CROPPING SYSTEMS: AN ADAPTIVE STRATEGY FOR MITIGATING SOIL POLLUTION

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Cropping system refers to the crops, crop sequences and management techniques used on a particular agricultural field over a period of years. It aims at the sustainability of the production system aiming at maximum production along with preserving the natural resources and environment. In cropping systems, sometimes a number of crops are grown together or they are grown separately at short intervals in the same field.

Advantages of cropping system in mitigating soil pollution

- Improves soil productivity through soil and water conservation
- Efficient use of available soil resources
- Integrated nutrient management through nutrient recycling thereby reducing soil and environment pollution
- Integrated plant protection through crop rotation, timely planting of crops and ecological engineering
- Minimizes the spread of disease and pest
- Weed management through cover cropping or allelopathy to control weeds thus avoiding the use of herbicides

Systems of cropping

Cropping systems are classified based on the type of crops and cropping pattern

- Monocropping : In this system only a single crop is grown continuously over a period of time. This system reduces the soil fertility and damage the soil structure
- Mixed cropping: Growing two or more crops simultaneously with no distinct row arrangement. Eg; Sorghum, pearl millet and cowpea and broadcasted in rainfed conditions
- Row cropping: Growing two or more crops simultaneously where one or more crops are planted in rows. Eg; maize+greengram, groundnut+redgram

- Strip cropping: Growing two or more crops simultaneously in different strips wide enough to permit independent cultivation but narrow enough for the crops to interact ergonomically. Eg; groundnut+redgram (6:4) strip
- Relay cropping: Growing two or more crops simultaneously during part of the life cycle of each. A second crop is planted after the first crop has reached its reproductive stage but before it is ready for harvest
- Multiple cropping : Growing two or more crops on the same field in a year. It is type of polyculture eg: Tomatoes+onions+marigold
- Crop rotation
- Sequential cropping : growing two or more crops in sequence on the same field in a farming year. Eg : Marigold-Gomphrena cropping system
- Parallel Cropping: Under this cropping two crops are selected which have different growth habits and have a zero competition between each other and both of them express their full yield potential.

  E.g. Bindi or amaranthus with banana
- Companion Cropping: In companion cropping the yield of one crop is not affected by other, In other words, the yield of both the crops is equal to their pure crops.

  E.g.1) Mustard, wheat, potato, etc. with sugarcane

2) Marigold-vegetables in coconut garden

- Multistoried Cropping: Growing plants of different height in the same field at the same time is termed as multistoried cropping. It is mostly practiced in orchards and plantation crops for maximum use of solar energy even under high planting density.

  E.g. 1)Coconut + Pineapple + Turmeric/Ginger.

2) Sugarcane + Mustard + Potato

- High density multi species cropping system: The practice of growing different crops of varying heights, rooting pattern and duration in a same piece of land. The objective of this system of cropping is to utilize the vertical space more effectively. In this system, the tallest components have foliage tolerant of strong light and high evaporative demand and the shorter component(s) with foliage requiring shade and or relatively high humidity.

  E.g. Coconut + black pepper + cocoa + pineapple.

Role of cropping system in maintaining soil quality

Soil quality is the ability of the soil to sustain productivity without affecting the environment. It is the efficiency of the soil to support crop growth without resulting in degradation. Decline in soil quality can occur due to soil erosion, loss in organic matter, soil compaction or desertification. The quality of soil can be improved by adopting restorative measures such as organic addition, conservation tillage, crop rotation etc. Cropping system is an effective strategy for improving the soil quality and mitigating its pollution. Soil and water conservation, soil fertility and soil problem management is possible through natural biological cycles in a cropping system. Component crops, frequency of a crop and crop sequence affects the productivity of the system. It helps in the optimum utilization of available natural resources and accelerates the soil chemical, physical and biological activities.

Soil chemical quality

It refers to the chemical properties and processes important to plant growth and environment. Maintenance of sufficient plant nutrient balance is critical to soil chemical quality. Adoption of high yielding varieties and intensive cropping enhanced the need of adequate fertilization. Inclusion of leguminous crops in the system promotes favourable soil chemical qualities in comparison to monoculture. The development of sustainable cropping system enhances the soil quality, maximizes the return of investment and minimizes the adverse effects associated with soil loss. Leguminous green crops have great potential as an alternative source for inorganic nitrogen. It contributes to the N content of soil through biological nitrogen fixation when grown as a sole crop in rotation or as an intercrop. Intercropping practices alleviate soil related constraints, enhance organic content and improve the physical quality. Continuous cropping with optimum level of fertilization can maintain or enhance the P status as well. In short, the chemical quality of soil can be maintained by adopting proper cropping systems.

Soil physical quality

The physical quality of the soil plays an important role in determining the movement of air, water, ions and root penetration. Decline in the quality of physical properties leads to crusting, compacting, drought, anaerobiosis, erosion and desertification of the soil. Soil physical properties become favourable in a mulch-based cropping system. Mulching reduces the erosion processes and maintains the colloid contents of the soil surface. Intensive monoculture adversely affects the soil structure which in turn affects hydrologic balance and water quality. Inclusion of suitable plant species in a cropping system and adopting appropriate agronomic methods are essential to enhance soil

aggregation and other parameters of soil physical quality.

Cropping system refers to the system of cultivation in which different crops are managed on a particular piece of land for over a period of years. If only one crop is involved in the cropping system, it is called monocropping. Coconut, the major plantation crop of coastal ecosystem, is seldom remunerative as a monocrop. Inclusion of other components in the system helps in improving the farmer's income. The compatibility of the component crops is important for the success of the cropping system. In a cropping system, each crop should be provided with the recommended dose of nutrients. With the advance of technology chemical utilization increased in the field of agriculture with usage of chemical fertilizers and pesticides. The ecological balance gets damaged through the widespread contamination of the soil. Plants in the system Cropping system approach helps in mitigating the soil pollution through intensive agriculture. Crop residue recycling can be practiced for the effective utilization of soil nutrients there by reducing soil pollution. This can reduce the usage of chemical fertilizers and subsequent soil acidity. Acidic deposition in the soil slows down the ability of soil to buffer changes in soil pH. The reduced pH results in uncongenial conditions for effective absorption of plant nutrients from the soil. Fertilizer based soil pollution can also result in the leachage of nutrients into lakes or ponds causing algal bloom, stunted growth and mineral deficiencies. Growing crops with allelopathic effect helps in reducing the use of herbicides. Allelopathy is the effect of one plant species in inhibiting the growth of another plant species through release of chemical substances. Sequential cropping system- the practice of planting a second crop immediately following the harvest of first crop, thus harvesting two crops from the same field in one year- can be adopted in areas with specific soil problems.

Soil biological quality

Soil biota affects the nutrient transformations and alters soil fertility and structure. Cropping system approach helps in nurturing the soil invertebrates which are an important biological factor for mitigating soil pollution. It also influences the soil organic carbon content. Agricultural intensification results to increase in soil organic carbon content by supplying higher organic carbon through crop roots and residues. Type of crops in the cropping system influences the microbial growth and decomposition process in soil. A cropping system that conserves soil organic carbon content may provide agriculture from a carbon source to carbon sink. In low input agricultural systems, this plays an important role in retaining mineral nutrients in the soil and makes it adequately available to plants. Growing cover crops, crop rotations with legumes, addition of organic matter or mulching, intercropping and reduced tillage in cropping systems helps

in preventing the loss of soil organic matter. The incorporation of plant residues and other plant wastes enhances the soil organic content of the system. Monocropping systems with low rate of fertilizer application can decrease the soil organic content where intensive cropping system with addition of fertlisers may enhance the organic content due to greater amount of residue returned to the soil. Such management systems help in increases sequestration of carbon in soil, and reduced fossil fuel consumption.

In general, using diverse crops and cropping systems with contrasting effects on soil physical ,chemical and biological quality. Designing suitable farming systems helps in optimizing the use of locally available resources and reducing the use of chemical inputs mitigating soil health.

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