SUCCESSFUL ORGANIC FARMING THROUGH EARTHWORM ECO-TECHNOLOGY

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Abstact: Recent approach to soil fertility is shifting from the chemical management to organic agriculture because of both economic and ecological concerns.Chemical agriculture has not only triggered bio-diversity loss but also has resulted in initiating chain reactions for the local to global changes. This present work is an example to substantiate the value of earthworm community for bio-diversity for bio-indication of land use pattern in comparison to the native forest. The study was conducted in protected native forest, degraded open forest, organically grown tea agro ecosystem and chemically grown tea agro ecosystem in Assam.

This present work done in Jutleebaree Tea Estate(500 Hectares) which is chemically grown tea for last more than 50 years out of which 100 Hectares were converted into organic and nearby reserve forest which is natural native forest and a portion of this forest was converted into tea estate long ago and chemicals used for tea growing, degraded open forest and degraded marginal open land of tea estate in upper Assam from 1998 to 2002.

There has been decrease in the soil biological communities in the man managed ecosystem as compared with the native forest. Total numbers of 9 earthworm species were found in protected native forest, 5 species in the organically grown tea agro eco-system and 2 species in the chemically grown tea agro-ecosystem.

Table I Total number of earthworm species found in different Ecosystems identified by Dr.J.M. Julka

Protected Native Forest	Degraded Open Forest	Organically grown tea Agro-Ecosystem	Chemically grown tea Agro-Ecosystem
Lampito marutii	*Lampito marutii*	*Lampito marutii*	*Lampito marutii*
Drawida nepalensis	*Drawida nepalensis*	*Drawida nepalensis*	*Drawida nepalensis*
Pentascolex corethrurus	*Pentascolex corethrurus*	*Pentascolex corethrurus*	
Amynthas gracilis	Amynthas gracilis	Amynthus gracilis	
Amynthas cortices	Metaphire houlleti	Metaphire houlleti	
Amynthas alexandri			
Eutyphoeus callosus			
Metaphire houlleti			
Kanchuria Sumerians			

Note: The table shows decrease in number of species from protected native forest 9 to 5 in degraded oopen forest and 2 in chemically grown tea agro ecosystem but when it converted into organically grown tea agro ecosystem then again number of earthworm species start increasing. The population of earthworms were maximum in rainy season and minimum in winter season.

Earthworm species number is also significantly correlated to the oxidisable organic matter level. The earthworm species(9) and population was maximum in native protected forest and decreased in degraded open forest(5) and minimum(2) in chemically grown tea agro ecosystem which again increased(5) in organically grown tea agro ecosystem which indicate number of species and population of earthworms directly related with tea agro ecosystem which indicate number of species and population of earthworms directly related with soil organic matter and maintain porosity, aeration, structure, waterholding capacity, organic carbon, humus status, fertility and overall ecosystem of soil and named soil ecosystem managers.

The same pattern is seen for beneficial soil microbes like decomposers, Nitrogen fixers, Phosphate solublisers, soil borne disease controller and other soil activity processors which were maximum in Native protected forest, decreased in open forest and minimum in convention tea agro ecosystem which again increased in organically grown tea agro-ecosystem workers.

In our experiment when a block of soil of size 1 cubic ft was dug out from protected native forest and we found 12 earthworms, but 5 in degraded open forest and none in chemically grown tea agro ecosystem which again increased to 5 in organically grown tea ecosystem and same pattern was found for soil beneficial microorganisms and soil was porous with high waterholding capacity, proper aggregation, so proper aeration, better soil structure, high organic carbon and humus and all nutrients, so overall good fertile soil in native protected forest while soil was hard with poor porosity, less waterholding capacity, poor aggregation, structure and overall fertility in conventionally grown tea agro ecosystem which again improved in organically grown tea agro ecosystem which indicate role of earthworms and beneficial microbes in maintenance of overall fertility and chemical and physical properties of soil i.e. overall soil ecosystem and also in sustainable and successful organic farming.

The index of diversity was found to be 2299, 1969, 1654 and 0.451 and the index of dominance was 0.255, 0.297, 0.418 and 0.828 in the protected native forest, open degraded forest, organic tea agro ecosystem, conventional tea agro ecosystem respectively. The higher value of species diversity index in the protected native forest indicates existence of diverse varieties of earthworm with low dominance index. There is gradual decrease in species diversity and increase in dominance index along the gradient of land use pattern. Dominance of only two species of earthworm in the chemically grown tea agro ecosystem indicates extreme impact of land use pattern.

There has been a decrease of about 86% in soil organic matter, 95% in earthworm biomass and 78% in earthworm species diversity in conventional tea agro-ecosystem from that of the native protected forest. This indicates negative changes in the land use pattern because of higher deviation with respect to bio-diversity parameters of the native forest. Land use through conventionally grown tea agro-ecosystem is perhaps the worst option than in comparison to organically grown tea agro-ecosystem and potential degradation of native forest.

For reclamation of degraded land from conventionally grown tea agro-ecosystem to successful organically grown agro-ecosystem a technology has been developed called Earthworm Eco-Technology. In this technology all types of beneficial earthworm species (Epegeic- Surface living and only garbae processors, Anaceic – Both garbage and soil processors and deep burrowing type make vertical tunnels in the soil and move up and down in the soil upto 10 ft. deep and Endogeic – Only soil processor and move horizontally and live in soil microbes such as decomposers, Nitrogen fixers, Phosphate solublisers, soil borne disease controllers and mobilisers of all other soil processes etc. are cultured on the farm *in situ* and humus bio-fertilizer is produced by adding bio-degradable agro-wastes (all types of weeds, stems of banana trees, pruning litter of tea, tea waste etc.) and cow-dung in 2 inch thin layers periodically after every 7 days and regular watering is done in Eco organic manure, vermicasting based humus bio-fertilizer production bins and eco organic manure is produced in these bins. By adding 8 Tons of this Eco-organic manure- vermicasting based humus bio-fertilizer to one hectare of farm soil the number of beneficial earthworm species (Anaceic and Endogeic) and all types of beneficial microbes is increased in the soil and successful organic farming can be done by maintaining ten earthworms and one million microbes in one cubic inch of soil by regularly adding it every year. By this technology soil structure, porosity, water holding capacity, aeration and overall fertility is maintained as required for good growth and health of plants and sustainable high yield can be taken in organic farming at low cost and eco-system can be maintained equivalent to native protected forest land.

Table 2 – Dynamics of bio-diversity and physio-chemical parameters of different agro-ecosystem

Ecosystem	Protected Native Forest	Degraded Open Forest	Organically grown Tea Agro-ecosystem	Conventionally grown Tea Agro-ecosystem
About ground biodiversity (Dominant vegetation)	Sof weeds(Dicot)	Soft Weeds(Dicots)	Soft weeds (Dicots)	Both dicots and Monocots
Number of Species of earthworms	9	5	5	2
Depth at which they are found	From surface to upto 5 ft. below	From surface to upto 5 ft below	From surface to upto 5 ft below	From surface to upto 3 ft below
Dominance index	0.255	0.297	0.418	0.828
Divesity Index	2299	1969	1654	451
Soil Organic Carbon (total)	5%	3%	3.3%	0.7%
Soil pH	6.8%	6.8%	5.5%	4.5%
Water holding capacity (WHC)	68%	48%	44%	22%
Porosity	Good	Average	Average	Poor
Aggregation	Good	Average	Average	Poor

The above dates clearly indicates that soil was healthy with maximum population and species of earthworms and microorganisms and self sustainable fertile soil in native forest became degraded, hard and poor in all physical and chemical properties with low organic carbon, minimum soil microorganisms, low in pH, poor in water holding capacity, aeration, porosity and overall fertility which again start reviving in organically grown tea agro ecosystem by application of Earthworm Eco-Technology.

Table 3 – Dynamics of the physico-chemical parameters in the tea agro-ecosystems after application of Earthworm Eco-Technology.

Type of Tea Agro-ecosystem	Conventionally Grown Tea Agroecosystem (1st Year)	Conventionally Grown Tea Agroecosystem (2nd Year)	Convention-ally Grown Tea Agroecosystem (3rd Year)	Organically Grown Tea Agroecosystem (1st Year)	Organically Grown Tea Agroecosystem (2nd Year)	Organically Grown Tea Agro-ecosystem (3rd Year)
Above ground Bio-diversity (Dominant Vegetation)	Both Dicots and Monocots	Both Dicots and Monocots	Both Dicots and Monocots	Both Dicots and Monocots	Both Dicots and Monocots	Soft weeds (Dicots)
Number of species of earthworms	2	2	2	2	3	5
Depth at which they are found	From 1 Ft to 3 Ft	From 1 Ft to 3 Ft	From 1 Ft to 3 Ft	From 1 Ft to 3 Ft	From surface to 5 Ft	From surface to 5 Ft
Dominance Index	0.828	0.828	0.828	0.828	0.623	0.418
Diversity Index	451	451	451	451	924	1654
Soil Organic Matter (Humus Oxidisable)	0.4%	0.35%	0.35%	0.7%	1.2%	2.2%
Soil Organic Carbon	0.8%	0.7%	0.7%	1.4%	1.2%	1.1%
Soil pH	4.5	4.5	4.5	5	5.5	5.5
Water Holding Capacity (WHC)	22%	22%	22%	28%	37%	44%
Porosity	Poor	Poor	Poor	Poor	Average	Average
Aggregation	Poor	Poor	Poor	Poor	Average	Average
Made Tea Production (Kg/Ha)	1528	1749	1317	1730	1658	1780
Tea quality specifications	Normal	Normal	Normal	Both liquor and flaovour improved	Both liquor and flavour improved	Both liquor and flavour improved
Expenditure/ Income Ratio	9.5:10	9.5:10	9.5:10	10:10	10:11	10:12
Market Acceptibility	Auction Sale	Auction Sale	Auction Sale	Privately Accepted	Immidiate Sale in Private Market	Immediate Sale in Private Market
Frequency of Pest and Diseases	High	High	High	Average	Low	Low

The data of the above table indicates that chemical farming done for the last more than 50 years has changed the physical and chemical properties of the soil and deteriorated the complete soil ecosystem. The soil has now become hard and poor in porosity, aeration, water-holding capacity, organic carbon, humus, population of earthworms and soil microorganisms and overall fertility and more pest and diseases on plants, poor quality of produces and dependence on maximum external inputs as fertilizers or pesticides. When Organic farming was started through Earthworm Eco-Technology then physical and chemical properties and fertility of the soil started improving with better quality of produces, more population of earthworms and microorganisms and reduction in the attack of pest and diseases, soil ecosystem becoming self sufficient and healthier, so less use of external inputs and farming became more profitable and healthier due to less cost of production and better prices of produces.

Conclusions:

The successful organic farming can be done with low cost and high yield through Earthworm Eco-Technology which is simple and cheap and can be adopted by all farmers on their farms for overall improvement of complete ecosystem. The Earthworm Eco-Technology is also on stroke solution of most of the burning problems like pollution, unemployment, poverty, poor health of soil, plants, animals, human beings and overall ecosystem, prevention of Incurable diseases at the grassroot level, more requirement of irrigation water, depletion of underground water table, topsoil erosion, more floods and increase of wastelands.