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An Analysis on Constraints Perceived by the Farmers in Adoption of Conservation Agriculture Practices in Selected Districts of Tamil Nadu

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

The study was conducted to find out the constraints perceived by the farmers in adoption of conservation agriculture practices. Ex post facto research design was used for this study. The study was conducted in 12 blocks of Cuddalore, Viluppuram and Tiruvarur districts respectively. The constraints part of the interview schedule had open ended questions which were administered to 233 respondents to collect constraints related to adoption of conservation agriculture practices as perceived by the farmers. It has been found from the study that lack of awareness on conservation agriculture principles, non-availability of labours, lack of local manufacturers of conservation agriculture machineries, strong belief in ploughing, insufficient training programme were the major knowledge, agronomical, technology, socio-economic and institutional constraints respectively. Also, suitable suggestions and strategies such as capacity building of farmers as well as extension agents on conservation agriculture, promoting local manufacturers to develop technologies which may suit the local conditions, promote minimum tillage concept instead of intensive ploughing and organizing pre-season training programmes on conservation agriculture practices were discussed to overcome the constraints perceived by the farmers.

Keywords: Conservation agriculture; farmers; constraints.

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1. INTRODUCTION

Land degradation threatens the ecosystem health and food security worldwide and will remain high priority on international agenda [1]. Conservation Agriculture (CA) offers potential solution which not only enhances the productivity but also maintains the environmental safety and ecological sustainability. Conservation Agriculture (CA) technologies involve minimum soil disturbance, permanent soil cover through crop residues or crop covers and crop rotations for achieving higher productivity [2]. The key elements of CA include: (i) minimum soil disturbance by adopting minimum tillage and traffic for agriculture operations (ii) leave and manage the crop residues on the soil surface and (iii) adopt spatial and temporal crop sequencing / crop rotations to derive maximum benefits from inputs and minimize adverse environmental impacts. Conservation agriculture stresses the very beneficial impacts of a conservative way of cultivation on the global environment (soil, air, water and biodiversity) compared to traditional agriculture [3,4]. Conservation agriculture and its components have been associated with many benefits including greater soil water storage [5], improved soil quality [6], decreased erosion [7], and in some instances, greater yield and net farm income [8,5]. These benefits have led to the identification of CA as an important tool to help ensure future food production and help buffer agricultural productivity against extreme climate events, such as drought and heat waves, which are likely to increase in frequency under climate change [9]. A major hurdle in promoting conservation agriculture is to convince the farmers about the potential benefits of conservation agriculture that includes, shrinking production costs mainly by tillage reductions, efficient use of agricultural inputs, increased yields and environmental sustainability. Lack of appropriate seeders especially for small and medium scale farmers, the wide spread use of crop residues for livestock feed and fuel, burning of crop residues,lack of knowledge about the potential of CA to agriculture leaders, extension agents and farmers and lack of skilled and scientific manpower are the major constraints expressed by the farmers [2]. FAO [10] asserted that introduction and adoption of CA must overcome a range of constraints that have been highlighted by a number of stakeholders. The present study was intended to explore the constraints perceived in adoption of CA technologies among the farmers of selected districts of Tamil Nadu.

2. METHODOLOGY

The study was conducted based on the Ex-post facto research design. An ex-post facto research is a kind of research design in which the researcher predicts the possible causes behind an effect that has already occurred. It is also known as "after the fact" research design. In Tamil Nadu, three districts namely Cuddalore, Viluppuram and Tiruvarur were selected purposively for this study as these districts stand in first three positions based on maximum area under cultivation of principal crops.

Based on maximum area under cultivation of principal crops four blocks from district were selected for the study. A total of 24 villages were selected from the 12 blocks based on the criteria of villages with highest number of farmers. From the 24 villages, a total of 233 respondents were selected by using proportionate random sampling method.

A pre tested and well-structured interview schedule was used for data collection and the data were collected by direct interview method. The constraints part of the interview schedule had open ended questions related to conservation agriculture practices as perceived by the farmers were administered.

The constraints were further grouped under five categories. The data collected were tabulated and analysed by using the descriptive statistics such as frequency and percentage analysis. The constraints were assigned with ranks based on the percentage values and presented in this paper.

3. RESULTS AND DISCUSSION

The constraints perceived by the farmers in practicing conservation agriculture is operationalised as bottlenecks, which impedes the farmers in adopting conservation agriculture practices. As environment and quality of the products get deteriorating over and above, there is an imperative need to identify the scientific explanation behind constraints enlisted in adoption of conservation agriculture practices among farmers. The constraints perceived by the farmers in practicing conservation agriculture were presented under each category. With the constraints, the possible suggestions were also

collected from the respondents and presented along with the constraints in this paper.

3.1 Knowledge Based Constraints

The perceived constraints are presented in Table 1.

It could be observed from Table 1 that 'lack of awareness on CA principles' (78.54%) was identified as the first major constraint in the case of knowledge-based constraints perceived by the farmers. The reason might be due to the fact that the farmers are very much adapted to the conventional farming practices and readily accessibility of inputs in conventional farming. Inadequate training programmes on conservation agriculture practices was also a reason for their unawareness.

Moreover, absence of knowledge on CA practices (73.82%) were identified as second major constraint based on rank. Conservation agriculture consists of three main principles which includes minimum or no-tillage, organic soil cover and crop diversification comprises multiple cropping and crop rotation. It was found that farmers possess good knowledge on crop diversification and partially on soil organic cover. Majority (92.70%) of the farmers were unaware about the minimum or no-till concept. Further, farmers have to be educated to use all three principles simultaneously to obtain best results.

Furthermore, complexity exists in adoption of CA practices (52.36%) was reported as third major constraint perceived by the farmers. Lack of interest in the technology showed that the technology had failed to reach the farmers besides having economical, agronomic and environmental benefits. Further farmers also felt the uncertainty about the success of the new technology.

To overcome these constraints, public extension system must promote and popularize the conservation agriculture practices among the farmers on a large scale. Policy support for capacity building of farmers as well as extension agents by organizing training on CA is needed. Efforts to adequately train all new and existing agricultural extension personnel on CA should be made in relevant departments.

3.2 Agronomical Constraints

In case of agronomical constraints, non-availability of labours during peak season (73.39%) was identified as the first major constraint perceived by the farmers based on the rank. Hence, there are not enough work opportunities for agricultural workers in a period other than sowing and harvesting of the crops. Incidentally, the non-farm opportunities for agricultural workers can provide them employment in the remaining period. Due to dearth of enough farm and non-farm opportunities throughout the year, agricultural workers look for opportunities outside the village, and often migrate. This is the main reason behind labour shortage in agriculture. The farmers perception on non-availability of labours as a major constraint can be sort out by providing enough knowledge about the concept as reduction in labour requirement is one of the important benefits of conservation agriculture.

Problem of weed dominance in unploughed fields (69.10%) was identified as the second major constraint perceived by the farmers based on the rank. Weeds are controlled when the cover crop is cut, rolled flat, or killed by herbicides (Carter et al., 2002). The mulch residue cover can control weeds by excluding light (Ross and Lembi, 1985). Crop rotation, one of the pillars of CA, leads to diversification of cropping practices and therefore, changes weed populations and species composition, leaving less opportunity for an individual weed to become dominant (Hobbs and Govaerts, 2010). Kennedy (1999) also observed that farming practices that maintain soil microorganisms and microbial activity, which is common in CA, can also lead to weed suppression by biological agents. The results of the experiments showed positive effect on weed control in CA system and further all three principles to be adopted concurrently to attain finest results.

Table 1. Constraints perceived by the farmers regarding knowledge (n=233)*

S. No.	Constraints	No.	%	Rank
1.	Lack of awareness on CA principles	183	78.54	**I**
2.	Inadequate knowledge on CA practices	172	73.82	**II**
3.	Complexity exists in adoption of CA practices	122	52.36	**III**

**- Multiple responses obtained*

Table 2. Constraints perceived by the farmers regarding agronomical practices (n=233)*

S. No.	Constraints	No.	%	Rank
1.	Non availability of labours during peak season	171	73.39	I
2.	Problem of weed dominance in un ploughed fields	161	69.10	II
3.	Persistence of causal organisms of pest and diseases due to stubbles	96	41.20	III
4.	Grazing of cattle into cultivated lands	71	30.47	IV

*- *Multiple responses obtained*

Persistence of causal organisms of pest and diseases due to stubbles (41.20%) was identified as the third major constraint perceived by the farmers based on the rank. Organic soil cover using crop residues left over after the harvest of the previous crop protects erosion of the top soil, control weeds by cutting light and aeration and add organic matter to the soil after decomposition of the stubbles. Those stubbles may also become a path for causal organisms of pest and diseases to affect the crop. However, retention of stubbles also tends to increase diversity of predators, parasites and beneficial microorganisms that can help break insect pest cycles naturally.

Grazing of cattle into cultivated lands (30.47%) was identified as the last major constraint perceived by the farmers regarding bio-physical constraint. The conventional cropping pattern involves tillage of the soil once the crop is harvested that tends to kill the weeds and destroy weed seed bank. Whereas in CA, the land is left untilled after the harvest of the crop resulting weeds to emerge. The weeds had to be destroyed either by grazing of cattle or by spraying weedicides before planting the next crop. Grazing of cattle into the cultivated land might damages the ridges, furrows or beds but provides good manure to the soil when the cattle releases dung while grazing.

To overwhelm the constraints, promotion of minimum tillage concept instead of intensive ploughing as it reduces production costs, e.g., fuel, machinery operating costs, maintenance costs and labour costs.

Policy framework for resource poor and small holder farmers for easily availing critical inputs as they do not have economic access to purchase seeds, herbicides and seeding machineries etc.

3.3 Technological Constraints

Among technological constraints, lack of local manufacturers of CA machineries (76.82%) was identified as the first major constraint perceived by the farmers based on the rank. Sowing the seeds without tillage needs specialized machineries like happy seeder, disc seed drill machine etc. are often not readily available to the farmers. The conventional agricultural implements were widely owned by farmers and tractor owners but in this case zero till seed drill machineries were rarely owned by them. Timely accessibility to zero till seed drill machineries by the farmers might increase the adoption of CA practices.

Difficulties in irrigation of un-ploughed land (72.10%) was identified as the second major constraint perceived by the farmer under technological constraints. The reason might be that the irrigation path in the field may get damaged or weeds grown heavily over the path and interrupt the water delivery reducing irrigation efficiency. This can be rectified by regular monitoring of the irrigation paths by repairing the damages and timely spraying of weedicides over the path will reduce the difficulties in irrigation of un-ploughed land.

Regarding technological constraints, lack of faith in conservation agriculture technologies (60.09%) was identified as the third major constraint perceived by the farmers based on the rank. The observability of the results of the CA technologies was not widely exposed to the farmers. The results of the conservation agriculture technologies must reach the farmers by conducting demonstrations, field visits and educational tours.

Difficulties in intercultural operations (29.18%) were identified as the fourth major constraint perceived by the farmers based on the rank. This might be due to non-maintenance of the field after harvest. Since after the harvest of the previous crop, immediate sowing of the next crop had to be done to ensure the field to be maintained well.

To overcome the constraints by increase the manufacturing of conservation agriculture machineries, viz. happy seeder, turbo seeder,

laser land leveller, zero-till multi-crop planters etc. and ensure its availability by promoting local manufacturers to develop technologies which are adapted to local conditions, increase employment opportunities and reduce costs. In case of importing conservation agriculture, equipment consideration could be made on removing or reducing tariffs on imported conservation agriculture equipment and implements to encourage and promote their availability.

Building partnership among scientists, farmers, extension agents, policy makers and other stakeholders in the private sector will be important in developing and promoting CA technologies.

3.4 Socio Economic Constraints

Among socio economic constraints, strong faith in ploughing (70.39%) were identified as the first major constraint perceived by the farmers based on the rank. Conservation agriculture emphasis on conservation tillage rather than intensive tillage practices. Tillage practices have been used in crop cultivation to prepare the soil for sowing and to inhibit weeds. The modern agricultural system involving intensive tillage practices have increased the rate of soil erosion in recent times.

Moreover, no incentive for CA adoption (66.95%) was identified as the second major constraint perceived by the farmers based on the rank. Conservation agriculture relatively being a new concept, but comprises practices which are being adopted by the farmers as unknowingly. The concept of CA is adopted only when all three principles are implemented at the same time might results in lesser yield which affects the income of the farmers. In order to stabilise the revenue of the farmers economic incentives could be given the farmers to motivate them to adopt CA practices.

Non availability of money to purchase CA implements (59.66%) were identified as the third major constraint perceived by the farmers based on the rank. Hence, the government may consider for providing lease or rental facilities of CA implements through customer hiring centre.

Influence of family members and fellow farmers who are non-adopters (44.21%) were identified as the fourth major constraint perceived by the farmers based on the rank. Conservation agriculture being a new concept doesn't have widespread awareness among farmers. The farmers who are progressive desired to adopt CA practices could be demotivated by their family members and fellow farmers.

Dependence on crop residues for livestock feed and fuel (41.63%) were identified as the fifth major constraint perceived by the farmers based on the rank. This might be due to the fact that most of the farmers had not cultivated fodder crops and mainly depends on residues of previously harvested crop and weeds emerges in the field despite possessing good number of livestock.

To overcome the above constraints, creation of awareness among farmers on fodder production technologies which had dual benefit of feeding the cattle as well as utilize residues for soil cover. Provision of credit to farmers to buy the equipment, machinery, and inputs through banks and credit agencies at reasonable interest rates. At the same time government need to provide a subsidy for the purchase of such equipment by farmers which might results in a considerable increase in area under CA.

3.5 Institutional constraints

Regarding institutional constraints, insufficient training programme (74.68%) was identified as the first major constraint perceived by the farmers based on the rank. Majority of the farmers had reported that they had not attended any training programmes on conservation agriculture. It showed that the extension agency like ATMA had failed to organize appropriate training programmes to farmers at grass root level. The farmers were not fully aware about conservation agriculture practices. Hence, the government had to provide training on conservation agriculture practices and guide the farmers to adopt CA practices in parallel for achieving best results.

Limited number of publications available in Conservation agriculture technologies (67.81) was identified as the second major constraint perceived by the farmers. The reason might be due to that most of the research projects on conservation agriculture were in the pipeline, ongoing and need sufficient time period to come out with strong recommendations. Moreover, significant research outcomes on conservation agriculture practices could be obtained only after longer period is one major hindrance to motivate the farmers to adopt CA.

Table 3. Constraints perceived by the farmers regarding technology (n=233)*

S. No.	Constraints	No.	%	Rank
1.	Lack of local manufacturers of CA machineries	179	76.82	**I**
2.	Difficulties in irrigation of un-ploughed land.	168	72.10	**II**
3.	Lack of proven technologies in conservation agriculture system	140	60.09	**III**
4.	Difficulties in intercultural operations	68	29.18	**IV**

**- Multiple responses obtained*

Table 4. Constraints perceived by the farmers regarding socio-economic factors (n=233)*

S. No.	Constraints	No.	%	Rank
1.	Strong faith in ploughing	164	70.39	I
2.	No incentives for CA adoption	156	66.95	II
3.	Non availability of money to purchase CA implements	139	59.66	III
4.	Influence of family members and fellow farmers who are non-adopters	103	44.21	IV
5.	Dependence on crop residues for livestock feed and fuel	97	41.63	V

**- Multiple responses obtained*

Table 5. Constraints perceived by the farmers regarding institution (n=233)*

S. No.	Constraints	No.	%	Rank
1.	Insufficient training programme	174	74.68	I
2.	Limited number of publications available in conservation agriculture technologies	158	67.81	II
3.	Inadequate extension service at village level	87	37.34	III
4.	Non availability of crop insurance scheme	74	31.76	IV
5.	No mainstreaming of CA in National Programmes	66	28.33	V

**- Multiple responses obtained*

Inadequate extension service at village level (37.34%) was identified as the third major constraint perceived by the farmers based on the rank. During the survey, it was observed that there were no regular visits made by the extension personnel of Government departments and most of the times the farm advices were received from input dealers in the village. Farmers need consistent and periodical guidance from extension functionaries throughout the year for getting timely technical advisory services on crop selection, fertilizer application, crop protection, weather advisories and in addition with that awareness and knowledge on CA practices might ensure higher adoption rate.

Non availability of crop insurance scheme (31.76%) was identified as the fourth major constraint perceived by the farmers based on the rank. The first and foremost reason might be due to that most of the farmers were being not aware of crop insurance schemes and were not interested to buy it. The second reason was that farmers who took crop loans on their Kisan Credit Cards, the insurance premium amount was deducted mandatorily from their loan amounts. The third reason was that some farmers insured their crops separately and not as a part of taking agricultural credit also did not receive the compensation. Farmers do not need a claim during good farming years and the claim is not settled during bad farming years so they consider it is a waste of premium payment. Even farmers who received settlements also reported significant delays.

No mainstreaming of CA in National Programmes (28.33%) was identified as the fifth major constraint perceived by the farmers based on the rank. The programmes implemented at the national level aimed to bring focus on aspects such as minimum mechanical soil disturbances practices, residue retention practices and crop diversification practices to enhance the adoption of Conservation agriculture practices.

To overcome the constraints mentioned above by pre-season training programmes on conservation agriculture practices could be organized through ATMA at gross root level. Conducting result demonstrations to show the results of CA technologies which in turn increases the faith on CA practices among farmers.

CA had to be mainstreamed in relevant ministries, departments or institutions and

supported by adequate provision of material, human and financial resources to ensure that farmers receive effective and timely support from well trained and motivated extension staff.

Adaptive research is required to tailor CA principles and practices to local conditions. by establishing collaboration with local communities and other stakeholders.

4. CONCLUSION

Conservation agriculture offers a new paradigm for agricultural research and development different from the conventional one, which mainly aimed at achieving specific food grains production targets in India. A shift in paradigm has become a necessity in view of widespread problems of resource degradation, which accompanied the past strategies to enhance production with little concern for resource integrity. Integrating concerns of productivity, resource conservation and soil quality and the environment is now fundamental to sustained productivity growth. Developing and promoting CA systems will be highly demanding in terms of the knowledge base. Bottom-up approach is required where the farmers are enabled through provision of equipment and training to experiment with the technology and find out whether the technology works well and what fine-tuning is needed to make it successful on their land rather than top-down approach where the extension agent places CA demonstrations in farmer fields and expects the farmer to adopt. Conservation agriculture offers an opportunity for arresting and reversing the downward spiral of resource degradation, decreasing cultivation costs and making agriculture more resource – use-efficient, competitive and sustainable. Policy intervention is required to change the focus from food security to livelihood security, which could help to prevent overexploitation of natural resources by prohibiting the practice of a single cropping system with crop diversity. “Conserving resources – enhancing productivity” has to be the new mission.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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