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Conservation agricultural practices for Vidarbha region

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ABSTRACT

Conservation Agriculture (CA) in Vidarbha plays a crucial role in addressing agrarian distress, especially drought-related challenges, through integrated water and soil management practices. Techniques such as rainwater harvesting, farm ponds, and check dams enhance water availability, while residue retention and minimum tillage improve soil structure and conserve moisture for key crops like cotton, soybean, and sorghum. This approach aims to boost productivity, enhance climate resilience, and alleviate rural poverty by reducing runoff and encouraging efficient resource use. However, its adoption is limited by financial constraints, technical challenges, and lack of awareness among farmers. Therefore, supportive policies, improved access to resources, and capacity-building initiatives are essential to promote wider adoption and ensure long-term agricultural sustainability.

KEY WORDS

Conservation agriculture; Vidarbha region; Soil health; Carbon sink; Climate Resilience

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Introduction

Conservation agriculture is a set of farming practices design to protect and improve the soil. At its core, it emphasizes minimal soil disturbance, permanent soil cover and diverse crop rotation- a trio often called the “three pillars” of CA. Soil does much more than just anchor the crops. It provides nutrients, stores water, support biodiversity and act as carbon sink. But with widespread use of intensive tillage, monocropping and chemical inputs, soil health around the world is declining, erosion compaction, loss of organic matter and declining fertility are now common issues. This is where Conservation Agriculture (CA) comes in [1].

Discussion

Current agriculture scenario in Vidarbha

- Vidarbha region in Maharashtra comprises 3 regions i.e. Western, central Vidarbha and eastern region that includes 11 districts viz. Yavatmal, Akola, Amravati, Wardha, Buldhana, Washim, Nagpur, Chandrapur, Bhandara, Gadchiroli and Gondia. Around 65% rural population of this region is dependent on agriculture and allied activities. However, agriculture in this region is comparatively less productive than the State and National averages (Table 1).
- Cotton, soybean and pigeon pea are the most important crops of western Vidarbha region. Eight of eleven districts of Vidarbha are primarily cotton growing. Cotton farming is the backbone of the farmers of Yavatmal, Akola, Amravati, Wardha, Buldhana and Washim districts of western Vidarbha [2].
- However, with about 400-600 mm of annual rainfall and very limited irrigation facilities at disposal, cotton farmers are often exposed to higher risks that many a times result in loss of income. Besides low rainfall condition and scarcity of irrigation, lack of micronutrients in soil, frequent pest attacks and other physical characteristics of this region result in lower productivity of cotton farming which is about 15% lower than State average and 46% than National average.

Table 1. Kharif and Rabbi Crops in Maharashtra

location	Kharif	Rabi
Kokan	5.12	0.32
Khandesh	20.21	3.22
West Maharashtra	20.53	25.03
Marathwada	40.23	20.56
Vidarbha	48.89	7.15
Total area	134.98	56.28 ha

(Source: Census of India/ Maharashtra/ agriculture)

Western and central vidarbha region

- The soils of the region are shallow (Entisols) to deep black (Vertisols), neutral to alkaline in reaction, low in available nitrogen and phosphorus and high to very high in available potassium.
- In few pockets of western Vidarbha, Alfisols are also observed. The salt affected soils are observed in Purna valley covering the part of Amravati, Akola and Buldana districts.
- Most of the soils are calcareous, highly base saturated, fairly well drained, well supplied with potash, moderate to low in phosphate, but low in organic matter content and slightly alkaline.
- Soils of the Central Vidarbha are derived from basalt rock, black in colour and having varying depth depending upon their physiography. Inceptisols and Entisols are developed from basalt and they are very shallow [3].
- AICRPDA Dr. PDKV, Akola has recommended conservation agriculture practices for central and western vidarbha region in terms of cropping system, tillage, rainwater management and residue cover.

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Opening of furrow

- Land treatments for improving moisture regime in pulse-based cropping system by opening of furrows (after two rows) at seeding or at 30 DAS is essential for improving moisture status of the soil.
- For obtaining higher cotton yield of early cotton grown in shallow soils were studied at Akola and it is recommended to open furrow after two rows at 30 DAS with a hoe for getting higher seed cotton yield in shallow soils [4].

Integrated nutrient management

- For obtaining higher cotton yield, monetary returns and improvement in soil fertility status, integrated application of 50% RDF (25:12.5:12.5 kg ha-1 N:P: K) + FYM @ 5t ha-1+ PSB + Azotobactar and opening of furrow in each row at 30-40 DAS is recommended under dryland condition.

Intercropping

- Intercropping of sorghum and pigeonpea in cotton was studied at Dryland Research Unit, Akola and recommended that, for getting higher monetary returns and to meet the requirement of food, fodder and fuel of the famers. Cotton + sorghum + pigeonpea + sorghum (6:1:2:1) four tier intercropping system is recommended under rainfed situation.

Green leaf manuring

- Green leaf manuring in sorghum, sunflower and pigeonpea (Alley cropping) was carried out at Akola and it was observed that Leucaena loppings @ 3.5 t ha-1 each year, if added for two years, curtail the fertilizer requirement and improve the soil health [5,6].
- Gliricidia green leaf manuring indicated that the application of 100% NP + 10 Kg K (inorganic) + 20 kg K through Gliricidia in vertisols under semi-arid agro ecosystem.

Broad Bed and Furrows (BBF)

- Planting of cotton crop either on Ridges and Furrows or Broad Bed and Furrows (BBF) conserves 30 to 40 % of the 1 to 2 TMC (Thousand Million Cubic Feet) run off available on one hectare area depending upon the amount of rainfall, intensity, slope of soil etc.
- BBF also protects crop under both excess and deficit soil moisture situation by maintaining optimum level of available soil moisture in the root zone. VIIDP will attempt to bring more cotton crop area under BBF. Broad bed and furrow system involves preparation of broad bed of 90-120 cm, furrow of 45 cm and sowing of crop at row spacing of 30 cm [7].
- In medium rainfall regions, the broad bed and furrow (BBF) system significantly increased the crop yields, particularly the soyabean yields in Vertisol up to 83% over the farmer's practice. During high rainfall events BBF drains the runoff through furrows, while also acts storage which moisture availability during scarcity period (Figure 1).

Figure 1. Broad Bed and Furrows.

Watering through earthen pots for multipurpose and dryland tree species

- In the alternate land use systems on one hand, it is necessary to develop perennial plantation on non-arable lands. However, on other hand it is also true that due to the scanty and vagarious monsoon the survival of plantation under rainfed condition is difficult [8]. MPTS like Neem, Ber and Anjan tree given favourable response in terms of survival and growth for the watering through earthen pots is superior to other systems of watering (Figure 2).
- Similarly, the dryland fruit trees like Custard apple (Annona squamosa), Aonla (Emblica officinalis) and Karvand (Carrica carrandus) given the favourable and at par response in terms of survival and growth for watering through earthen pots and drip irrigations.

Figure 2. Watering through earthen pots.

Management of saline tract of Purna river basin

- The soils in saline tract of Purna river valley are saline sodic and groundwater is alkaline.

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- The soil management in the saline tract of Purna river valley is difficult due to the severe erosion rate, swelling, cracking and seizing characteristics. During monsoon with the first intensive storm along with runoff there will be severe soil erosion.
- To overcome these problems adoption of in situ soil and water conservation practices like cultivation across the slope, contour cultivation and farm pond to harvest and recycle the runoff is beneficial. The findings generated will be of applicable value for improving the life span of the farm ponds [9].
- In the saline tract of Purna river valley it is recommended to adopt across the slope or contour tillage in the catchment and to provide Brushwood inlet spillway to the farm ponds.

Deep cultivation up to 30 cm background

- Deep cultivation across the slope up to 30 cm depth retained higher soil moisture during dry spell, enhanced rainwater uses efficiency and increased yield of sole cotton, soybean and intercrop over shallow cultivation up to 20 cm depth.
- The results generated will be of applicable value in vertisol and in saline sodic soils of Purna river valley. In medium deep soil, cultivation up to 30 cm depth is recommended for maximum in-situ water conservation.

Eastern Vidarbha region

- Alternative to continuous flooding of rice have been the research focus over the past few years because of climate change.
- Anaerobic decomposition of organic material in flooded rice fields produces methane (CH_4), which escapes to the atmosphere primarily by diffusive transport through the rice plants during the growing season.
- Upland rice fields, which are not flooded, do not produce significant quantities of CH_4, account for approximately 10 per cent of the global rice production and about 15 per cent of the global rice area under cultivation.
- Modified crop establishment practices like System of Rice Intensifications (SRI), direct seeding puddled and unpuddled soil (aerobic rice), minimum/zero tillage conservation agriculture have been seen as possible alternatives to discount enormously on water input in rice cultivation [10].

Direct seeded rice

Direct seeding of rice (DSR) is considered as one of the potential alternatives to transplanted rice. It may solve the problem of emerging shortages and high costs of water and labour. There is potential of 20-30% saving of irrigation water with direct seeding compared to transplanted rice.

Grassed waterways

- A grassed waterway is a vegetated channel that carries runoff at a nonerosive velocity to a stable outlet. Grassed waterways can be enhanced by including filter strips to filter runoff and to trap sediment outside of the waterway.
- Grassed waterways are a good solution to the erosion caused by concentrated water flows when the watershed area generating the runoff water is relatively large Grassed waterways are broad, shallow and typically saucer-shaped channels designed to move surface water across farmland without causing soil erosion.
- The vegetative cover in the waterway slows the water flow and protects the channel surface from the eroding forces of runoff water. Left alone, runoff and snowmelt water will drain toward a field's natural draws or drainage ways. Itis in these areas that grassed waterways are often established [11].

Benefits of conservation agriculture in Vidarbha region

Moisture conservation - Moisture conservation in dryland agriculture uses techniques to capture, store, and retain water in the soil, reducing evaporation and runoff. Key practices include using mulches to cover the soil surface, applying conservation tillage to leave crop residues, rainwater harvesting methods like pits and bunds, and cultivating drought-resistant crops. Agronomic practices like crop rotation, intercropping, and agroforestry also improve soil structure and water retention.

Improved soil fertility - Improved soil fertility due to CA results from practices like minimum soil disturbance, permanent soil cover, and diversified crop rotations that increase soil organic matter, improve soil structure for better water infiltration, and enhance nutrient availability, leading to greater soil health and higher crop yields. Specifically, Conservation Agriculture leads to increased soil organic carbon, better aggregation and structure, and higher levels of available nutrients like Nitrogen (N), Phosphorus (P), and Potassium (K).

Reduce soil erosion – Practices that minimize soil disturbance, such as no-till or minimum-tillage farming, and maintain continuous crop residue cover on the soil surface. Other CA principles include promoting cover crops and perennial plants to protect the soil, and practicing crop rotation to improve soil health and structure, which enhances infiltration and reduces runoff.

Resilience to climate variability - Resilience to climate variability in Vidarbha is improving in some areas, such as eastern Vidarbha and Nagpur, due to initiatives like climate-resilient farming, agroforestry, and the presence of research institutions like Krishi Vigyan Kendras (KVKs). However, western Vidarbha remains highly vulnerable due to erratic rainfall and reliance on cotton monoculture. Grassroots efforts, improved market access, and the adoption of drought-tolerant seeds are key to building resilience, but ensuring these benefit all farmers, including tribal communities and women, is a significant challenge.

Difficulties to adopt CA in Vidarbha region- Vidarbha region mainly have Black cotton soil and it required tillage practices. Some of the following reasons make difficulties to adopt conservation agriculture in black soil.

High clay content- Black cotton soil is rich in clay, which makes it prone to compaction and poor drainage. Conservation agriculture practices such as no-till or reduced tillage may face challenges in this soil type due to difficulty in breaking up compacted layers.

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Water logging and cracking- Vertisols can exhibit extreme behavior, with high water holding capacity leading to waterlogging during the rainy season and extensive cracking during dry periods. This poses challenges for managing water efficiently and adopting practices that require stable soil structure.

Seedbed preparation- Establishing a suitable seedbed for crops can be challenging in black cotton soil. The soil's tendency to form hard clods makes it difficult to create a favorable environment for germination and root development.

Equipment limitations- Heavy clay soils may pose challenges for farm machinery, especially during wet conditions. No-till or reduced-till equipment may face difficulties in black cotton soil, and farmers may require specialized implements. These are the main reasons that make difficulties to adopt CA in Black cotton soils of Vidarbha region.

Recommendations

1. Farmer training and demonstrations.
2. Government support and subsidies for CA implements.
3. Farmer producer organization (FPO) for collective adoption.
4. Policy integration with schemes (PKVY, RKVY, Watershed programs).

Conclusions

The use of chemical fertilizers, pesticides, and high-yielding variety (HYV) seeds has led to a temporary increase in crop production. However, in the long run, these practices often degrade soil health, reduce biodiversity, and cause environmental pollution, making them unsustainable. Continuous dependency on synthetic inputs can also diminish soil fertility and increase production costs over time. In contrast, organic farming, though initially requiring higher investment and effort, promotes long-term sustainability by improving soil structure, enhancing microbial activity, and reducing environmental harm. The use of natural resources, along with regular monitoring of soil quality, ensures ecological balance, economic viability, and sustainable agricultural productivity for future generations.

Disclosure Statement

No potential conflict of interest was reported by the author.

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