International Journal of Environment and Climate Change

Volume 13, Issue 8, Page 318-323, 2023; Article no.IJECC.99300
ISSN: 2581-8627
(Past name: British Journal of Environment & Climate Change, Past ISSN: 2231–4784)

A Review of Soil Preparation for Agriculture

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJECC/2023/v13i81956

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/99300

Mini-review Article

Received: 03/03/2023
Accepted: 05/05/2023
Published: 24/05/2023

ABSTRACT

The soil preparation is a plan according to which crops are grown on individual field preparations of a farm during a given period of time with object of obtaining minimizes cost of preparation and higher from each crop without imparting the soil fertility. A soil preparation which can utilize input and other technology available on cultivator, ploughing, levelling etc. should be adopted by the farmer. Thus, soil levelling, land scraping and banding are related to the most profitable use of resources, land, labour, capital and management by the intervention of Artificial Intelligence. In this review article, here trying to cover all challenges faced by farmers by using conventional practices of farming and how Artificial Intelligence is playing a revolutionary role in agriculture by replacing conventional practices of land preparations.

Keywords: Soil preparation; conventional practices; new technology.

1. INTRODUCTION

"Soil, land and water are essential resources for the sustained quality of human life and the foundation of agricultural development. India holds the record for second-largest agricultural land in the world, with around 60% rural Indian households making their living from agriculture.

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No soil is ideal hence it necessitates the preparation of the soil before and after the cultivation. Soil fertility may be lost due to continuous farming; for the replenishment of soil contents, it is prepared prior to sowing of seeds. In agriculture, ploughing, levelling, and manuring are the three steps of soil preparation. Dual use of land J. A. U. model Agrivoltaic system is highly recommended for farmer's community for harnessing energy as well as crop production from the same agricultural land. This system makes farmer's energy independent for agricultural and other operations" [1].

2. DIFFERENT METHOD FOR SOIL PREPARATION IN AGRICULTURE

2.1 Ploughing

Ploughing includes loosening and digging of soil. During ploughing, the soil is loosened which improves the aeration in the soil thus air is available for breathing and roots are easily penetrated between soil. The loosened soil is important for the growth of microorganisms and earthworms. They further turn and loosen the soil and also add humus to it by decomposing the organic matter. Ploughing also brings the nutrient rich soil to the top. Other purposes of ploughing are the integration of manure, uprooting of weeds, removal of infectious pathogens, insects etc. Ploughs of wood or iron are used for this purpose. Bullocks or tractors are used to pull this plough. Hoe is another tool used to uproot weeds and loose soil.

"Seedbed preparation to achieve desired aggregate size requires many tillage operations when performed on dry soil. A very common implement used for the initial operation is the mouldboard plough, subsequent passes may include disk, chisel ploughs, cultivators, rototillers and harrows. Therefore, ploughing should form flat soil surface to ensure favourable conditions for performance of subsequent operations. Mechanical reconsolidation by fragmenting and packing at spot ploughing on dry soils was studied in a soil bin, and on loam soil in the field" [2].

2.2 Levelling

"Precision land levelling must be treated as a precursor technology for improving crop yields, enhancing input-use efficiency and ensuring long-term sustainability of the resource base in intensively cultivated areas" [3]. Levelling helps in even distribution and soil is levelled after ploughing. A plank of wood or iron is used for this. Levelling also helps in water distribution without logging during irrigation.

"Laser leveling of a field is accomplished with a dual slope laser that automatically controls the blade of the land leveler to precisely grade the surface to eliminate all undulations tending to hold water. Laser transmitters create a reference plane over the work area by rotating the laser beam 360 degrees. The receiving system detects the beam and automatically guides the machine to maintain proper grade. The laser can be level or sloped in two directions. This is all accomplished automatically without the operator touching the hydraulic controls" Fig. 1. [3].

2.3 Manuring

After ploughing and levelling, manure is applied to further stages of farming. Manuring is done to replenish the soil with nutrients and thus helps in the proper growth of the crop. Soil preparation makes an agricultural field fertile and ready for farming. Manuring and removal of weeds at a regular interval and frequency help farmers yield a better product.

"Agriculture is one of the most important sectors in the global econ-omy. It is a basic source of food and forage with a significant impact on the environment. According to many reports, agriculture is the largest user of water resources (in most regions of the world, over 70% of freshwater is used for agriculture) and an anthropogenic source of greenhouse gases (GHG)" [4-7]. "Moreover, agro- chemicals used in agriculture, mainly in the form of chemical fertilizers and pesticides, increase the pressure on the natural environment. Excessive use of chemicals on crops may cause serious ecological problems (eutrophication, etc.), degrade soil quality (e.g. by raising the acidity level) and generate high production costs" [7].

"Proper use of land depends on the suitability or capability of land for specific purposes. Geographic Information Systems (GIS) techniques have become very useful techniques in this respect and it can offer various opportunities to manage the land in their care more efficiently. In order to consider sustainable agricultural land use in Ethiopia, GIS based suitability map of the whole country for each target crops were developed and it is revealed that this GIS based approach is the best in identifying agricultural land to be considered for

target crop production. Through the analysis, the suitable areas for each target crops were identified. The results can be used for broad scale land use planning, as a basis for assessing priorities and selecting areas for detailed survey and evaluation. Depending on the available additional spatial data, the accuracy and reliability of the result could be high" (kidanu et al, 2009). Farmer mostly used traditional cultivation practices for production of groundnut, which are labour and time intensive [8].

3. CULTIVATED LAND USE LAYOUT ADJUSTMENT MODEL

"Cultivated Land Use Layout Adjustment includes crop layout optimization and spatial relationship coordination. The crop planting suitability is the main basis for this study to optimize the crop layout. To facilitate the large-scale management of cultivated land, the cultivated land concentration is also an important factor to be considered. The agent-based model for optimal land allocation (AgentLA) can well take into account the land suitability and space compactness [9], which can be used for crop layout optimization". "Based on the optimized crop layout, the planting characteristics, farming system, food needs, and planning orientation are take into consideration to clarify the priority order of crops occupying the same space. ArcGIS spatial analysis tools are used to achieve spatial relationship coordination between crops, and then the plan for cultivated land use layout adjustment is determined" Fig. 2 [10]. "J. A. U. model Agrivoltaic system is high-ly recommended for farmer's community for harnessing energy as well as crop production from the same agricultural land. This sys-tem make farmer's energy independent for agricultural and other operations. The crop production is 15% higher in Agrivoltaic sys-tem as compared to open field condition. Additional five to ten fold income can be generated in the form of electricity revenue for the farmer" [11]. "Reduce crop damage, machinery like the finger weeder and torsion weeder need precise steering. Al though they operate well, brush weeders need a back operator or operators to maneuver the brush into and out of the crop row. The additional innovative vision-based weeders require slow forward speeds with a larger plant spacing to ensuregood weed control. Automation is a logical progression for this idea, as it has the ability to significantly increase the effectiveness of weed management and reduce the likelihood of plant harm" [12]. " These various engineering properties helps significantly for designing of equipment, enhance plant production, developing new technologies in which agricultural residues are used as raw material" [13-16]. "The cotton stalks bio-chars can be effectively used as a raw material for the preparation of activated carbon for the soil amendment" [11].

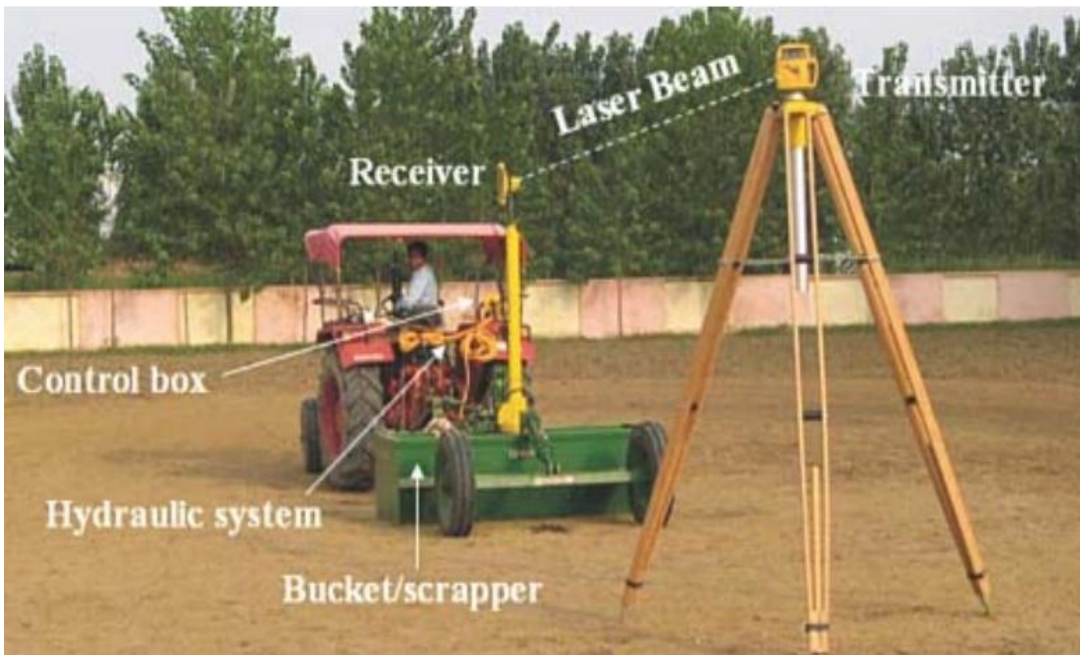

Fig. 1. Different method for soil preparation in agriculture

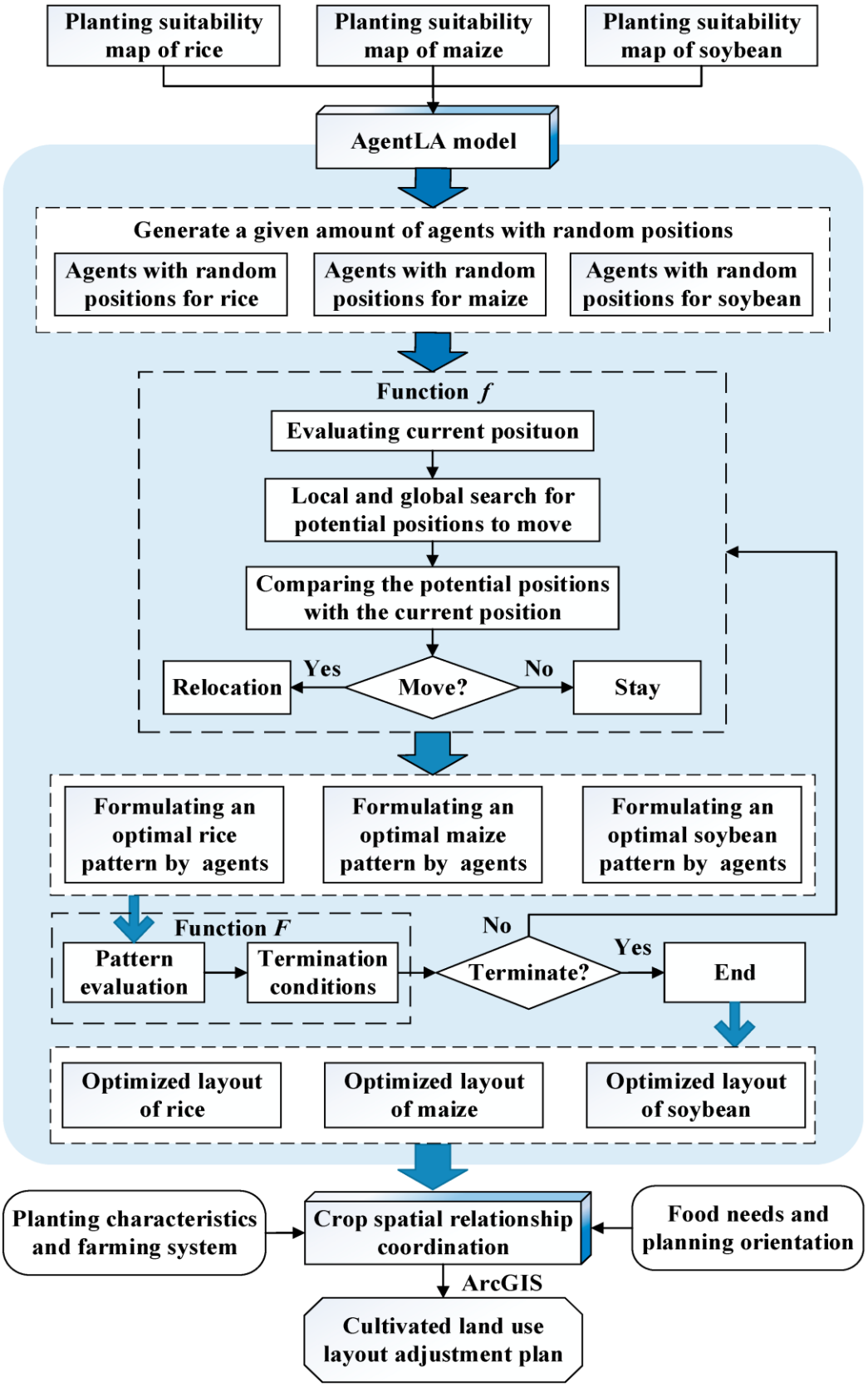

Fig. 2. Procedure of cultivated land use layout adjustment

4. CONCLUSIONS

In India, a new resource-conservation technology endeavour involves laser levelling of agricultural land. The outcomes are really positive. It has the ability to alter how food is produced by improving the resource-use efficiency of crucial inputs without having any negative consequences on the ecosystem's productive resilience. Popularisation of this technology among farmers in a participatory mode on a comprehensive scale, therefore, needs appropriately focused attention on priority basis along with requisite support from researchers and planners. The change in our vision of future agriculture in relation to food and nutritional security, environmental safety and globalisation of markets demands improving resource-use efficiency considerably to reach the desired growth levels in food production and agricultural productivity. Laser levelling is evidently one of the ways by which we can address these issues to a great extent.

HIGHLIGHTS

- User-friendly laser land leveling system
- Cropping system with precision land leveling in various agro-ecological regions
- Long-term effect of precision land leveling on ground water recharge and its quality
- Environmental impact of laser land leveling on sub-eco-regional/regional basis
- Crop diversification through laser land leveling
- Long-term economic evaluation

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/99300