, MS, MSc, PhD, Indonesia
11:05 – 11:20	Question and Answer

11:25 – 11:30	MORNING PARALLEL SESSION 1: Towards Best Practices in Organic Agriculture Moderator: Edgardo Uychiat, IFOAM-Organics Asia Vice President
11:30 – 11:45	“Organic Shizukuishi: PGS Initiatives Activities in Japan” by Atsushi Kato, Katsuaki Takahashi, Setsuko Douzen, Rumiko Yamazaki, Ryoichi Komiya, Japan

11:45 – 12:00	“Developing Ecological Values & Sustainable Models” by Garima Shahi and Jayaram, India
12:00 – 12:15	“Chemical Intensive Rice Production vs. Organic System of Rice Intensification (SRI) : Which direction shall Cambodian Rice Agriculture Be?” by Savuth Sem, Cambodia
12:15 – 12:30	Question and Answer
12:30 – 13:30	Lunch

11:25 – 11:30	MORNING PARALLEL SESSION 2: Organic Agriculture and the Non-Food Sector Moderator: Selina Gan, Malaysia, CEO of Opika
11:30 – 11:45	The Need for Organic Protocol in Cosmetics /Body Care by Satish Kumar Dhar, India
11:45 – 12:00	Exploration of Vegan Organic Cosmetics by Xiao Lin Deng, China
12:00 – 12:15	Super Compost for Organic Agriculture by Kandiah Pakeerathan, Vithujan K, Aruchchunan N, Sri Lanka
12:15 – 12:30	A Database Design to Find Organic Produce Using Latitudes, Soil Orders and the Internet by Ryoichi Komiya and Katsuaki Takahashi, Japan
12:30 – 12:45	Question and Answer
12:45 – 13:30	Lunch

13:30 – 13:35	AFTERNOON PARALLEL SESSION 1: Organic Food along Covid19 Pandemic Moderator: Li Feng, IFOAM-Organics Asia China Office Director
13:35 – 13:50	Arla Representative
13:50 - 14:05	Pregnant Women Scheme in Korea by Jennifer Chang
14:05 – 14:20	Organic Food during the Pandemic in China by Professor Qiao Yuhui, China
14:20 – 14:35	Question and Answer

13:30 – 13:35	AFTERNOON PARALLEL SESSION 2: Indonesia Organic Product Export Development Moderator: KEMENDAG
13:35 – 13:50	“Policy and Program to Support SMEs to Export Indonesia Organic Products” by Didi Sumedi, Director General for National Export Development, Ministry of Trade
13:50 - 14:05	“Capacity Development of SMEs to Access Organic Export Market” by Emilia Setyowati, Indonesia Organic Alliance
14:05 – 14:20	“Organizing Women Organic Coffee Farmers to Penetrate the Export Market: KKWG Experience” by Riskani Ahmad, Koperasi Kopi Wanita Gayo, Aceh
14:20 – 14:35	Question and Answer

Closing Ceremony	
15:00 – 16:00	Opening Remarks <ul style="list-style-type: none"> • Emilia Tri Setyowati, President of Indonesia Organic Alliance
	Reports from the Sessions <ul style="list-style-type: none"> • Moderators from the Sessions
	Achievements of the 4th OAC (Video presentations)
	Adoption of the 4th OAC Declaration (to be read by 2 local youth from OYF)
	Message of Thanks <ul style="list-style-type: none"> • Mathew John, President of IFOAM-Organics Asia
	Farewell Message and Closing <ul style="list-style-type: none"> • Bayu Krisnamurthi, Head of Bina Swadaya Foundation

Topic: Organic Agriculture and Social Inclusivity

Emancipating Marginal Farmers through Collective Organic Farming within a Water Commune

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INTRODUCTION:

Farming is no more a viable profession for small and marginal land holding farmers. The reasons are many; small landholdings, availability of farm credit in time, availing farm equipment, inadequate market exposure; the list goes on. Recent failure of monsoons makes the water availability more critical and hence the small farmers are forced to leave their villages and move towards nearby urban region in search of livelihood. Hence it becomes imperative to re-create farming facilities in their farming region so that they are back home and continue agriculture.

Keeping water as a connecting point, we create “Water Communes” in which the small farmers come together, form Farmer Producer Companies, do Organic Farming and market their produces efficiently. The success of this ideology remains in the transparency and ensuring that every stakeholder gets their legitimate share. The entire landholding is made to a single farm and the community will perform farming activities as an extended family.

UNIQUE APPROACH:

- Water and other resources will become a common entity and will be used purely on need basis
- A common Agri-equipment workshop will be available
- Organic Vegetable cultivation, Milk production, Mushroom cultivation and Bee keeping
- Common facilities for milking, fodder production, silage making, and compost preparation will be created
- Profit sharing will be done proportionately to the members’ contribution

The community will form a small working group to monitor daily activities such as irrigation, planting, weeding, fodder management, accounting, marketing, etc. Different farming activities will be done in the commune; dairy productions, mushroom cultivation, medicinal herb cultivation, vegetable growing is some of the areas the community will work with. Farmers should be encouraged to practice Organic Farming which is the only way out for a sustainable livelihood.

The unique idea of our model is that all farming activities will be carried out as a single farm or a farming family. Commune members who are working in the farm will be paid their wages. Profits will be shared among the members on quarterly or annual basis. Depending on the income

generated, annual dividends will be paid to all members / shareholders and a corpus is also created for any emergency financial need or for future expansion projects.

New bore wells will be made apart from deepening the existing bore wells. Watershed plans will also be structured so that the region would become water sufficient over a period of time. For short term goals, rainwater harvest facilities are to be created for all bore wells individually. The available water source must be handled efficiently by installing modern water distribution system like Drip Irrigation, Micro Sprinklers, Rain Hose Irrigation, etc. Irrigation schedules will be controlled by modern apps so that the available water will be irrigated efficiently only to the needy crops. In this way no over or under irrigation happens and hence no wastage of water.

The commune should not only concentrate on production, but also in value addition and direct marketing wherever possible. Since the model involves lots of equipment, planning, finance management, technologies, value addition and marketing, some kind of hand-holding by an expert organization is necessary and this could be an NGO working with farmers and environment.

To improve the profitability, a direct marketing system is to be developed. We may also consider a CSA model, Community Supported Agriculture in which a very close bonding is developed between the farmer and the consumer. Moreover, a part of the working capital required for this project could also be raised through this CSA model of business.

PROJECT IMPLEMENTATION TIMELINE:

Stage I

- Identify the ground water potential through satellite imaging or any other scientific method
- Create a farmers group (FPC or FPO or any other model)
- Identify the total area available for cultivation
- Identify the total number of families (members) to be involved in this "Collective Organic Farming Through a Water Commune" project
- Make cultivation plan for the entire commune - Crop, season, water needs, crop protection, value addition, marketing, etc.
- Arrive at the right "Water Budget" - Water requirement per day, per season / cycle, water loss due to human errors and climatic factors, etc.
- Design the right / appropriate water conveyance - distribution - application methods (drip, sprinkler, rain gun, etc.)
- Make financial analysis and prepare the budget
- Work out a suitable insurance coverage in case of natural disasters, crop failure including personal life and medical insurance for commune members

Stage II

- Drill bore wells
- Construct bore well recharge mechanisms to individual bore well in addition to the overall water shed creation
- Fix submersible pumps with the existing EB connection
- Install conveying pipes, drip system, sprinkler system with necessary pre-filtration set up
- Create / construct water collection tanks (we can use some of the existing tanks constructed by Mother Lea)

Stage III

- Start cultivation and create facilities for making compost and other Organic inputs
- Work out a "Crop monitoring software" which will help farmers to monitor the growth of the plants, pest issues, nutritional issues, watering intervals, etc.
- Conduct farmers group meetings periodically to evaluate the status of the project and create cohesiveness among them
- Harvest and Value addition
- Sorting, packing and forwarding

Stage IV

- Finalize the repayment installment amount / schedule after discussing in the commune meeting
- Make financial analysis (profit & loss) crop wise, farmer wise, season wise & commune wise
- Create a corpus which will support commune members' welfare and future development activities

PILOT PROJECTS:

- Shiradokhi, a Tribal village in Yawatmal district of Maharashtra, India is identified to implement the pilot project. 40 + farming families with 174 acres land will do Organic Collective Farming. Farmer Emancipation Consortium, Mission Samriddhi and Nagpur Naturals are the leading stakeholders in this project.
- Inba Seva Sangam, Sevapur in association with SAWES, Belgium will be implementing a similar project in South India to emancipate 200 marginal farmers from two backward hamlets

Access pictures [here](#).

To conclude, we are working out a model of creating a commune in which a group of farmers come together, work and prosper together. Let us redefine agriculture to bring fortune to all our brothers and sisters of the farming community through “Organic Collective Farming”.

ACKNOWLEDGMENTS:

1. Mr. Raghavan, Founder, Farmer Emancipation Consortium
2. Bro. Jayakaran, Founder, The School of Biodynamic Farming, Tamilnadu
3. Inba Seva Sangam, Sevapur, Tamilnadu
4. Ms. Anthoniselvi, Woman Farmer, Sevapur, Tamilnadu

Sundarban Organic Women Dairy Cooperative: Driving Sustainable Food System in India

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SUMMARY

Sundarban Cooperative Milk & Livestock Producers' Union Limited is the first organic women multi-commodity producers' cooperative operating in Sundarban region of West Bengal state, India. Though the area is extremely difficult, the cooperative has taken up this challenge as an opportunity by initiating organic movement to sustain the fragile ecology and gainfully employ the women and their families and thereby developing a sustainable food system in the region. The cooperative supports the women farmers by promoting and procuring indigenous varieties of paddy and pulses, vegetables, free range poultry eggs, wild forest honey, in addition to indigenous cow milk.

BACKGROUND

Sundarban region is located at South 24 Parganas district of West Bengal in India. Sundarbans is also the World's largest mangrove forest and UNESCO World Heritage Site. In Sundarban, people live in the riverine islands which are generally low-lying land masses with challenging geographical conditions. The livelihood of the rural families includes paddy cultivation, fishing, forest honey collection, dairying, and poultry. The area is resource poor and because of limited livelihood opportunities, rural men generally migrate to Kolkata and urban areas for work.

In this backdrop, Sundarban Cooperative Milk & Livestock Producers' Union Limited was registered in 1997. However, due to operational issues, the organization never worked well and got closed in 2014. In order to support the small and marginal farm families of South 24 Parganas district, the state Government of West Bengal with technical support from National Dairy Development Board, India, re-started operations of Sundarban Cooperative from 1st November 2015 with a decision to develop an all-women dairy producers' cooperative.

SUNDARBAN PATTERN DAIRY COOPERATIVE

Sundarban cooperative is the first organic women dairy producers' cooperative initiative in South Asia. The operational area of Sundarban cooperative is South 24 Parganas district of West Bengal. The key innovation of the cooperative is that it decided to support the women producer members

by promoting and procuring indigenous varieties of paddy and pulses, vegetables, free range poultry eggs, wild forest honey, etc. in addition to indigenous cow milk. The vision of the Sundarban is to ensure prosperity and happiness among the women producer members, employees, supply chain actors and consumers while mainstreaming organic farming for sustainable development.

ACHIEVEMENTS OF THE COOPERATIVE

During the first four years of operation, the cooperative has been able to organize the women farmers from the different villages and the officers and staff into closely knit group, who are together building a strong organic cooperative. Major achievements are given below:

- At present, there are 90 village level women dairy cooperative societies covering over 4500 women farmers;
- First organic women multi-commodity producer cooperative in India, procuring indigenous cow milk, wild Mangrove forest honey, rice, pulses, etc.;
- Established system for organic input and extension services, including supply of fodder seeds, azolla, mineral mixture, de-wormers and facilitating vaccination and artificial insemination services;
- Developed women Jaibo Monitors (Organic Monitor) for promotion and monitoring of organic farming and ethno-veterinary medicine in the societies;
- First dairy cooperative in India to market milk based traditional sweetmeat or Bengali Mishti by opening specialty outlets in Kolkata under the brand Sundarini Naturals;
- Training and capacity development of the women farmers and employees;
- Implementation of government schemes and programmes with outlay of more than USD 500 thousand, including National Dairy Plan Phase I, IFOAM Asia, etc.

SUNDARBAN COOPERATIVE DRIVING SUSTAINABLE FOOD SYSTEM DEVELOPMENT:

According to the Food and Agriculture Organization (FAO), a sustainable food system delivers food security and nutrition for all in such a way that the economic, social and environmental bases to generate food security and nutrition for future generations are not compromised.

ECONOMIC IMPACT

Sundarban Cooperative's food system is sustainable as the operations and activities of each stakeholder, including support service provider are commercially viable. The cooperative is:

- Ensuring fair and transparent procurement system for milk, agro and allied produce through computerized procurement system in the societies, wherein price is determined based on quality of the produce, acknowledgement slip is provided, and payment is made every 10 days into the bank account
- Maximizing profits for the farmers by ensuring higher price than market for milk and other Agri produces supplied by them
- Providing input and extension services to the farmers at reasonable cost

SOCIAL IMPACT

Sundarban Cooperative is being recognized as an instrument of change to bring out gender equity, better nutrition and healthcare, socio-economic and socio-cultural transformation. The cooperative is:

- Women led organic producer organization that ensures gender equity, where not only farmers, even the staff of dairy societies and plant workers are women
- Providing opportunity for financial independence and increased status of women farmers
- Encouraging young women to join the organic cooperative movement
- Increased women members' participation in government's developmental programmes, viz. Digital India campaign, etc.
- Ensuring reduction in food loss and waste as women farmers are extremely careful in proper handling of food
- Promoting wholesome healthcare of farm families through Anthroposophic doctors
- Reducing forced migration of the male family members

ENVIRONMENTAL IMPACT

Sundarban Cooperative has initiated organic farming and multi-commodity food basket as a means for developing the status of women farmer members. The cooperative is:

- Promoting certified organic farming that is environmentally friendly and ecologically sustainable
- Focusing on Farmers First, but also conscious about consumers
- Promoting production of green fodder, bio-fertilizers & pesticides
- Ensuring use of eco-friendly (non-plastic) products in the value chain
- Promoting affordable and clean energy – solar electricity and biogas for cooking at home
- Assuring responsible waste and effluent disposal
- Promoting biodiversity and afforestation by planting variety of 100000 trees

CONCLUSION

Sundarban Dairy Cooperative is an organizational innovation of being a multi-commodity women producers' cooperative in one of the most difficult geographical conditions in the world. However, the cooperative has taken up this challenge as an opportunity by initiating organic movement to sustain the fragile ecology and gainfully employ the women and their families and thereby developing a sustainable food system in the region.

As a result, the cooperative has been awarded nationally by National Dairy Development Board of India and Federation of Indian Chambers of Commerce & Industry and internationally by IFOAM Asia.

Promoting Entrepreneurship Among Farm Women via Organic Value Chains

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INTRODUCTION

"Just as a bird couldn't fly with its one wing only, a nation could not march forward if the women are left behind. India has a tradition of women playing important role in the advancement of civilization" by Swami Vivekananda.

Among several benefits of organic agriculture, emphasis on gender equality is one important aspect which makes it unique as it is believed that it empowers women. This can be contrasted with conventional agriculture, which is said to marginalize women. Women comprise 43% of the agricultural labour force globally. In least developed countries, 64.3% of women were employed in agriculture and are active in agricultural and food systems around the globe, but mostly as invisible workers. In many subsistence agricultural systems, they have the primary responsibility for food crop production and livestock rearing. Despite women's active role in agriculture, they are often ignored or excluded from agricultural services and systems. Organic agriculture being gender sensitive system can be helpful in empowering women by opening up entrepreneurship opportunities engaging them, not only in primary production, but also in processing and marketing of value-added organic food products. This way, women's formal participation will improve their economic contribution, visibility and self-reliance leading to an enhanced self-esteem too.

UNIQUE APPROACH

Entrepreneurship involving women in organic agriculture value-chains could be an instrument for securing food security, reducing poverty and empowering women. Agricultural entrepreneurship stabilizes the market prices of agricultural commodities; generate assured income from farm produce; creating opportunities to get additional income by utilizing farm produce; utilizing the additional revenue or surplus money to develop a viable business and adequate income to sustain livelihoods. For instance, women dairy co-operatives could play appreciable role in the livelihoods of rural women farmers in India.

Yet, there is not much evidence of entrepreneurial development among women farmers. Research findings of the studies carried out during 1997 among the members of women dairy co-operative societies of Andhra Pradesh as a part of author's postgraduate research work on entrepreneurial behavior of rural dairy women and also as a supervisor of student's work among

livestock-based women self-help groups in 2013, reveal that still a large gap existing when it comes to their empowerment. Although two-thirds of poor livestock keepers are rural women, knowledge gaps still exist about rural women's roles in livestock keeping and the opportunities livestock-related interventions could offer them. Keeping in view of the growth in export opportunities for high-value agricultural commodities and the emerging domestic agri-food retail chains, the rural women need to gear up themselves to tap the potential opportunities offered by Organic farming ventures. Many startups have come up recently working on various aspects in the organic production value chains, wherein, women too are taking an interest.

Dissemination of needed information on organic production, processing and marketing to women farmers is important. But almost all extension services lack something crucial i.e., very low female participation. Ignoring women while delivering services and technologies creates a gap as many of the agricultural operations are performed by women only. Lack of extension services in combination with a continuing gap in access to resources, bio-inputs and technologies needed for organic farming, negatively affects women farmers' ability to create sustainable livelihoods from their farms which are largely owned by males due to patriarchal system. If women had the same access to productive resources as men, they could increase yields on their farms by 20 to 30 percent, raising total agricultural output in developing countries by 2.5 to 4 per cent, in turn reducing the number of hungry people in the world by 12 to 17 per cent (FAO 2011). It is used as a mechanism to apply the technological products to derive impacts which enhance the welfare of the stakeholders.

The entrepreneurship development activities of extension services focus on the farmers' welfare. So, the extension services must take note of specific needs of women farmers towards guiding them for organic production, processing and marketing. The strong relationship between market orientation and empowerment levels suggests that linking women to markets can be a pathway to enhancing their empowerment in agricultural domains. Closing the gender gap in agriculture would generate significant gains for the agriculture sector as well as society for whole by bringing EQUITY, promoting ENTREPRENEURSHIP and realization of EMPOWERMENT. The author organized trainings for farm women and field veterinarians towards making them entrepreneurial, self-reliant including their improved communication skills.

The Women Dairy Co-operative societies(WDCS), Women Self Help groups (WSHG) and the women-based farmer producer organizations (WFPO) need to focus on the development of entrepreneurship in organic production of food and fiber. To this end, among several other things, ICT tools like mobile phones are of great help in breaking traditional physical barriers and backwardness. With its fast & wider reach out and neutrality to social and gender bias, it can strengthen the current ongoing extension reforms towards empowering women. The ICTs can help in bridging gaps in access and in linking rural economy with globalised markets with women as partner in this development process.

In last few years, the author worked with rural women groups including sensitizing them for entrepreneurship and using mobile phones for sharing information on dairy and poultry production. Also, it could be observed that women empowerment happening due to women specific Self-Help Groups (WSHGs), women dairy cooperatives (WDCS) etc. Slowly, women are securing ownership of land too. These changes are creating demand for female extension agents, more information access by women farmers and more formal participation of farm women in agricultural development institutions. The farmer training centers like the Farm Science Centers, known as Krishi Vigyan Kendra (KVKs) are also focusing attention on farm women. The rapidly increasing smart phone penetration even in rural areas of India, digital tools being made available in local languages, government support to formation of Women SHGs are some of the empowering mechanisms.

IMPACT

An alternative orientation to organic farming has the potential to alter gender relations in agriculture, both by creating a labor process context in which women can more readily participate in farm production and management and by introducing and promoting alternative ways of thinking that are more consistent with gender equality. By creating social relations, gender equity aims at improving gender relations and gender roles and achieving gender equity. Development must encompass rural women's long-term needs and aspirations, their decision-making power, access to and control of critical resources such as land and their own labor. With this background, the author conclude that organic farming has potential to promote gender equality and empowerment of women, which is very much required for socio-economic upliftment of women in developing countries in particular.

This paper discusses the way forward for women-based self-help groups, farmer producer organizations to get engaged in organic value chains on entrepreneurship mode. This will not only improve the income, livelihoods, self-reliance of farm women, but also improve their visibility, changing their status from invisible workers. *Building Prosperity for Women Producers, Processors and Women Owned Businesses through Organic Value Chains* could an excellent idea worth promoting for any Asian country particularly the developing countries like India.

It is appreciable that at the 4th Organic Asia Congress 2021 (OAC), IFOAM Asia has launched "Women in Organic Agriculture in Asia (WOAA), which can create a platform to promote, engage and address the role and contribution of women in organic agriculture. This will also boost women's prospects for enhanced economic contribution via their engagements in organic value chains.

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Attitude Level of Organic Basmati Growers cum Dairy Farmers towards Organic Dairy Farming in Subtropics of Jammu Region of India

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ABSTRACT

The aim of this study was to develop an attitude scale about organic dairy farming and measure the level of attitude of dairy farmers towards organic dairy farming practices/standards. As attitude assists individuals in processing complex information and to make decisions, an instrument has been developed to measure attitude of organic basmati growers towards organic dairy farming, for which 'Likert method of summated ratings' was followed. On the basis of responses received from judges, a total of 30 statements were retained based on relevancy weightage, and these were subjected to item analysis by administering to 60 marginal dairy farmers cum organic basmati rice growers from the adjoining villages of international border of India and Pakistan of block R.S.Pura in subtropics of Jammu region of India.

A total of 21 statements were selected based on the critical 't' values (above 1.75) resulted from the item analysis and included in the final scale for calculating reliability and validity. Split-half reliability was calculated using Spearman Brown Prophecy Formula and was found to be 0.88. Internal consistency of the attitude scale was calculated using Cronbach's alpha (α) and the value was calculated to be 0.89. The validity of attitude scale was established through content validity. Thus, the instrument was developed to measure the attitude level of farmers towards organic dairy farming representing the various aspects of organic dairy farming such as conversion period, breeds and breeding aspects, care and management, certification, sustainability, quality of organic products including views of farmers based on their cognitive and affective reactions. The marginalized dairy farmers were categorized into two levels of attitude on the basis of Tau score namely less favorable (< mean attitude score) and more favorable (> mean attitude score).

It was found that 39 per cent dairy farmers had less favorable and 61 per cent had more favorable attitude towards organic dairy farming practices in Organic Farming Cluster (OFC), whereas, in case of non-Organic Farming Cluster(non-OFC), 67 per cent had less favorable and 33 per cent had more favourable attitude towards organic dairy farming practices. Statistically there is a significant difference between attitude level of dairy farmers of OFC and non-OFC towards organic dairy farming practices (t value=2.176, p-value=0.031). The reliability and validity of the

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scale indicates its precision and consistency. This scale can be used to measure farmers' attitude and level beyond the study area with suitable modifications in future.

INTRODUCTION

Pesticides in crop production and antibiotics, hormones in livestock production, though had made us world leaders in food and milk production, giving food and nutritional security to our nation to some extent but along with such progress, it had endowed our body with many ailments due to bio-accumulation of those chemicals. The plant and animal produce treated with such chemicals serves as a slow poison for humans which are slowly killing our health and future generations. So, all around the world, the major producers are reverting back to chemical-free farming i.e. organic farming. Thus, organic farming strives for sustainability, ensures crops and livestock production which do not have any harmful residues, and enterprises methods which are sustainable and maintain harmony with nature (Darnhofer *et al.*, 2010).

Alongside cereals, spices, cotton, tea etc., the Government of India is now keen to promote organic animal husbandry through focused attention on native breeds and local practices. The organic livestock and poultry standards developed under National Programme for Organic Production (NPOP), 2014 have also been notified for implementation by Agriculture and Processed Food products Export Development Agency (APEDA) since 1st June 2015, which, however, are not yet known to the stakeholders indicating the need to fill this gap. Ranbir Singh Pura (R.S.Pura) in sub tropics of Jammu region of Jammu and Kashmir Union Territory is known for the production of one of the best quality of aromatic Basmati Rice in India. Considering the importance of organic farming and its export potential at remunerative prices, the Department of Agriculture, Jammu Division has taken an initiative for production of organic basmati and made a cluster of 10 groups of basmati grower farmers with its headquarters at Suchetgarh in R.S.Pura block of Jammu region. Though, dairy animals are an essential component of organic farming, much has not been done to orient organic farmers towards organic dairy farming, unlike in crop sector, where farmers are getting premium prices for organic food products.

Attitudes are acquired through experience and exert a directive influence on subsequent behavior and moreover, help individuals to interpret new information and to make decisions more efficiently than would otherwise be the case. To promote organic dairy farming alongside organic basmati rice cultivation, it is essential to study the attitude level of farmers towards organic dairy farming practices, as attitude forms an essential component for better implementation and success of any innovative farming practice.

MATERIALS AND METHODS

The study was conducted in sub-tropics of Jammu region of India. Purposive cum random sampling was adopted for selection of respondents for attitude level measurement. The method of summated rating suggested by Likert (1932) was followed in the development of scale. The different steps and procedure adopted in computing and standardization of scale to measure the attitude of dairy farmers cum organic basmati growers towards organic dairy farming by using

'Likert' method of summated rating were collection of statements, relevancy of statements by experts, selection of items, item analysis, validity and reliability, content validity of attitude scale.

RESULTS

The instrument (final attitude scale) Table 1 with 21 attitude statements having critical 't' value greater than 1.75 'representing various aspects of organic dairy rearing such as conversion period, breeds and breeding aspects, care and management, certification, sustainability, quality of organic products including views of farmers based on their cognitive and affective reactions were selected.

Table 1: Statements selected for inclusion in the final scale

S. No.	Statements	't' values	S A	A	U	D	S D
1	ODF production system optimally utilizes locally available resources	2.26					
2	ODF lays less stress on use of synthetic inputs such as drugs, hormones, feed additives etc.	3.06					
3	ODF takes into account the physiological and behavioral needs of animals	2.01					
4	My family will have a better quality of life in ODF compared to conventional farming	4.58					
5	Preventive management practices are better than curative treatment in ODF	2.12					
6	There is lack of proper government policies for promoting ODF	3.00					
7	I will have problems in sourcing organic inputs, if I convert to ODF	4.58					
8	Judicious use of Indigenous Technical Knowledge is an essential component in treatment of sick animals under ODF	6.21					
9	ODF cannot fulfill current milk demand	4.58					
10	Organic rearing practices are not fit for exotic animals	3.50					
11	ODF is a way to preserve old traditions and traditional values	3.06					
12	Future market will be more for organic dairy products due to increasing consumer quality consciousness	2.26					
13	It is cumbersome to maintain day to day record in case of ODF	1.87					
14	I cannot manage my livestock health without allopathic medicines.	2.26					
15	The success of organic dairy depends upon more aware consumers	2.65					
16	ODF is a good source of becoming micro-entrepreneurs	3.50					
17	With increasing per capita income, change in lifestyle and food habits, demand for organic dairy products is growing in domestic market	4.00					
18	I can save the input costs, if I convert to ODF	3.33					
19	Certification of dairy farm is important to promote organic trade to assure the consumers the quality of production and processing	2.65					
20	ODF works better, when farmers operate in groups than individually	4.58					
21	Farmer needs technical and financial assistance to convert to ODF.	2.65					

SA: 'strongly agree', **A:** agree, **U:** undecided, **D:** disagree and **SD:** strongly disagree

Attitude level of Dairy farmers towards organic dairy farming practices

Table 2 reveals the attitude level of dairy farmers towards organic dairy farming practices. The dairy farmers were categorized into two levels of attitude on the basis of tau score namely less favourable (< mean attitude score) and more favourable (> mean attitude score).

Table 2: Attitude level of Dairy farmers towards organic dairy farming practices Categorization on the basis of tau-score (per cent farmers)

Attitude level of Dairy farmers towards organic dairy farming practices	OFC Dairy farmers (n=180)	Non-OFC Dairy farmers (n=60)	Statistics (p value)
Less favourable attitude (< 51)	39	67	t =2.176*(0.031)
More favourable attitude (> 51)	61	33	

It was found that 39 per cent dairy farmers had less favourable and 61 per cent had more favourable attitude towards organic dairy farming practices in Organic Farming Cluster (OFC), whereas, in case of non-Organic Farming Cluster(non-OFC), 67 per cent had less favourable and 33 per cent had more favourable attitude towards organic dairy farming practices. Statistically there is a significant difference between attitude level of dairy farmers of OFC and non-OFC towards organic dairy farming practices (t value=2.176, p-value=0.031).

DISCUSSION

According to Edwards (1954), any 't' value (critical ratio) equal to or greater than 1.75, indicating the average response of the high and low groups to a statement differs significantly, provided 25 or more subjects in the high group as well as in the low group can be included in the final format of attitude scale. Reliability is the accuracy or precision of a measuring instrument (Kerlinger 1964). Reliability is concerned with the ability of an instrument to measure consistently while the reliability does not depend on validity of an instrument (Tavakol *et al.*, 2008). Reliability in the present study was measured by split-half method. The coefficient of correlation between forms was found to be (r) 0.79. The value of reliability of the full-length test R was found to be 0.88. The internal consistency of the scale was calculated using Cronbach's alpha and the value was calculated to be 0.89, testifying the internal consistency of the attitude scale. All the coefficients were found to be significant at one per cent level of significance. Hence the attitude scale constructed was highly stable and reliable.

CONCLUSIONS

Organic farming in general and organic dairy farming is in early stage in India and moreover, development of organic farming depends on the proper adoption of practices which in turn depends upon the attitude of farmers. The scale will serve as a tool to ascertain the attitude of stakeholders regarding organic dairy farming practices. The scale can be used by researchers, institutes, and organizations for ascertaining the attitude of respondents in similar agro-ecological regions. The scale can be used for estimating the net attitude levels regarding organic

dairy farming practices that will thrust policy makers in this direction. Assessment of attitude and motivational interventions to adopt organic farming can be made using the scale. The scale items presented in the scale are simple in nature and easily understandable making the scale handy to use.

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Topic: Government Policies in Promoting Adoption of Organic Agriculture

A Paradigm Shift in Promoting the Adoption of Organic Agriculture

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Our food production threatens climate stability and ecosystem resilience. It constitutes the single largest driver of environmental degradation and transgression of planetary boundaries. There is a need for radical transformation of the global food system. The global food systems contribute enormous greenhouse gas emissions. From production to the time it is eaten, our food emits about 44-57% of all greenhouse gases causing global warming and climate

Many of our farmers are losing interest in farming and they are ageing (57 years average), are advising their children not to go to farming. Farmer's children are migrating, looking for non-farming jobs. On the extreme, farmers are committing suicide due to their heavy indebtedness.

INTRODUCTION

In the Philippines, a big legal push to promote Organic Agriculture was initiated when Republic Act No. 10068 "the Organic Agriculture Act" was enacted on 6 April 2010. It became the policy of the State *to promote, propagate, develop further and implement the practice of organic agriculture in the Philippines*. But 10 years after the law had been enacted, there was no significant increase in the number of farmers practicing organic agriculture. As a whole, more than 98% still practice the conventional highly agri-chemical intensive production systems.

Hence, in this paper, we are proposing a paradigm shift in promoting the adoption of organic agriculture which is a consumption-based and demand-led approach to the adoption and promotion of organic and agro-ecological agriculture.

What constitutes a demand-led approach to the promotion of organic agriculture? The demand-driven promotion of organic requires changing food consumption patterns. In turn, it requires

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consumer welfare education and food production policies and programs supportive of consuming organic and healthy foods.

Consumer welfare education

Demand-driven consumption is anchored on changing food habits. Habits develop from young age present huge challenge. In consonance with the provisions of Organic Agriculture act of 2010, this calls for incorporating organic and healthy food system education at all levels. It is a holistic consumption-oriented training and mind-setting to become a responsible food consumer. This will entail a drastic change from the usual school gardening content at the primary and secondary levels. It will deal with understanding the processes and consequences of the food system, more than skills in any component like simplified gardening and planting crops. In this manner, the educated persons learn the connection of their food decisions they make every day with the problems of society. Holistic education may go deeper into the best production technology and farm ecology. Understanding food technology may go deeper into the effects of food processing on nutritional and health value of food, aside from the usual food durability, flavor and safety issues. Health and medical-related education and training may go deeper into the influence of food in human immune system, cellular repair processes, and organ recovery after illness.

Food production policies and programs

Food production policies and programs supportive of consuming organic and healthy foods should be institutionalized as follows :

1. Government-led and private sector sponsored feeding programs in schools to nourish children and to serve and feed victims of calamity (floods, mega typhoons) or even those who find daily living a calamity by itself;
2. Restaurants and canteens in government offices, hospitals, prisons and military camps and food stalls in malls, hotels should serve organically grown foods.
3. The government and private sector should take a more active role in promoting responsible consumption i.e., avoiding food wastage, consumption of brown rice, rice-corn mix, white corn and root crops. Thus, a more consumer-welfare oriented multi-quad-media campaign with emphasis on the use of social media, in terms of information, education and communication modalities must be launched to empower consumers to adopt responsible consumption under the platform of nutrition and health security considerations which in turn, support demand-led promotion of organic and green agriculture.
4. As a guide in designing food production program, the government can now use the planetary health diets (PHD) concepts. Planetary health diet is a new systems paradigm and discipline that integrates the health of the human civilization and of the natural systems on which it depends. One of the major human systems driving transformations is the food system. Food is essential for sustaining the health of human populations, but

its production and distribution are exerting tremendous pressures on the Earth's vital processes (Guinto, 2021). In brief, PHD diets require dietary shifts like consuming more of root and tuber crops, fruits, vegetables, nuts, and legumes. In turn, consumption of red meat and sugar should be reduced. PHD is plant-based diet with fewer animal sourced foods. It confers both improved health and provides several interrelated environmental benefits. According to Prof. Walter Willett of Harvard T.H. Chan School of Public Health, *Transformation to healthy diets by 2050 will require substantial dietary shifts. Global consumption of fruits, vegetables, nuts, and legumes will have to double, and consumption of foods such as red meat and sugar will have to be reduced by more than 50%. A diet rich in plant-based foods and with fewer animal source foods confers both improved health and environmental benefits.*

PHD applied in the Philippine setting calls for an increase in consumption of starchy root and tuber crops containing complex carbohydrates. This requires increased government support for the production of root and tuber crops (*camote, cassava, taro, yam, adlai, turmeric and arrowroot*). Root crops can be easily grown pesticides-free. Mungbeans or sweet potatoes or *camote*, being a short-season crop can be grown following the wet season rice crop, taking the place of the dry season rice crop. Rice requires 3 to 4 times more water than root crops or upland crops like corn, cassava, taros and yams.

Planetary Health Diets (PHD) include the revival of food culture diversity echoed in the legendary Filipino song *bahay kubo* where 18 indigenous vegetables and fruits are mentioned. Improving resilience to climate change, reduction of greenhouse gases emissions, and the limitations of land and water due to soil and water pollution and degradation are well addressed in this song.

Food is the single strongest lever to optimize human health and environmental sustainability on earth. Adopting planetary health diets (PHD) is needed to adequately feed nearly 10 billion people globally; or the Philippines, whose population could reach 150 million by 2050 (Mendoza, 2008)

Food Production in support to the massive adoption of Organic agriculture

Consider this scenario: If all farmers adopt abruptly zero use of chemical fertilizer when they shift from conventional/chemical agriculture, yields may drop by as much as 50-60%. Many Filipinos will go hungry, unless we import a lot of rice (5 to 6 million tons of well milled rice, costing about P175 billion to P210 billion, at P35 per kilogram) (Montemayor et al. 2021).

An effective organic agriculture program must recognize the actual conditions of most farmers. It should assist farmers in undertaking a gradual, calibrated reduction of chemical inputs while progressively transitioning to a more robust or fully organic regime. Our soil fertility has declined by almost 40 to 50% (Mendoza, 2009). Soil organic matter (SOM) currently ranges from 1.5 to 2.0% only. Our benchmark SOM in the transition process is 3%. Building up soil health (using crop/weed biomass recycling only) is slow. Chemical fertilizer (NPK) may be applied, together

with micronutrients and farm-produced compost or humus, under a “balanced fertilization” regime⁴. We emphasize farmer-made compost or humus, because buying them will cost a prohibitive P7,000 per hectare (P350/bag of 50 kilos x 20 bags).

Hence, the Department of Agriculture (DA) and Local Government Units (LGUs) should provide technical, financial, and other support, including bulk procurement of farm animal manure. Municipalities must encourage poultry or hog growers to sell their manure only in their localities. Under the Sagip Saka Law, LGUs may procure these manures and convert them into composted organic fertilizer for free or at-cost distribution to farmers.

Another equally important need of farming communities is the acquisition of basic equipment, tools, and suitable small machineries. Organic agriculture is labor intensive. To lighten farming work, each village must have a foundry shop so that farmers can repair, improve, and even manufacture farm tools and equipment locally.

Another dimension in the transition towards organic agriculture entails moving farming systems from mono-cropping to bio-diverse or integrated farming systems. Organic agriculture is a multi-faceted undertaking. Synergism among component activities occurs (e.g., livestock manure is made into compost; excess crop biomass yield is fed to animals). There should be various crops planted as companion/inter crops or as sequence/rotation crops to manage nutrients and pests. Seeds and planting materials must also be provided to farmers to facilitate the transition process. For greater sustainability, farmers should be trained to produce and save their own seeds. Many farmers have neglected the traditional growing of health-enhancing vegetables. The DA and LGUs must revive “Bahay Kubo Cropping” and provide farmers with planting materials and training. Farmers should have cattle or carabaos to serve as farm power and as sources of manure for composting. An appropriate subsidy and/or credit support program will encourage these actions.

Starting in 2022, following the Supreme Court’s Mandanas case ruling, LGUs’ share in national tax revenue will increase by 27%. LGUs should now devote at least 10% of their increased Internal Revenue Allotment (IRA) for agriculture and fisheries programs, with at least one-fourth of the IRA earmarked for organic agriculture.

Another crucial factor is significant investment in Research, Development, and Extension (RD&E) on Organic Conversion Technologies, which tackle the transition processes and procedures to facilitate entry into the conversion stage (zero chemical inputs). Pure and adaptive research on Organic Agriculture in Transition also needs funding by DA and the Department of Science and Technology (DOST).

⁴ Under our current laws as well as in the International Federation of Organic Agriculture Movements (IFOAM), “organic conversion” starts when a farmer has stopped using agro-chemicals and ends when his farm enterprise is declared 100% organic or chemical-free, following a rigorous certification process. IFOAM and Asian Regional Organic Standards (AROS) for market-mandated certification require about three years of zero-use of chemicals.

CONCLUSION

The consumers must recognize the need for nutritional and medicinal foods. They must be made conscious of the costs to our planet's ecosystem brought about by Modern Chemical Agriculture. This body of knowledge must then be managed and translated into a concrete consumer demand that will lead to corresponding changes in the supply side. This in turn will lead to changing the supply-oriented agricultural production systems that more than 98.0% of our Filipino farmers currently adopt. A well-planned and progressively funded and implemented organic agriculture in transition and conversion programs should be designed that will ultimately result in a more sustainable food consumption habits and consumer welfare-oriented organic and agro-ecological agriculture.

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Organic Agro-Tourism in Nepal: Policy Implications at Local Levels

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INTRODUCTION:

There is adequate literature in Nepalese context that suggests that Nepal is an agrarian country. With most parts of the country constituting of rural and sub-urban settings, a large proportion of the population is engaged in agriculture activities. However, there has often been a difficulty in accurately measuring the actual contribution of the sector in the national accounts, given the fact that a large part of the agricultural processes is informal in nature or in other words subsistence based. As of the fiscal year (FY) 2018/19, agriculture contributed to 27 percent to the GDP which has declined from 28.1 percent in the previous FY 2017/18 (Economic Survey, 2019/20).

The agriculture sector has the second highest contributions to the GDP. The diversification of organic agriculture production, value-addition and technical assistance in sustainable organic agriculture technology are crucial for the sustained growth of the sector because of the growing demand for organic products in the country (Aryal et.al., 2009). Add to this fact, the immense tourism potential of the country also signals towards the need for development of integrated approaches for mainstreaming organic agro tourism promotion policies at national, sub-national and local levels to reap the maximum benefits.

The recent COVID-19 pandemic has immensely affected all development related activities globally. Nepal is no exception to it. The agriculture sector is one of the majorly hit sectors in the context of Nepal because of the lack of proper systemic and regulatory measures at the community levels to safeguards the interests of small-holder farmers. In this context, structural adjustments to promote organic agriculture combining it with the natural tourism prospects within such remotely located and isolated communities can create an opportunity for sustainable portfolio diversification and increased incomes for such farmers.

RATIONALE:

The paper examines the prospects of development of a cyclical model of organic agro tourism, where small-holders and commercial farmers can benefit in the long-run. The cyclical model recommended forth importantly analyses the social, economic, and ecological effects of sustainable organic agro-tourism, which clearly reflect the principles of sustainable development. The model covers nine of seventeen goals envisioned by Agenda 2030.

Nepal has undergone rapid transformation in state structure and governance in the past couple of decades. However, the share of GDP from the agriculture sector has been in a declining trend in the past five years. The reliance of smallholder farmers on traditional primitive technology and lack of effective market networking ultimately reflecting in high post-harvest loss and low farm prices are among the underlying causes for the decline.

The trends of international migration of youths divergent from agriculture sector is an example that proves the case. Another pressing issue is the inability to adapt to effects of climate change such as irregular rainfall patterns, high plant mortality rates ultimately affecting both production scale and productivity (Adhikari et.al., 2020). Finally, the administrative hassles and inadequate capacity for organic certification and intermittent regulatory processes are major impediments for the development of the sector.

ORGANIC AGRO TOURISM IN NEPAL:

The need for organic product specialization by ensuring certified organic production is particularly important for sustained market reach, finally reaping highest levels of economic and ecological benefits, specifically for the marginalized, women and smallholders in Nepal. These practices also address the global concerns of effective climate actions targeted towards small-holder farmers and marginalized populations across Nepal through scientific forest management and development of forest-farm based enterprises such as farm stays and home stays.

Similarly, an effective regulatory framework along with well-directed policies and programs is necessary for reaping of sustainable benefits through organic Agrotourism related interventions. Developing countries such as Nepal lack a clear systemic approach towards the implementation of sustainable applications of sustainable tourism practices through organic agriculture at national and sub-national levels.

Add to that, lack of adequate knowledge among small holder farmers, local and sub-national governments and line agencies, and discrepancies in financing mechanisms and research and development are the underlying causes impeding the creation of enabling environment for potential benefits from the organic Agrotourism.

The national policy of Nepal regarding organic Agrotourism outreach in Nepal; Agrotourism Promotion: Program Implementation Action Plan, 2017 highlights the policies and programs, key areas of intervention, issues and challenges regarding the Agrotourism related activities in Nepal. However, it lacks a clear program of action for implementation of organic Agrotourism applications in local and sub-national levels (Agriculture Development Directorate, 2017).

According to the approach paper drafted by the Ministry of Land Management, Agriculture and Cooperatives as highlighted in the 14th Plan niche organic agriculture products are placed as one of the priority sectors. However, reliance on traditional subsistence farming methods, overuse of chemical fertilizers and pesticides, and discrepancies in local level programming are the major impediments for achieving targeted growths in the sector.

Some of the few strategies that need to be adopted for the sustainable development of the organic Agrotourism in Nepal are (but not limited to):

- conduct market-oriented research on the understanding and level of awareness of small holder farmers, and local/electoral governments towards organic Agrotourism applications
- create inventory of existing practices of organic Agrotourism related programs and its implementation in sub-national and local context
- develop strategies to address the financial, technical and policy constraints for organic Agrotourism applications
- identify and pilot key areas of interventions
- develop a scientific and policy research forum to advocate organic Agrotourism activities
- capacitate farmers for using sustainable technologies
- create knowledge sharing platform/s and branding parameters by collaboration between private sectors, academic institutions, local/electoral government, and other line agencies

Organic Agrotourism industry has brought itself to the limelight as the future for sustainable Nepalese tourism. Nepal is one of the most beautiful countries in the world because of its incredible scenic places, diverse and unique traditional cultures, and heritages. Its unique geographical positioning within the lap of the Himalayas and diverse altitudinal variations has made Nepal the biggest natural museum in the world. Similarly, Nepal has a natural potential for producing varieties of organic agriculture produces and livestock due to its geographical diversified structure, suitable climate, and availability of other organic inputs such as water and soil. In a nutshell, the sustainable development of organic Agrotourism now is evident to become a major step towards economic and ecological revival for Nepal.

Overall, given the focused intent and vigor for development of specialized organic Agrotourism related products in community, local levels, and establishment of institutional mechanisms for technology and knowledge sharing platforms, the overarching objective of economic empowerment through organic Agrotourism and agricultural modernization is possible in Nepal, which remains crucial for sustained economic growth.

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Topic: The Role of Organic Agriculture for the Rural Revitalization

Poverty Alleviation, Inclusive Development, and Empowering Communities: Revealing the True Potential of Organic Agriculture through Corporate Social Responsibility in India

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INTRODUCTION:

No doubt that post-independence, India marched ahead on all the development indicators. However, after 74 years, it is now time to reflect on whether we have achieved the desired level of change that we estimated? Quite clearly, the answer in most of the cases will be No. According to (Gaur & Rao, 2020, p. 5 & 6), from time to time, various high-level committees were constituted by the Government of India to estimate the number of people living in poverty in India. One such committee that was recently constituted to review the status of poverty was the 'Rangarajan Committee' (2014). This committee recommends a Monthly per capita consumption expenditure of INR 1407, and INR 972 in urban and rural areas respectively at the 2011-12 prices as poverty line all over India. The national poverty in 2011-12 was estimated at INR 1000 for urban, and INR 816 in rural areas, per capita per month.

On the other hand, in 2013, an important historical decision was taken by the Ministry of Corporate Affairs, Government of India by introducing a Mandatory Corporate Social Responsibility (CSR) law that directs certain companies to spend at least 2% of their net profits on social development. I endorse this step of the government primarily because the larger understanding of CSR in India is equated with corporate philanthropy. An additional argument is that CSR in India has been driven by the ideologies of Jawaharlal Nehru (Socialism), and Mahatma Gandhi (Trusteeship).

This paper is an attempt to redirect the CSR policy and underline the potential of the corporate sector in empowering the communities, eradication of poverty, and ensuring inclusive "Genuine development" through promotion of organic agriculture.

METHODOLOGY:

The paper has been developed by critically reviewing the High-level Committee report on CSR in 2019. Further, the author also examined the details of the CSR activities of the top 25 companies

that are spending the most on their CSR projects. The timeline of the review has been kept as 2014-18. It is because the author aimed at understanding the present status after CSR was made mandatory in India. With all these backdrops, an attempt is made to understand the gap in CSR practices and explore the possible role of CSR in the promotion of organic agriculture in India.

PROBLEM ANALYSIS:

The experience to date questions the "Genuineness" of the approach, and efforts of the governments. In other words, if I fall under the Below Poverty Line in 2020, and in 2021, and if my income increases by just a minimum amount, then according to the government, I have graduated out of poverty. But can we say that to be genuine poverty alleviation in a real sense? Corporate houses, post mandatory act have spent 52,208 crores INR (from 2014-2018), (Ministry of Corporate Affairs [MOCA], 2019) in a range of activities that qualify as CSR. Considering the 130-crore population, rate of backwardness, and a wide number of activities, it would not be justified to expect a miracle from the CSR, given the low budget (See...Figure 1).

Figure 1: CSR expenditure by companies as of March 31, 2019

Year of filing	FY 2014-15		FY 2015-16		FY 2016-17		FY 2017-18	
	No of companies	Total CSR amount spent (in Rs. cr.)	No of companies	Total CSR amount spent (in Rs. cr.)	No of companies	Total CSR amount spent (in Rs. cr.)	No of companies	Total CSR amount spent (in Rs. cr.)
NON PSU	10,083	7,249.11	12,551	10,302.39	12,810	11,026.63	11,314	10,787.50
Average spend by NON PSU	0.72		0.82		0.86		0.95	
PSU	335	2,816.82	404	4,201.26	372	3,285.40	270	2,539.19
Average spend by PSU	8.40		10.40		8.83		9.40	
Grand Total	10,418	10,065.93	12,955	14,503.65	13,182	14,312.03	11,584	13,326.69

Source: cited from (MOCA, 2019, p. 24).

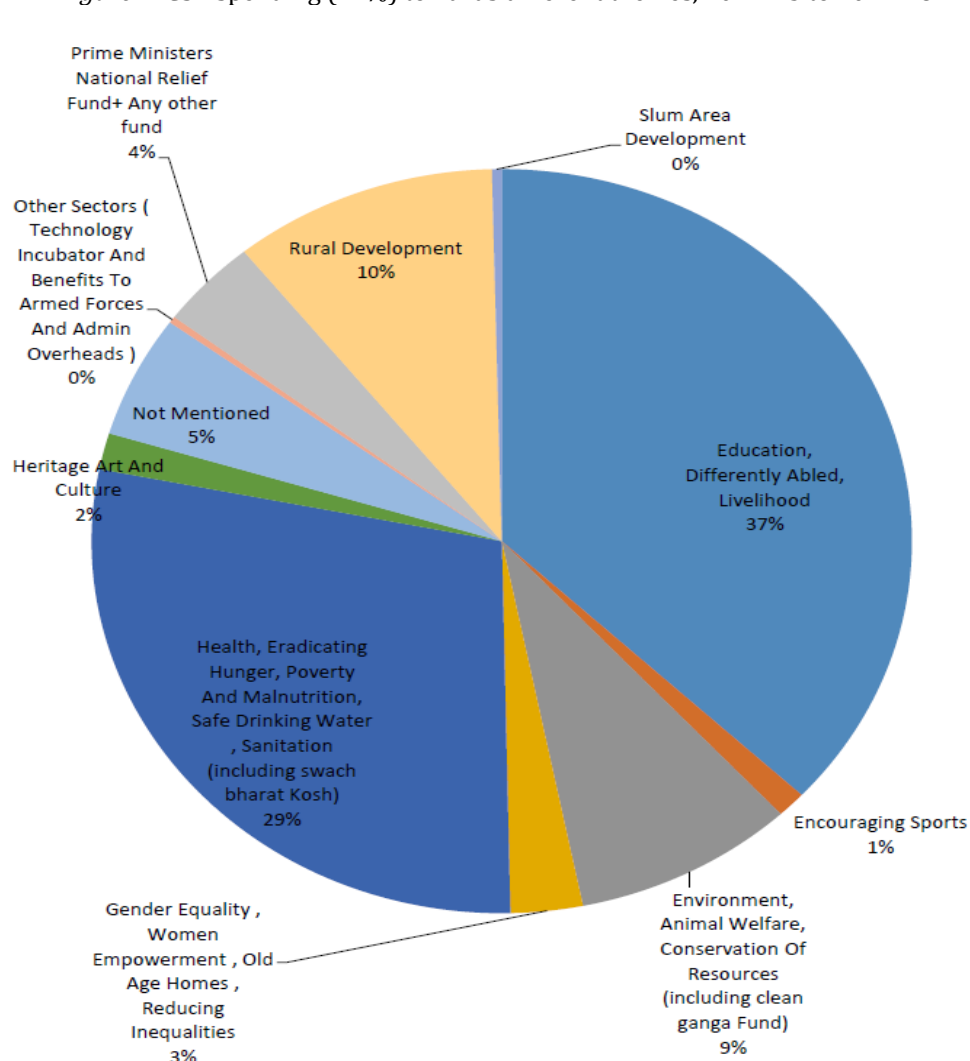
The entire debate must revolve around how we are going to make the CSR act more meaningful and relevant by placing the communities at the center. The reason why we need to raise this question is that a comparison between the development indicators and the massive spending shows that there is a mixed co-relation between these two.

This paper narrows down the opportunities before the corporate houses to only two activities. It can be easily observed from Figure 2 that the two areas where the companies have widely spent between 2014-15 and 2017-18 are (i) Education, differently-abled and promotion of livelihood – 37%, and (ii) Rural development- 10% of the total budget.

Figure 1 shows that in the case of livelihood, on one hand, there is an increase in the spending by the CSR on the promotion of sustainable livelihood and skill development programs, but, a report by the Economic Times ("India's unemployment rate", 2019) reveals that India's unemployment rate is highest in the last 45 years during 2017-18. This again also does not mean that CSR has completely failed to deliver. The point that the paper underlines is- CSR alone cannot be expected to bring any significant development. It is also evident that according to a report by Money Control ("Reality of skill India", 2019) that 33% of skilled youth in India are jobless and the unemployment rate is very high among the skilled youths. These few indicators and reports are sufficient for us to understand that there are very little gel and sync between the ongoing missions of the government and CSR projects.

This indicates that the focus today is to increase the number of beneficiaries and do wide activities, while severely compromising the quality.

Figure 1: CSR spending (in %) towards different themes, 2014-15 to 2017-18



Source: cited from (MOCA, 2019, p. 41).

POLICY BRIEF:

As mentioned earlier- the CSR budget of the country cannot certainly be held responsible for any significant impact. CSR verticals, therefore, need to highlight the “critical gaps” after the implementation of any project by the government, and then in fact CSR must fulfil those gaps.

One cannot deny the visible changes that have taken place, but a deeper analysis pushes us to questions like:

1. Whether the CSR projects are need-based?
2. Our CSR initiatives rights-based?
3. Whether the communities are ready to take up ownership of the activities?
4. Are the CSR projects making the communities dependent upon the corporate or making them self-sustainable?
5. Are the CSR projects enabling the bottom-up approach of development?
6. Are the CSR projects enabling the participation of the communities for the need and or impact assessments?

Just less than 60% of India’s population depend upon agriculture for their source of livelihood (India Brand Equity Foundation, n.d.) The CSR wings therefore can converge their livelihood, and rural developmental initiatives only on capacity building of the farmers through training, research, consultation, management, and assisting in marketing. Organic agriculture if focused seriously can prove out to be a game-changer and play a vital role in poverty eradication and increasing the capacities of the farmers. Organic agriculture is not only the future but, has been proving out to be a profitable deal from an income enhancement point of view.

Only when at least 50-75% of the CSR money is confined to promotion of organic agriculture, can create a significant impact in the next 10 years. This initiative will not just develop the communities, but can also positively impact the society in other ways like- (1) continuous reduction in cases of diseases caused by chemical-driven food, (2) better nutrition, and (3) promoting soil health, and associate.

EXPECTED IMPACT:

- Redefining of CSR activities and narrowing it down to focus on only 2-4 themes
- A new breed of trained, socially, and environmentally conscious farmers will lead the agrarian economy
- Genuine empowerment of the farmers
- The CSR projects will be easy to monitor, evaluate, and mapping of the impact will be easy and more scientific (measurable CSR works)
- CSR will start focusing on human problems over compliance fulfillment
- Increase in the area of Organic Converted/ in conversion agricultural land in India

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Topic: Biodiversity and Natural Resources Management Under Organic Agriculture Systems

Biodiversity and Natural Resources Management through Organic Farming: An Experience from the Western Ghats, Kerala, India

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ABSTRACT

The sustainable farming practices adopted by the small and marginal farmers of Peermade Development Society, by enhancing the ecosystem services provided through regenerative management of biodiversity and natural resources of the Western Ghats Argo-ecosystem of Kerala, is described in the paper.

INTRODUCTION: THE AGRO-ECOSYSTEM OF WESTERN GHATS AND THE NEED FOR INTERVENTION.

The Western Ghats is one of the world's biodiversity hotspots and has a fragile ecosystem. Over 90% of the farmers in the region are small spices farmers including women and tribal. The terrain is mountainous with slopes and valleys and the cultivation is largely rainfed. The adverse impact of climate change like unpredicted onset of rainfall, disruption in rainfall pattern, frequent high intensity rainfall resulting in flash floods, landslides, soil erosion; periodic droughts and other natural calamities, had an unprecedented impact on the Agroecology of the region and also on farming, thereby challenging the sustainability and livelihood of the farmers. Over to this catastrophe, the practices of industrialized agriculture glorified as 'green revolution' resulted in almost death of the living soil, destruction of eco-system and contributed to the heavy loss of bio-diversity.

Peermade Development Society (PDS), an NGO, located in Peermade village in the Western Ghats, since 1980, has intervened with resource poor and marginalized farming community to adopt sustainable farming practices and biodiversity management systems in harmony with the ecosystem. The sustainable agriculture practices followed by PDS farming community on the principle of life in abundance and PDS has been following sustainable farming practices, which are mainly focused on soil health, climate resilience, water conservation, Biodiversity protection and enhancement of the farm income.

A. Soil health regeneration

With over 2000mm annual rainfall falling on an undulating topography, primary focus was given for soil protection and its regeneration targeting the humus content and soil biota. The major steps of action are:

- In-house laboratory analysis-based soil health assessment of individual farms in every 2-3 years of all 3000 farmers of PDS network and defining individual farm-based action plan for soil rejuvenation.
- Growing of cover crops like Pueraria, Mucuna, Sesbania, Crotalaria and other locally available leguminous species to prevent soil erosion and to harvest free atmospheric nitrogen into soil as well as to conserve soil moisture.
- Increasing soil organic matters through incorporation of cover crops, addition of compost, vermicompost and biodynamic composts, Cow horn manure and local traditional knowledge-based manures.
- Supply of good quality organic Agri-inputs to the farmers through input production center of PDS
- Planting of local Vetiver grass along contours of farms to stabilize soil and prevent soil erosion.
- All the plant base is enriched with local strains of Arbuscular Mycorrhizae as well as native soil microbes enriched cow dung based organic liquid manures like kunapajala, Jeevamrutham and others through women entrepreneurships

B. Water management and conservation

In spite of the abundance of rainfall, scarcity of water is quite frequent in the hilly areas during summer due to the drying up of dug wells and springs. The status of irrigation among the farmers is quite low with majority of crops are largely rainfed and others having open wells, small ponds, or check dams for sourcing irrigation water. The life cycle of the spices is completely dependent on the seasonal climatic conditions. So, the water management is an important driver in the Western Ghats food system.

- Rainwater harvesting structures and water recharging systems has been built in all the farms and processing center. PDS Organic Spices has achieved water neutral production at the processing center with harvesting more than 1,000,000 liters of rainwater thereby meeting the entire annual requirement of water for the processing center
- On a landscape scale, watershed management program including terracing, bunding, construction of check dams was undertaken through PDS projects
- Maintaining soil cover in the farms prevents water loss due to evaporation.
- River Conservation program by planting local trees like neem, cassia, Ficus and other medicinal trees.
- Water budgeting and capacity building on optimum utilization of water in farm

operations, specifically focusing on critical stage of crop growth and animal husbandry.

C. Biodiversity protection and Ecosystem services

Multi-storied cropping and multiple cropping systems are the norms of farming under PDS farmer network. Since the area of farmland is only around one hectare, traditionally farmers have designed the cropping system to increase cropping intensity through mixing adoptable crops to maximize utilization of available natural resources like land, water and light. Tall tree crops like coconut, arecanut, nutmeg, cloves and other fruit trees including jack form the upper layer of harvester, and next layer is constituted by small trees like cinnamon, pepper/vanilla on tree standards like *Glyricidia*, *Erythrina* that require only 50-75% sunlight. Next layer, close to the ground is annual crops, herbs and spices, vegetables, grass, and other cover crops (30-50% light).

Engaging with GiZ, Germany on contract to support the process of adapting Biodiversity Action Plan in the field level. The objective of this project is to support the process of adapting the Biodiversity action plan with farm practices with local knowledge in spice farms of the Western Ghats. The major components of the action plan which PDS is implementing are as follows;

- Conduct of regular awareness program for farmers on Biodiversity & eco- system services under GiZ supported program, Private Business Action Plan on Biodiversity. (PBAP)
- Monitoring of soil microbial population in all spice farms under PDS network (Table.1)
- Identification, multiplication, and distribution of Climate resilient local & farmer varieties of spice plants. Identification and promotion of local plants that flowers during various seasons and planted the mix of plants along the boundaries of the farm to ensure availability of flowers through the year to support pollinators and insects within the farm and surroundings. It helps to increase the floral, faunal, and microbial diversity in the farms.
- Assessment of Carbon sequestration by trees at individual farms and documentation using scientific tools. It is estimated that on an average a farmer having one hectare of land sequester almost 100MT of carbon through the existing trees within the farm.
- Documentation of traditional knowledge on biodiversity and climate resilience and its utilization in the field level.
- Identification of medicinal plants that could be introduced as intercrops in the spices farms to increase farmer revenue.
- Wherever possible inland fish farming is promoted with the support of Fisheries department.
- Creation of seed bank for protection of local varieties and its popularization. Food crops, vegetables, tuber crops fruit crops and medicinal plants are conserved for protection in the seed bank of PDS.

Scouting farmer's innovations to address localized farming problems:

PDS has inverted the current approach of Lab to Land to "Land to Lab" to fill the gap in technology adaptation at farm level. The Center for Land to Lab initiatives promotes local/farmer varieties of spices plants and local innovations and unique traditional knowledge practices. This approach has been widely accepted and recognized as a participatory tool for promoting farmer's innovations. The commendable farmer innovations include best locally adapted high yielding varieties in spices like cardamom, pepper, nutmeg, ginger and vegetables; organic inputs making and composting techniques, post-harvest machinery like dryers and cleaners, best organic rooting hormones from Moringa leaves, grafting and layering methods and pest and disease management solutions and best farming practices acquired by generations of practical farming experiences.

Reduced Carbon Footprint and Efficient Resource Utilization

By adopting modern technology, PDS Organic Spices is taking conscious efforts to reduce carbon emissions each step of the supply chain and make the farm and processing operations water and energy neutral. In association with business partners, PDS has installed a mobile application to record and monitor the carbon emission in each stage of the value chain and based on that, necessary steps have been adopting to reduce the carbon foot prints in each stage. The pooled purchase system of PDS enables to reduce the carbon footprint during the transportation.

Conserved water from the rainwater harvesting and recharging systems, is using for the farm and factory operations throughout the year, thus making the operations water neutral. Biogas units are established in many of the farmer households to effectively recycle kitchen and other biological wastes.

The utilization of solar energy, like solar dryer system, solar lightings etc., reduced the dependency on non-renewable energy is being promoted with the farming community, but with limited success mainly due to the cloudy weather prevailing in the region. (Pic.9)

CONCLUSION

By upholding the philosophy of imparting Life in abundance, from its inception Peermade Development Society has been focusing on ecology as its business. All farming activities are designed to sustain biodiversity and ecology and with the very conscious mind that, what PDS do are for the future generations on earth and not for the present.

Agrobiodiversity Beyond Organic for Pandemic-Resilient Futures

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INTRODUCTION

A global pandemic continues to shut the world down and numerous activities are still put on the back burner. It seems otherworldly and Governments across the globe are stumbling through month on month. We have enough data today to prove that large-scale industrial farming does not and cannot feed the world's population. Agrobiodiversity is an incredible wealth of knowledge and wisdom that is the perfect blend of the traditional and contemporary. In the days to come, the youth of today will find Agrobiodiversity to be critical in providing stability, adaptability and resilience to create truly holistic sustainable food systems.

UNIQUE APPROACH

I have been living on a homestead with the principles of Agrobiodiversity. The piece of land is an absolute oasis for hundreds of species of flora and fauna and is a vibrant farm with grains, vegetables, fruit, greens, and wild plants. Agrobiodiversity is the most holistic approach to sustainable farming – for every portion harvested it is like giving back twenty times.

In some schools of thought organic and natural farming suffices. There remains an undue amount of stress on pure productivity of farms and also continues to play into market demands only. This leaves a huge vacuum when it comes to the millions of other beings that share this planet and its resources with us.

This context becomes further complicated as this recent pandemic has shown. Rural India has seen the average landholding size decline and most of our farmers are marginal farmers with three to five acres of land. These farmers make up almost 70% of the agricultural sector and their average monthly income is Rs 2,803 (37.78 USD).

Large numbers migrated out of rural areas to diversify income options, usually out of a lack of choice. Farmers, especially those in high-risk areas such as rain fed agriculture regions and cyclone zones have moved to reduce the risk to themselves and their families. At the macro perspective, migration is multifaceted driven by demographic, social, economic, political, environmental, and personal factors. It is into this scenario with which we must view the exodus of migrants going back to rural areas due to corona.

Recent estimates have indicated that almost 20% of the migrants in various Indian cities will not go back to urban India once the corona wave subsides. Having left their villages in search of better jobs and increased pay, the virus has shown them that actually, they feel true safety, albeit social safety, 'back home'.

For a large number of migrants in India, 'back home' could mean a homestead. Years of policy have alienated farmlands as a separate managed entity from the home and village set up. Homesteads were, and in many cases are still, sources of production of fresh vegetables, fermented and preserved foods, pollination friendly flowers that supported healthy bee colonies, free-range poultry and meat, dairy such as milk and yogurt, and took care of all the needs of animal husbandry such as cattle feed and in house veterinary aid. A lot of homestead management was intuitive as well as based on years of traditional ecological knowledge. A number of other creatures benefited from this approach – not just at the homestead/ food gardens but at the farms as well.

For traditional farmers, the political arena around farm laws is a whole other set of challenges. India's agriculture and food production sectors are in crisis. Our rural economies and ecologies are on the verge of collapse; they have been for some time now.

However, a lot of people were shocked as farmers marched into Delhi in late 2018 and early 2019. These marches are underrepresented in mainstream media and the ruling elite, and their supporters were quick to dismiss the farmers as 'politically motivated'. We were all somehow expected to ignore the thousands marching as call it mere political antics.

While political ambitions are played out in any crisis it would be foolish to ignore the underpinnings of these movements and not see the reality that the rural marginalized face. Our agrarian crisis is a complex and historically long one cutting across many lines. One reason can be attributed to the series of policies and trade agreements favoring industrial agriculture as opposed to smallholder farming practices.

Reports have shown without a doubt that the majority of the world's population is fed and remains relatively healthy from small home gardens and small farm holdings. It seems to be that now more than ever, in India as well as globally – Agrobiodiversity in organic farming is going to offer a plethora of solutions.

IMPACT

Despite the slow uptake of Agrobiodiversity practices, it remains abundantly clear that this approach has incredibly multi-faceted returns for everyone. There are some stellar organizations and initiatives that promote the principles of Agrobiodiversity while promoting organic farming. I truly commend them for having the vision to engage in land activities that are as much about 'giving' as 'taking'.

I have been very interested in the approach of the Tse-Xin Organic Agriculture Foundation in Taiwan. Here they actually champion farmers who support wildlife and biodiversity in their farm holdings. They also encourage nutritional sovereignty of the farmers in very remote and rural areas. This is an incredible thought process that weaves in market dynamics but also the wisdom of sharing through kindness.

They have done a remarkable job of making local fauna and flora priority for their organic farmer members. As per their website, they have been on this mission for twenty years now and their conservation work has actively protected forty-six species in the farmers' fields. They reward and encourage farmers to have a holistic vision of organic farming and till date have handed out one million green conservation medals. They mention that as of 2019, there are nearly 450 certified farms with over 600 hectares of land encompassing important ecosystems now under sustainable management. Now, many people actively support these standards and encourage wider adoption of stewardship practices in producers.

In collaboration with the Forestry Bureau, TOAF launched a Green Conservation program to promote environmentally friendly agriculture which promotes ecological conservation. The primary focus of the program is to protect threatened species and their habitats through technical training and assistance to local farmers who are transitioning from conventional to organic agriculture. Farms that meet the GC standards receive the right to promote and market their products with the GC seal of approval. Since then, the program has grown and evolved into a widely recognized label nationally. Consumers in Taiwan recognize the label as a symbol of environmental, social, and economic sustainability.

The Timbaktu Collective in South India is another one such place where they have chosen to be the example. Over 30 years the vibrant agroforest habitat has had thousands of people visit and learn the framework the community operates within. The idea that wild animals have equal rights over resources is in itself revolutionary. There is a special focus on 'celebrating life' where every life form is acknowledged. This attention to agrobiodiversity on a homestead and farmlands is also shared and inculcated in the farmer run cooperative with over 1000 farmer members over 12,000 acres.

The Collective runs a massive eco-restoration project on over 7000 acres of degraded community common lands with their perspective being a holistic vision of protecting and conserving flora and fauna that in turn aid the overall health of the ecosystem.

Vanastree, an NGO in rural Karnataka takes a different approach to creating zones of agrobiodiversity. They focus on small scale food systems in the Malnad region of Western India. They build on the Traditional Ecological Knowledge of their members and that of the region to promote sustainable forest gardens. This woman run Collective saves seeds, tubers and other wild foods that are crucial to ensuring seed and food sovereignty and promotes 'forest gardens and forest farms' – the perfect situation for agrobiodiversity to thrive.

Vanastree has grown to have 150 members in 15 villages. Their impacts and outreach have been conserving biodiversity, educating, and training, sustainable livelihoods, product sales, research and documentation. On their website, they have listed several research papers that are of great interest for anyone interested in agrobiodiversity. Of special mention to the context of this paper are 'A Spatial Analysis of Plant Diversity in Forest Home Gardens of Western Ghats, India' and ' Faunal Diversity in Forest Home Gardens of the Malnad, India. The baseline survey looks at faunal diversity in forest home gardens around Sirsi. Butterflies, odonates, amphibians, reptiles, birds and mammals were documented. They add that though no conclusive biodiversity index can be established, it is an important step in looking at home gardens as preserves of wildlife. In their own words, 'Key to all of our initiatives, Vanastree demonstrates that challenges related to global food security and positive social change do have dynamic solutions that exist as small-scale working models in local ecosystems.

To summarize, it is beyond obvious that agrobiodiversity is the next step in ensuring nutritional sovereignty while simultaneously enhancing the quality of soils, ecosystems and communities. It provides environmental services to animals, plants, humans and other species. As the world of organic farming gathers more momentum, adding the dimension of agrobiodiversity will forge an incredible path forward for the coming generations to address gender inequality, nutritional sovereignty, explore local markets and circular economies and last but certainly not the least, address the need of the hour – climate resilience.

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Building Integrated Biodiversity Index for the Assessment of Organic Farming and Agri-Environment on the Perspective of Environment Performance

Authors: Xu Xi¹, Ada Qin²

Abstract

Biodiversity as part of one of the four principles of organic agriculture “ecology” gains more and more attention from the supply chain worldwide. However, how to precisely assess the level of biodiversity for an organic farm is a great challenge. The Integrated Biodiversity Index (“IBI” in abbreviation) is a measurement tool for assessing the holistic biodiversity level of a farm. It is built on three aspects including 10 indexes³. It is a simple and applicable measurement tool for both professional users and the amateurs whether for contributing to a whole-picture farm report or for self-assessment. Based on Abovefarm’s 8 Chinese best practice organic farms’ application during 2019 to 2021 (See Table 1), IBI has proved to be an effective tool for farms’ biodiversity measurement. It is also an innovation in the organic sector.

Background & introduction

Agri-environment is across the urban and wildness districts as important corridors for wildlife survival and migration. Although land of organic farms in China only occupies 1.6% (2019) of total agricultural land, it offers significant opportunities for biodiversity conservation. Benefits brought by birds, weeds and habitats diversity are often replaced by ignorance, misunderstanding and hatred. Organic farming takes the responsibility of re-exposing the right balance between the yield value and biodiversity conservation. Simplified from Singapore City Biodiversity Index (CBI) we developed IBI assessment tool. We went around China and conducted the site survey in 8 Chinese ecological organic farms to check the effectiveness of the tool.

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³ biodiversity status (including bird diversity, plant diversity, invasive species and other special animal groups), habitat status (including area, quality and natural capital investment), ecosystem services brought by biodiversity (including yield, environmental education participants and agricultural education participants).

The lack of long-term scientific recorded data is one of the biggest challenges for the evaluation on biodiversity performance, especially on agri-environment globally. Birds are often used as a representative group which are frequently considered as a biodiversity compartment that is highly sensitive to agricultural patterns; Plants express a more fundamental level of biodiversity which most severely affected by human's behavior and could an obvious indicator of environment change; As for the landscape scale, farmland biodiversity is related to environmental heterogeneity since reduced habitat heterogeneity is often viewed as a key indicator of the relativeness between changes in agriculture and farmland biodiversity.

The Integral Biodiversity Index (IBI) aims to assess organic farms with scientific field-survey data to improve the credibility of organic and reduce the cost of evaluation. It is established and designed to meet three important goals: (1) to not only make the biodiversity performance of agricultural practices measurable but also the ecosystem services and management ability measurable; (2) to be a self-assessment tool as it is not only for comparisons among farms but also a guide for a farm toward a better biodiversity management; and (3) to be simple, quick and scientifically credible tool.

Methods

We built the IBI tool's framework and developed the system by site survey at 8 Chinese best-practice ecological organic farms in sustainability and finally constructed the index system. It is an open system and will keep evolving.

The Integrated Biodiversity Index (IBI) was built to scoring each organic farms from three aspects: biodiversity status (including bird diversity, plant diversity, invasive species, and other special animal groups), habitat status (including area, quality and natural capital investment), ecosystem services brought by biodiversity (including yield, environmental education participants and agricultural education participants).

- **Farms' pick-up**

The 8 Chinese farms were selected from Abovefarm's data base. Abovefarm is a 3rd party independent non-profit farm sustainability rating organization. They collected thousands of global organic farms data and site visited more than 300 outstanding candidates during 2016 to 2020. They measure a farm's sustainable in 3 dimensions: ecology, economy, and society. The 8 farms located in different area of China, from the northern part to middle-China, from the eastern part to the western province.

Table 1 The farms characteristics on ecological perspectives of selected 8 farms

Selected Farms	小柳树	天赐	绿我	百欧欢	璞心	深耕细 耘	华德福	中德
	XLS	TC	LW	BOH	PX	SGXY	HDF	ZD
Geographic Location								
City, province	Beijing	Beijing	Xi'an Shanxi	Shanghai	Huzhou, Zhejiang	Wuhan, Hubei	Changzho u, Jiangsu	Taizhou, Zhejiang
Wildlife fauna	North China			Central China				
Flora	Warm temperate deciduous broad-leaved forest area			Subtropical evergreen broad-leaved forest area				
Landscape diversity								
Habitat type	Suburb, plain	Rural, hills around	rural, plain	Suburb, plain	rural, wetlands, hills around	Wildness, wetland and hills	Suburb, plain, wetlands	Rural, wetlands with hills around
Habitat score	I	III	II	I	IV	V	II	IV
Farm management								
Organic certification		Y	Y	Y		Y	Y	Y
Do not use chemical pesticides and fertilizers	Y	Y	Y	Y	Y	Y	Y	Y
Use a small amount of less toxic chemical products								
Use plastic film	Y			Y				
Weeds tolerance	N			N				
Reduce tillage and reduce soil disturbance		Y	Y			Y		Y
Protection of hedges shrubs and woodlands		Y	Y	Y	Y	Y	Y	Y

Protection of natural plots		Y	Y	Y	Y	Y	Y	Y
Diversified planting	Y	Y	Y	Y	Y	Y	Y	Y
Use native seeds		Y	Y		Y	Y	Y	Y
Use of biodynamic agents			Y			Y	Y	Y
Planting green manure	Y	Y	Y	Y	Y	Y	Y	Y
Legume crop rotation	Y	Y	Y	Y	Y	Y	Y	Y
Use organic fertilizer			Y	Y				
Use self-made fertilizer	Y	Y			Y	Y	Y	
Use of large machinery		Y	Y	Y		Y		Y
Use self-made machinery	Y		Y					

● Bird survey

Birds are important indicator of biodiversity conservation since they are capable of indicating changes in the general status of wildlife and of the countryside. The data were collected during 8:00–10:00 am and 4:00–6:00 pm along the line transects on the farms. Every line transect was about 500–600 m long, with 50 m wide each side. Field glasses (Kowa 8*BD42) and camera (Sony DSC-RX10M4) were used during the investigations while walking at a speed 1.0–1.5 km/h, and birds were recorded when seen, heard, or flying over.

During the line transect investigation the sample point method was also applied to record birds seen or heard within 25 m radius, each point staying 8–10 min. For each transects environment recorded data include: the species, number, and activities of the birds as well as information about the surrounding environment, such as habitat types, plant coverage, proportion of water surface, proportion of impervious surface, etc. The bird diversity index was calculated including richness, abundance, Simpson diversity index, Shannon index and Pielou' evenness index.

● Weed survey methodology

The weeds in three different habitats of each farm were compared, including planting field (paddy field, dry crop land, vegetable land, green manure land, rotation land etc.), ridge and natural land (hillside, under woods, stream and ditch, wetland, etc.). For each habitat, we randomly selected 5 weeds quadrats to do the survey, using 1m*1m quadrat to record the

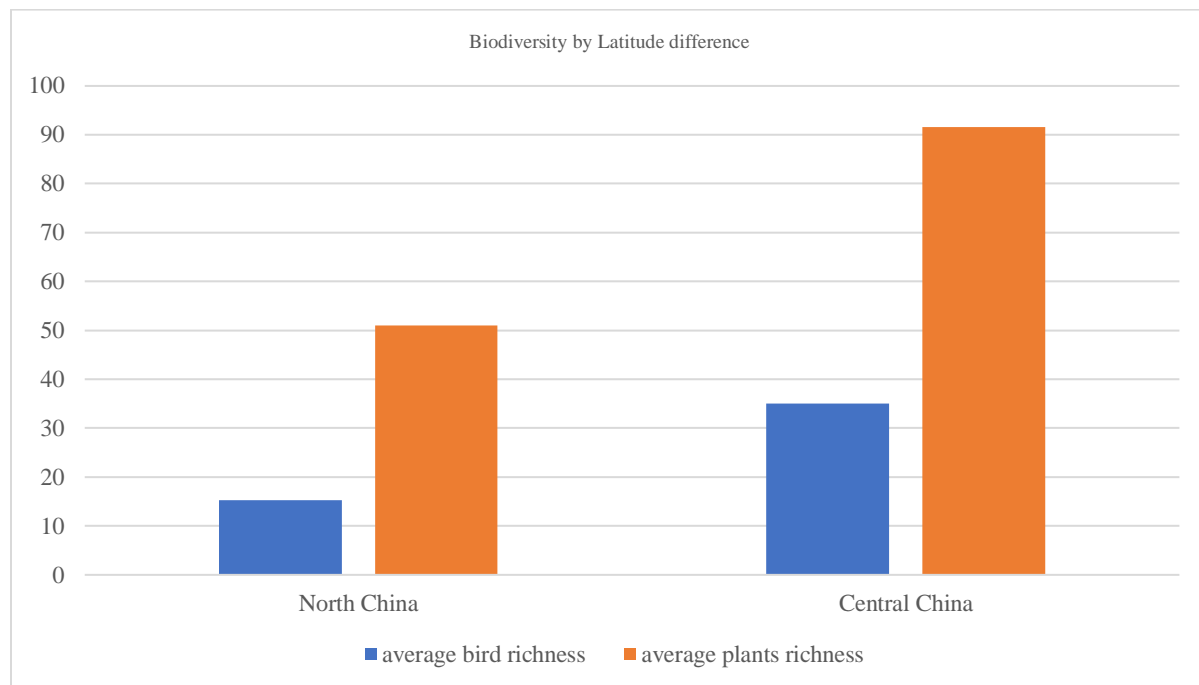
species, density, and coverage of all vascular plants in the quadrat. The weeds diversity index was calculated including richness, abundance, Simpson diversity index, Shannon index and Pielou's evenness index as well as the important value of weeds communities on each farms.

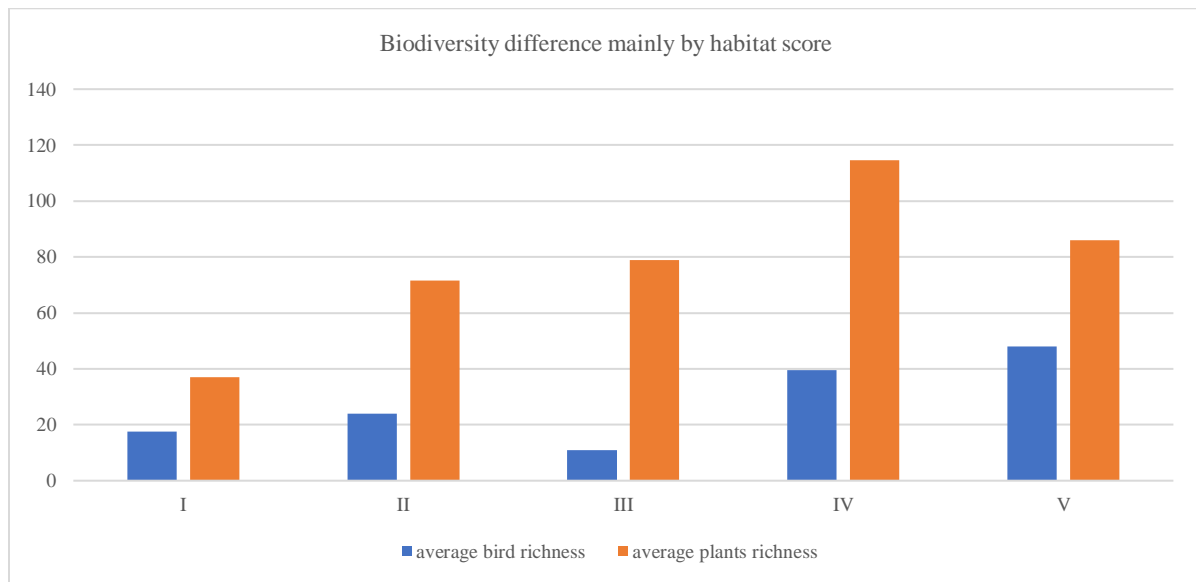
- IBI rating system

An integrate Biodiversity index (IBI) was built to scoring each organic farms from three aspects as stated above. Based on the IBI we constructed the IBI-1 index to adjust the indicators that can be changed due to human management factors, so that the index can measure the farmers' awareness and ability of biodiversity management.

Results:

The results showed generally the biodiversity status of Agri-environment of organic farms in the South is higher than North China; Farms with hills and wetlands around is higher than plains; farms in the wildness are higher than rural and suburb. However, for farm's management of planting, compost, weeds, and habitats do matters the IBI scores since even in close-by farms which belong to the same area or similar landscape, the IBI score sometimes have big difference. What's more, management objectives and capabilities of the farmer's sight will much determine the farm's biodiversity level.





Conclusions

Based on the above preliminary survey results, we established the IBI rating system with easily accessible data and easily popularized methods, including biodiversity indicators, such as 1.1 bird richness, 1.2 raptor (top species) and mammal richness, 2.1 total plants richness, 2.2 weeds richness in the field, 3.1 invasive species richness, 3.2 extent of spread of invasive species, habitat indicators, such as 4.1 proportion of natural habitat, 4.2 habitat quality, and ecosystem services factors, such as 5.1 number of ecological and farming education activities, 5.2 number of participants for each activity. We found that the influence and popularity of the farm in ecological protection (mainly decided by the number of visitors and activities) are inconsistent with the biodiversity status of the farm itself, limited by farm location, marketing strategy, management philosophy and public understanding of biodiversity.

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Topic: New Trends in Organic Agriculture

Organic Livestock Production in India: The Emerging Opportunity

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ABSTRACT

With largest number of organic producers, India is one among the top five producers of certified organic products in the world (Willer et al 2021). India currently exports across the globe a range of certified organic edibles & fiber to 58 countries. Organic food products exports grew by 51% to US\$1040 million in 2020-21 compared to US \$689Million in 2019-20, beating Covid-19 induced hiccups in the supply chain. The organic markets in domestic and exports are growing at a CAGR of 28% and 23.35% during last 5 years.

The share of India's exports to total international trade stands at 0.82%. With this significant progress backdrop, this paper explores the emerging opportunity & way forward for organic animal husbandry supply chain in India. Recently, organic products of animal origin have triggered the interest of producers, making entry of certified animal products into market including small quantity exported too. The domestic market for organic milk, meat, eggs and products thereof is picking up. Organic animal production including Research & Development activities, import & exports are mostly confined to EU, USA, Australia & few other developed countries. But, now many start-ups including enterprising farmers, private companies and dairy cooperatives are engaged in organic animal production, processing and marketing of certified animal products in India.

The recent export of certified organic butter oil from India to UAE was encouraging experience motivating many to pay attention to this hitherto neglected area. There is growing demand for information, knowledge, skills, and marketing opportunities for organic animal production, especially many youths, start-ups & enterprising farmers have been looking for capacity building & hand-holding opportunities in this emerging area. The government of India has been supporting organic farming including animal production under different schemes resulting in positive outcomes.

INTRODUCTION

As on 31st March 2021 total area under organic certification process (registered under National Programme for Organic Production) was 4339184.93 ha (2020-21). This includes 2657889.33 ha cultivable area and another 1681295.61 ha for wild harvest collection. India produced around 3496800.34 MT (2020-21) of certified organic products which included all varieties of

food products namely Oil Seeds, fiber, Sugar cane, Cereals & Millets, Cotton, Pulses, Aromatic & Medicinal Plants, Tea, Coffee, Fruits, Spices, Dry Fruits, Vegetables, Processed foods etc.

The production is not limited to the edible sector but also produces organic cotton fiber, functional food products etc. The total volume of export during 2020-21 was 888179.68 MT. The organic food export realization was around INR 707849.52 Lakhs (1040.95 million US\$). Indian organic products are exported to USA, European Union, Canada, Great Britain, Korea Republic, Israel, Switzerland, Ecuador, Vietnam, Australia etc.

However, these impressive figures have only a very little contribution of organic livestock products so far. This paper, thus, has reviewed the developments concerning organic livestock production in particular, which is emerging as a potential new opportunity for youths, startups, enterprising & innovative farmers, while ensuring high quality animal products to consumers.

MATERIALS AND METHODS

The author undertook a research project, 'Organic livestock production in India: A SWOT analysis during 2005-2011 and followed the developments relating to organic livestock production ever since. Also, he supervised 3 Masters & doctoral theses on organic animal husbandry topics. While serving as member of technical committee on organic livestock products of the Agricultural and Processed Food Products Export Development Authority (APEDA) that implements National Programme on Organic Production (NPOP) in India, the author gained significant insights on constraints & opportunities in organic animal production. This review is based on the experiences of research work conducted and supervised as also the following up the various programmes & policies of government of India including handling training programmes on organic animal husbandry. The author undertook face to face training sessions, online lectures, radio talks & field visits towards capacity building of farmers on organic animal husbandry. Many queries received via WhatsApp, mobile phone messages & telephone calls were addressed by the author. The author also trained the veterinary officers/Livestock development Officers of Sikkim state which has been declared fully organic state in 2016. Also, he produced a document, "Roadmap to organic animal husbandry development in Sikkim, together with Sikkim Organic Mission. The Animal Husbandry Officers, Dairy Development Officers, extension officers of various Indian states and auditors of Certification bodies were trained on organic animal husbandry under various schemes by the author, so that they can take up orienting & training farmers on organic livestock production.

RESULTS

There are 52 certified organic dairy operators, 66 meat operators & 3 certified egg operators in India. The information on domestic sales of organic livestock products indicates the availability of certified organic milk and milk products in India (Table1). Also, India exported 2125.6 kg of certified organic Ghee (Clarified butter) to UAE during 2019-20. Animals not only produce products for direct human consumption, but also help produce organic by-products like cattle urine & cow dung used to enhance soil fertility.

Table1: Production & sales of certified organic milk & milk products in India (2019-20).

S.NO.	Item	Quantity MT(Metric Ton)
1.	Milk	16050
2.	Ghee (Clarified butter)	400
3.	Butter	9
4.	Milk Cream	390
5.	Skimmed Milk	320
6.	Skimmed milk powder	660

At ICAR-Indian Veterinary Research Institute as well as several other animal science research institutes and Veterinary Universities/colleges initiatives are underway to promote organic animal husbandry. For instance, the ICAR- National Research Centre on Meat got its organic sheep unit certified having the knowhow to handhold and guide the prospective farmers through all the processes involved in taking up organic sheep farming and certification. Out of total 32 accredited certification bodies (CBs) in India, 7 CBs are accredited for certification of livestock & poultry. It has taken initiatives to train certification bodies and evaluation committee to inspect & audit organic livestock operations.

The author has been associated with all such capacity building programmes undertaken by APEDA to develop organic animal husbandry in India. Also, he has been training the Inspectors of certification bodies on certification process for organic livestock products. The start-ups, entrepreneurs including the farmers wishing to convert to organic animal husbandry need to be aware of the conversion, production & certification procedures for organic livestock production (Prakati 2020).

The Government of India is supporting several projects on organic agriculture that includes organic animal husbandry too. At the Agribusiness Incubation Cell (ABI) of ICAR- Indian Veterinary Research Institute, project proposals are invited for nurturing/incubating. The selected candidates are regularly mentored & financially supported to further develop the proposals including on organic production having market potential. They are trained on the topics like product development, branding, market assessment, launching in the market, winning consumers' confidence, product innovation, labeling, packaging, managerial aspects, record keeping etc. The trainees, wishing to start organic livestock and poultry production, are mentored through capacity building programmes. They are being introduced to the established certified organic farmers and export value-chains for awareness, knowledge, and opportunities in the sector. The trainees are often very apprehensive of export markets for organic livestock products which have serious challenges mainly due to existence of infectious diseases in India like Foot & Mouth Disease (FMD) which restrict export to FMD free countries mostly in developed countries.

The capacity building initiatives on organic animal husbandry including mentoring of start-ups has been helping the farmers and entrepreneurs to get constructively engaged in enterprises

related to organic livestock production. The startups are making organic food more accessible and affordable to the consumers, while creating new opportunities for farmers by motivating them to adopt organic livestock farming practices. Not only organic foods but the start-ups are engaged in producing value added products from animal by-products, which has attractive market in India and have possibilities of exports too.

The initiatives have also been taken in India regarding certified organic sheep wool production. It would be better if pastoralist system prevailing in parts of country like barren mountainous regions/Islands/deserts/areas inhabited and managed by nomads are covered first under Participatory Guarantee System (PGS) and gradually switched to Third party certification considering the market potential of products from such areas and communities. The Sundarban in West Bengal is one good example, wherein, communities have been organized under Women Dairy Cooperative Societies and production of milk; milk products, honey etc. have been certified and being marketed as 'certified organic'.

DISCUSSION

Organic animal husbandry research & developmental activities are largely concentrated in countries in the north, EU, and some other developed countries. Yet, developing countries like China, Mexico and Brazil are main exporting countries of eggs & Honey to EU. Bovine meat and non-edible animal products are imported from Uruguay. Organic sheep and goat meat originate from New Zealand, while cheese is imported in EU from the USA (Willer et al 2021 & Chander et al 2011). This shows the potential for countries like India to export organic livestock products to EU and other developed countries. Certified Organic animal products are being supplied by several companies in India with growing demand. When the quality conscious consumers are looking for organic animal products, domestic sales and exports is picking up, it calls for efforts to promote organic animal husbandry.

CONCLUSIONS

Organic Animal Husbandry happens to be an emerging area which requires attention given its growing potential for domestic as well as export market. The start-ups including farmers engaged in organic farming and entrepreneurs need support in terms of information, technical knowledge, financial, incubation, hand-holding and marketing of organic animal products.

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Topic: Current Studies on Organic Rice

True , Full, Fair Costs Accounting of Rice: The Staple Food of Half the People of the World

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ABSTRACT

True Cost Accounting (TCA) in food is an evolving method for assessing the true costs and benefits of different food production systems. TCA was employed in accounting the true cost of rice, the staple food of over half of the people of the world. Our objectives were: to calculate what is the true and full cost and to recommend transformative or progressive transition policies to reduce the full costs of rice.

Results of our calculation showed that true/full costs of well milled rice were PhP266/kg (the costs of biodiversity loss and health are not yet included). It increased further to PhP302/kg when President Biden TWG SCC for methane (US\$1,500/ton) and nitrous oxides (US\$18,000/ton) were adopted.

The market/monetary price of conventionally grown rice at PhP37/kg (US\$ 1= PhP50) accounted for 11-13 % of the total or full costs. At this price, we are only paying 11-13 centavos of the one (1) peso worth of rice. Of the 3 costs items, the cost of carbon emission monetized as social costs of carbon (SCC) was the highest at P161 to 196 /kg for rice grown the highly chemical intensive/conventional way. This was due to the high soil emissions of methane and nitrous oxide.

The inter-related challenges of reducing the monetary costs, water footprint, and the high emissions of methane and nitrous oxide in paddy fields at 72% of the total CO₂eq emission (4.8 tons per ton of milled rice) call for transformative culture in growing and eating rice. Consuming dehulled rice or brown rice increases milling recovery by 10% and reduces per capita consumption (PCC). For the Philippines, reducing PCC from 119 to 80 kg per person shall make the Philippines self-sufficient in rice.

The progressive transition of growing organic rice through the systems of rice intensification (SRI) reduced the oil-based energy footprint, water footprint and the social costs of carbon emission

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due to reduction of nitrous oxide and methane emission. This led to about 48 to 58% cumulative reduction on the true and full costs of rice. Transforming culture, particularly, growing and eating rice need supportive government. To support and promote brown rice consumption, the government should finance the re-adjustments, retrofitting or re-manufacturing of our current rice mills to mill brown rice. The government should declare organic SRI in transition as the strategy in growing organic rice (5 to 10 years).

INTRODUCTION

Rice is the staple food of the 90% Filipinos and Asians. It is centroid to food security of about half or more people of the world. It supplies up to 70% of food calories in Asia and over 20 percent of global food calorie intake. More than 90 percent of world rice production and consumption is in Asia, and it is a source of livelihood of around 140 million rice farming households or 3 million rice farming families in the Philippines. There are many challenges in ensuring an adequate and stable supply of rice which is affordable to poor consumers (FAO, 2014). And they are as follows: deceleration in the growth of rice yields, environmental degradation associated with intensive rice production, global climate change, increasing competition of land, labor and water from industrial and urban sectors. Yet, we need to produce about 50% more rice by 2050.

Food prices are perceived to be high though food prices had decreased by 40% in real terms. This is true in the Philippines where 7.5 million families are poor. Its prices are kept affordable or low because of the many food poor. But it is at the expense of the farmers. Food production, distribution, retailing and consumption are causing unintended damages to the environment, soil, climate, biodiversity, rural communities and public health. These are oftentimes called externalities or hidden costs of foods and we are not paying for them.

At PhP 41.67/kg (well milled rice) and PhP milled rice 36.93/ (regular milled rice in 2020, is the price of rice **high**? We tried to calculate true and full price of rice through the procedure called True Costs Accounting (Gould (2018), Bogdanski and Attwood *et al.* (2021). True Cost Accounting in food and agriculture is an evolving method for assessing the true costs and benefits of different food production systems. In this study, we employed true cost accounting in rice, the staple food of 90% of Filipinos and over half of the people of the world. Our objectives were: a) to calculate the true and full cost of rice and to recommend transformative or progressive transition policies to reduce the full costs of rice.

METHODOLOGY

Briefly, the true or full costs of rice per kg in the Philippines was calculated as follows :

$$\sum TCr = \sum MC \text{ prod+post-prod.} + \sum OCH_2O + SCC (CO_2 \text{ n.e.}) + ES_L$$

Where: $\sum MC \text{ prod+post-prod}$ is the monetary costs of rice incurred in production to post-production. ; $\sum OCH_2O$ is the opportunity costs of water using domestic price here in Laguna, Philippines at PhP23/m³; $SCC(CO_2 \text{ n.e.})$ is the social costs of carbon (SCC), and ES_L is the ecosystems services lost as rice fields are previously tropical forest ecosystems (Carrasco *et al.*2014)

It should be pointed out that our study is still w.i.p. (work in progress) since we were not able to calculate the health costs, and the costs of biodiversity losses

Source of data/technical coefficients

1. The data for the monetary costs of rice production to post production, we obtained from the study of May soe and Mendoza *et al.*(2018).
2. The data for the water bill defined as the opportunity costs of water, we use the prices of domestic water here in Laguna, Philippines at PhP23/m³.
3. The data for the carbon emission given monetary values, the social costs of carbon (SCC), we used the data we generated in our previous studies namely: Taghavia and Mendoza *et al.* (2017) and May soe oo and Mendoza *et al.*(2018). The lengthy and tedious process of calculations are described in the 2 studies.

We recalculated the $SCC_{CH_4 + N_2O}$ by using President Biden Technical working group (TWG) given for methane and nitrous oxides at US\$ 1,500 and US\$ 18,000 per ton respectively. The GWP values of CH₄ and N₂O over 100 years is 25 and 298 times that of CO₂, respectively (<https://www.epa.gov/ghgemissions/understanding-global-warming-potentials>). The SCC for CH₄ and N₂O emission from production of 1 ha rice was estimated using the following equation

$$SCC_{CH_4 + N_2O \text{ e}} = SCC_{CH_4} + SCC_{N_2O}$$

Where : $SCC_{CH_4} = (W_{(CH_4)} \times GWP \times D) / 1000 \times 1,500$; $SCC_{N_2O} = (W_{(N_2O)} \times GWP \times D) / 1000 \times 18,000$; $W_{(CH_4)}$ (kg) = weight of CH₄ emitted from 1 ha rice per day; $W_{(N_2O)}$ (kg) = weight of N₂O emitted from 1 ha rice per day; GWP = global warming potential, CH₄ = 25 and N₂O = 298; D = number of days from transplanting to harvesting; 1,000 = coefficient of kilogram to ton.

Methane and nitrous oxide together contribute about 25% of the global warming that has occurred during the last century. Global methane (CH₄) emissions from RICE paddy soils range from 31 to 112 Tg per year(19% of total emissions) while 11% of global agricultural nitrous oxide (N₂O) emissions come from rice fields (Khalil et al.2009).

4. The value of ecosystems lost of the previous tropical ecosystems where rice is now being grown was estimated as follows:

$ES_{loss} = G_v ES - R_{vyr}^{-1} / R_y ha^{-1}$; Where: ES_{loss} is the value of Ecosystems loss per kg of rice ; $G_v ES$ is the gross value of ecosystems services (Carrasco et al.2014) ; R_{vyr}^{-1} is the net revenue per ha ; $R_y ha^{-1}$ rice yield per ha per year (May soe & Mendoza 2018)

RESULTS

The total costs (TC) accounted for milled rice was P282/kg to PhP317/kg for conventionally grown rice based on the 4 main costs items (Table 1) . It was lowest at PhP 37/kg (11-13%) for monetary costs followed P69 (21-24%) for water bill and highest PhP161-196 /kg(61-69%) for the social costs of carbon (SCC). The monetary costs which accounted for 11-13% of TC is suggestive that at present, we are only paying fourteen 11-13 centavos of the one (1) peso worth of rice that we are consuming. It suggests further that the future generations will be paying the 87-89 centavos by way of the damages that will be brought about by global warming and climate change.

The monetary costs of milled rice grown under conventional chemical intensive method was P37/kg. We highlighted the logistic costs of P9/kg based from the study of Quicoy (2017) .Transport or hauling costs is about 50% of the logistics costs item (Quicoy, 2015). It may increase further since the distance considered is only 120 km. Rice maybe transported up to 800 km by land and by sea. It will increase further when the price of oil will increase.

Of the 3 costs items, the cost of carbon emission monetized as social costs of carbon (SCC) was the highest at P161/kg and PhP 75/kg for conventional and organic rice, respectively. The carbon emission was high due to methane and nitrous oxide at 72% of the total CO₂eq emission at 2.98 tons per ton of unmilled rice (Taghavia and Mendoza et al., 2017)

Table 1. The total costs (PhP) of Conventionally produced rice

	SCC at 120\$/t	BidenTWG
Monetary price of rice (PhP)	37	37
SCC of CO2 emission *(PhP)	161	196
Water footprint (PhP)	69	69
Health Cost	n.d	
Biodiversity lost	n.d	
Ecosystems services lost (PhP)	15	15
Total cost	282	317

Ave. from Study 1 : Taghavia and Mendoza et al.2017 and

Study 2 : Maysoe and Mendoza et al .2021

SCC were recalculated using President Biden TWG SCC given

for methane at \$1,500/ton and \$18,000/ton for nitrous oxides.

Value for Ecosystems lost by Carrasco et al.2014 (1USD to 50 PhP)

Growing rice the organic way (Table 2) reduced the monetary price of rice and the social costs of carbon as well as the water footprint. Growing rice organically led to 46 to 58 percent reduction in the total costs of rice (Table 3). The SCC of CO2 emission contributed to the major costs (61-69%) when rice was grown the high inputs or conventional way. But this was reduced by 30% (PhP75/ kg) when rice is grown organically (chemical N fertilizer usually account up to 40 % energy footprint in energy intensive conventional agriculture)

Table 2. The total costs of Organically produced rice *

	Organic
Monetary price of rice	28
SCC of CO2 emission *	75
Water footprint	34.5
Health Cost	n.d
Biodiversity Cost	n.d

Ecosystems services lost	15
Total cost	153

* *Maysoe and Mendoza et al. .2021* n.d no data

Value for Ecosystems lost by *Carrasco et al.2014*

Table 3. The total costs of Conventionally & Organically produced rice

	Conventional©		Organic(O)
	SCC 120\$/t	BidenTWG	
Monetary price of rice(PhP)	37	37	28
SCC of CO2 emission *(PhP)	161	196	75
Water footprint (PhP)	69	69	34.5
Health Cost	n.d		n.d
Biodiversity lost	n.d		n.d
Ecosystems services lost	15	15	15
Total cost	282	317	152.5

Ave. from Study 1 : *Taghavia and Mendoza et al.2017* and

164.5

Study 2 : *Maysoe and Mendoza et al. .2021*

SCC were recalculated using President Biden TWG SCC given for methane at \$1,500/ton and \$18,000/ton for nitrous oxides.

Value for Ecosystems lost by *Carrasco et al.2014* (1USD to 50 PhP)

DISCUSSION

Is the price of rice really **high**?

The current retail price of conventionally grown rice at P28/kg to P55/kg (Ave. RMR=PhP36.6, WMR=41.67) is only 10.5% to 20.6% of its total costs at PhP282-317/kg. Even the inflation corrected price at PhP115 /kg is only 36- 41% of the calculated total costs at PhP282-317/kg. This leads us to the question “Who will pay or shoulder the cost burden in paying for the Total Costs?” Surely, the future generations will pay? This is too unfair and unjust for them! These calculations were conceived before the COVID 19 pandemic. As recognized earlier, the pandemic made many people poorer, about 150 million globally and about 7 million Filipinos. The Pandemic affects all 17 SDGs but most especially SDGs 1, 2, 3, 4, 8, and 10.

Jacking up the total costs was the SCC of rice. At SCC=P161-196/kg, it is 57-62% of the TC at PhP282-317/kg.

How do we reduce the SCC?

1) Grow rice aerobically can reduce the water footprint which is about PhP69/kg or about 21-24% of the total costs (TC).

2) Grow rice the organic way.

Stop using chemical fertilizers, particularly, N fertilizer whose N₂O emission is about 3.5% of the N-applied. Including manufacture, about 12.14 kg CO₂ per kg-N is being emitted. The true costs of Nitrogen fertilizer are also under valued by 74%. True cost of N fertilizer is PhP45.6 but retailed only at PhP 12/kg.

Growing rice, the organic method can reduce the total costs of rice by 46-58%. Add the reduction of 21% when rice is grown the aerobic way. This summed up to 67-79% reduction. More R/D funds for breeding aerobic rice cultivars growing in association with N-fixing microorganisms i.e., Frankia, or free-living N-fixers like Azotobacter, Aspergillum, localized manufacture of tillage equipment for dryland preparation.

Scientists must transform their outlook by following Einstein thinking: *that doing the same thing and expecting different outcome is the height of stupidity*. A 50% more rice by 2050 by growing rice the same way shall mean more GHG emissions, more water usage, and nutrients.

Final reckoning is – ***why eat a lot of rice?***

Rice consumption per capita is increasing. From 97 kg/cap in the 2000s, Filipinos now eat more rice at 119 kg/cap (2020). A number of our ASEAN neighbors eat more rice. In 2001, Rice consumption in Vietnam was 168kg, Indonesia 151 kg; Myanmar 211kg) (Kenny, 2001). By 2016, rice per capita consumption in Myanmar was 306 kg, Vietnam 285kg, Thailand 233kg, Bangladesh 229kg and Indonesia 210kg while the global average per capita consumption of rice was estimated at 72 kg/year in 2016. It was only 54 kg in 2008. In the 2020/2021 crop year, about 504.3 million metric tons of rice was consumed worldwide, up from 437.18 million metric tons in the 2008/2009 crop year (FAOSTAT). When we say rice, it refers to well milled rice. Eating lots of well milled rice is correlated with the high incidence of Diabetes type 2.

Why eat lots of rice? In addition to the health baggage of eating lots of rice, *rice is just as damaging over the long term as annual carbon dioxide emissions from fossil fuels in Germany, Italy, Spain, and the U.K. combined. Rice cultivation could be as bad for global warming as 1,200 coal plants. Growing rice in flooded conditions causes up to 12% of global emissions of methane, a gas blamed for about one quarter of global warming caused by humans.* (<https://blogs.scientificamerican.com/roots-of-unity/should-we-eat-less-rice/#>). Methane and nitrous oxide together contribute about 25% of the global warming that has occurred during the last century. Global methane (CH₄) emissions from RICE paddy soils range from 31 to 112 Tg per

year (19% of total emissions) while 11% of global agricultural nitrous oxide (N₂O) emissions come from rice fields (Khalil et al.2009).

Poor rice consumers complain about the high price of rice but they only pay 11-13% of its total/full cost as 61 to 69% of the total costs, the social costs of CO₂ equivalent emissions are not paid. What rice consumers are not paying will increase further if the biodiversity and the opportunities losses of previous pristine forests will be valued.

After the pandemic, the most challenging issue or concern is increasing *global rice production 50% or more by 2050? or decreasing rice consumption?*

For overall sustainability considerations, there are twin steps in addressing rice security concern. 1) reduce rice consumption and 2) shift progressively in growing rice into organic or agro-ecological methods and/ or aerobic rice to reduce considerably the high total price of rice via the hidden cost – the social costs of carbon (SCC) emission.

1) Reducing rice consumption requires shifting to dehulled rice or brown rice instead of well milled rice (white rice). It will achieve increased milling recovery by 10%, and reduced per capita consumption to 80kg per capita, a 33% reduction. (Our calculation showed that the Philippines becomes rice self-sufficient up to year 2045. We do not need to import rice!).

Adopting organic SRI (Systems of Rice Intensification) practices like intermittent irrigation, mid-season moist fields only, no flooding shall lead to less water usage. Instead of the 3,000 – 5,000 li/kg, it can be reduced to 1,000 to 1,500 li/kg rice (50-60%reduction). Methane and nitrous oxides emission and oil-based energy footprint will also be reduced. The 3 costs items in the costs accounting will all be reduced by 67-79% reduction (monetary 3%, SCC 30%, water 12%, Total = 46%). Add the reduction in irrigation water footprint if rice is grown aerobically at 21-24%. The total is 67-68% reduction.

SYNTHESIS AND RECOMMENDATION

Transforming culture, particularly, on eating rice as the staple food and supportive government policies should be pursued to reduce considerably the true costs (TC) of rice. *On* consumption, eating dehulled rice means 10 % more rice available, in turn, reducing per capita consumption by 28% (from 119 kg/cap to 80 kg per cap. Consuming 80kg per cap, translate to 18.91 million tons. Philippines is self-sufficient in rice up to 2045).

The government should declare organic SRI in transition as the strategy in growing rice (5 to 10 years). The Sri Lankan President had declared their country as organic agriculture country. Bohol and Negros are already organic agriculture provinces. Organic SRI planted in 80% of the 4.6 M ha

of harvested rice shall reduce carbon emission by 32.94 million tons (SCC= US\$3.952 billion or PhP189.711billion (1USD = 48 PhP).

The progressive transition of growing organic rice through the systems of rice intensification (SRI) reduced the oil-based energy footprint, water footprint, and the social costs of carbon emission due to the reduction of nitrous oxide and methane emission. This shall lead to about 46 – 58 % cumulative reduction on the true and full costs of rice. Add the less emission and water footprint if rice is grown aerobically at 21-24% summed to 67-78% reduction of total costs.

Transforming culture, particularly, growing and eating rice need supportive government. To support and promote brown rice consumption, the government should finance the re - adjustments, retrofitting or re- manufacturing of our current rice mills to mill brown rice.

Research and development and expanded provincial agricultural extension services, along with zero to nominal interest and collateral free credit must be provided to our farmers. All palay produced the organic – SRI way will be purchased at P25/kg so farmers will be motivated to adopt organic SRI. Buying 30 % of the 19 billion tons harvest per year will require PhP 72 billion as roll over capital which is only 38% of the peso costs of reduced social costs of C-CO₂ eq. emissions.

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Research on Ecological Benefits of "Rice-Duck Farming" and Analysis on Economic Benefits of its Application in Ecological Farm

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ABSTRACT

The ecological benefit of "rice-duck farming" were analyzed according to previous studies and research was carried out according to actual production in an ecological farm, all of the inputs including pesticides, fertilizers, labors, and the costs for management were comprehensively analyzed in "rice-duck farming" system and conventional rice cultivation process. The prospect of "rice-duck farming" production in ecological farm has also been analyzed. The results showed that a lot of organic fertilizers, labors and biological pesticides were invested in the early time in "rice-duck farming" system, and the effective panicle number of rice was less, which led to the yield of rice decreased, eventually resulted in the price of rice reaching 8.20 CNY/kg without considering the cost of organic certification, which was much higher than that of conventional rice. However, the pesticides and chemical fertilizers in the "rice-duck farming" system were abandoned, so the soil and air environment were improved, and there were no pesticide residues in the rice which could be very easy certified as an organic production, at last, the net income was 76 000 CNY/hm² which was much higher than the net income of ordinary rice cultivation (27 595 CNY/hm²).

INTRODUCTION

Rice is one of the important food crops in China, nowadays, rice production is based on a large amount of fertilizers and pesticides, which ensure that the stable high yield of rice meets the demand of people for food, however, this is also a threat to the ecological safety of the paddy, environmental health, and the quality of agricultural products. Along with the sustained economic growth and the continuous improvement of people's living standard, people pay more and more attention to the production and consumption of agricultural products with high safety and no pollution. Therefore, the green and ecological rice growing mode and management system have attracted the high attention of the state, society, and scientific and technological personnel[1].

High yield, quality, safety, and efficiency are the goals pursued by comprehensive cultivation of rice fields[2]. "Rice - duck farming" is that a certain number of ducks were fed in paddy fields,

ducks eat weeds, aquatic insects, and small animals, and through constantly wandering foraging in the paddy field, discharge manure and muddy water, to control insects and weeds, stimulate and promote the growth of rice, which reduced the use of chemical fertilizers and guaranteed the quality of the rice[3-6]. However, the "rice-duck farming" in ecological farm is different from the conventional "rice-duck farming".

Combining previous research with the production of ecological farm, the study comprehensively analyzed the ecological benefit of "rice-duck farming" system, as well as compared with ordinary rice cultivation in the process of pesticides, fertilizers, labor, management, and other inputs. Which could provide theoretical and technical support for the improvement of the "rice-duck farming" technology and its applications in ecological farms.

MATERIALS AND METHODS

The experiment was carried out in Yuan lin Ecological Farm and the adjacent conventional farmland in Zhengzhou City, Henan Province. Three treatments were assigned: (1) "Rice-duck farming" (RD): 15 t/hm² organic fertilizer, and 225 ducks/hm²; (2) Rice+insect-trapping lamp (RL): 15 t/hm² organic fertilizer, no ducks; (3) conventional treatment (Rice+pesticide, RP): 375 kg/hm² compound fertilizer (17%N, 17%P₂O₅, 17%K₂O), 375 kg/hm² urea, no ducks. Among them, RD and RL were in the organic growing area of Yuanlin Farm, while RP was located in the conventional farmland near the farm. Each treatment had 3 replicates, and each plot was 16.7 m×40 m.

RESULTS

YIELD AND ITS COMPONENTS

In this study, the effective panicle of RD and RL was significantly lower than that of RP ($P < 0.05$), which was decreased by 15.5% in RD and 11.8% in RL; However, grain number per spike and 1000-grain weight were increased, increased by 1.8% and 7.4% in RD, and increased by 1.4% and 5.4% in RL, respectively. which led to rice yields in RD and RL being 7.7% and 5.7% lower than those under RP, respectively Although the percentage of polished rice of RD and RL was higher than that of RP, the difference was not significant, resulting in a 7.3% and 5.6% lower rice yield of RD and RL than that of RP.

ECONOMIC BENEFIT ANALYSIS

The total input of RD and RL in this ecological farm was 82 090 CNY/hm² and 50 990 CNY/hm², respectively, which were higher than that of RP (39 435 CNY/hm²), mainly because of the high cost of fertilizer and pest control in ecological farm (Table 1). In RD, there were some inputs on duck breeding, the cost of the duck was 138.2 CNY per duck, if the selling price of the farm duck was 150 CNY per duck, the net profit of a duck would be 11.8 CNY. In ecological farm, planting rice required a lot of labor input than that of planted by farmers. If the farm planted rice in accordance with conventional farming, the cost of rice would be 5.88 CNY/kg, the local price of

"Huangjin Qing" rice was about 10 CNY/kg, so the net income will be 27 595 CNY/hm². Without considering the cost of organic certification certificate, the cost of rice would be 8.06 CNY/kg in RL. In RD, excluding the cost of raising ducks, the cost of rice would be 8.20 CNY/kg. The market price of organic rice is 20~40 CNY/kg, and the rice produced in RD and RL completely met the organic standard. In this study, the net income of the two treatments was 75 570 CNY/hm² and 76 000 CNY/hm² respectively according to the price of rice being 20 CNY/kg.

Table 1 The economic benefits in the different treatments

Economic benefits		RD (CNY·hm ⁻²)	RL (CNY·hm ⁻²)	RP (CNY·hm ⁻²)
	Land rent	15 000	15 000	15 000
	Land consolidation	1 500	1 500	1 500
	Fertilizer	9 000	9 000	1 950
	Labor for applying fertilizers	1 050	1 050	750
	Rice seedlings	4 500	4 500	4 500
	Cost for planting	3 000	3 000	3 000
	Cost for irrigation	1 500	1 500	1 500
	Duckling	11 250	0	0
	Feeds for duck	8 100	0	0
	Duck house (depreciation)	5 000	0	0
Inputs	Seine (depreciation)	3 750	0	0
	Insect-trapping lamp (depreciation)	3 500	3 500	0
	Bio pesticide	900	900	0
	Chemical pesticide	0	0	195
	Cost for applying pesticide	240	240	240
	Cost for Management	8 000	5 000	5 000
	Harvest	1 800	1 800	1 800
	Others (transportation, shell removal, etc.)	4 000	4 000	4 000
	Total	82 090	50 990	39 435
	Duck	33 750	0	0
Income	Rice	124 340	126 560	67 030
	Total	158 090	126 560	67 030
Net income		76 000	75 570	27 595

DISCUSSION

Previous study found that under "rice-duck" mode, the activities of duck can effectively improve the environment at the base of rice, remove dead leaves, prey on pests, circle air and water, and reduce the occurrence of sheath blight⁷. The use of organic fertilizers and biological pesticides reduced the pollution caused by chemical fertilizers and pesticides, improved the quality of agricultural products, and met the green or organic standards. This study also found that conventional farm required not only pest control, but also disease control. However, in the rice-

duck farming ecosystem, there were fewer diseases, only biological control of pests was carried out during the rice growth period, and there were not pesticide residues was detected.

Unlike previous studies, this study found that while ecological farm stops the use of chemical fertilizers and pesticide, but more investment was needed in the prophase of organic fertilizers to improve soil as well as a lot of artificial and necessary biological pesticides. Although the cost of rice produced in RD was high, the rice produced does not have pesticide residues, and it was easy to pass the organic certification and become organic rice.

In conclusion, "rice-duck farming" could avoid of chemical pesticides and fertilizers inputs, the rice produced without pesticide residues, which can be more easily through organic certification, and to obtain the organic certification. However, if it will be managed by an ecological farm, the early organic fertilizer, biological pesticides, labor cost and the demand of the market should be considered.

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Topic: Innovations in Organic Agriculture

Efficacy of Botanicals to Control Virus Diseases Transmitted by Aphids in Organic Potato Production

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ABSTRACT

An experiment was conducted to evaluate the efficacy of five different botanical pesticide to suppress the aphid infestation and thereafter incidence of two major virus diseases namely PLRV and PVY in potato field under organic management practices. The experiment was executed at the organic block under TCRC research field, Joydebpur during the year of 2019-20. Five botanicals namely rape seed oil, mahogany oil, neem oil, karam cha oil @ 2 ml/liter and Bioneem Plus (Azadiractin) @ 1ml/l were chosen as the treatment. BARI Alu-36 was used under organic production system where soil fertility was managed with different organic fertilizers like Cow dung, Vermicompost, Trichocompost, and Neem Oil Cake @ 5t/ha each and different treatments were applied at 10 days interval from 30 days after planting to haulm pulling. Mean aphid number per ten plants as well as incidence of PLRV and PVY was recorded at three different dates. In most cases, neem oil performed better in reduction of aphid infestation as well as viral diseases. Furthermore, plant vigourity as well as tuber yield were found better from the plot treated with neem-based products.

INTRODUCTION

Potato (*Solanum tuberosum*) is currently the third most important food crops globally after rice and wheat, and over half of its production currently occurs in developing countries (Devaux et al. 2014). In Bangladesh, it is being grown as a commercial crop with a cultivated area over 4,77,400 ha and a production exceeding 10 million tonnes (BBS, 2019). The high production potential per unit area, high nutritional value and great taste make potato as one of the most important food crops in the world. Food safety is receiving increased attention worldwide and many countries have adopted organic policy to produce safe food.

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The Bangladeshi government also adopted National Organic Agricultural Policy in 2016 and potato is one of the selected crops in organic policy to be produced following organic practices. However, there are many constraints to produce organic potato specially to manage pest and disease of potato. In recent years, as temperatures increase virus vectors often become more abundant and the incidence of virus disease increases. It is estimated that virus diseases could decrease about 50% or more of the total yield potential (Harahagazwe et al. 2018). PVY and PLRV are now the most damaging viruses of potato worldwide including Bangladesh, with PVY having overtaken PLRV as the most important. Tuber yield losses are caused by either of them in single infections and can reach more than 80% in combination with other viruses (Kreuzer et al., 2020). Hossain and Ali (1993) also claimed the fact that these two viruses are important in Bangladesh and reported that tuber yield could be reduced up to 78 and 95% by PLRV and PVY, respectively. Both viruses are transmitted by aphid vector and while aphids crossed the critical level (20 aphids/100 compound leaves) is quite difficult to control them (Awasthi and Verma, 2017). This is more applicable for organic production systems.

There are several ways and means to achieve organic farming. The use of botanical pesticides is one such method which utilizes various plant products to achieve and ensure good crop health and has become really important in to-days agriculture specially in organic agriculture. Botanical pesticides are derived from plant extracts which are alternatives to chemical pesticides and are considered as eco-friendly as they break down into harmless compounds within hours or days in the presence of sunlight. Botanicals may contain a mixture of compounds, which can work together towards reducing a pathogen or pest with varying modes of action; therefore, using botanicals could lead to reduced occurrence of pathogen and pest resistance development (Shuping and Eloff 2017). Botanicals can in some cases also positively stimulate the plant's metabolism and/or defenses, and consequently act as plant strengtheners (Dubey et al. 2008; Guleria and Tikku 2009).

Bangladesh has a rich source of plants that could be harnessed as botanicals. Among the botanicals, neem is regarded as the panacea for organic farming. Besides neem, there are many more botanicals namely rape seed oil, 'Mahogoni' oil, 'Karam cha' oil etc. could be used in pest and disease suppression. Hence, this investigation was undertaken with the objective to find out the superior plant extract(s) to suppress aphid infestation as well as virus incidence.

MATERIALS AND METHODS

Experimental site and soil characteristics: The experiment was conducted at 'Organic Block' under the experimental field of Tuber Crops Research Centre, Joydebpur, Gazipur during 2019-20. Organic practices have been being followed in this block since 2015. After harvesting the crops in each year, the land was allowed to grow green manure like *Sesbania* sp. and they were fully decomposed before the commencing of the next season. The experimental plot was a high land having sandy clay loam soil.

METHODOLOGY

Treatment details and planting method: Five botanicals such as Rape seed oil, 'Mahogany' oil, Neem oil, 'Karam Cha' oil @ 2 ml/liter and Bioneem Plus (Azadiractin) @ 1ml/l were chosen as the treatment and accordingly total treatment number including control (zero application) was six. Potato variety – BARI Alu 36 was planted on 28 November 2019 maintaining the plant spacing with 60 cm × 25 cm in 3m × 3m unit plots. The experiment was laid out in a randomized complete block design (RCBD) with three replications.

FOLLOWED ORGANIC PRACTICES AND STANDARD

Soil fertility management was done following organic practices and standards. Cow dung, Vermicompost (VC), Trichocompost, and Neem Oil Cake (NOC); each one was applied @ 5t/ha. All organic fertilizers except NOC were applied as basal dose while NOC was applied in 3 equal installments. The first one was in pit and the other two installments were applied at the side of the row and covered with soil at the time of first and 2nd time of earthing up followed by irrigation. Treatment was applied at one-week interval started from 35 days after planting and continued up to second last week of harvesting (before haulm pulling). Intercultural operation, only weeding was done one time during the vegetative stage over the whole growing season. Data on aphid number per ten plant (about 100 compound leaves) and disease incidence of PLRV and PVY were recorded at 45, 60 and 75 days after planting while plant vigor (1 – 10 scale; 1= very poor and 10 = best vigorous plant) was recorded by eye estimation at 60 DAP. Arcsine transformation method was used to convert data on disease incidence. Potato was harvested on March 04, 2020, and yield was calculated. Data were analyzed statistically and means were separated by using LSD through MSTATC statistical computer program.

RESULTS

There was no significant variation among the treatments in emergence percentage but statistical difference was observed in terms of mean number of aphid per ten plants at different dates as well as in plant vigourity (Table 1). Bioneem plus gave the best performance (0.39 aphid/10 plants) at 45 DAP which was at par with neem oil (0.41 aphid/10 plants) but statistically different from others. However, neem oil performed better for the next two data recording dates (at 60 and 75 DAP) which was followed by Bioneem plus and was identical. Among the botanicals, poor performance was found in karam cha oil for all dates which was followed by rape seed oil but there was no significant difference between these two treatments.

TABLE 1: EFFECT OF DIFFERENT BOTANICALS ON APHID POPULATION AT DIFFERENT DATES IN ORGANIC POTATO FIELD

Treatment	Emergence %	Mean No. of aphid per 10 plant at DAP			Plant Vigority at 60 DAP
		45	60	75	
T ₁ = Rape seed oil	84.6	0.73	3.53	7.45	6.9
T ₂ = Mahogany oil	81.8	0.65	2.96	6.12	7.0
T ₃ = Bioneem Plus	87.3	0.39	2.12	4.02	8.1
T ₄ = Neem oil	82.6	0.41	1.98	2.78	7.8
T ₅ = Karam Cha oil	85.5	1.07	4.23	9.32	6.5
T ₆ = Control	84.3	2.19	9.18	21.4	6.1
Mean	84.35	0.91	4.0	8.52	7.07
SD	1.98	0.68	2.68	6.73	0.76
LSD (0.05)	NS	0.0783	0.167	1.471	0.417
CV (%)	14.1	17.9	21.1	24.2	16.8

Both PLRV and PVY infection was varied significantly among the treatments at different dates (Table 2). In case of PLRV, neem oil gave the best performance for maximum dates which was followed by Bioneem plus and was statistically similar. However, Bioneem plus gave the best result to suppress PLRV at 60 DAP and was identical with neem oil. More or less similar trends were observed in case of PVY. In that case, neem oil significantly reduced the PVY disease at all dates which was identical with Bioneem plus but statistically different from other botanicals while the least performance was found in control and was significantly different from all treatments. There was significant variation among the treatments in terms of yield. The yield ranges from 23.7 to 19.3 tonnes per hectare. The highest yield (23.7 t/ha) was found in neem oil treated plot which was identical with other botanicals but significantly different from control plot (19.3 t/ha).

Table 2: Incidence of virus diseases and yield of potato as influenced by different botanicals.

Treatment	% Incidence of PLRV at DAP			% Incidence of PVY at DAP			Yield (t/ha)
	45	60	75	45	60	75	
T ₁ = Rape seed oil	1.4	2.9	7.2	1.3	4.0	7.8	21.8
T ₂ = Mahogany oil	1.6	3.1	8.1	1.1	3.4	6.3	22.6
T ₃ = Bioneem Plus	0.8	1.3	6.1	0.6	2.3	5.2	23.2

T ₄ = Neem oil	0.6	1.5	2.1	0.4	1.9	3.2	23.7
T ₅ = Karam Cha oil	1.2	2.1	4.6	0.9	2.1	6.1	21.9
T ₆ = Control	6.1	8.9	17.2	4.1	9.3	23.4	19.3
Mean	1.95	3.3	7.55	1.4	3.83	8.67	22.08
SD	2.07	2.84	5.18	1.36	2.80	7.37	1.55
LSD (0.05)	0.583	0.596	2.473	0.685	0.398	2.63	1.891
CV (%)	19.7	21.1	23.7	18.3	19.6	22.1	16.7

DISCUSSION

This result suggests that neem-based products significantly reduced the aphid number which was previously examined by many researchers (Schmutterer 1990; Patel & Srivastava 1989). This result might be due to phytotoxic effects of neem and thereafter playing the role as plant strengtheners which was confirmed earlier by Dubey et al. (2008); Guleria and Tikku (2009). In case of plant vigourity, the maximum vigorous plant (8.1) was found from the plot treated with Bioneem plus which was statistically similar with neem oil but the poor performance (6.1) was observed in control plot and was identical with Karamcha oil (6.5).

CONCLUSIONS

Considering all factors, neem-based products could be chosen to control aphid as well as aphid transmitted viruses. However, the effect of neem on predators and parasitoids of aphids should be studied more fully to determine the usefulness of neem to suppress aphid in organic potato field.

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Intervention of Inhana Rational Farming Technology for Climate Resilient Organic Seed Development

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ABSTRACT

Development of climate resilient seed with economic viability for organic / low input agriculture is a major challenge for the Agriculturists. Intervention of Inhana Rational Farming Technology has successfully demonstrated development of climate resilient organic vegetable seeds. The finding clearly showed that organic seeds have higher seed vigour in comparison to its chemical counterpart. But most importantly organic seeds were proved to be more climate resilient and in terms of climate resilience Index these seeds are 28 – 69 % more efficient in terms of performing under abiotic stress factors. At the same time if the technology can be transferred to the farmers' field, seed cost could be less than 10 % of the present market rate of conventional seeds.

INTRODUCTION

Organic/ low input agriculture is considered to be part of climate change mitigation and adaptation strategies. But the major drawback is lack of quality seeds, as recent findings have shown that seed developed for input dependent conventional agriculture lack the important traits that are required under organic and low – input production system, (van Bueren, 2011). Those seeds are generally high fertilizer responsive; hence, they lack the quality traits *viz.* higher nutrient use efficiency, disease resistance and resilience against biotic and abiotic stress, that are required for sustaining crop yields, irrespective of the changing climatic patterns (Mukhopadhyay *et al*, 2021). Especially the vegetable crops are highly sensitive to climatic adversities, where a sudden rise in temperature or irregular rainfall at any stage of crop production can affect crop yield. To mitigate the adverse impact of climate change on the productivity of vegetable crops, quality seeds need to be developed under organic environment for higher climate resilience

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(Navdanya, 2016), but at the same time need effective interventional technology to make it economically viable.

MATERIALS AND METHODS

Organic vegetable seed development program was initiated at Nadia Krishi Vigyan Kendra (ICAR), West Bengal, India in collaboration with Inhana Organic Research Foundation (IORF), Kolkata during 2017-18 to 2019-20 with the intervention of Inhana Rational Farming (IRF) Technology which bears the essence of '**Trophobiosis theory**' of French Scientist F. Chaboussou; that emphasizes on 'Healthy Plants'.

Inhana Rational Farming (IRF) Technology: IRF Technology is a comprehensive organic approach towards Ecologically and Economically Sustainable Crop Production which focuses on Energy Infusion or Energization of the two critical influential components of crop production i.e., Soil and Plant System. The soil energization approach aims to restore the population and functional abilities of the native soil microflora towards soil health rejuvenation. While energization of the plant system is aimed at stimulation and reactivation of the plants' physiological, metabolic, and biochemical functions, through the scheduled application of 'Inhana Energy Solutions' towards reactivation of the two lost qualities of the plant kingdom i.e., Sense of Self- Nourishment and Sense of Self- Protection.

Experimental Module: Seven different crop varieties were selected for organic seed development viz. Brinjal (*Solanum melongena*);, Chilli (*Capsicum frutescens*), Tomato (*Solanum lycopersicum*), Okra (*Abelmoschus esculentus*);, Bitter Gourd (*Momordica charantia*), Pumpkin (*Cucurbita maxima*;) and Beans (*Phaseolus vulgaris*). Standard experimental protocol for seed experiment was followed and the management was done as per the guideline of IRF Technology (Barik & Bera, 2019). The quality of conventional and organic vegetable seeds was compared in terms of Seed Viability Study with Tetrazolium (TZ) assay test (SV%), seed vigour etc. following standard methodology. Seed resilience under abiotic stress (considered to be a parameter for testing climate resilience) was tested as per four parameters viz. Germination under water stress (G_{WS} %), Germination under salt stress (G_{SS} %), Germination under Accelerated ageing (G_{AA} %) and Electrical conductivity test to assess seed membrane integrity. Then the cumulative impact of these four studies was used to develop Climate Resilience Index (CRI) to evaluate the impact of organic management on the quality traits of seeds in terms of climate change adaptation.

RESULTS

Quality of organically produced seeds in terms of germination percent and Seed Viability Study with Tetrazolium (TZ) assay test was higher (1.7 to 10.6 %) than the conventional seeds (Table 1), however; the values were not found to be statistically significant for all the parameters.

Comparative study of seed vigour in terms of Germination Velocity Index (GVI), SV-I and SV-II showed significantly higher (3.2 -29.9 %) value for organic seeds, with few exceptions. The study of germination under stress (G_{WS} %) showed that under water stress germination potentials of both the type of seeds reduced considerably, but more resilience was observed in the case of organically developed seeds which scored up to 18.3 % better performance than their conventional counterparts.

Similarly, studies like Germination under salt stress (G_{SS} %) and Germination under accelerated ageing (G_{AA} %) indicated that although germination potential decreased under both conventional and organic management, the decrease was considerably lower under organic management, irrespective of the seed type. Electrical Conductivity (EC) test which represents cell membrane integrity in relation to tolerance of adverse field conditions, showed significantly higher (up to 29.2 %) leakage of exudates, reflecting the loss of cell membrane organization and selective permeability in case of conventional seeds as compared to their organic counter parts. The organic seed productivity under the study was well within the reference range of conventional seed productivity irrespective of the seed type. But most importantly, the production cost of organic seeds came out at less than 10% when compared with the market rates of quality conventional seeds (Table 2).

Table 1: Comparative study of Seed Viability, Seed Vigour and Seed Resilience against Stress under IRF Technology intervention.

Seeds	Seed Quality parameters	Seed Viability		Seed Vigor			Seed Resilience against Stress			
		¹ G %	SV %	³ GVI	⁴ SVI-I	⁵ SVI-II	G_{WS} %	G_{SS} %	G_{AA} %	⁶ EC
Brinjal	^a Org. Seed	95.7	97.8	15.13	1440	312.2	74.6	71.4	84.6	0.037
	^b Conv. Seed	91.6	95.1	14.02	1215	240.4	66.2	63.0	78.7	0.044
Chilli	^a Org. Seed	94.2	97.6	13.43	1580	326.1	76.4	70.0	84.4	0.071
	^b Conv. Seed	90.4	93.2	11.70	1424	298.5	69.4	66.4	78.3	0.081
Okra	^a Org. Seed	94.7	97.8	21.59	1890	504.0	72.0	66.1	82.4	0.062
	^b Conv. Seed	90.2	93.0	18.40	1605	480.4	65.1	60.2	77.8	0.088
Tomato	^a Org. Seed	96.2	97.0	15.69	1858	530.2	71.4	70.8	80.8	0.063
	^b Conv. Seed	89.3	92.1	14.40	1786	492.4	63.2	64.1	73.1	0.074
Bitter gourd	^a Org. Seed	93.3	95.3	10.56	1630	450.8	73.6	68.4	80.2	0.076
	^b Conv. Seed	84.4	91.6	8.14	1510	378.4	62.2	60.2	73.8	0.084
Pumpkin	^a Org. Seed	92.1	95.4	15.13	1680	508.2	65.5	61.6	78.0	0.055
	^b Conv. Seed	90.2	94.1	14.08	1420	412.4	60.4	57.4	68.2	0.062
French	^a Org. Seed	92.5	95.7	26.12	1686	325.4	63.2	61.5	83.1	0.039
Bean	^b Conv. Seed	90.1	91.0	25.30	1505	285.5	60.3	58.4	76.2	0.042

^aOrg. Seed : Organic seeds developed at Nadia KVK (ICAR), ^bConv. Seed : Conventional seeds collected from recommended source;; ¹G % : Germination percentage ³GVI : Germination Velocity Index; ⁴SVI-I : Seed Vigor Index–I (Seedling length(cm) X Germination); ⁵SVI-II : Seed Vigour Index –II (Seedling Dry Weight (mg) X Germination); ⁶EC : Electrical conductivity(dS/m/g).

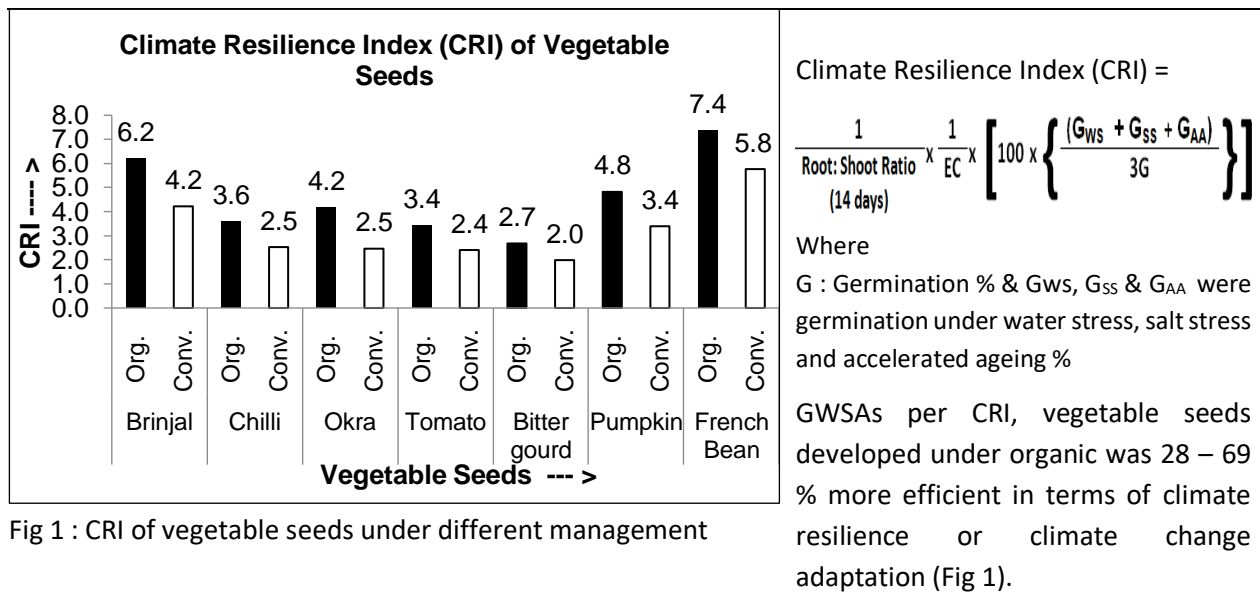


Fig 1 : CRI of vegetable seeds under different management

DISCUSSION

The findings indicated the qualitative superiority of the organically grown seeds over conventional seeds in terms of seed vigour and seed germination. Importantly the organic seeds were found to be more resilient towards the stressful environmental conditions as compared to the conventional seeds. Qualitative enhancement of the organically grown seeds might be due to focus on 'Plant Health Management' under IRF Technology that works towards activation of plant physiology. Activation of plant physiology facilitates the transfer of enhanced quality traits into the seed including higher survival potential w.r.t. biotic and abiotic stress factors. Organic management through the intervention of IRF Technology perhaps also enables higher energy accumulation (reserve) in the seeds; which efficiently translocate during germination and seedling establishment and supports the photosynthesis-independent growth; resulting in better seed vigour and better resilience towards stressful conditions.

When considered in terms of seed yield and its economics, the organically managed plants again showed better results over their conventional reference both in respect of seed productivity and the cost of seed production. If the technology can be transferred to the farmers' field, the farmers can produce quality seeds to fulfill their own requirements at much lesser expense than the market rates of quality seeds.

Table 2: Vegetable seed productivity and economics under Organic Management

Vegetables	1000 gm seed weight (g)		Seed Yield (Kg/ha)		Per ha (Rs in Lakh)	Per Kg (Rs)	SMR* (Organic Seeds)	Seed Cost(Rs/ha)	
	¹ Org.	² Conv.	¹ Org.	² Conv.				¹ Org. Seed	As per market price of Conv. seeds**
Brinjal	5.1	4.3 - 5.2	285	200–300	2.06	722	1037	199	3300
Chilli	5.6	5.0 – 6.5	310	200–300	1.65	532	248	665	27500
Okra	64.2	60 – 65	1124	1000–1200	1.07	95	32	3331	42000
Tomato	2.54	1.9–2.7	124	80 – 120	1.08	870	276	391	2700
Bitter gourd	164.5	160–170	287	100 – 300	1.45	505	61	2396	26125
Pumpkin	146.5	130- 150	340	300 – 400	1.5	441	194	772	9625
French Bean	278.4	200 -275	2650	2000–2500	1.25	47	44	2830	48000

¹Org.: Organic seeds produced under the study; ²Conv.: Conventional seeds of same variety from authentic source; *Seed Multiplication Ratio; **Authentic market price of organic seeds are not available but it was 100 to 300 % higher cost than the conventional seed price; Note : 1Dollar equivalent to 74.2 Indian rupee (as on 26.6.2021).

CONCLUSIONS

Organic seed development program with intervention of IRF Technology helped to improve the seed quality traits in terms of higher vigour and resilience towards abiotic stress. The findings gain further importance in respect of the changing climatic scenario. But the significant conclusion is that the seeds grown organically with intervention of IRF Technology can serve as a potent tool for promoting sustainable organic or low input agriculture.

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Topic: The Adoption of Organic Agriculture and Climate Change

Comparative Carbon Sequestration of Nine Agroforestry Systems (AFSs) and Pristine Forest in Zamboanga City, Philippines

Authors: Tabal, E. P.¹ and Mendoza, T. C.²

ABSTRACT

Massive deforestation of uplands had occurred in the Philippines. For about 5 decades, agroforestry was done to massively plant trees. This study was conducted to account for the C storage capacity of major agroforestry systems (AFSs) across the 16 community-based forest management (CBFM) sites in Zamboanga City, Philippines. The major AFSs were compared to pure forest stand. Among the AFSs, the rubber+3-based AFS had the highest C stocks at 68.93 tC ha⁻¹ as compared to other major AFSs: lanzones-based at 60.33 tC ha⁻¹, marang-based 60.23 tC ha⁻¹, mango-based at 60.01 tC ha⁻¹, rubber+2-based at 52.90 tC ha⁻¹, coconut+2-based at 48.77 tC ha⁻¹, coconut+3-based at 45.83 tC ha⁻¹, and coconut+1-based at 40.74 tC ha⁻¹, respectively. In terms of CO₂ equivalent (net CO_{2e}) sequestered, the pure forest stand (PFS) had the highest in the amount of 1,098.62 tCO_{2e} ha⁻¹ compared to the top four AFSs with the highest net tCO_{2e} sequestered such as the rubber+3-based, lanzones-based, marang-based and mango-based AFSs where each had about 248.66, 217.70, 218.17 and 217.42 tCO_{2e} ha⁻¹, respectively. The annual monocrop systems like rice and corn had 58.66 and 54.96 tCO_{2e} ha⁻¹, respectively. This means that the multi-tree crops AFSs can sequester 4 times more C.

None of the AFSs could approximate the total CO_{2e} sequestered of the PFS. The PFS had 5-7 times higher CO_{2e} sequestered compared with the top four AFSs. Five (5.0) ha of AFS is equal to 1.0 ha pristine forest. All AFSs were observed to be net user of water that explains why there was no water available in the 16 CBFM sites. The community residents had to fetch water for their household use. Also, Zamboanga City, Philippines had insufficient water for domestic use during extended rainless or El Nino months. As a land use option, establishing agroforestry systems should be done to address food security and environmental protection in the uplands of Zamboanga City, Philippines.

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INTRODUCTION

The concentration of carbon dioxide (CO₂) and other greenhouse gases (GHGs) in the atmosphere has considerably increased over the last century. Before the industrial revolution in the 19th century, the global average atmospheric CO₂ concentration was 280 ppm (Ewald, 2013). The Global atmospheric mole fractions of GHGs reached record levels in 2018 with CO₂ at 407.8±0.1 ppm, methane (CH₄) at 1869±2 ppb and nitrous oxide (N₂O) at 331.1±0.1 ppb. These values constitute, respectively, 147, 259 and 123% of pre-industrial levels. Early indications show that the rise of CO₂, CH₄ and N₂O continued in 2019 attributable to energy usage, industrial activities, and land-use changes, all these constituted a record high of 53.5 GtCO_{2e} in 2017, an increase of 0.7 GtCO_{2e} from 2016. The global GHG emissions in 2030 need to be approximately 25 and 55% lower than in 2017 to put the world on a least-cost pathway to limiting global warming to 2°C and 1.5°C, respectively (IPCC, 2017). This has led to a deepening international and domestic concerns for the development of viable methods to help slowdown the addition of GHGs to the atmosphere.

One way to enhance the rate of C sequestration is to utilize a practically feasible and much affordable alternative method of which AFSs could play important roles. AFSs provides a long list of benefits but the two (2) most important include the provision of food and income to the farm households. There are sixteen (16) community-based forest management (CBFM) sites in Zamboanga City covering more than 12,000 hectares in the uplands, with an elevation of about 100-400> meter above sea level (masl) with a range proximity to the national highway of 12-16 km. Specifically, this study was carried out to account the carbon storage capacity of the nine (9) major AFSs and compare them to the C stocks of the pure forest stand (PFS).

MATERIALS AND METHODS

Zamboanga City is located at a latitude of 6°55'17.19" N and a longitude of 122°4'44.5" E. There were 16 Community Based Forest Management (CBFM) sites with nine identified AFSs covered for this study, namely: 1) coconut+1-based, 2) coconut+2-based, 3) coconut+3-based, 4) rubber+1-based, 5) rubber+2-based, 6) rubber+3-based, 7) lanzones-based, 8) mango-based, and 9) marang-based. The study was carried out from July-December 2018.

Calculating the biomass and C stocks

The nested plot sampling method was modified to obtain biomass measurements of perennial woody trees, coconut, banana, and other understorey vegetation present within the 2,000 m² sampling frame (Figure 1).

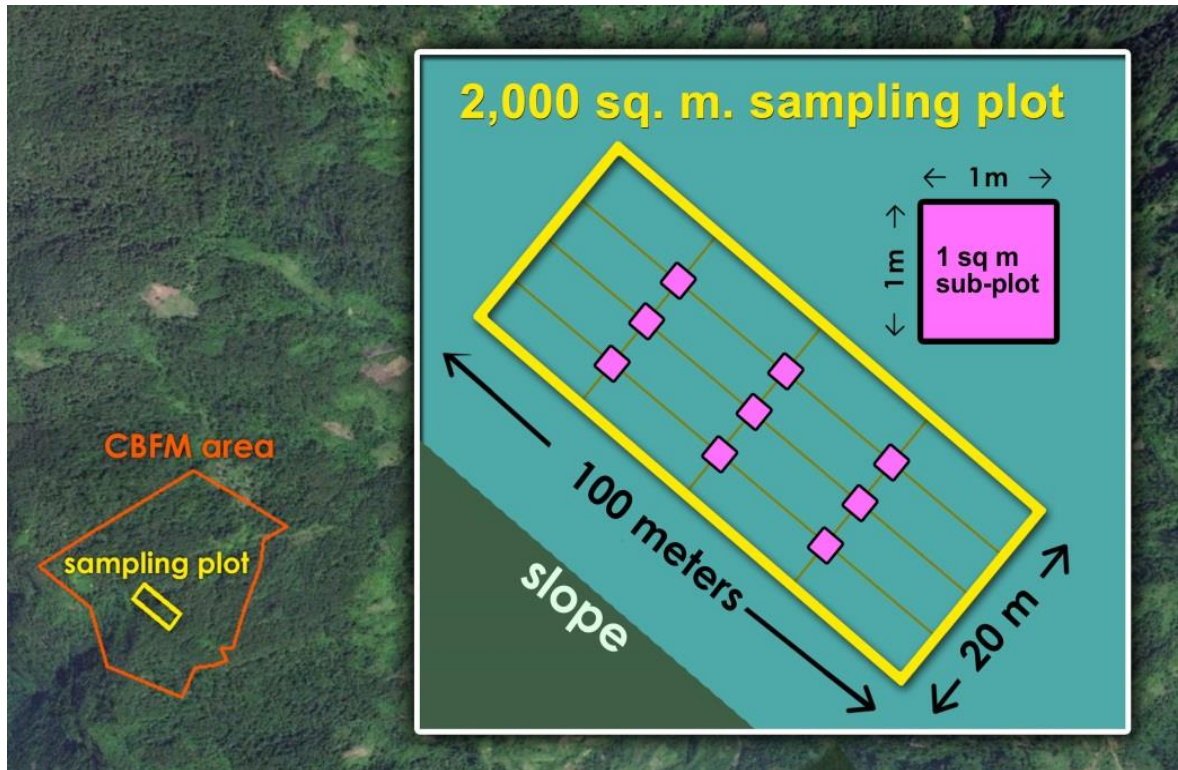


Figure 1. Modified nested plot sampling method

The circumference of woody trees was measured at 4.5 ft from the ground using a measuring tape and later converted to its diameter at breast height (dbh) equivalent using the equation: Diameter (cm) = C/π (Eq. 1), where: C = circumference of tree (cm) and $\pi = 3.1416$.

Destructive sampling was not applied to larger trees with >5.0 cm in dbh. Allometric and regression models typically relating tree dbh to aboveground biomass (AGB) developed by Unruh *et al.* (1993), Brown (1997), Ketterings *et al.* (2001) and Banaticla *et al.* (2007) were used and the C content were assumed at 45% (Lasco and Pulhin, 2003). The resulting mean of AGB was used as basis to compute for the C stocks on biomass yield (CBY) expressed in $tC\ ha^{-1}$ using the formula: $CBY\ (tC\ ha^{-1}) = Biomass * 0.45$ (Eq. 2).

And the CO_2 equivalent (CO_{2e}) was computed using the equation: $tCO_{2e}\ ha^{-1}\ (trees) = CBY * 3.6667$ (Eq. 3), where: 3.6667 = constant factor (CO_2 to C ratio) (Romm, 2008).

The biomass of coconut palms was computed using the allometric/regression equations developed by Frangi and Lugo (1985) and Goodman *et al.* (2013) and the resulting mean was used to compute for the C and CO_{2e} stocks ha^{-1} using Eq. 1 and 2.

For trees and other woody vegetation, the use of allometric equations relating tree dbh to biomass was adopted. The biomass value is then used to calculate the C in trees. All trees with a circumference or dbh > 5.0 cm that fall within the plot were measured using Eq. 1. Tree biomass was calculated using the allometric equation from Brown (1997): $Y\ (kg) = \exp \{-2.134 + 2.53 * \ln$

* D} (Eq.4), where: $\exp \{...\}$ = “raised to the power of”, \ln = “natural log of (...)”, Y = biomass per tree in kg, D = dbh in cm.

The allometric/regression biomass models for banana were adopted from Armechin and Gabon (2008), Arifin (2001) and Moore (2012). The resulting mean was used to estimate the C and CO_{2e} stocks.

For the below ground biomass yield (BGBY) or root biomass (RB) of trees, palms and banana, the average of 22.0% was used from the studies of Moura-Costa (1996), Santantonio *et al.* (1997), Cairns *et al.* (1997), Green *et al.* (2007), Moore (2012). The equation for C stocks is shown as: BGBY (tC ha⁻¹) = Biomass • 0.22 • 0.45 (Eq.5), where: Biomass = AGB of trees, coconuts and banana.

Carbon yield of understorey biomass (USB), floor litter (FL) and soil organic carbon (SOC) were obtained. The C yield of USB, FL and SOC were computed using Eq. 6, 7 and 8:

CYUSB (tC ha⁻¹) = (ODW•CF•10,000)/1,000 (Eq.6), where ODW = oven dry wt. in kg, CF = C fraction = 41%, default value (Lasco and Pulhin, 2003), 10,000 = 10,000 sqm = 1.0 ha area, 1,000 = conversion factor, 1.0 ton = 1,000 kg.

CYFL (tC ha⁻¹) = (ODW•%C•10,000)/1,000 (Eq. 7), where: %C = percent C from the laboratory analysis.

SOC (t ha⁻¹) = (A) • (SD) • (BD) • (%OC) (Eq. 8), where: A (Area) = 10,000 m² = 1 ha, SD (Soil depth) = 0.30 m, %OC = %organic carbon (OM) = %OM/1.72, BD (g/cm³) = bulk density, %OM = soil laboratory result, 1.72 = conversion factor (constant value).

Carbon yield on biomass

The C yield on biomass (CYB) expressed in tC ha⁻¹ is the sum total of AGB, CYUSB, and CYFL as shown in the equation: CYB (tC ha⁻¹) = AGB + CYUSB + CYFL (Eq. 9), while the gross C yield (GCY) is the sum total of CYB and SOC as shown in the equation: GCY (tC ha⁻¹) = CYB + SOC (Eq. 10).

Gross CO_{2e} on biomass. The gross CO₂ equivalent (GCE) on biomass expressed in tCO_{2e} ha⁻¹ was computed using the equation: GCE (tCO_{2e} ha⁻¹) = (GCY • 3.6667) (Eq. 11), where: 3.6667 = CO₂ to C ratio, constant factor (Romm, 2008).

The GCE and NCE of pure stand upland rice and yellow corn, pure stand coconut, pure stand mango, pure stand rubber, and pure forest stand (PFS) were computed. The relationships of predictors (biomass and C) per system were analyzed using descriptive statistics. Means, percentages and sums were compared.

RESULTS

The C stocks yield expressed in tC ha⁻¹ and tCO_{2e} ha⁻¹ of various agroforestry and monocrop systems are shown in Table 1. Among the AFSs, the rubber+3-based stored the highest gross C stocks at 68.93 tC ha⁻¹ or an equivalent of 252.75 tCO_{2e} ha⁻¹, followed by lanzones-based at 60.33 tC ha⁻¹ (221.21 tCO_{2e} ha⁻¹), marang-based at 60.23 tC ha⁻¹ (220.85 tCO_{2e} ha⁻¹), and mango-based

at 60.01 tC ha⁻¹ (220.04 tCO_{2e} ha⁻¹) and rubber+2 based at 52.90 tC ha⁻¹ (193.97 tCO_{2e} ha⁻¹), respectively, while all coconut-based AFSs yielded a gross average of 40.74, 48.77 and 45.83 tC ha⁻¹, or these are equal to 149.38, 178.82 and 168.04 tCO_{2e} ha⁻¹, respectively. The result further showed that the tree-based AFSs composed of rubber, forest and fruit trees yielded the highest C stocks as compared to coconut-based AFSs. On the other hand, the pure upland rice and yellow corn systems obtained a gross yield of 16.26 and 15.39 tC ha⁻¹, while the pure mango stand, coconut and rubber yielded 33.49, 44.59 and 50.56 tC ha⁻¹, respectively, but when compared to PFS which had a gross C stock of 299.62 tC ha⁻¹ or equal to 1,098.62 tCO_{2e}. This was significantly higher than any of the agroforest types and monocrop systems. Of this gross amount, the C yield on biomass was 266.95 tC ha⁻¹ and this was 89.1% of its gross C stocks, while RB and FLB contributed at 17.8 and 0.4%, respectively. Of the total C yield on biomass of PFS (266.95 tC ha⁻¹), the AGB contributed 81.8% as compared to 43.0 to 70.5% (17.49 to 42.56 tC ha⁻¹) yield levels of various systems across the 16 CBFM sites.

The SOC contributed about 30-57% of the C stocks across all agroforestry and monocrop systems (Table 1). Results showed that the coconut+1-based (coconut+banana) had a total SOC of 23.25 tC ha⁻¹, coconut+2-based (coconut+rubber+banana) at 25.53 tC ha⁻¹, coconut+3-based (coconut+rubber+banana+mahogany) at 22.49 tC ha⁻¹, mango-based (mango+coconut+banana+mahogany) at 28.06 tC ha⁻¹, marang-based (marang+coconut+banana) at 28.96 tC ha⁻¹, rubber+2-based (rubber+coconut+banana) at 25.23 tC ha⁻¹, rubber+3-based (rubber+coconut+banana+marang) at 27.02 tC ha⁻¹ and lanzones-based (lanzones+coconut+banana+Spanishcedar) at 17.77 tC ha⁻¹, respectively. Almost comparable to this amount were the pure coconut and pure rubber stands where each had a total SOC stock at 25.04 tC ha⁻¹ and 21.7 tC ha⁻¹, respectively as compared to pure stand mango (14.23 tC ha⁻¹), upland rice (14.74 tC ha⁻¹) and yellow corn (13.79 tC ha⁻¹), respectively, while the PFS had the highest SOC stocks at 32.67 tC ha⁻¹.

Above, we call them the total gross C stocks because CO₂ emitted during crop establishments, crop care and management, harvest and postharvest operations were not computed by earlier researchers. Deducting them as the net C emissions derived from the total energy inputs (TEI) of each AFSs (Tabal *et al.*, 2021) led to the net C sequestration ([Table 1](#)).

The highest net C sequestered was found in rubber+3-based AFS at 266.66 tCO_{2e} ha⁻¹, followed by marang-based (218.17 tCO_{2e} ha⁻¹), mango-based (217.42 tCO_{2e} ha⁻¹) and lanzones-based (217.70 tCO_{2e} ha⁻¹) AFSs, while the rest obtained significantly lower than the 200.0 tCO_{2e} level especially in upland rice (58.66 tCO_{2e} ha⁻¹) and yellow corn (54.96 tCO_{2e} ha⁻¹) systems, respectively. Results further showed that combining the net C stocks of mango-based, marang-based, rubber+3-based and lanzones-based (considered as best systems) still it cannot reach the net sequestered C of PFS at 1,098.62 tCO_{2e} ha⁻¹.

DISCUSSION

The PFS was considered a benchmark value to compare the C stocks of the different AFSs. None of the AFSs could replace PFS in terms of C sequestration. PFS ecosystem as C sink is irreplaceable. The higher C stocks in a PFS vegetation means that any of the AFSs and monocrop systems cannot replace the condition of real pristine forest in terms of C sequestration.

Also, any of the AFSs cannot sustain water availability – an inherent function only found in PFS. This only mean that AFSs without a forest cannot achieve sustainable water retention. AFSs cannot replace forest in terms of its hydrologic role in addition to C sequestration and biodiversity conservation. This means that in areas where there are still forest stands, they should be preserved and protected for sustainable water source in the community and addressing the water shortage crisis in the entire City of Zamboanga during the prolong dry months and El Nino events.

The C stocks on SOC varied among all the systems analyzed attributed to the varying amount of OM in the soil. The low SOC resulted in lanzones-based AFS, pure mango and pure rubber stands was attributed to low amount of OM in the upper layer of the soil measured at 30.0 cm depth. These areas were once intensively tilled for growing upland rice and yellow corn which involved tillage agriculture that enhanced loss of OM due to soil erosion. Upland farming practices, management and climate are among the major factors affecting OM and SOC build-up (Sakin, 2012).

PFS yielded 5-7 times higher in terms of C sequestration than the major AFSs. About 4.3 hectares of rubber+3-based AFS (highest C stocks) to equalize the rate of total C stocks of PFS (assumed that each having the same age and stands of tree components), and about 6.0, 6.7 and 9.0 hectares of pure rubber, coconut and mango stands (best monocrop systems), respectively, to reach the same C stock levels to that of PFS.

Human population pressure continues to convert forests land to agriculture and other land uses. In 1934, Philippine forests was about 17.1 M hectares (57%) of the country's total land area. In 2010, the forest cover has gone down to 23% or about 6.8 M hectares mainly due to increasing agriculture, commercial and illegal logging, and slash-and burn (kaingin) among others. Using the data on C sequestration, 5-7 hectares of AFS is needed to equal 1.0 hectare of PFS. This means that 30-42 M hectares of AFS should be established to match the 6.0 M hectares deforested areas, or 50-70 M hectares for the 10.0 M hectares deforested areas since the start of the 19th century. The Philippine has only 30.0 M hectares, this strongly implies that we cannot pin our hopes on AFSs alone to significantly address climate change and the lost hydrologic role of PFS, more so its role on biodiversity conservation and protection.

On the other hand, majority of the AFSs had significant $tC\ ha^{-1}$ and $tCO_{2e}\ ha^{-1}$ stocks compared to annuals monocrop systems like rice and corn at 58.66 and 54.96. $tCO_{2e}\ ha^{-1}$, respectively This means that the multi-tree crops AFSs can sequester 4 times more C than the annual monocrop that are tree-less.

The net tCO_{2e} sequestered were derived after deducting the computed C emission equivalent derived from the total energy input (TEI) of each agroforestry and monocrop systems (Tabal and Mendoza, 2020). With this development, the earlier works of Nair *et al.* (2010); Kumar and Nair, 2011; Sarangle *et al.* (2018) and various authors were over reported because the C emission from the energy based inputs in each agricultural crop components involved within the AF system were not computed and deducted.

CONCLUSIONS AND RECOMMENDATIONS

The PFS had the highest CO₂ sequestered at 1,098.62 tCO_{2e} ha⁻¹ compared to the top four AFSs with the highest net tCO_{2e} sequestered such as the rubber+3-based, lanzones, marang and mango-based AFSs. The PFS had 5-7 times higher CO_{2e} sequestered compared with the top four AFSs.

None of the AFSs can replace the real pristine forest in terms of C sequestration. That no water is available in the 16 CBFM sites and community residents had to fetch water for their household use is a clear proof of the major hydrologic limitation of AFS that must be addressed.

As a land use option, establishing AFSs should be done in the context of watershed to address the soil erosion prevention, biodiversity conservation and protection, and basic role of forest in the hydrologic cycle. And a combination of two or more systems can be established suitably to help restore the estimated 6.3 M hectares deforested lands while at the same time producing food for the booming Philippine population and environmental concerns in the uplands.

There is a need to validate the much-claimed potential impacts of AFSs as climate change mitigating strategy through C sequestration. The development of appropriate management plans can better promote fairness and equality among the upland communities and to the environment where they live.

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Geo-spatial Technologies for the Adoption of Organic Farming: a Policy Implication

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ABSTRACT

The knowledge of spatial variability in soil organic carbon (SOC) is an important consideration in organic farming as well as site specific nutrient management. Geographic Information Systems (GIS), Global Positioning Systems (GPS) and Remote Sensing (RS) are effective tools in assessing the spatial variability and mapping of SOC. A total of 268 soil samples were collected in a systematic grid design using GPS covering four sites: Delduar, Melandah, Mirpur and Fultala under two major alluviums-the Ganges and the Brahmaputra. ARC/GIS, interpolated values of SOC revealed that about 66 to 92 percent farming area belongs to below the reference soil quality level. As the SOC value is low, it is possible to take a pragmatic and location-based organic farming e.g. In-situ crop residue management to adopt carbon sequestration at the rate of 0.1-0.3 t/ha/year in similar climatic regions like Bangladesh. Such organic management has potential to enhance carbon sequestration in the soils of Bangladesh as introduced '4 per 1000 initiative' by French Government in 2015.

INTRODUCTION:

With climate change and environmental issues dominating global concerns, soil organic carbon (SOC) has received increasing attention worldwide because of its important role in the global carbon cycle and its potential feedback on the global warming (Davidson and Janssen, 2006). A small loss of SOC pool due to changes in fertilization, cropping system, cropping intensity, crop residue management, general farming practices, and soil erosion could significantly increase the atmospheric CO₂ (Liu et al., 2011). BARC (2018) reported that more than 50% of the agricultural soils in Bangladesh have <0.86% organic carbon. The reason for low SOC is perhaps due to the low residual input with higher cropping intensities without any fallow periods. In Bangladesh, the use of imbalanced chemical fertilizer in agricultural soils with the target of higher cropping intensity causes the deterioration of soil physical properties. As a consequence, the physical fertility of the soils regarding loss of SOC either remains stagnant or worsens. This causes a general decrease in the yield of crops per unit area all over the country.

MATERIALS AND METHODS:

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Soil samples were collected in one-minute latitude and longitude interval, equating to a grid size of 1600 m. whilst a smaller size grid would have better captured the spatial variability, resource and time constraints prevented the use of a more intensive sampling strategy. GPS Magellan was used to identify the geographic coordinates. 268 soil samples were collected from the 0-30 cm depth on a grid basis across the four sites covering the Brahmaputra and the Ganges alluviums. Soil samples were processed and preserved for soil organic carbon analysis in the laboratory. Organic carbon in soil was determined by the wet oxidation method of Walkley and Black (1934) as described by Nelson and Sommers (1982). SOC datasets interpolations were done in ARCGIS 9.3.

RESULTS:

From the SOC distribution map (Uddin et al. 2020), it is seen that 66% of the farming area in the Fultala site contains SOC <1.11% (Fig. 1). In Delduar site, 71% of the total farming area contains SOC <1% (Fig. 2); 69% of the farming area in the Melandah Upazila site contains SOC below <1.0% (Fig. 3) and 92% of the farming area in the Mirpur Upazila site contain SOC below <1.0% (Fig. 4). Among the 4 sites, SOC contents were very much alarming in the Mirpur site because of their land use patterns. This site is extensively used with tobacco cultivation by the local farmers. Generally, it may be said that all the 4 study sites have low contents of SOC (<2%).

DISCUSSION:

It is recognized that SOC threshold for sustaining soil quality/fertility is widely suggested to be about 2% (20 g/kg), below which deterioration in soil quality occurs (Patric et al., 2013). It is evident that SOC contents are below the critical levels and thus the soil qualities in the study sites are deteriorating. We should adopt best management practices (BMPs) to fulfill the steps of organic farming. In Bangladesh perspective, it is important to introduce mulch farming or crop residue incorporation in the agricultural land management to restore soil quality. Considering the above, some SOC management packages are highlighted to boost carbon sequestration and adopting organic farming. In tropical countries like Bangladesh, it is possible to sequester carbon 0.1-0.3 ton carbon/ha/year by introducing mulch farming e.g. crop cover residue mixing in soils (Lal et al. 1999). Carbon input is one of the most efficient factors for the accretion of SOC, which is also confirmed by the highly significant correlation between SOC content and C input from crop residue incorporation (Liao et al. 2015).

It is important to note that the '4per1000: Soils for Food Security and Climate' was launched at the COP21 with an aspiration to increase global soil organic matter stocks by 4 per 1000 (or 0.4 %) per year as a compensation for the global emissions of greenhouse gases by anthropogenic sources. The above concept was launched during COP21 in December 2015 where Stakeholders are committed in a voluntary action plan to implement farming practices that maintain or enhance soil carbon stocks in agricultural soils. An outcome of the Paris Climate Agreement was the 4per1000 initiative, which is a voluntary initiative aiming to increase global SOC stocks by 0.4%

per year, both for climate change mitigation and to contribute to food security (Minasny et al. 2017). Minasny et al. (2017) suggested that there is scope to increase SOC stock by “4 per 1000” (0.4%/year). To achieve the targets of the “4 per 1000” initiative arising from the Paris Climate Agreement, a SOC gain of 4 parts per thousand (=0.4%) is approximately equivalent to an annual increase in SOC of 0.11-ton C ha⁻¹ year⁻¹ (Sinivasarao et al. 2014). It aims to boost carbon storage in agricultural soils by 0.4% each year to help mitigate climate change and in increasing food security.

It is believed that the declining productivity of soils in Bangladesh is the result of depletion of organic matter caused by higher cropping intensities. These SOC vulnerable sites should be managed urgently through the use of crop residues. In Bangladesh context, rice is the main crops grown for 3 or 4 times in a year where there is huge production of rice straw. So, the rice straw or the crop residues would be easy and convenient sources of organic carbon addition in soils. In Bangladesh crop residues are widely used for fuel and sometimes as fodder and usually not returned to the soil. As a result, fields become barren, and addition of organic residues is almost non-existent, and the ultimate result is a decrease in organic matter contents.

Thus, incorporation of rice residues or other crop residues in the low SOC sites is a good option for nutrient addition and SOC management. Incorporation of crop residues of both crops in the rice-wheat cropping system has increased the soil organic and total nitrogen contents (Sharma and Prasad, 2008). Usually in Bangladesh, farmers use excess amounts of N fertilizer in intensively cultivated areas where an excess amount goes to water bodies and causes water pollution. So, it is suggested to introduce incorporation of crop residues as a means of nutrient supplementation, particularly in the low SOC areas of Bangladesh.

CONCLUSIONS:

The above targeted approach of SOC management by organic farming is likely to improve soil quality and crop productivity while reducing reliance on chemical fertilizers. A carbon farming and trading scheme may promote site specific SOC sequestration by the local stakeholders in Bangladesh. Special allocation or incentives may encourage poor farmers to engage in organic farming practices via crop residue management. It would be easy to estimate the input requirements in the targeted areas or crops. Local government or local policy makers may take initiative to implement the detailed SOC distribution map-based input requirements in the targeted areas.

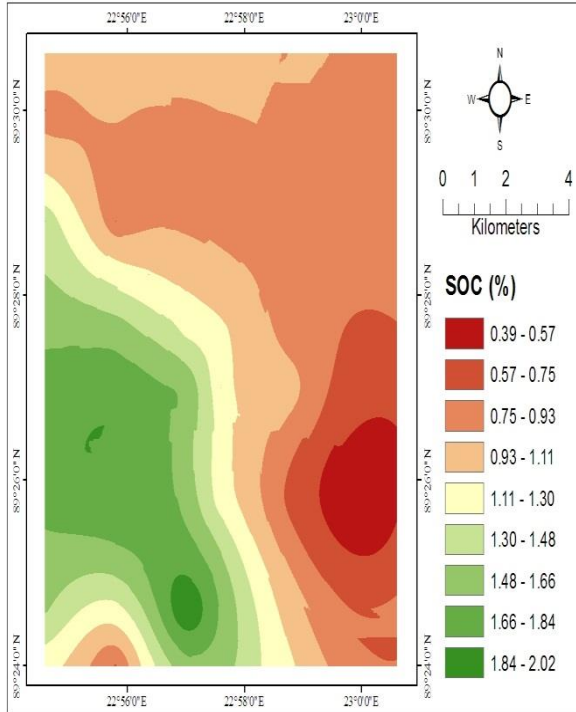


Fig.1. Distribution of SOC contents (%) in the Fultala site under Khulna district of Bangladesh (Data source:Uddin et al. 2020)

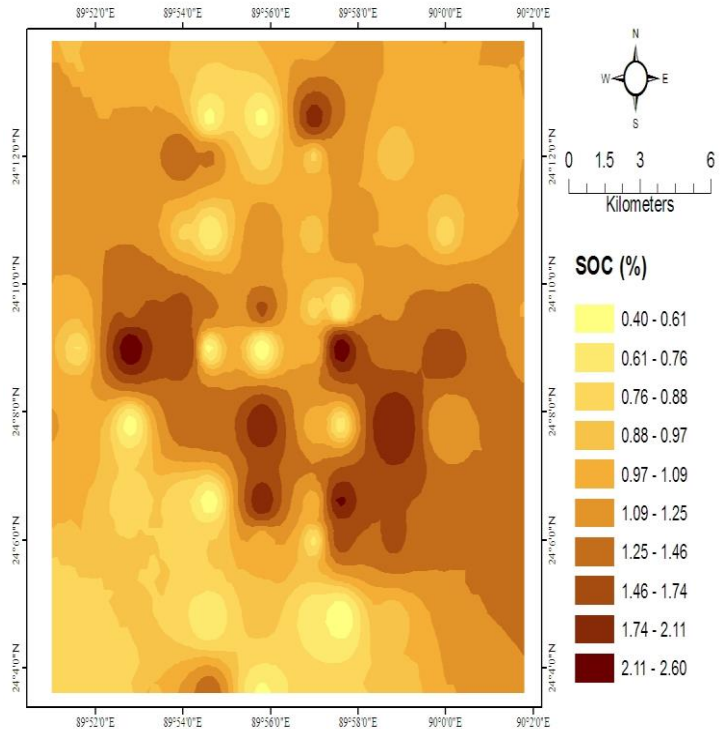


Fig.2. Distribution of SOC contents (%) in the Delduar site under Tangail district of Bangladesh (Data source:Uddin et al. 2020)

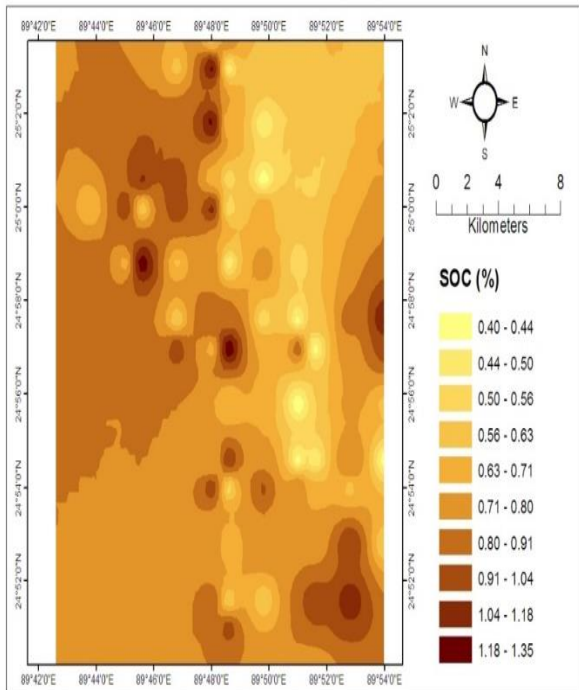


Fig.3. Distribution of SOC contents (%) in the Melandah site under Jamalpur district of Bangladesh (Data source:Uddin et al. 2020)

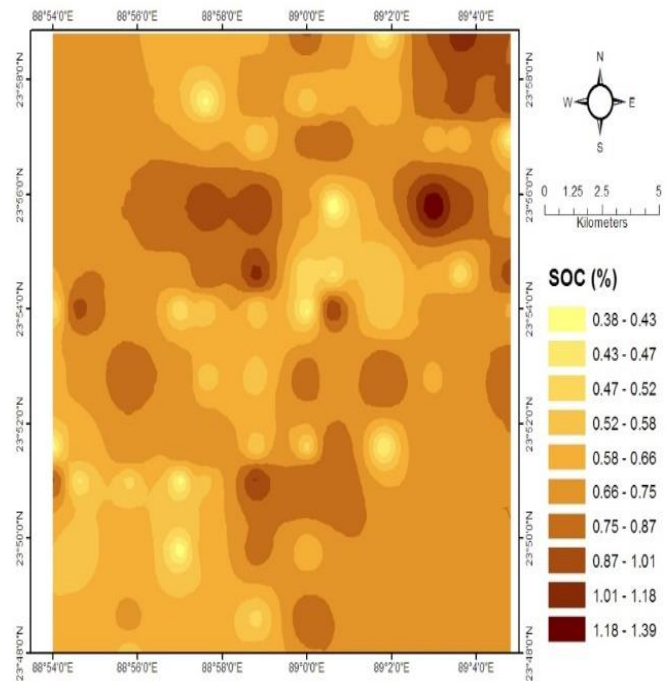


Fig.4. Distribution of SOC contents (%) in the Mirpur site under Kushtia district of Bangladesh (Data source:Uddin et al. 2020)

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Topic: Towards Best Practices in Organic Agriculture

Organic Shizukuishi: PGS Initiatives Activities in Japan

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INTRODUCTION

We are the smallest and youngest of the IFOAM Officially Recognized PGS initiatives in the world. We began first in Japan in December 2018 with only 22 stakeholders. Our PGS Initiatives' name is Organic Shizukuishi located in Shizukuishi town Iwate Prefecture, Japan¹.

We started learning organic agriculture with several members in 2015 following the six key elements and ten features of Official IFOAM PGS Recognition program.

Since then, we have conducted our members' fields inspections according to our created documents as recommended by an IFOAM PGS Committee².

Through these activities, we submitted the Self Evaluation Form (SEF) to the IFOAM PGS Committee in 2016 for the first time. It was hard for us to get the IFOAM Officially Recognized PGS Initiatives because we had to answer the serious IFOAM PGS Committee questions on our submitted SEF. It took about three years to achieve the IFOAM Officially Recognized PGS Initiatives.

UNIQUE APPROACH

Our unique approaches to the PGS implementation methods are:

- the gathering of stakeholders with different expertise to form the PGS within a 20 km range scattered throughout the local community.
- field peer review area is set within 20 km diameter for easy move by car between farms by stakeholders in one day.

¹Organic Shizukuishi <https://directory.ifoam.bio/affiliates/382-organic-shizukuishi>

²Ryoichi Komiya et al., "The PGS and Small Organic Agribusiness", 19th Organic World Congress, New Delhi, India, November 9-11, 2017

- the implementation of more economical farm inspections than the third-party certification (JAS), but inspected produce quality is equivalent or more than that of JAS³.
- farmers' peer reviews have been done by our documentation started with the Organic Shizukuishi PGS Application, Grower Pledge, and Farm Assessment Report, including notes, comments, redress actions suggested at the wrap-up meetings at the end of farm inspections. Then finally we received the Organic Shizukuishi PGS Certificate.
- stakeholders understood quickly and efficiently the organic agriculture through farm surveys and through the Organic Shizukuishi regular monthly meetings.

Other unique approaches are:

- the organic diet education for children at a day care center⁴
- job creation for handicapped friends through organic farming
- uses of organic produce at our member's B&B meals
- revitalization of deserted arable lands by organic no-till farming methods⁵
- assistance in getting the prospective IFOAM Officially Recognized PGS initiatives (Hiroshima, Gifu, Nagano) in Japan.⁶

Our unique PGS activities are always associated with the local community as mentioned above.

While JAS only focuses on the farm produce inspections and certifications, it has no bridging functions between farmers and local community. On the other hand, our PGS activities will contribute to the sustainable organic farming and educating the general public to understand the advantages of safe and secure organic produce.

Comparisons between JAS and PGS are illustrated in [Table I](#).

³Japanese Agricultural Standard for Organic Plants

https://www.maff.go.jp/e/policies/standard/specific/attach/pdf/organic_JAS-6.pdf

⁴ Ryoichi Komiya et al. "Promotion of Food System 3.0 in Organic Shizukuishi PGS Group", 19th Organic World Congress, New Delhi, India, November 9-11, 2017

⁵ Katsuaki Takahashi et al., "Regeneration Techniques of Abandoned Farmlands into Organic", 20th Organic World Congress, Rennes, France, 8-10 September, 2021

IMPACT

1. The yield increase: One of the PGS activities is farm peer reviews. During reviews stakeholders gave me a wide variety of suggestions through discussion from farming techniques to pest control. By following their suggestions, my farm production soybean yield has been increasing as shown in [Table II](#).
1. Environmental protection: The PGS contributes to an increase in the number of small family organic farmers and an increase in the number of conversions from conventional farming to organic. Therefore, the PGS provides a good environmental protection movement with the augmentation of plentiful organic produce in the world.
2. Society: The PGS will also stimulate the interests of both the small family farmers and consumers in the local community because they exchange organic knowledge at annual farm peer reviews and regular monthly meetings in which any local people can attend even if they are not Organic Shizukuishi stakeholders.
3. Implementation of organic mindset for nursery school children: Organic dietary education has been effective and efficient to let them know how the produce grows. Some of them believe that all produce is coming from supermarkets.
4. The further understanding of PGS functions: The PGS is not only the economical certification of the produce quality, but also it is a key driver to the revitalization of the local community based on the locality's organic farming.
5. Rapid implementation of new organic farming techniques: Growing prospective of new produce, simple ridging, living multi usages and organic fertilizers and pesticide knowledge exchange through annual farm peer reviews on site contribute to increase implementation of new organic farming techniques.
6. The latest Information exchanges in world agriculture trends: Organic Shizukuishi monthly open meetings are quite a rapid method to share a wide variety of organic agriculture knowledge such as hidden costs and the Organic 3.0 ^{6,7}.

⁶True Cost Accounting

<https://sustainablefoodtrust.org/key-issues/true-cost-accounting/>

⁷Organic 3.0: For Truly Sustainable Farming & Consumption

<https://www.ifoam.bio/why-organic/organic-landmarks/organic-30-truly-sustainable>

7. The positive involvement in international activities such as paper submissions to OWCs and MOTIONS proposals to prospective IFOAM directions at the IFOAM general assembly.
8. Safe and secured produce supply to consumers: In the PGS, farm peer reviews have been conducted by many stakeholders to guarantee the produce safety. The system has been extended around the world with safer and more economical certification than the third-party's one.
9. Influences on other territories or sectors The PGS can be applicable to the small family farmers in other territories or sectors who are feeling difficulties in applying the third-party certification.
10. Our proposed PGS implementation method: Easy and practical PGS implementation method can be generalized in any local community around the world.

View Pictures [here](#).

Therefore, our approach to the PGS should have an impact on all small farmers regardless of gender, age, and locality around the world.

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Developing Ecological Values & Sustainable Models

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INTRODUCTION

The Green Path is a value based Social Enterprise standing on the core belief Organic Farming is way of Life. Founded by H R Jayaram, an organic farmer & an eco-social entrepreneur having his humble roots in a village amidst the forest. He took the plunge to contribute his bit to make man experience the vastness of Nature and her compassion. His background of being born and brought up in a village made him realize he must invest his resources wisely to start and support the Natural Farming Movement.

Developing Ecological Values & Sustainable Models is the key motto of the GreenPath with the “Vision” to celebrate the fullness of life by honoring and preserving the natural ecology of Mother Earth as well as mankind – as part of one universe and “Mission” to create easily replicable models of sustainable living through organic farming and good food movement in order to inspire more people to adopt an Eco-conscious lifestyle.

The Green Path is a web of several eco-initiatives including Organic farms, Stores, Eateries, Eco-Stays & Eco-Retreats in Bangalore, Nelamangala & Coorg. From Demonstrating Organic Farmer’ Entrepreneurs Models - Experience Eco Farming & Eco Tourism – Building Farmer Forum/Federation to opening a Forgotten Food Restaurant, Detox Café & Organic Food Store:

Everything has acted as foundation to spread awareness & has created legacy by community development in an organic way, thus widening organic value system.

“The GreenPath Organic State” started in 2016 in Malleshwaram in the heart of city is India’ biggest Organic multi-experience destination for shopping, eating & eco-friendly get togethers. Organic State acts as an Organic Experience Centre consisting of Era Organic Food Store & Detox Cafe on Ground Floor, Forgotten Food Restaurant on 2nd Floor, Terrace Garden on 3rd Floor & Confluence Hall to promote the space for Socio- Ecological Movements on 1st Floor.

“The GreenPath Era Organic Store” started in 2007 is India’ largest Organic Store is a ‘Soil to Soul’ enterprise that brings nature’ goodness to your doorstep. Only the finest and the freshest produce, organically grown in our food forests is handpicked, curated and delivered which made us the initiators of Organic Campaigns in Bangalore thus supporting local Indian brands selling Organic produce. One can source a wide variety of whole grains, pulses, fresh vegetables, and fruits & forgotten foods with high nutritive values like millets. All 100% organic, come enter a new organic era with just few clicks as we launched online version of Era Organic in 2016 and during pandemic revamped and relaunched the Online Organic Grocery Store to cater to the segment who value Health & Sustainability.

“The GreenPath Sukrishi Farm” started in 1998 is where the foundational stones of the Green Path were laid. Spread across 40 acres amidst serene verdant landscapes of Nelamangala, the farm is home not just to hundreds of different crops and trees, but diverse animals and birds in their natural habitat. As custodians of this planet, we respect Nature in all its forms. Our crops are grown naturally and organically, using only rainwater that we harvest and has got a bamboo house for farm stay. It has been chosen farm tourism destination in India, hosts visitors from all over the world as also provides extensive training to local farmers.

“The GreenPath Forgotten Food Restaurant” was started to take forward the Good Food Movement through the restaurant. At Forgotten Food, we bring to your table traditional cuisines and secret recipes you may have forgotten that too 100% organic! Our buffet celebrates all kinds of millets & delicacies made from local, seasonal, and organic ingredients. At our terrace garden we grow organic greens and vegetables using vermicomposting.

The “Eco-Stays” in Bangalore & Coorg providing options for residential work stays and wellness retreats in the most sustainable ways possible.

“The GreenPath Eco-hotel” in Bangalore a village in the city. Started in the year 2008 the Eco-Hotel brings eco-consciousness in you. The only lush green option located in the midst of Bangalore on New BEL Road, the GreenPath Eco-Hotel represents environmentally responsible hospitality at its best. The GreenPath is a unique set of 55 rooms with a host of sustainable amenities. The Eco-Hotel has been tagged as Traveler’s Choice Destination by TripAdvisor.

“The GreenPath Eco-retreat” in Coorg started in 2014 hosts national as well as international volunteers and guests who have taken away with them our sustainability models & organic way of life. Set amidst the stunning coffee plantations lets you be at one with Nature. The Eco-Retreat has won coveted awards for its Eco-sensitive construction and responsible tourism.

“The GreenPath, Coorg” has got its charm to make one experience the green acres beaming with aroma of coffee flowers and witnessing the breathtaking beautiful, lush coffee plantations. The Sustainability enthusiasts to relish the taste, flavor, and richness of locally and organically grown coffee bean. From Bean to Box, one experiences the Farm with every sip and slurp.

UNIQUE APPROACH

The vision of attracting mainstream population for Organic & Sustainable Living was served through Organic Food Store, Wellness Café, Organic Forgotten Food Restaurant, Eco-Conscious Conversations, Urban Farming under one roof. While the Organic Farmers were helped to sell their food as through store their produce was sold to Organic Food Enthusiasts. Special gatherings such as Green Tea Evenings were organized every fortnight along with the fairs, exhibitions, workshops, melas, awareness campaigns to promote organic to the masses in a culturally vibrant way. Not only that sustainable diet was redefined & the culture of Forgotten Food was revived.

At GreenPath Sukrishi Farm 40 Acres of Barren Land being transformed to a Food Forest growing all certified organic produce. Forgotten food forest is supported with self-sustaining water body

through harvested rainwater. To introduce responsible hospitality by lessening power consumption, reducing food mileage by serving local seasonal & traditional &; using techniques such as rainwater harvesting, solar power plants, indigenous knowledge employed through waste management (vermicomposting & biogas fuel) & urban farming are employed for GreenPath Eco-Apartment Hotel. Not only that, eco-tourism support amidst of 28 Acres coffee plantation through GreenPath Coorg by employing stabilized mud block technology, using recycled-upcycled wood is used in the styling of the interiors.

IMPACT

TGP is playing a vital role in Indian Organic & Good Food movement. From running a food forest offering which has attracted hundreds of people from all over the world from last two decades, while introducing the citizens to sustainable models of thriving.

Hundreds of gatherings with thousands of people were introduced to Good Food Movement through GreenPath Organic State. Marketplace for Organic Farmers & Vendors following fair trade values through GreenPath Era Organic Store. Eco-tourism for urban community, farmers/farming enthusiasts' guidance support being provided along with consecutive revenue generation for farmers through GreenPath Sukrishi Farm. Local, seasonal, traditional foods among the masses were popularized through GreenPath Forgotten Food Restaurant.

Awareness and models of Ecological Living brought to life through GreenPath Eco- Apartment Hotel. And the awards received for responsible tourism and eco-conscious construction while hosting international volunteers who have taken with them our replicable models through GreenPath Coorg. The Green Path has come a long way and determined to make sure that the new way of being, new way of living, new way of breathing and new way of working, everything is in alignment with the laws of Mother Nature.

Topic: Organic Agriculture and the Non-Food Sector

The Need for Organic Growing Protocol for Medicinal Herbs

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INTRODUCTION:

Lot of herbs go in pharmacology and cosmetics, and they are broadly called medicinal and aromatic plants. Almost all traditional medicine protocols like Chinese, Indian, eastern and homeopathy and folk lore medicines depend substantially on botanicals. Even in allopathic medicines lot of medicines are formulated from botanicals like in cancer medicine almost 70 to 80 % origin is botanicals.

And with renewed global interest in herbs and its by-products especially post covid situation great focus of research is happening on active ingredient and their use in Phyto chemistry of plants. In earlier times it was preferred to harvest them from wild; mostly forests and wild collection but with growing demands, the need of growing them commercially involving agronomy has increased.

So, use of them in medicine and cosmetics is already very high and going to increase over the decades to come. That means aggregate per capita average use of botanicals per person will increase.

THE PROBLEM:

Most researchers of drugs & cosmetics industry come from natural chemistry further extending to phytochemistry, botany –Phyto botany specifically, and never from agronomy philosophy. For them, an agricultural product is a just a product. They are never taught that an agricultural product is a complex mix of production protocols, soil, weather, seeds, farmers knowledge and agronomy procedures adopted. The term often we use in research and development circles “the cubicles of knowledge” are so isolated while human health needs collapsing of those cubicles since the goal is same. This is not placed to go in history of such dichotomy but its reality.

We can easily understand its impact well by citing the example of Indian curcumin. When curcumin became very popular as antioxidant after researching in USA, huge imports of curcumin extracts and turmeric (from which curcumin is extracted) started and the turmeric cultivation bloomed. A situation came in India turmeric prices hit roof, there were massive shortages since

everyone went in extraction. Within one year FDA realized the percentage of calcium content in extracts reaching from India has is very high and hence was rejected. So, a booming industry was not only halted but, it crashed putting lot of back yard misery. What had happened in background was simple to understand:

Initially when all this started, the turmeric with highest curcumin (different turmeric's come with different percentages of curcumin (.75 % to 6 -7 %) that came from east India, was used. That area by default was also organic belt. As demands increased, even turmeric with lower curcumin were used and that increased the dependence on regular formal turmeric, and the result was catastrophic in one year.

Even in research labs it's a nightmare to do the standardization of botanicals with so much demographic variance and growing/farming protocols. During the discussions with one chemistry professor I know, was using lavender oils from two locations with different protocols. One alleviated her headaches while from other area decreased it; and such finer details cannot be detected in a lab, where agricultural protocol is not understood and appreciated.

Why is it necessary:

After food the maximum use of botanicals use is cosmetics especially in older societies (like Asia /Middle east /Latin America) and its used-on skin the largest organ of human body. Human body either evaporates it or absorbs it or washes it in ground. Evaporation and washing off takes the thing back in environment causing its own issues. A point that has never been given serious thoughts upon. But what body absorbs –is the area of great concern. In other words, we can say it becomes like food for human body and might be with greater danger. Studies shows whenever we apply anything over our skin it takes 65 seconds to the skin to absorb the content and mix it in the blood stream without passing it through the acidic atmosphere of digestive tract.

Over last few decades we are witnessing increased skin and hair problems especially in the cases of acne, it has been observed that patients are suffering at reduced age levels and are more chronic.

In fact, between the time laps of abstract submission and today a major problem arose in Indian exports of India stuff:

When European Commission derecognized 5 certifying agencies, all global names and also Apeda (govt. of India) for failure to ensure compliance on ETO. Ethylene Oxide (ETO) is a toxic compound that is used to sterilize food items, spices, and medical and pharmaceutical products. Exposure to ETO residue can cause severe health problems. An acute exposure can lead to lot of health issues including one of major being respiratory issues and cosmetics can be extremely good source for that.

DISCUSSION:

According to the newly published report, “Herbal Medicinal Products Market: Global Industry Analysis. (2012-2016) and Opportunity Assessment (2017-2027),” the global herbal medicinal market revenue is expected to grow a healthy CAGR of 7.6% over the forecast period of 10 years, i.e., 2017-2027. The global market for herbal medicinal product market represents an absolute \$ opportunity of US\$ 8,858.3 Mn in 2018 over 2017 and incremental opportunity of US\$ 142.07 Bn between 2017 and 2027. In terms of value, this market is likely to reach at US\$ 272.64 Bn in 2027.

And post covid this is growing at faster speed and around 25 % goes in the cosmetics segment.

Even in formal allopathic medicines a lot of % is coming from botanicals segments estimated to be around 20-30 % and in case of certain lifesaving drugs and cancer to almost 60 to 80 %.

Earlier most of herbs will come either from forests or wild collection so had no issues with regards to its organic and non-organic nature. Since now the cultivation of more and more herbs has become necessity as per growing demands of the industry, it's time to have serious thought on it.

That organic protocol of cultivating herbs offers better advantages. About excess minerals % India has already burnt its hands with calcium content in curcumin extract that was found to be higher than acceptable by FDA.

There have also been reports of heavy metals in herbs and hence toxic. “The concentrations of five heavy metals cadmium (Cd), lead (Pb), arsenic (As), mercury (Hg) and copper (Cu) were investigated using Inductively Coupled Plasma Optical Mass Spectrometry (ICP-MS) with 1773 samples around the world. According to Chinese Pharmacopoeia, 30.51% (541) samples were detected with at least one over-limit metal. The over-limit ratio for Pb was 5.75% (102), Cd at 4.96% (88), As at 4.17% (74), Hg at 3.78% (67), and of Cu, 1.75% (31). For exposure assessment, Pb, Cd, As, and Hg have resulted in higher than acceptable risks in 25 kinds of herbs.

The maximal Estimated Daily Intake of Pb in seven herbs of Cd in five, of Hg in four, and as in three exceeded their corresponding Provisional Tolerable Daily Intakes. In total 25 kinds of herbs are present at an unacceptable risk as assessed with the Hazard Quotient or Hazard Index. Additionally, the carcinogenic risks were all under acceptable limits. Notably, As posed the highest risk in all indicators including Estimated Daily Intake, Hazard Index, and carcinogenic risks. Therefore, further study on enrichment effect of different states of As and special attention to monitoring shall be placed on as related contamination.¹

Problems of nitrate leaching:

Nitrogen(N) is one of the most important nutrients needed by plants for their growth. Information on the role of nitrogen in plant physiology is plentiful in literature. Nitrogen is

involved in many physiological processes in plants including growth and photosynthesis. Consequently, nitrogenous fertilizers are among the most used fertilizers in the world. Nevertheless, excessive use of N can have negative economic and the environmental implications. Intensive N fertilization can lead to toxic N levels in plant tissues and herbivores. Thus, there are calls for implementation of better nitrogen use efficiency (NUE).

“Periwinkle, a medicinal plant that is rich in terpenoid alkaloids, when exposed to mixture of nitrate and ammonium, produced the highest content of amino acids, proteins, total alkaloids, vincristine and vinblastine compared to each of the different N forms. It was also observed in the same study that an increase in N level beyond 11 mM had an antagonistic effect on alkaloid content. Previous studies have indicated that when plants have N deficiency, they tend to have increased concentration of C-based secondary metabolites. Future studies that identify critical N levels for important medicinal plant species will guarantee both high production of medicinal material and quantity and quality of bioactive medicinal principles”². In fact, there was lot of nitrates leaching in sugar beet in USA where in Pediatrics found it a cause of cancer where in lot of medicines its used in as ingredient.

A lot of these issues can easily be helped if the growing protocols of herbs are shifted to organic growing protocols. Farming protocols of agronomy change not only yield parameters but also change the life cycle of plants and hence even impact the bio active compounds profile of the plant product.

Though GAP exists, but there are no serious studies about the different results and change in profiles by different agriculture processes. It will require bringing in experts of agronomy, Phytochemistry/ Botany, and pharmacology on one platform to find a working benchmark for medicinal herbs to be grown in organic protocols.

CONCLUSION:

Increased use of botanicals in pharma & cosmetics industry has also increased the demand of commercial cultivation of the herbs leading to impacting health and consequent damages it may cause. We need to move forward trying to develop a protocol for evolving a right procedure for organic (chemical/pesticide free) raw materials for two specific reasons: one its healthier for humans and second farming of medicinal & aromatic products is financially most profitable segment. Increased resources at farmers level might give incentives to farmers to try organic farming in other segments.

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Exploration of Vegan Organic Cosmetics

Author: Xiao Lin Deng¹

ABSTRACT

In China, the proportion of female entrepreneurs is more than 50%. The cosmetics market has huge potential; however, organic cosmetics are still scarce due to the high cost of research and development, also the cost of marketing. We have thousands of years of using herbs in ancient China, whereas in modern times, the use of natural plants has been marginalized due to the rapid development of the chemical industry. Nowadays, more and more attention has been paid to food safety, cosmetics safety should also be paid attention to, as it is widely used onto our skins daily. Organic enterprises take on social responsibility, in the process of brand development, organic enterprises ought to actively contribute more to social development and human progress.

Female entrepreneurship

Ten years ago, I left financial industry to follow the true voice of my heart. I started traveling around the world. In Kazanluk, Bulgaria, I saw people using distilled rose water as daily drinks and skin moisturizer. At Mr.Tarun's organic farm and zero-carbon factory in Jodhpur, India, I saw all kinds of herbs being picked, dried, grounded and powdered to make organic and natural hair dye. In a small town of Spain, Sabadell, it was my first encounter with organic skincare products, there were no chemical additives, only floral water, vegetable oil, essential oil and beeswax, the ingredients were so clean that filled my heart with joy.

After studying and observing many organic farms and organic brands, I founded my own vegan organic skincare and cosmetic brand in 2018. In China, nearly 1 million new enterprises are created every year*, the proportion of female entrepreneurs exceeds 50 percent*. I am very grateful to live in an era that more room and acceptance for women to bring their talents into play, other than getting married, having children, and taking care their families.

As a woman, I am more concerned about the use of organic content in cosmetics. From 2015 to 2020, along with the increase of residents' incomes and the boost of urbanization, the size of China's cosmetics market grew from \$204.9 billion to \$340 billion*. Among many domestic cosmetics brands, organic skincare and makeup products are almost too difficult to find. According to Future Market Insights, a global market research agency of UK, the global natural cosmetics market will grow by an average of 5.2% per year in the future and reach \$54.4322 billion dollars by 2027. A global market research publishing & management consulting firm, Grand View Research estimates that the market for organic skincare products is projected to grow at a compound annual growth rate of more than 10 percent between 2016 and 2025, according to Data from Grand View Research.

¹ Crystal's Garden Organic Farm. Email:1959069381@qq.com

Development of Vegan Organic Cosmetics

Early in the brand's creation, we've already begun to research and develop organic formula independently. We chose lipstick as the first category to be developed. Compared to other parts of our skin, lips have no epidermis, hence they are more fragile and sensitive. Chemical synthetic agents and heavy metals contained in normal lipsticks will directly penetrate the body. Among those makeup products for daily use, lipstick is the most frequently used, for a woman's life. Therefore, the safety of lipstick is extremely important.

In nature, many vegetables and fruits are color red. This color comes from a natural ingredient anthocyanin. Anthocyanins have excellent antioxidant properties and have significant effect on repairing skin, but the technical problem that needs to be solved is that anthocyanins are unstable and soluble in water but insoluble in oil. After many studies and adjustments, our laboratory introduced the NATPURE X-Fine patented black technology by Sensient company, the colors are enriched and extracted from fruits and vegetables, this way we can obtain 100% natural vegetable extract, through spray drying to let it be coated on natural substrates, then the pure natural anthocyanin color powder is formed. After many optimizations and upgrades, we finally developed the first anthocyanin natural lipstick.

Homology of cosmetics and food

As people pay more and more attention to organic food, more and more people are aware of the importance of natural and safe cosmetics and toiletries. The skin is the largest organ in human body, with numerous hair follicles, sweat glands and sebaceous glands. In 2009, Japanese pharmaceutical doctor Kumisi Takeuchi proposed the theory of "Percutaneous Detox", toxins are absorbed through the skin into the blood and lymph, causing harm to the body. There are many kinds of cosmetics, which are used frequently in our daily life. Different chemical additives accumulate in the body forming a synergistic effect, which is potentially very harmful*.

The term "Homology of cosmetics and food" originated from the theory of "Homology of medicine and food" in Traditional Chinese medicine. It means that the raw materials used in cosmetics come from food-grade raw materials which is natural and pollution-free, and the production of cosmetics must pursue the same safety standards as the food production. In the modern market segment, the future development of cosmetics should also use more natural organic plant materials, combine the efficacy of cosmetics and fragrances, with health, safe of natural organic plant materials, to truly achieve sustainable healthy and beautiful life.

In the history of Chinese herbal medicine for thousands of years, there are many ancient skincare and hair care formulas that can be applied with edible herbs. For example, Chinese herbal medicine *bletilla striata*, oral use can invigorate the liver and kidney, brighten your eyes, external application can whiten your skin, and remove spots. In recent decades, the development and application of chemicals have penetrated various fields, while natural plant materials have been gradually marginalized due to some weak points such as high costs and instability.

After the development of anthocyanin natural lipstick, facing the needs of the epidemic, we developed Guardian Herbal bag originated from an ancient formula of eliminating plague for internal prescription in the Qing Dynasty, which is composed of rhubarb, notopterygium, radix

bupleuri, asarum, and other traditional Chinese medicinal materials, broken into powder and made into a small bag. It can be put inside of the mask to inhibit the growth of bacteria. We tested the guardian herbal bag in the laboratory, the antibacterial effect is over 90%.

Difficulties and prospects of organic cosmetics market

Like all new things, the emergence of organic cosmetics in China has been met with a lot of skepticism.

1. Public opinions are confused, it's difficult for consumers to distinguish between good and bad

The competition in China's cosmetics market is very fierce. Every year, large capital enters and takes over market share. Plants and high technology are the biggest selling points in advertising. But in fact, in terms of formula, typical cosmetic products are all based on a variety of chemical additives as the main raw materials, many plant ingredients are just conceptual additions. For example, in recent years in China, a very popular color changing lipstick, is advertised as using cherry extract to achieve changes of lip colors, as different temperatures present different colors, but in the actual formula, the real effect is actually due to the chemical color-changing powder added in the lipstick.

As a result of information asymmetry, consumers believe that the existing cosmetics on the market are already natural. So, when real natural organic cosmetics enter the market, their advantages cannot be fully recognized and appreciated.

2. It is easy to make products that please consumers, but difficult to make products that guide consumers

The fierce competition in the daily-use chemicals market has led to the research and development of products based entirely on consumer preferences. For example, shampoo, consumers would think that the more bubbles produced, the cleaner it is washed. But it is to meet this kind of cognition of consumers, most of the shampoo products on the market are added foaming agent, whereas the real natural plant saponin such as sapindus, tea seed produce very few bubbles, but the cleansing effect is excellent.

In order to gain a foothold in the market, organic cosmetics enterprises should not only have the ability of continuous innovation, but also take the responsibility of educating consumers. It is not easy for consumers to accept a brand-new concept, the cost of time and money invested in it is very high. Therefore, the development of organic enterprises has a long way to go with heavy responsibility.

Social responsibility of Organic enterprises

In the early days of the brand establishment, we have been actively participating in various social welfare activities to promote the concept of organic life. Thanks to a charity aroma therapy course, we began to encounter the visually impaired group. There are 17 million blind people in China, that is, one out of every 80 people is visually impaired*. Most of them can only work in

massage parlors for the blind. At the Organic Skincare Studio in Guangzhou, we offer free organic skincare and hair care courses for visually impaired people to explore more career possibilities.

Three years ago, we started to combine organic living with natural music and hold regular sound healing concerts for public benefit. The original intention of organic enterprise development is to promote the idea and way of organic life. What is an organic idea of life? It is to put people into the whole natural ecosystem, instead of expanding our needs and constantly occupying natural resources just to meet our own desires. Symbiosis with nature, mutual nourishment and find the balance.

In China, the organic cosmetics market segment has not yet formed, it still needs a long time to develop, we believe that with the progress of society and the shift of people's perception, the future will be bright.

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Super Compost for Organic Agriculture

Authors: Konesalingam Jeyavithuyan¹, Kandiah Pakeerathan¹ and Aruchchunan Nirosha¹

ABSTRACT

Green Revolution introduced high-yielding varieties that solely relied on synthetic fertilizers and pesticides to gain substantial yield. Recent experiences of human health hazards due to over-exploitation of synthetic fertilizers, the Sri Lankan government has banned to import synthetic fertilizers and pesticides, and motivating growers towards organic agriculture. Therefore, agricultural scientist's major role is to find nutritionally and biologically fortified organic inputs to maintain the yield potential of high-yielding improved and traditional varieties. Annually 38 billion metric tons of bio-waste is generated around the world and are not effectively converted into nutritionally rich organic compost.

Therefore, this research was planned to recycle plant waste into biologically fortified vermicompost. Four substrates paddy straw, garden waste (banana and maize leaves), sawdust, and kitchen waste were used as mushroom substrate and then mushroom grown waste was converted into bio-fortified vermicompost using exotic earthworm *Eisenia fetida*+ *Trichoderma viridae* + *Pseudomonas fluorescens*. The pH, Electric Conductivity (EC), organic matter content (OMC), total organic carbon (TOC), total nitrogen, total phosphorus, and total potassium were subjected to ANOVA using SAS 9.1. Tukey's HSD multiple comparison test was used to identify the best treatment combination at $P < 0.05$.

The results revealed that the pH of the vermicompost varied from 7.28 to 8.14, The lowest and neutral pH of 7.28 was observed in the garden waste-based vermicompost bio-fortified with *T. viride* and *P. fluorescens*. The electrical conductivity range of bio-fortified vermicompost was from 1.11 to 2.36 mS/cm and were not significant at $P < 0.05$. Organic matter content and TOC of the vermicompost were ranging from 23.6 % to 52.4% and 13.39% to 30.39%, respectively. A highly significant OMC of 52.4% was observed in sawdust+*T. viride*.

Total organic carbon was highly significant with the value of 30.39% in paddy straw substrate vermicompost fortified with *P. fluorescens*. Total nitrogen content of these bio-fortified vermicompost ranging from 1.06% to 2.1%. The highest significant N value of 2.1% and the highest P content of 1.87% was recorded in the kitchen waste-based *T. viride* fortified bio compost and kitchen waste-based *P. fluorescens* fortified vermicompost, respectively, at $P < 0.05$. The total potassium content of these bio-fortified vermicomposts ranging from 0.654%

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to 1.38%. The highest K value of 1.38% was recorded in kitchen waste substrate-based vermicompost fortified with *P. fluorescens*. This study concludes and recommends that bio-fortified kitchen waste-based vermicompost has high N, P, and K, therefore, excellent bio-fortified vermicompost for organic farming.

INTRODUCTION

High-yielding modern germplasms can quickly respond to synthetic fertilizers; therefore, high yield can be obtained. But in long term, the over-application of synthetic fertilizers definitely degrades land fertility and can make a negative impact on the natural ecosystem, food safety, and health hazard to the human being. According to the World bank report 2018, Sri Lanka is in 4th place of highest chemical fertilizer consuming country in Asia (kilograms per hectare of arable land). To avoid these problems, the Sri Lankan government has banned the importation of synthetic pesticides and fertilizers. Therefore, as an alternative, we have to produce nutritionally rich organic compost at the commercial level. Worldwide average organic waste production from livestock, crops, and humans is nearly about 38 billion metric tons annually. Moreover, mushroom industries are generating a large amount of by-products (organic waste) called the spent mushroom substrate (SMS). This SMS is not also properly recycled into organic amendments.

One of the environmentally friendly methods in organic waste management is vermicomposting. The red worms (*Eisenia fetida*) species are most frequently used in vermicomposting because they have been widely distributed and naturally colonize organic material, have narrow life cycles a broad temperature and moisture tolerance range, and are resilient earthworms that can be easily handled (Dominguez and Edwards, 2019).

Vermicomposting is the non-thermophilic bio-degradation of organic matter by earthworms and microorganisms, in which organic substances residuals are rapidly fragmented into far finer particles by sending them through some kind of crushing gizzard while maintaining nutrients for use by earthworms for waste management, organic matter stabilization, soil detoxifying, and vermicomposting (Garg et al., 2006). Vermicompost is recognized as a potential agricultural input since it can stimulate and increase nutrients uptake by plants and increase plant tolerance to abiotic and biotic stress (Edwards et al., 2006).

Further bio-fortification of organic amends by adding antagonistic microbes *Trichoderma viride* and phosphate-solubilizing *Pseudomonas fluorescens* while vermicomposting is another level of nutritional enrichment of organic waste materials (Mahanta et al., 2012). An investigation was planned to produce nutritionally enriched and biologically fortified vermicompost through composting of bio-wastes to overcome the existing severe shortage of quality organic amendments nationwide organic agriculture in Sri Lanka under import banned scenario of all forms of synthetic agrochemicals.

MATERIALS AND METHODS

The laboratory and field studies were conducted at the Department of Agricultural Biology, Faculty of Agriculture, University of Jaffna, from February 2021 to June 2021. The details of materials used, and methodology adopted are described below.

3.1 Collection of plant wastes and preparation for mushroom bed

Four substrates paddy straw, garden waste (banana and maize leaves), sawdust, and kitchen waste were used as inputs in this investigation. Vegetable wastes were collected from the markets, and sawdust and paddy straw were collected from timber mills and farmer fields, kitchen wastes were collected from the university food court in Kilinochchi district, Sri Lanka. Then vegetable wastes and paddy straw were chopped into small pieces and dried under shade for a week. Water was added to soak the substrates for 4 hours. Excess water was allowed to drain off. The substrate was subjected to a steaming by the traditional method and allowed to be drained off under shade. Steamed substrates were mixed thoroughly with the 2% CaCO₃ and MgSO₄. Polypropylene bags of 6*8 inch² size were filled with each substrate separately as 200g of layers. Mother spawns a culture of *Pleurotus ostreatus* was spread over each layer, likewise, five layers of substrate and spawn's layers were added into the bags and made it as 1kg of weight. Finally, bags were kept in mushroom growing dark rooms maintained aseptically at 20±5 °C and 80% Moisture. Fruiting bodies of mushroom were harvested in three weeks from the inoculation.

Bio-fortification and vermicomposting of mushroom waste

Collected utilized mushroom substrates (mushroom wastes) were mixed well with cow dung slurry in the ratio of 4:6 (Nik Nor Izyan, Jamaludin and Mahmood, 2009) and allowed for fermentation for seven days. Microorganisms of *Trichoderma viride* and *Pseudomonas fluorescens* pure culture slants were collected from the Microbiology Laboratory of Department of Agricultural Biology, Faculty of Agriculture, University of Jaffna. Mature red worms (*Eisenia foetida*), 100/kg of the substrate, 40 ml/kg of 2*10⁶ spores/ml of *Trichoderma viride* and *Pseudomonas fluorescens* solution were inoculated (Datar and Babookani, 2011; dos Santos Pereira et al., 2020) and basins were covered by using fabric cloth and kept it for vermicompost production. Once in three days, an adequate amount of water was sprayed by using a sprayer and manual turning was also performed.

Physicochemical analysis of bio-fortified vermicompost

Total organic carbon was determined by the loss on ignition method. Nitrogen was analysed by semi-micro Kjeldahl method), Phosphorous percentage was measured by vanado-molybdate yellow spectrophotometric method at the wavelength of 450 nm, Potassium percentage, percentage was measured by flame photometer [JENWAY- PFP7] (Jackson, 1973). pH value, and EC value of the organic liquid fertilizers were measured using pH meter [DKK-TOA(HM-30P)] and Electrical Conductivity meter [DKK-TOA(CM-42X)], respectively.

Data collection and Statistical Analysis

The pH, electric Conductivity (EC), organic matter content (OMC), total organic carbon (TOC), total nitrogen, total phosphorus, and total potassium were subjected to ANOVA using SAS 9.1. Tukey's HSD multiple comparison test was used to identify the best treatment combination at $P < 0.05$.

RESULTS

The results of physicochemical properties such as pH, Electric Conductivity (EC), organic matter content (OMC), total organic carbon (TOC), total nitrogen, total phosphorus, and total potassium content of the bio-fortified vermicompost were measured and summarized in Table 1. The pH of the vermicompost varied from 7.28 to 8.14 but not significant among them were at $P < 0.05$. The lowest and neutral pH of 7.28 was observed in the garden waste-based vermicompost bio-fortified with *T. viride* and *P. fluorescens* whereas kitchen waste-based vermicompost fortified with *P. fluorescens* exhibited the highest pH of 8.28. The electrical conductivity range of bio-fortified vermicompost was from 1.11 to 2.36 mS/cm and was not significant at $P < 0.05$. Kitchen waste-based vermicompost fortified with *P. fluorescens* exhibited the highest EC value of 2.36 whereas the lowest EC of 1.11 was detected from the garden waste treated with *T. viride* and *P. fluorescens*. In other all treatments, EC was below 2.00.

Organic matter content (OMC) and TOC of these studied vermicomposts were ranging from 23.6% to 52.4% and 13.39% to 30.39%, respectively. The OMC and TOC were significantly on par at $P < 0.05$. The highly significant OMS was observed in V4T2. The OMC among V4T3 (46.5%), V4T4 (41.8%) and V5T3 (40.5) were significant and were in 2nd rank. The OMC in V2T3 and V3T3 were the lowest non-significant. Total organic carbon was highly significant with the value of 30.39% in paddy straw substrate vermicompost fortified with *P. fluorescens*. The highest organic matter content and total organic carbon were observed in sawdust substrate-based vermicompost bio-fortified with *T. viride*.

Total nitrogen content of these bio-fortified vermicompost ranging from 1.06% to 2.1%. The highest significant nitrogen value of 2.1% was recorded in the kitchen waste-based *T. viride* fortified bio compost at $P < 0.05$. The lowest nitrogen value was recorded in sawdust substrate-based vermicompost fortified with *P. fluorescens* with a value of 1.06%. The highest total phosphorus content of 1.87% was observed in kitchen waste-based *P. fluorescens* fortified vermicompost whereas the lowest phosphorus value of 0.73 % was recorded in the sawdust substrate vermicompost fortified with *T. viride*. The total potassium content of these bio-fortified vermicomposts ranging from 0.654% to 1.38%. The highest potassium value of 1.38% was recorded in kitchen waste substrate-based vermicompost fortified with *P. fluorescens*. The lowest potassium value was recorded in garden waste-based vermicompost fortified with *T. viride* and *P. fluorescens*.

Table 1: Physiochemical properties of bio-fortified vermicompost

Physiochemical properties	V1		V2		V3			V4			V5		
	T1	T2	T3	T4	T2	T3	T4	T2	T3	T4	T2	T3	T4
pH	8.06	7.49	8.01	8.06	8.15	7.59	7.28	7.8	8.09	8.08	8.04	8.14	8.11
EC (mS/cm)	1.45	1.47	1.46	1.59	1.32	1.19	1.11	1.46	1.25	1.19	1.76	2.36	1.89
Organic matter content (%) ±0.36	36.80 ^{cd}	30.96 ^e	22.66 ^g	28.20 ^d	30.43 ^e	25.50 ^{fg}	26.96 ^f	51.53 ^a	45.86 ^b	41.33 ^c	38.06 ^c	39.83 ^c	36.36 ^{cd}
Total carbon (%)±0.20	20.99 ^{cd}	17.88 ^d	13.25 ^e	16.35 ^d	17.06 ^d	14.33 ^e	15.35 ^f	30.20 ^a	26.51 ^b	24.12 ^{bc}	21.87 ^c	23.22 ^c	21.24 ^c
Total Nitrogen (%)±0.001	1.34 ^d	1.42 ^d	1.23 ^d	1.64 ^c	1.43 ^d	1.09 ^e	1.25 ^d	1.28 ^d	1.06 ^e	1.35 ^a	2.08 ^a	1.83 ^b	2.04 ^a
Total phosphorus (%)±0.01	1.32 ^c	0.93 ^e	1.42 ^c	1.02 ^d	1.00 ^d	1.15 ^d	1.17 ^d	0.75 ^e	0.93 ^e	0.83 ^e	1.41 ^c	1.85 ^a	1.64 ^b
Total potassium (%) ±0.003	0.98 ^{bc}	0.97 ^{bc}	1.04 ^c	0.80 ^d	0.72 ^{de}	0.71 ^{de}	0.66 ^{de}	0.94 ^c	0.87 ^d	0.96 ^{bc}	1.12 ^b	1.36 ^a	0.93 ^c

Values with the same alphabets are not significantly different according to the Tukey's HSD at 95% confidence interval

DISCUSSION

In organic agriculture, compost is the major input to provide nutrients to crops. Traditional composting defines that the conversion of degradable organic products and wastes into stable products with the aid of microorganisms under controlled conversion. The shortcomings of traditional composts are pathogen detection, low nutrient status, long duration of composting, long mineralization duration, and odor production. But vermicomposting needs limited controlled conditions and enhance the nutritional qualities and adding beneficial biota the suppress the pathogen to compost.

The ideal compost pH to be used for most of the applications in agriculture should be around 7.5. The C/N ratio should be between 25 to 30 and the average bio-compost must contain about 33.3% organic matter, but not less than 20% (Azim et al., 2018; De Bertoldi, 2013). The current bio-fortified vermicompost's pH range was 7.28-8.11 and OMC 22.66-51.53. The good quality vermicompost should contain N, P, K within the range of 0.51-1.61%, 0.19-1.02%, and 0.15-0.73%, respectively. But the bio-fortified compost N, P and K ranges were 1.06% to 2.1%, 0.73%-1.87%, 0.654% to 1.38%. Therefore, the current investigation produced bio-fortified vermicompost's nutritional quality is superior.

The high nutritional quality may be the addition of *P. fluorescens* and *T. viride*. Singh and Sharma (2002) reported that *Trichoderma* spp enriched vermicompost's nitrogen content through mineralization. Further, Mahanta et al., (2012) also supported that the *P. fluorescens* and *T. viride* have the ability to solubilize the phosphate and make it into a freely available form of phosphorus. Composting is a long-used technology, though it has some shortcomings that have reduced its extensive usage and efficiency. Moreover, the nutritional quality of the compost highly influenced by the raw material used (Raviv, 2005).

CONCLUSIONS

All the bio-fortified vermicompost nutrients content was significantly higher than control. This might be the activity of *P. fluorescens* and *T. viride* which converted N, P, and K P from an unavailable form into available form using specific enzymes. Therefore, this research concludes that bio-fortified kitchen waste-based vermicompost's nutritional quality is exceptional and recommended for organic agriculture.

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A Database Design to Find Organic Produce using Latitudes, Soil Orders and the Internet

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ABSTRACT

Organic agriculture has had a long history especially after the establishment of IFOAM in 1972. However, the organic share is still 1.5 % in the world. This article proposes a database design methodology to find new organic produce according to latitudes and soil orders using the Internet. As a result, we have completed the practical database which could be used by any organic producers around the world.

INTRODUCTION

IFOAM has led the global organic agriculture by defining Organic 1.0, 2.0 and 3.0 up to this time. We are now at the era of Organic 3.0. One important challenge in Organic 3.0 is to accelerate the conversion from conventional to organic agriculture. It is extremely important for farmers to find new, profitable, and attractive produce (crops, fruits, herbs) in each organic farming sector globally. In this paper we study the relationship between latitudes, soil orders and produce by reviewing papers, and then, with the use of the Internet, we have designed a database.

MATERIALS AND METHODS

We have chosen three parameters to measure the produce grown on farms around the world, that is the relationship between latitudes, soil orders and organic produce (crops, fruits and herbs) raised worldwide and then collected relevant data via the Internet. Through these activities, everybody knows the produce identities and differences at various farming locations. The database is designed to identify produce which is suitable to farmers' locations (relevant to temperature and precipitation) and soil orders.

The latitudes selected for the database design are from equator to 20th parallel north/south, 40th parallel north/south and 60th parallel north/south allowing for an error of plus/minus five degrees. The latitude ranges are appropriate as to limitations on the areas of produce growth due to the range in temperature and precipitation. Soil orders selected for the database design are entisols, aridisols, inceptisols and alfisols because they occupy 55 percent of the global ice-free area. Based on the two parameters of latitudes and soil orders, we can define cities or towns

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from the Internet. Then, a list of organic produce is also made from the Internet and the database is completed.

RESULTS

The database composed of crops, fruits and herbs of organic farms ranging from 60th parallel north to 60th parallel south has been made. The length of the database is 4 pages in total; therefore, only two pages of database have been displayed in this paper that is produce in 40th parallel north/south and the equator in Table I. We skipped the 20th parallel north/south because produce in the region is almost same as 40th parallel north/south. But these ranges are appropriate because at the 60th parallel north, farmers can't produce anything without using artificial energy (mainly electricity) and at 60th parallel south only the sea is observed. We must promote organic farming which is environmentally friendly. In the table, the colors of yellow, blue, green and grey indicate soil orders. The commonly grown produce is indicated by colors for each soil orders in the table, meaning that two or more farms have been raising them.

The non- colored crops, or as we call them, the uncommonly grown produce, means that only one farm in each city on the latitude has grown them. Sample size of farms in this database is from one to six depending on the latitudes and the expanse of the soil orders. The uncommonly grown produce would thus become prospective new candidates in any organic farms around the world. There is produce encircled in the table illustrating same produce has been growing both in 40th parallel north/south. This is because the mean air surface temperature measured at a standard height of 1.2 m (4.0 ft) above the ground surface on the 40th parallel north/south is 12.5 degrees centigrade.

The precipitation at the 40th parallel north/south is 15.2kg/square meter. The results in [Table I](#) clearly illustrate trends that in both 40th parallel north/south almost the same crops can be grown in the same soil orders.

DISCUSSION

Benefits of the database are as follows:

[1] Sustainability: Sustainability is one of the most important elements of ORGANIC 3.0. The database can contribute to help farmers find new organic crops appropriate for their farms. This facilitates crop rotation to improve soil characteristics by maintaining soil bacteria because farmers are able to select a wide variety of produce from the database. In this way, organic farmers can grow various kinds of produce for future generations continuously. At the same time, they can satisfy the requirements of earth-friendly organic farming.

[2] Economy: The database covers various kinds of organic produce around the world. So, farmers located in the same latitudes with the same soil orders can successfully try out new crops economically and with ease. This also contributes to an increase in the number of organic farmers and an increase in the number of conversions from conventional farming to an organic farming.

[3] Even today, the organic share is only 1.5% of the entire arable lands in the world.

[4] The database provides a good environmental protection movement with the augmentation of plentiful produce in the world.

CONCLUSIONS

[1] The database would provide good suggestions for farmers to try out new produce in their farms.

[2] The database design for organic produce will contribute to the acceleration of IFOAM ORGANIC 3.0 in terms of organic farming, its sustainability and support of public awareness.

[3] Future works: The database is not exhaustive at this point in time, because desirable produce might change according to the consumers' taste, farmers' efforts and global warming. Therefore, every year we will need to revise the database. It would be necessary to publish a yearbook of the organic produce database through the cooperated efforts of farmers around the world and update it annually. The periodical exhaustive database update activities should include IFOAM or IFOAM Asia and FIBL to increase data and accuracy.

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