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Strip Cropping Suits for Small Farm Mechanization

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Abstract

Farmer's livelihood is linked with the monsoon in the rainfed province. The monotony of the cropping pattern with giant investment coupled with dry spells impedes the farmer's economic and mental stability. To overcome crop failure and losses, it's high time to adopt crop diversification rather than monocropping. Though the crop diversification with the traditional way may not be advantageous to the farmer,however strip cropping is an alternative old age practice that can be modified for its suitability to modern farm mechanization. Thus, it has an edge over other intercropping systems under Indian conditions. Strip cropping can address various issues by utilizing all-natural resources through spatial, temporal, and genetic diversity in one platform to reap a big harvest compared to the sole and inter-cropping systems.

1. Introduction

Farmer's livelihood is invariably linked with rain, particularly in drought-prone rainfed districts. Miniscule amount and unpredictable rainfall with consecutive dry spells during the crop growth were an immense challenge in rainfed areas. Monocropping to a large extent of the areas with high investment and frequent dry spells in the crop season leads to farmers under severe distress due to continuous crop failure (Hedge et al., 2005). Monocropping is no more a viable option for the farmers under the present dwindling climate scenario in rainfed areas. However, strip cropping is an alternative and best method in rainfed areas which was very common in European countries for the different crops and pastures across the slope. However, in the context of Indian agriculture, apart from soil and water erosion, the labor shortage is a major threat to farm production and operations. In that context, strip cropping which can be suitable for mechanized operations viz., sowing, inter cultivation, spraying, and harvesting has a lot of scope in future agriculture production systems.

2. Context and adaption of Strip cropping to Indian Scenario

In the 21st century, Indian agriculture is trekking towards the

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double-digit growth of agriculture and related sectors (GOI, 2020). Still, Indian agriculture productivity is oscillating like a pendulum on one side with high potential irrigated areas, with small landholdings across the length and breadth of country. Though the yields were higher and reached to plateau despite many efforts and technologies, and on the other end large land holdings coupled with minimal productivity in rainfed areas. In this scenario *viz.,* higher cost of cultivation particularly excess labor requirement is the major hitch which may hit the productivity in rainfed agriculture which is big bunch contribution in Indian agri-food basket. Though the existing cropping systems are working fine, they still need to be readdressed in a resilient, versatile, and flexible manner which has to coexist and converge with the small- and large-scale mechanization aspects. Strip cropping system is a versatile cropping system that suits Indian conditions which can address the agriculture manpower paucity from the farmer of 1 ha land to the farmer/corporate with thousands of hectares at a stretch in concert with small scale mechanization to large scale mechanization (Ditzler et al., 2021). A field experiment in Eastern Ghats of Odisha concludes that among different ratios of strip cropping, four rows of groundnut with six rows of foxtail millet consistently gave higher yield with efficiency and implications for improving the soil and crop productivity of the marginal landowners of uplands in that region (Jakhar et al., 2015)

3. How to Implement

In typical rainfed areas of Rayalaseema, neither monocropping nor intercropping or mixed cropping system is very common from long age-old practice. Those rainfed areas are hit by monsoon vagaries and affect the harvest causes huge losses. Instead of the traditional practices, farmers can adopt a strip cropping system coupled with mechanization by using a small tractor (up to 25 HP) or a big tractor(25 to 45 HP) can mechanization depending on the farmers' interest and resources.

1. Strip cropping for marginal farmers
2. Strip cropping for small/medium farmers
3. Strip cropping for large farmers

3.1. Strip cropping for marginal farmers

Marginal farmers (< 2.5 ha) are generally resource-poor and cannot much invest in the farm for resource development. They can adopt and diversify their land to a greater number of crops with small tractor mechanization or cattle pair sowings with less investment and more diversity index.

Chinnahagari and Upparahalla watersheds of Chitradurga and Bellary districts belong to the dry belts of Karnataka are prone to frequent droughts experienced by the small and marginal farmers. Strips of cereal crops were introduced amidst strips of groundnut crop by the farmers. Groundnut under strip crop method produced 690 kg of pods while the plots with groundnut alone produced 905 kgs per ha (Table 1). Though this seems to be lesser in absolute terms, however, the total production in a strip crop method is much higher. It also includes the production of millets to the extent of 313 kg of grain from the same piece of land. Groundnut under sole crop reaped gross returns of Rs. 16050 ha^{-1} whereas, the strip cropping system reaped gross returns of Rs. 19401 ha^{-1} (Hegde et al., 2015)

Table 1: Economics of groundnut crop from different cropping systems

Cropping system	Sole crop (Groundnut)	(Sole crop + Strip crop) (Groundnut + Fingermillet)	
	Groundnut	Groundnut	Fingermillet
Yield (kg ha^{-1})			
Pods / Grain	905	690	313
Fodder	1590	1560	1167
Gross returns (Rs ha^{-1})			
Pods / Grain	14460	11040	5634
Fodder	1590	1560	1167
		12600	6801
Total (Rs ha^{-1})	16050	19401	

3.2. Strip cropping for small/medium farmers

Small and medium farmers can adopt the via media genetic, spatial, and temporal diversity of 3 to 4 crops suitable for the ease of mechanization aspects. Further medium farmers can get a commendable income and sufficient food basket. In rainfed strip intercropping of sorghum and pigeonpea under 4:4 replacement series in comparison with 2:1 intercropping under additive series for system productivity, economic efficiency, and family food security (Maruthi et al., 2017). In the Netherlands, strip cropping systems are developed at medium-sized organic vegetable farms (40-60 hectares) (Merel et al., 2020)

3.3. Strip cropping for large farmers

A large area can be sown with multiple ratios of tractor sowings and different mechanized operations that reduce the manpower further which suits the mechanical

harvesting through crop combiners. It can be easily adopted and diversified with one important cereal, pulse, and/or oilseed crop.

Three dimensions of crop diversification (time, space, and genes) on the provision of agro-ecosystem services and the interactions between those three dimensions of crop diversity experimented within 115 ha of research farm of Wageningen University, Netherlands. Experiments with different strip widths are done on a practical scale with strip widths of 6, 12, and 24 meters. The tested rotation is based on the crops most commonly grown by arable farmers in the Netherlands, and on local practice. The experiment examines 3 crop pairs: cabbage – wheat, carrot – onion, and potato – grass-clover against the local practice of grass-clover – cabbage – onion – potato – wheat, and carrots. The results provide a foundation for understanding how spatial crop diversification can be utilized to promote synergies between ecosystem services and facilitate a transition towards system redesign for sustainable agriculture (Stella D.Juventia et al., 2021).

4. Factors to be Considered for Strip Cropping

4.1. Strip width

In general strip width largely depends on the extent of slope and soil texture and depth. The strip width to the different farmers, farms can be decided based on the type of the package of equipment that eases operations and masks the manpower. In general, based on the sowing equipment width, it can adopt in multiples which better fits for forthcoming operations. (FAO, 1965).

4.2. Strip length

Strip length at field conditions depends on the available stretch of land and type of the soil conditions.

This can be adopted as the extent of the length of the individual farmland boundary leaving the turning radius for the mechanical equipment. Results show that potatoes obtained a significantly higher yield and nitrogen yield in the 12 m strips. Carrot and cauliflower showed yield and dry matter yield benefits in the 24m strips. No significant differences were found in the DMR of the three crops. (Zhang, 2020).

Table 2: Suitable strip length for different soil types

Soil type	Strip Length (m)
Sandy soil	6.0
Loamy sand	7.0
Sandy loam	30.0
Loam	75.0
Silt Loam	85.0
Clay loam	105.0

4.3. Slope

Strip-cropping can be adopted across the slope to obstruct the runoff. Further, running water should walk and walking water to stop and infiltrate is the main motto in this system. In practice, the width of strips will vary according to the soil, climate and slope, and other local conditions. However, there is not possible to apply the universal formula for designing strips however the table mentioned below may be the initial guide for fairly permeable soils.

Table 3: Strip width (m) suitable for the different gradients of soil slopes (%)

Percent slope (%)	Strip width (m)
2-5	30-33
6-9	24
10-14	21
15-20	15

Figure 1: Pigeonpea + Foxtail Millet (8: 8) strip cropping system suits for small tractor mechanization

Figure 2: Mechanized (Millet + Pulse) Pearlmillet + Pigeonpea contour strip cropping

Figure 3: Small/ Mini tractor (25 HP) operated automated Ananta planter suitable for strip cropping

5. Mechanization in Strip Cropping

Strip cropping is defined as growing two or more plant species in strips that are wide enough to allow mechanization. Mechanization will be a much greater challenge with narrow strips than with wide strips. In general strip, cropping will be adopted in rainfed areas with a narrow sowing window. Mechanization is essential to ensure the sowing in the narrow sowing window. Further to reduce the cost of cultivation and to facilitate the ease of farm operations strip crops with mechanization saves time and cost.

In the case of small farmers / marginal farmers mini tractor (25 HP) operated automated Ananta planter can able sow four rows of crops at stretch to farm a strip of 4 rows. Strip cropping also facilitates inter cultivation equipment, spraying through drones and combiners for harvesting.

6. Cost Economics of the Strip Cropping System

Strip cropping system has an advantage over the other existing traditional cropping systems such as monocropping of groundnut and intercropping of Groundnut +Pigeonpea (7:1, 15:1, 21:1) systems which was very common in Ananthapuramu district. Net returns of the strip cropping system were Rs. 12,540 ha^{-1} compared with other cropping systems viz., 7:1 intercropping system in rainfed areas and sole groundnut.

Table 4: Cost economics of different groundnut cropping systems in Ananthapuramu district

Parameter	Strip cropping system (Piegonpea + Bajra)- 50%-50% percent in 1 ha	7:1 inter-cropping system in rainfed areas	Sole Ground-nut
Gross Returns (Rs ha^{-1})	17260	11355	6822
Cost of Culti-vation (Rs ha^{-1})	4720	8820	8060
Net returns (Rs ha^{-1})	12540	2535	-1238
B:C Ratio	3.66	1.29	0.85
Land Equiva-lent Ratio	1.82	1.32	1.00

7. SWOT Analysis for Strip Cropping Adoption

Strenghts	Weakness
Suitable for mechanisation Crop resilience and diversity Ehnanced biodiversity Edge over other cropping systems Temporal, spatial variation	Difficulty to adopt Low farmers accptence Handles more spatial, temporal aspects
SWOT	
Opprtunities	**Threats**
Incresed system productivity Maintence of soil nutrient balance Improved Soil quality & health Future of farmer adaption	Pest and disease resurgence Occurrence of new pest & disease

8. Conclusion

In view of reduced, restricted natural resources and manpower, the existing cropping systems should be fine-tuned and tailor-made without fading conventional best and successful systems. To conclude strip cropping offers an opportunity for integrating ecology and agriculture in industrial farming systems. Challenges about strip cropping remain in management and finding good crop combinations. Further, strip cropping can be integrated with mechanization, precession farming *viz.*, drone

spraying and satellite data to harvest the sizable Indian food basket.

9. References

Gurudatt, H., Reddy, R., Arun, B., 2005. Strip crop - A ray of hope for dryland farmers. LEISA 6, 34-36.

Jakhar, P., Adhikary, P.P., Naik, B.S., Madhu, M., 2015. Finger millet (*Eleusine coracana*)-groundnut (*Arachis hypogaea*) strip cropping for enhanced productivity and resource conservation in uplands of Eastern Ghats of Odisha. Indian Journal of Agronomy 60(3), 365-371.

Lenora, D., Dirk, F.V.A., Rogier, P.O.S., Pablo, T., 2021. Redefining the field to mobilize three-dimensional diversity and ecosystem services on the arable farm. European Journal of Agronomy 122, 01- 15.

Merel, H., Isabel, C., Dirk, V.A., Walter, R., Chris K., 2020. Diversification of Organic Farming by Implementing Strip Cropping in Vegetable Farming of the Netherlands. paper presented in organic world congress, September, 20-27th, Rennes.

Maruthi, V., Reddy, K.S., Pankaj, P.K., 2017. Strip cropping system as a climate adaptation strategy in semi-arid alfisols of South-Central India. Indian Journal of Agricultural Sciences 87(9),130-137.

Stella, D.J., Walter, A.H.R., Lenora, D., Dirk, F.V.A., 2021. Spatial and genetic crop diversity support ecosystem service delivery: A case of yield and biocontrol in Dutch organic cabbage production. Field Crops Research 261(1), 1-13.

Zhang, Y., 2020. Effects of Strip Diversification on Crop Performance in Strip-Cropping System in the Netherlands. MSc. Thesis of Organic Agriculture (MOA) Farming Systems Ecology, Wageningen UR, 6700AK, Wageningen, the Netherlands.