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Non-monetary and low-cost technology role in Sustainable agriculture

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Abstract

In recent time increasing population, land degradation and other major problems in agriculture field has led to reduction in overall production. One of the major goals of sustainable agriculture is continuous stability of production for longer period and this can only be attained by management of soil and water resources but it should be kept in mind that cost of cultivation should be within range of marginal farmers. Low cost and non-monetary technologies had played major role in attaining this statement of sustainable agriculture. Various low-cost technologies such as crop rotation, green manuring and mulching not only control cost of cultivation but also helped in conserving soil and moisture. Non-monetary inputs include soil management by growing leguminous crops, weed management and increment in crop diversity.

Keywords: Sustainable agriculture, mulching, soil, weed management

Introduction

An agriculture skilled to repeatedly provide food and other properties to growing world population is of vital status for human life and therefore any human activities. However, now and in the future excessive number of problems that intimidate this capability of agriculture to satisfy human need, including climate change, a high rate of biodiversity loss, soil erosion through land degradation, compaction and pollution, reduction and pollution of water properties, expending production costs, an ever-diminishing number of farms, poverty and reduction of rural population (Beus, 1990; Rivera-Ferre, 2013) [8, 30]. Agriculture has been practiced over the last periods it also is a major cause to phase these problems of all these issues (Goodland, 1997; Koohafkan, 2012) [16, 19]. Sustainable agriculture is an animal production and plant practices having an integrated system of site specific application that will, over the long term: (i) needs for human food and fiber, (ii) develop environmental quality, (iii) make resourceful use of on farm resources, integrate appropriate natural biological rotations and controls and the most useful non renewable resources (iv) the economic viability of farm operation resist (v) improve the whole quality of farmers and society life. India has a 1.27 billion population in which 70% Of its population is engaged in agriculture and allied activities. By the total geographical area of the country 60.5 % in which 43% is arable land (U.S. Congress, 1990). Another time, from the total arable land, rainfed agriculture accounts for approximately 105 m ha of closely 70%, which contribute around 42% of country total food grain output and oilseeds and pulses over 90 percent. The total agriculture production of rainfed area is of the order 46% of the national agricultural production. If the available irrigation potential is developing to its full extent, nearly 50% pf cultivated land still remain under rainfed farming for the expected future (Anonymous, 2012) [5].

Organic Farming

The study USDA team on the definition of organic farming “It is an arrangement which avoids and chiefly excludes the use of artificial inputs such as fertilizers, pesticides and hormones etc. and to maximum extent possible depends upon crop rotation, animal manures, mineral grade, rock additives, crop residue, off farm organic waste and biological system of mobilization and

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plant protection". FAO suggested another definition that exceptional production is in organic agriculture that promotes and enhances agroecosystem health, including biological cycle biodiversity and this is accomplished by using on farm agronomic biological and mechanical method in elimination of all farm inputs. Since January 1994 "Sevagram Declaration" for promotion of organic agriculture in India, folds and enterprises has grown due to organic farming at Government and Non-Government level has given it a firm direction. While National Programme on Organic Production (NPOP) defined its regulatory framework, the National Project on Organic Farming (NPOF) has defined the promotion strategy and provided required support for area expansion under certified organic farming. Growing certified area before the implementation of NPOP during 2001 and introduction of authorization process for certification agencies, assessment of organically certificated area was no institutional area (APEDA, 2008) ^[16]. Approximately 42,000 ha of cultivated land were certified organic initially estimate during 2003-2004. By 2012 India had brought more than 11.2 million ha of land under certification (APEDA, 2014) ^[6].

Approximately 1.4 million ha out of while cultivable land, area remaining forest land for wild collection 8 million ha. Growing awareness, demand for increasing market, the phenomenal growth in total certified area during the last five years increasing predisposition of farmer to go organic and growing institutional support has resulted. The term of total area under certified organic wild harvest collection India and also achieve the status of single largest country. The status of largest of organic cotton grower in the world a year ago with the production of more than 77,000 m t of organic cotton lint India had achieved. With more than 50% of total world's organic cotton. A vital role plays agriculture in a developing country like India. The growing Indian population apart from fulfilling the food requirement, it also plays role in improving economy of the country. The Green Revolution technology approval between 1960 to 2000 has improved wide variety of agriculture crop yield per ha which increased 12-13% food supply in developing country. In this regard helped a lot of inputs like fertilizers and pesticides. But in spite of this fact, food insecurity and poverty still prevail obviously in our country. The negative impact on environment and increasing the health problem and many more have caused by uses of chemical biopesticides and fertilizers. India has modern agriculture practices has pushed it walls but traditionally practices organic agriculture. The positive impact on plant growth, health and treats organic waste in an environment friendly due to vermicomposting (Lazcano and Domínguez, 2011) ^[21].

Components of Organic Farming

Important mechanisms of organic farming are biological nitrogen fixation, biopesticides, biogas slurry, crop rotation and crop residues etc. major component in organic farming which is very effective in enhancing soil fertility and growth of crops in sustainable way due to vermicomposting. The several components of organic agriculture are: -

- 1. Crop Rotation:** There should be rotation of crops on the same land over a period of two years or more for maintaining soil fertility, control of weed, diseases and insects. For example, improves soil fertility for use of legumes crop in rotation.
- 2. Crop Residue:** India has great potential of using residues of crops and straw of cereals and pulses in recycling of nutrients during organic farming. Crop residues when

inoculated with fungal species improve physico-chemical properties of soil and crop yield.

- 3. Organic Manure:** By biological sources we can obtained organic manure such as plants, animals and human residues etc. Organic manure helps indirectly promoting soil productivity by increasing availability of major and minor plant nutrient through soil microorganisms and held in increasing crop growth directly by improving the uptake of humic substances.

Bulky Organic Manure: Bulky organic manure includes FYM, Compost and Green Manure having fewer nutrients in assessment to concentrated organic manure.

Farm Yard Manure (FYM): FYM refers to the well decomposed combination dung, urine, farm litter and fodder materials. FYM also encourages soil microbial activity which promotes the soil trace mineral supply and improve plant nutrients.

Compost: Large quantities of waste material (weeds, bhusa, sewage sludge, animal waste, human, sugarcane trash, vegetable refuse, stubble and industrial refuse) can be converted into compost manure by anerobic decomposition. Compost improved water retention.

Green manure: Green manure is practicing the soil undecomposed green plant tissues for improving physical structure and fertility of the soil. Green manuring increases the percentages of organic matter in the soil. The legumes crop supplies organic matter and additional nitrogen. It commonly used to be likes Sunhemp, Cowpea, Senji, Berseem, Dhaincha etc.

Concentrated Organic Manure: Concentrated Organic Manure are organic in nature made from raw material of animals of plant origin and contain higher %age of vital plant nutrient such as nitrogen, phosphorus and potash, as compared to bulky organic manures. Concentrated organic manures such as oilcakes, fish meal, hoof meal, blood meal and meat meal (Manchala Santhoshkumar, *et al.*, 2017) ^[24].

Vermicompost: Vermicompost is compost and organic manure produced by the use of earthworms that generally live I soil, eat organic matter and excrete it in digested form. These are rich in macro and micronutrient, vitamins, growth hormones and immobilized microflora important for plant growth (Nagavallema, *et al.*, 2004) ^[27].

Mulching

Organic mulching and Crop residue: The technique where the soil surface is covered by the organic residue of the previous crop (Erenstein, 2002) ^[12], like palm fronds, straw, maize stalk and stubble of leafy organic material that may also be brought from to a different place (Bot and Benites, 2005) ^[8]. Organic mulches contain woody material likes sawdust and bark (Merfield, 2002) ^[25].

Paper mulches used for material: Choosing most suitable qualities and composition of raw and manufactured materials for paper mulches may be a way of improving their functionality and suitability for agricultural purposes. Paper is characteristically permeable and hygroscopic. Its properties and presence can be influenced in many ways by different treatments such as creping and calendaring, and by different

ingredients likes dry and wet strengthening agents, colorants and water repellents. Wood derived fibers are biodegradable, allowing the farmer plough the used paper into the soil. Compared to polyethylene (PE) films and biodegradable films, paper is less elastic unless it is treated in a special way, for example by creping. Unlike polymer films, paper is hygroscopic, expanding and shrinking with change in its moisture content (Hakkila, 1998; Daene, 2005) ^[17, 11].

Improve soil health and Availability of nutrients by mulching: Mulching is improving the physical properties of soil and soil health to complete optimal productivity for individually soil and climatic conditions. Soil must be maintained in such a physical condition so as to allow suitable crop growth, this predicts that for increasing crop production. The soil physical environment unless is maintained at its optimum level, the genetic yield potential of a crop cannot be realized even when all the other requirements are fulfilled. No doubt, if these soils are managed properly for good physical health and increasing yield potential of different crops significantly. The decomposition of organic residue under plastic mulch adds organic acids to the soil resulting in low soil pH, which may be increases availability of micronutrients such as Cu, Mn, Fe and Zn etc. This was also apparent from the increased Fe and Zn content in soil under plastic mulch (Tisdale *et al.*, 1990) ^[33].

Temperature of soil: Temperature of soil under plastic film is usually high and it is also based on plastic mulches colour. The black plastic film mulch plots had significantly lower soil temperature than the clear plastic film mulch plots. Because of the solar energy absorbed by black plastic film mulch is lost to the atmosphere through radiation and forced convection (Schales and Sheldrake, 1963) ^[31]. The unmulched plots had the lowest soil temperature (about 1- 3.80C) at different times since planting compared to plastic film mulch plots (Anikwe *et al.*, 2007) ^[4]. Soil surface temperature increase by influence the heat balance and thus increased the soil temperature by different mulching techniques plastic film mulching and it also positively influenced the crop emergence (Aniekwe *et al.*, 2004) ^[3].

Soil water content: The black polyethylene mulch maintained high soil water contents compared to the no mulching and the bare soil treatments (Li *et al.*, (2001) ^[23]. The main methods of increasing the water use efficiency include reducing soil water evaporation and exploiting deep soil water, so as to support shoot biomass accumulation and optimize the dry matter allocation by selectively increasing the reproduction (Li *et al.*, 1997) ^[22]. The plastic film mulch was promoted root growth and that more roots were distributed in medium and deep soil, so that the plant can uptake water from the deep soil and increasing the grain yield (Kwabiah, 2004) ^[20].

Zero Tillage

The IGP (Indo-Gangetic Plains) are home to more than 20 percent of the global population and sustainability enhancing the productivity of the prevailing rice-wheat cropping system will be of extreme importance for ensuring future food security (Chauhan *et al.*, 2012) ^[9]. The potential to increase yield is particularly large in the Eastern IGP, such as the state of Bihar. On the one hand, Bihar has the lowest cereal yield in the IGP: over the period 2012-2013 and 2013 -2014 wheat yield averaged 2.34 t/ha, as opposed to 4.79 t/ha in the northwestern state of Punjab (MoA 2015) ^[26].

Non-monetary

Non-monetary inputs are defined as those cultural operations which help to achieve high yield at to no extra cost and whose cost does not change with the level of output. The different non-monetary technologies are.

- 1. Soil management:** Soil is the foundation of global life. Soil management practices defined are needed to protect and conserve the soil resources (Gineys *et al.*, 2015) ^[14]. The symbiotic microorganisms such as mycorrhiza form with plant roots and take nutrients from soil which roots are not able to contact to. Growing different types of crops in a specific area year after year is known as crop rotation. If same crop is grown every year in a particular area, it will remove the soil of one specific nutrient but if we will grow different crops every year, it will help in maintain the nutrient balance of soil (Teklit, 2016; Kumar and Singh, 2015) ^[32, 19]. Hence, crop rotation helps in maintaining soil quality. The fix atmospheric nitrogen is used leguminous crops to increase soil fertility with the help of rhizobium bacteria. Adding of manure also develops soil quality as it contains nutrients such as nitrogen (Raja and Masresha 2015; Abdel-Gawad *et al.*, 2015) ^[28, 1].
- 2. Weed management:** Weeds are the unwanted plants that struggle with the crop plants. Organic farming encourages weed management in a number of ways (Gbeddy *et al.*, 2015) ^[13]. Weed growth is decreased by using plastic mulch. Cutting and mowing removes the top growth of weeds. Organic crop rotation also promotes weed suppression (Al-Zaidi *et al.*, 2011; Cizmas *et al.*, 2015) ^[2, 10].
- 3. Crop diversity:** In ancient times, the practices of growing one type of crop was followed. But now a day's polyculture is coming in trend that is the practice of growing multiple crops within the same place. It improves the soil quality by supporting beneficial soil microorganisms (Sarkar and Kshirsagar, 2014) ^[30].

Conclusion

In modern time of agriculture the cost of inputs is very high and marginal farmer cannot use these inputs at regular basis. To attain one of the goals of sustainable agriculture e.i. low input and high output low cost technology and nonmonetary techniques can be highly efficient.

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