

# LEISA and Soil Organic Carbon in Aurangabad district (Maharashtra), India

Ajgaonkar S.S.<sup>1</sup> and Dr Patil S. S.<sup>2</sup>Research student, Dept. of Environmental Science, Dr. B. A. M. University, Aurangabad (MS), India<sup>1</sup>Professor, Dept. of Environmental Science, Dr. B. A. M. University, Aurangabad (MS), India<sup>2</sup>

**ABSTRACT:** Low External Input for Sustainable Agriculture (LEISA) emphasize on farm nutrition management by recycling the biomass. This is done by adoption of crop rotation, intercrops, mixed cropping and crop residue mulching, trap crops, bio fertilizers such as farm yard manure, cow dung and cow urine based preparations as nutrients and bio pesticides, herbal pesticides, neem extract, etc. The results of soil samples from Aurangabad district showing 51% samples have low organic carbon, 41 % sample have moderate and only 8 % samples have moderately high organic carbon content. New approaches integrating ecological and biological processes in food production, minimizing non-renewable inputs use, making productive use of the local knowledge and skills of farmers and substituting human capital for costly external inputs are needed. The ecological management of agro ecosystems like LEISA, population regulating mechanisms and resilience of system for climate change will lead to reform of agriculture.

**KEYWORDS:** LEISA, Soil organic carbon, Aurangabad.

## I. INTRODUCTION

Agriculture is a natural resource-intensive enterprise and it has a large influence on environmental quality. The food production systems utilize resources vigorously. The meeting increased demand for cereals and food with conservation of natural resources is emerged as a challenge for world. This includes trends in crop yields, land and nitrogen fertilizer use and carbon sequestration [1]. Low External Input for Sustainable Agriculture (LEISA) is a ray of hope for sustainable agriculture that meets human needs and protects natural resources. To mitigate global climate change and ensure food security for a growing global population, soil organic matter (SOM) has received considerable attention. The photosynthesis reduces atmospheric CO<sub>2</sub> concentrations by increasing plant carbon stocks. It is stored wood and in the form of SOM. The decomposition of SOM converts in soil organic carbon form and enhances soil fertility and water holding capacity [2].

The Task Force on Balanced Use of Fertilizers (2005) constituted by Department of Agriculture & Cooperation had estimated that in order to meet the requirement of 300 million tons of food grain by 2025, 36 million tons of fertilizers in nutrient terms would be needed to increase food grain yield to achieve required production, since there is limited possibility of further increase in total area under cultivation of 142 million hectares. National Academy of Agricultural Sciences has estimated (2009) that for meeting food needs of the country by 2025, India may have to increase its plant nutrient supply to over 45 million tons. Out of this, 35 million tons should come from chemical fertilizer sources and rest 10 million tons from organic sources.

The green revolution was brought in partly because of use of external synthetic agricultural inputs. However, Ever green revolution can be brought about in farming systems with the resources that are already available in terms of soil, water, renewable sources and there can be an increase in productivity, which does not have to occur at the cost of the environment [3]. It does not have to affect the environment or the society. The availability of nutrients depends on various factors such as soil types, irrigation facilities, pH and organic matter content [4]. Soil organic matter is the

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critical component in the functioning of terrestrial ecosystems, providing substrate and nutrients for biotic reactions. It maintains soil structure and soil permeability and resistance to wind and water erosion. Soil organic matter is essential for carbon and nitrogen turnover and nutrient retention ultimately for soil quality. Intensive cultivation has caused a heavy loss in soil organic matter relative to natural ecosystems.

Proportion of high value crops is low but can be increased. Recommended crop rotations or combinations are not followed. Cultivation practices do not fit the requirements of the crops or modern technologies. Organic manures have become rare. There is unbalanced use of chemical fertilizers both by focusing on a few selected crops like sugarcane and in uncontrolled doses likely to harm the crops and soils. Proven inputs like wormy culture, Bio fertilizers or Bio-pesticides are rarely used. There is vast scope for Bio-dynamic farming. These are the weakness registered in SWOT analysis of agriculture sector in Aurangabad in C-DAP, Aurangabad 2013. The current study is conducted to analyze the status of LEISA adoption, the SOC and productivity of soils from 12 villages of Aurangabad district.

## II. RELATED WORK

As per Agriculture diary of Vasanttrao Naik Marathwada Agriculture University, Parabhani, the soils of Marathwada are having organic carbon in range of 0.30 to 0.80 % [5]. The organic carbon content of soils in winter season ranged from 0.11 to 1.00 g/kg with a mean value of 0.46 g/kg. There are 64% samples were having low organic carbon content [6]. These same results were reported by More et al. (1987) in soils from salt affected area of Purna command area in Marathwada region [7]. Bacchewar and Gajbhiye reported that the organic carbon content ranged from 0.21 to 1.28 % with an average of 0.75 % in soil of Latur district, Maharashtra and also by Raut and Mali [8], [9]. Organic matter acts as adhesive for binding soil components and improve water infiltration and water holding capacity. Organic carbon or organic matter is the indicator of soil quality and productivity [10].

## III. MATERIALS AND METHODS

The present study has been carried out to know sustainable agricultural practices based on LEISA principles followed in Aurangabad district. The data regarding agricultural practices have been collected from 240 farmers from 12 villages of 3 blocks of Aurangabad district using questionnaire method in 2014. The villages selected for study were Shelud, Charatha, Hatmali and Naigavhan from Aurangabad block; Waghola, Lohagad Nandra, Babhulgaon and Gungi Gevrai from Phulambri block and Khandala, Bodvad, Mandana and Liha Khedi from Sillod block. The survey was carried out during 2014 and focused on farming systems adopted by the farmers. 20 farmers have been selected randomly from each class of farmers in village from study area and individually interviewed, following a structured Questionnaire. The scale used for study of adoption is developed by S.V. Supe and S. N. Singh [11] with some modification. They were classified as Farmers adopting sustainable agricultural practices with LEISA principle (FSA) and farmers adopting traditional practices (FTA) according to their score of adoption of LEISA by the farmer. The surface soil samples (0-22 cm depth) from 240 farmers were collected from 12 villages of 3 blocks. Modified method of Walkley and Black (1934) as described by Piper (1966) was used for determination of organic carbon [12].

## IV. RESULTS AND DISCUSSION

**Adoption of LEISA:** The adoption of farm practices was studied for evaluation of adoption of LEISA by farmers. The farmers were having excellent performance only in cropping pattern and Irrigation management i.e. 20 per cent practices. The farmers were having satisfactory performance only in tillage, intercropping operation and Integrated Nutrient Management i.e. 30 per cent practices. The performance of selected farmers was poor in adoption of LEISA techniques in livestock rearing, using manure and farm yard manure, seed, preparing manure at farms and Integrated Pest Management i.e. 50 per cent practices [Figure no 1]. The study of adoption of sustainable farm practices suggested that 65 per cent of women farmers adopted more than one agricultural practice [13].

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Figure no: 1 Adoption of LEISA

| Adoption of LEISA              |              | Aurangabad |     | Phulambri |     | Sillod |     | District |     |
|--------------------------------|--------------|------------|-----|-----------|-----|--------|-----|----------|-----|
|                                |              | FSA        | FTA | FSA       | FTA | FSA    | FTA | FSA      | FTA |
| Tillage                        | Poor         | 2          | 10  | 1         | 7   | 0      | 20  | 3        | 37  |
|                                | Satisfactory | 36         | 29  | 28        | 22  | 34     | 20  | 98       | 71  |
|                                | Excellent    | 2          | 1   | 11        | 11  | 6      | 0   | 19       | 12  |
| Livestock                      | Poor         | 16         | 17  | 2         | 18  | 6      | 34  | 24       | 69  |
|                                | Satisfactory | 12         | 10  | 18        | 13  | 18     | 5   | 48       | 28  |
|                                | Excellent    | 12         | 13  | 20        | 9   | 16     | 1   | 48       | 23  |
| Farm Yard Manure / Manure use  | Poor         | 18         | 20  | 4         | 19  | 12     | 34  | 34       | 73  |
|                                | Satisfactory | 17         | 11  | 26        | 12  | 22     | 6   | 65       | 29  |
|                                | Excellent    | 5          | 9   | 10        | 9   | 6      | 0   | 21       | 18  |
| Cropping Pattern               | Poor         | 4          | 29  | 6         | 21  | 1      | 31  | 11       | 81  |
|                                | Satisfactory | 9          | 2   | 8         | 16  | 9      | 6   | 26       | 24  |
|                                | Excellent    | 27         | 9   | 26        | 3   | 30     | 3   | 83       | 15  |
| Intercultural operation        | Poor         | 2          | 17  | 0         | 8   | 4      | 25  | 6        | 50  |
|                                | Satisfactory | 16         | 21  | 11        | 16  | 18     | 13  | 45       | 50  |
|                                | Excellent    | 22         | 2   | 29        | 16  | 18     | 2   | 69       | 20  |
| Seed                           | Poor         | 24         | 29  | 35        | 36  | 20     | 25  | 79       | 90  |
|                                | Satisfactory | 14         | 11  | 2         | 4   | 20     | 15  | 36       | 30  |
|                                | Excellent    | 2          | 0   | 3         | 0   | 0      | 0   | 5        | 0   |
| Integrated Nutrient Management | Poor         | 21         | 19  | 15        | 28  | 5      | 34  | 24       | 81  |
|                                | Satisfactory | 32         | 21  | 23        | 12  | 32     | 6   | 87       | 39  |
|                                | Excellent    | 4          | 0   | 2         | 0   | 3      | 0   | 9        | 0   |
| Preparing Manure at farm       | Poor         | 39         | 40  | 38        | 37  | 17     | 40  | 94       | 117 |
|                                | Satisfactory | 1          | 0   | 2         | 3   | 23     | 0   | 26       | 3   |
|                                | Excellent    | 0          | 0   | 0         | 0   | 0      | 0   | 0        | 0   |
| Integrated Pest Management     | Poor         | 14         | 21  | 10        | 22  | 17     | 40  | 41       | 83  |
|                                | Satisfactory | 19         | 16  | 27        | 17  | 22     | 0   | 68       | 33  |
|                                | Excellent    | 7          | 3   | 3         | 1   | 1      | 0   | 11       | 4   |
| Irrigation management          | Poor         | 1          | 10  | 10        | 17  | 13     | 32  | 24       | 59  |
|                                | Satisfactory | 7          | 10  | 21        | 17  | 5      | 5   | 33       | 32  |
|                                | Excellent    | 32         | 20  | 9         | 6   | 22     | 3   | 63       | 29  |

(FSA – Farmers following Sustainable Agriculture, FTA – Farmers following Traditional Agriculture)

### Organic Carbon

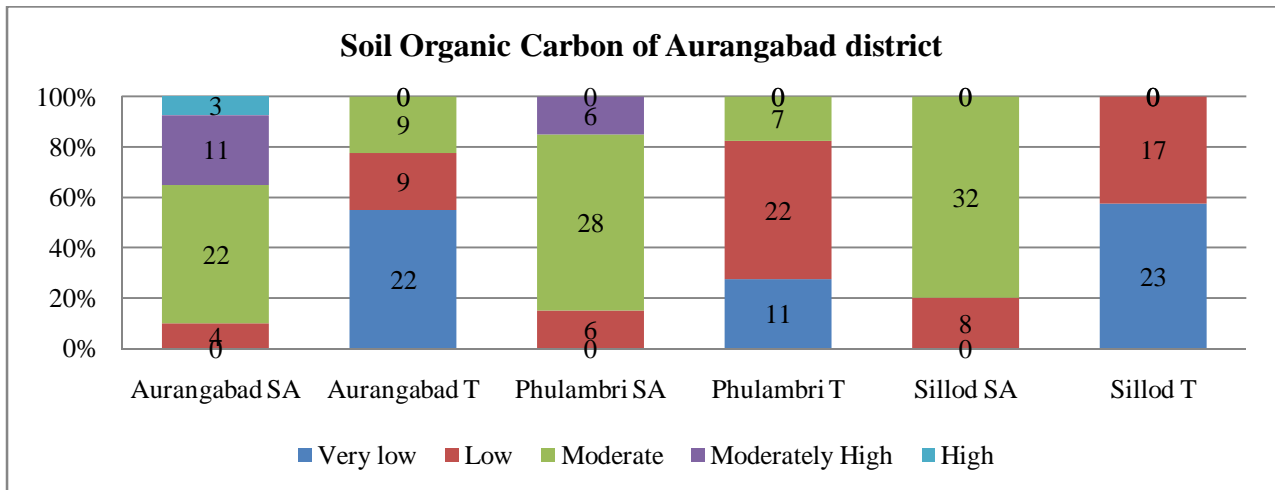
The organic carbon content of soils ranged from 0.15 to 0.90 g/kg with a mean value of 0.39 g/ kg. Out of 240 soil samples from Aurangabad district, 23% samples have very low, 28 % samples have low, 41 % sample have moderate, 7 % samples have moderately high and 1 % samples have high organic carbon content. The low content of organic carbon might be due to inadequate addition of organic matter through either artificially or naturally and its subsequent decomposition. In Aurangabad block 27.5 % samples have very low, 16.25 % samples have low, 38.75 % sample have moderate, 13.75 % samples have moderately high and 3.75 % samples have high organic carbon content. Whereas in Phulambri block 13.75 % samples have very low, 35 % samples have low, 43.75 % sample have moderate and 7.5 % samples have moderately high organic carbon content. In Sillod block 28.75 % samples have very low, 31.25 % samples have low and 40 % sample have moderate in organic carbon content. The Sillod block is having very low to moderate the soil organic carbon content.

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### The soil organic carbon and LEISA:

The 'r' value of correlation between OC of soil and farmers who are limiting their fertilizer use is 0.002 and significant at the 0.01 level. There is correlation between OC and Use of Biofertilizers, worm compost and micronutrient at the 0.01 level. The 'r' value of correlation between OC of soil and farmers using crop residue for manure making is 0.046 which is showing significant relationship at the 0.05 level. The use of biological agent for pest control, use of resistant variety, predator and parasite use for pest control and OC of soil is having significant correlation at the level of 0.01. The uncontrolled use of chemical fertilizers contributes mainly to the deterioration of environment through fossil fuels depletion, Carbon dioxide (CO<sub>2</sub>) generation and contamination of water resources and leads to loss of soil fertility impacts agricultural productivity and causes soil degradation. Now there is increasing realization that the adoption of ecological and sustainable farming can only reverse the falling trend in global productivity and environment protection [14], [15], [16]. Sustainability of soil productivity depends in part on soil and crop management practices which maintain soil organic matter. Crop rotations with high residue producing crops maintain surface residue cover with reduced tillage. This results in greater soil organic C and N, which may improve soil productivity [17]. The response efficiency of chemical fertilizer nutrients has declined tremendously under intensive agriculture due to imbalanced and inadequate fertilizer use coupled with low efficiency of inputs in recent years [18].

The organic matter is helpful in sustaining soil fertility. It improves soil health by retention of mineral nutrient, improving soil structure and water holding capacity, water infiltration, aeration, drainage and root penetration [19]. It also helps to maintain large of soil flora and fauna [20]. There is potential to expand production efficiently for achieving food security and poverty with limiting impacts on ecosystem values. This creates scope for governments and the private sector for adoption of sustainable land and water management practices such as LEISA to promote sustainable intensification and reduce risks in production. There was great progress in agricultural productivity with the help of increased use of fertilizers, irrigation, agricultural machinery, pesticides and land during last century. Now it would be difficult to assume that these relationships will remain linear in the future [21].

### V. CONCLUSION

LEISA emphasize on farm nutrition management by recycling the biomass from the farm itself. This is done by adoption of crop rotation, green manure crops, intercrops, mixed cropping and crop residue mulching, farm yard manure, cow dung and cow urine based preparations as nutrients and bio pesticides, trap crops to reduce pest attacks, herbal pesticides, neem seed or leaf extract, bio pesticides and bio fertilizers, etc. Seeds should be traditional local varieties or improved/selected varieties. The results of soil samples from Aurangabad district showing 51% samples have low organic carbon than recommendation, 41 % sample have moderate and only 8 % samples have moderately

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high organic carbon content. This situation suggest that new approaches integrating ecological and biological processes in food production, minimizing non-renewable inputs use, making productive use of the local knowledge and skills of farmers and substituting human capital for costly external inputs are needed. The ecological management of agro ecosystems like LEISA, population regulating mechanisms and resilience of system for climate change will lead to reform of agriculture.

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