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Conservation Agriculture Technology: Extent of Adoption & Constraints Faced by Farmers of Madhya Pradesh, India

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Authors' contributions

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

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ABSTRACT

Increase in human population and vigorously changing climate leading to declining natural resource are the emerging challenges for the world's agricultural systems, which need to produce more food for the increasing population. Therefore, change in our conventional agriculture practice is required by adapting practices or technology helping in coping up with the changing climate and sustainably

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using the resources for future productivity gains and Conservation Agriculture (CA) Technology is one of the best alternative. CA is a resource conservation practice which improves biodiversity and natural biological processes above and below the ground surface and includes a trifecta of no-till or minimum-till or zero-till farming, permanent soil cover and crop rotations which have existed for nearly a century, but its uptake has generally been slow and uneven. Present study was conducted at state Madhya Pradesh of India using ex-post facto research design to find out the extent of adoption along with the constraints faced by the farmer in adoption of this decade older technology. The study revealed that despite the proven benefits of CA, its adoption rate is very slow in the region. Further, majority of the farmers had moderate knowledge of CA but were afraid to adopt it completely. The major reason witnessed were complexity of CA in comparison to conventional agriculture, lack of awareness of this technology among farmers and high cost and unavailability of happy seeder.

Keywords: Climate change; increasing population; conservation agriculture; adoption; constraints.

1. INTRODUCTION

The world's population is estimated to rise from 7.90 billion in 2022 to 9.70 billion in 2050. Also around 2027, it is projected that India will overtake China as the world's most populous country [1]. In addition to this, ill effects of climatic variability, depleting soil fertility along with natural resources, hike in cost of inputs has also been observed as the major challenges before developing country like India. Consequently, this is the need of an hour to bring change in the current cultivation practices by removing the unsustainable parts of traditional agriculture viz. ploughing or tilling the soil, monoculture, eliminating all natural & organic material, etc. and adapting all the practices or innovations or technology helping farmers in dealing with the fluctuating climate along with gaining the productivity while conserving the natural resources.

Thus, a concept termed as "Conservation Agriculture (CA)", that combines minimum or no tillage with permanent soil cover (that leaves at least 30% of the soil covered between harvest and planting) and diversified crop species that include legumes [2] is one of the best alternative to deal with the concerns of sustainability of agriculture globally.

CA is considered as a sustainable practice, which increases natural biological process, both below and above the soil. This technology is an eco-friendly, more efficient technology, which restores soil fertility along with increasing crop productivity and improving moisture conservation, which directly acts a source of climate change mitigation and reduces total cost of cultivation and helps in timely operations. Moreover, it includes total prohibition of burning of crop residues and use of an tractor-drawn equipment "happy Seeder", which places seed and fertilizer simultaneously, by making a slit in the soil having crop residue of previously harvested crop, at proper depth. It also includes other practices, such as integrated nutrient and pest management on a site specific basis to help ensure its success. However, its impact on crop efficiency is profoundly fluctuating and depends on to local circumstances/ management.

Although, CA has uncountable number of benefits to farmers, but due to lack of awareness among farmers, the area covered under CA globally is only approximately 8 per cent of total cultivable land, which covers 154.8 Mha area [3]. This technology is extensively practiced in countries like USA, Brazil, Argentina, Canada and Australia. In developing country like India, adoption of Conservation Agriculture is still in its tender phase. But, in the last few years, adoption of zero tillage and CA has expanded to cover about 3 million hectares [4]. In state Madhya Pradesh, DWR (Directorate of Weed Research, Jabalpur) and BISA (Borlaug Institute of South Asia, Manegoan, Jabalpur) in alliance with many other organizations had conducted many successful trials on CA in Rice-Wheat cropping system and still the efforts are going on to bring more land under conservation agriculture and make farmers aware of this technology. Thus, the present study was conducted at Jabalpur district of Madhya Pradesh with the objective to evaluate extent of adoption of CA technology among farmers & constraints faced by them.

2. METHODOLOGY

In state Madhya Pradesh, many successful trials have been conducted on Conservation Agriculture Technology by BISA (Borlaug

Institute of South Asia, Manegoan, Jabalpur) and DWR (Directorate of Weed Research, Jabalpur), in collaboration with other institutes. Therefore for the present study, which was conducted in the year 2018-19, district Jabalpur of state Madhya Pradesh was selected, as majority of trials and demonstration of CA has been conducted by BISA and DWR in vicinity of this district. Out of seven blocks of district Jabalpur, four blocks namely Panagar, Patan, Shahpura and Sihora were selected purposively, as these are the blocks where CA technology has been adopted by the farmers. A list of respondents from 17 villages was prepared, among which 80 adopters of CA technology were short-listed randomly as respondents. An ex-post facto method as a research design was used in the present investigation, which gives information after occurring of events and it is a method of testing out possible antecedent of events that has happened and cannot be manipulated and influenced, research is done after event have occurred.

To assess the extent of adoption level of CA technology by respondents and constraints faced by them in adopting this innovative technology, an interview schedule was developed, consisting of 10 and 18 statements, respectively and the responses of the farmers were recorded through personal interview. The responses of the farmers were recorded on 3 point continuum viz. complete, partial, nil and most serious, serious and not serious giving them the scores of 3,2,1 to measure the extent of adoption and constraints, respectively. The collected data were tabulated and presented in the form of tables and graphs and analysis of the data was done by frequency, percentage, mean and rank to draw meaningful conclusion.

3. RESULTS AND DISCUSSION

Extent of adoption of CA technology by the respondents and constraints faced by them in adopting this technology was computed by totaling mean scores of their responses for individual statements and than giving rank to the statements on the basis of their total scores.

3.1 Extent of Adoption of CA Technology

Extent of adoption of practices under CA technology by the respondents is illustrated in the Table 1. It can be depicted from the table that, cent per cent of the adopters were completely maintaining permanent soil organic cover, in which residue or left over of the previous crop is utilized as mulch or cover crop for the existing crop. This helped them is conserving soil moisture, decreasing weed population, along with decrease in cost arising due to ploughing and cultivation of crop. As this practice was adopted by all the adopters, thus ranked first with mean score of 3. This statement was in line with the findings of Hengxin et al. [5] and Pradhan et al. [6] who found that conversion from conventional to zero tillage, reduced erosion, conserved soil moisture and avoided surface sealing because of crop residue cover on the surface and higher aggregate stability under zero tillage conditions. Further it was found that, 77.50 per cent of the farmers had complete adoption of integrated weed management and none of the respondents had nil adoption for this practice, thus ranking second with mean score of 2.77. Burning of crop residue is totally restricted in CA technology and this practice was completely adopted by 71.25 per cent and partially adopted by 28.75 per cent of adopters. But, still complete awareness is required among farmers to completely adopt this practice, as this helps in reduction in pollution and directly helping in decreasing green house gases in the environment responsible for climate change. These findings were supported by Bhan and Behera [7] and DWR report [8].

The results of the study also indicated that, higher percentage (63.75%) of adopters had completely stopped ploughing of their field followed by its partial adoption (26.25%) and thus following the basic principle of CA, i.e minimum soil disturbance or minimum tillage (no ploughing of field). The adoption level of this practice ranked fourth with mean score of 2.63. It was supported with the results of Jat et al. [4], Bisangwa [9] and Novas [10]. The residue of the previous crop help in conserving soil moisture, due to which no additional irrigation is required at the time of sowing, but because of insecurity and lack of knowledge only than half of the adopters (53.75%) were completely adopting this practice followed by no adoption (26.25%) and partial adoption (20.00%), securing ranked V with mean score of 2.27. Apart from the 3 principles of CA, other practices like plant protection and nutrient management practices are also essential. Thus, it was found that, only 45.00 per cent of farmers, had its complete adoption, followed by partial (36.25%) and nil adoption (18.75%). This practice stood sixth with mean score of 2.26.

Table 1. Distribution of adopters of CA according to their extent of adoption of individual practice

S.No	Practice	Adopters responses				
		C	P	Nil	MS	R
1.	Minimum soil disturbance is the first principle of CA technology i.e. ploughing of field through any plough is restricted.	51 (63.75)	29 (36.25)	00	2.63	**IV**
2.	Permanent soil organic cover is CA's second principle (in which residue of the previous crop is utilized as mulch crop for the prevailing crop.)	80 (100)	00 (00)	00	3.00	**I**
3.	Crop rotation is its third principle, which enforces a leguminous crop to be included in cropping system.	43 (53.75)	00 (00)	37 (46.25)	2.07	**VII**
4.	Burning of crop residue is totally prohibited	57 (71.25)	23 (28.75)	00	2.71	**III**
5.	Happy seeder is used for seed sowing, which places fertilizers at right depth in the soil, below seed	42 (52.50)	00 (00)	38 (47.50)	2.05	**VIII**
6.	Seed sowing is done in the same day of harvesting of previous crop	11 (13.75)	08 (10.00)	61 (76.25)	1.37	**X**
7.	Proper moisture should be available at the time of sowing and sowing of seed is done at residual moisture, while no additional irrigation is required	43 (53.75)	16 (20.00)	21 (26.25)	2.27	**V**
8.	Integrated weed management	62 (77.50)	18 (22.50)	00	2.77	**II**
9.	Plant protection and nutrient management practices	36 (45.00)	29 (36.25)	15 (18.75)	2.26	**VI**
10.	Crop diversification: Three crops must be taken in a year.	35 (43.75)	00 (00)	45 (56.25)	1.87	**IX**

C=Complete, P=, Partial, N=Nil, M= Mean score, R= Rank
(Figures in parenthesis indicate percentage)

Table 2. Distribution of adopters according to their overall adoption level

No.	Adoption level	Frequency	Percentage
1.	Low (10-16)	00	00.00
2.	Medium (17-23)	44	55.00
3.	High (24-30)	36	45.00
	Total	**80**	**100.00**

Table 3. Distribution of farmers according to the Constraints faced by them in adoption of CA

S.No.	Particulars	MS	S	NS	MS	Rank
(A)	**Technical constraints**					
1.	Unavailability of happy seeder and quality seed drill	80 (100.00)	00 (00.00)	00 (00.00)	3	**I**
2.	Unavailability of machine on custom hiring basis like other	80 (100.00)	00 (00.00)	00 (00.00)	3	**I**
3.	Requirement of high power tractor for operating happy seeder.	80 (100.00)	00 (00.00)	00 (00.00)	3	**I**
4.	Lack of Skilled mechanic for repairing the machines	07 (08.75)	36 (45.00)	37 (46.25)	1.62	**VII(a)**
5.	Lack of awareness, training/ capacity building	42 (52.50)	25 (31.25)	13 (16.25)	2.36	**VI**
6.	Spare parts are not available locally	07 (08.75)	36 (45.00)	37 (46.25)	1.62	**VII(b)**
7.	Lack of local manufacturers of machines	75 (93.75)	05 (06.25)	00 (00.00)	2.93	**II**
8.	Problem in operation under unleveled field/small size of holding	66 (82.50)	00 (00.00)	14 (17.50)	2.65	**IV(b)**
9.	Fear of hardening of upper layer of soil	00 (00.00)	15 (18.75)	65 (81.25)	1.16	**IX**
(B)	**Extension constraint**					
10.	Lack of adequate manpower from state extension agencies	64 (80.00)	00 (00.00)	16 (20.00)	2.65	**IV(a)**
11.	Lack of extension literature on CA	00 (00.00)	11 (13.75)	69 (86.25)	1.13	**X**
12.	Lack of attention of mass media	14 (17.50)	20 (25.00)	46 (57.50)	1.6	**VIII**
13.	Lack of knowledge of extension agencies	56 (70.00)	10 (12.50)	14 (17.50)	2.52	**V(a)**
14.	Inadequate extension facility at input agencies	42 (52.50)	38 (47.50)	00 (00.00)	2.52	**V(b)**
15.	Lack of fellow farmers co-operation	00 (00.00)	00 (00.00)	80 (100.00)	1	**XI**

S.No.	Particulars	MS	S	NS	MS	Rank
(C)	**Financial constraints**					
16.	Lack of credit facilities and subsidy in purchasing happy seeder	71 (88.75)	00 (00.00)	09 (11.25)	2.77	**III**
17.	Lack of fund for purchase of new machines and inputs	56 (70.00)	10 (12.50)	14 (17.50)	2.52	**V(c)**
18.	High cost of seed-drill	56 (70.00)	10 (12.50)	14 (17.50)	2.52	**V(d)**

MS–Most serious, S–serious, NS– Not Serious

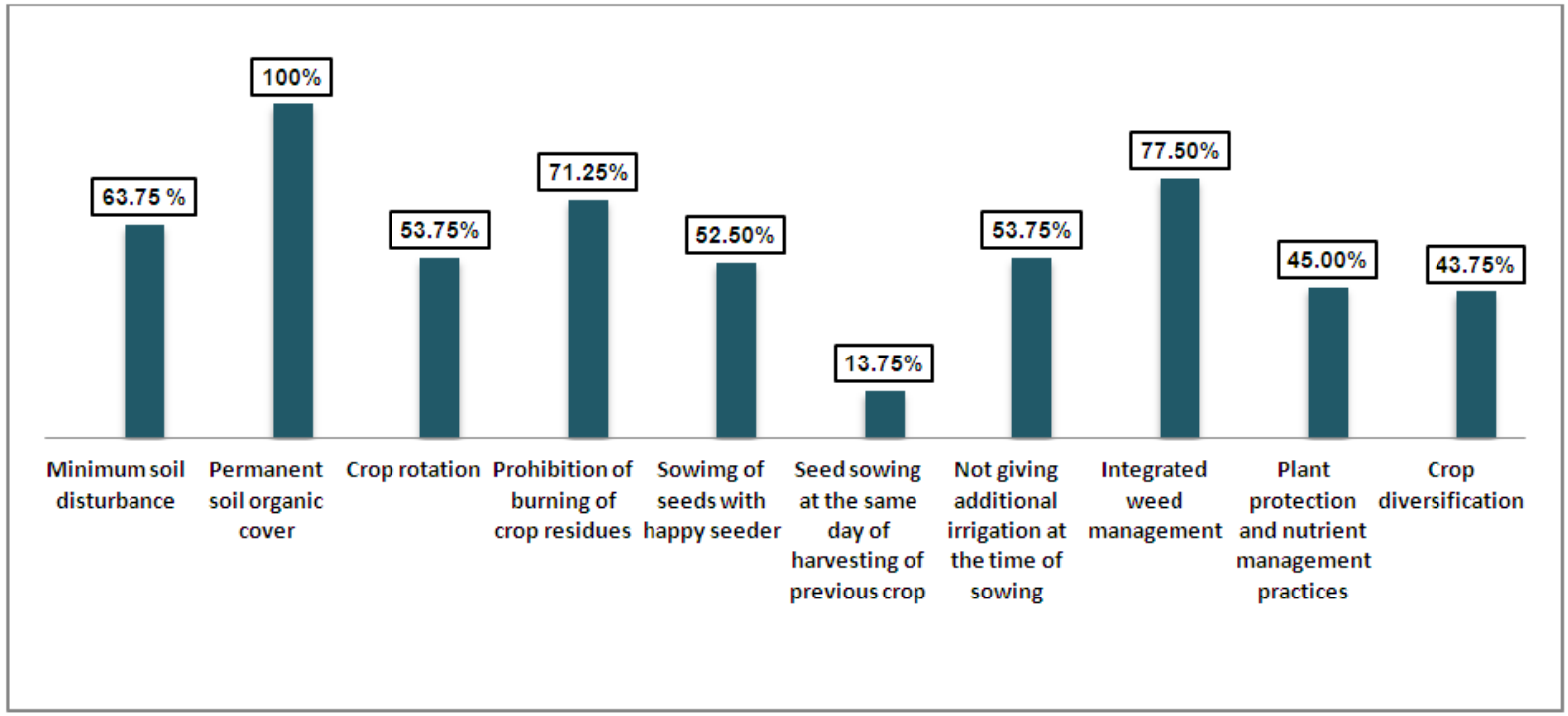

Fig. 1. Percentage distribution of farmers on the basis of complete adoption of practices under CA technology

Including a leguminous crop in crop rotation is a third principle of CA, still only half of the respondents (53.75%) had its complete adoption, followed by 46.25 per cent with nil adoption. The most probable reason for not including a leguminous crop in summer was unavailability of fencing and problem of over grazing by animals. Due to less adoption of this practice, it secured rank seventh with mean score of 2.07. "Happy Seeder", is one of the integral part of CA technology. It is equipment used for seed sowing, which places seeds and fertilizers simultaneously in the soil at proper depth by making a slit in the soil having crop residue of previously harvested crop. These findings were also reported by FAO [11,12]. Because of lack of availability of happy seeder only 52.50 per cent of the adopters were able to do seed sowing with the help of this implement, while higher percentage (47.50%) of farmers were unable to avail happy seeder at right time and used Zero-till seed drill for seed sowing. The total mean score for this practice was 2.05 and ranked 8th.

Taking three or more crops in a year (crop diversification), helps in adding income of the farmer. But, more than half (56.25%) of the farmers, were restricted to rice-wheat cropping system and only 43.75 per cent of adopters, included other crops like Soybean, Arhar, etc in Kharif and chickpea, lentil and mustard in Rabi. Due, to less adoption of this practice it secured ninth position with mean score 1.87. In CA technology, seed sowing is done in the same day of harvesting of previous crop, but in the present study it was found that majority (76.25%) of adopters had nil adoption of this practice due to lack of knowledge, followed by 13.75 per cent and 10.00 per cent of adopters having complete and partial adoption respectively. Due to mere adoption of this practice, it ranked last, with the mean score of 1.37. Similar above findings were also found by FAO [13], Albertina [14], Bhan and Behera [7] Aggrawal et al. [15] and Aga khan report [16].

Further, in the study overall adoption level of the respondents was also evaluated (Table 2) and it was observed that, out of the total adopters of CA, more than half (55.00%) of the respondents were having medium adoption level, followed 45.00 per cent of respondents having high adoption level, while none of them were having low adoption level. Thus, it can be concluded that, though the respondents are having knowledge about all the practices of conservation agriculture technology but higher percentage of adopters (55.00%) were having medium adoption level, the reasons for which may be fear in adoption of this new technology. As this technology is just a decade older technology in the state, thus the farmers are not certain about the results and are also not well verse with the technology, thus farmers are afraid in adopting CA technology completely. All these above findings were supported by the work of Bisangwa [9], Theodor et al. [17], Albertina [14], Aga Khan report [16], DWR report [8] and Pradhan et al. [6].

3.2 Constraints Faced by Adopters in Adoption of CA

Evaluation of the extent of adoption of the respondents revealed that the respondents are partially adopting the CA technology and therefore the reason for slow or partial adoption was analysed, which has been depicted in Table 3. The constraints faced by the adopters of CA have been divided into 3 categories viz. Technical constraints, Extension constraint and financial constraints. The results indicated that, as this technology is just a decade older in the region, therefore farmers are not very well versed with the technicality of the technology and are deprived with the availability of the implements used and thus cent percent of adopters reported un-availability of happy seeder and quality seed drill along with un-availability of machine on custom hiring basis like other implements and machineries and need of high power tractor for operating happy seeder to be the most serious problem in adopting CA technology. These three constraints secured rank first with total mean score of 3. The same findings were observed in DWR report [8].

Further, it was found that, majority of the adopters (93.75%) considered lack of local manufactures of happy seeder to be most serious constraint with 6.25 per cent considering it to be serious and thus fetching this statement rank second with mean score of 2.93. Third rank with mean score of 2.77 was given to the issue of lack of credit facilities with no subsidy in purchasing happy seeder and was found most serious constraint by 88.75 per cent of the adopters, while 11.25 per cent found it not to be serious. In addition to this, problem of operation under unleveled field/small size of holding and lack of adequate manpower from state extension agencies was considered most serious by 80.00 per cent of adopters and 82.50 per cent of

adopters respectively with mean score of 2.65 and rank fourth. In this ranking of problems faced by the farmers in adopting CA technology, fifth most serious issue raised by them was problem extension agencies are deprived of knowledge, extension facilities are inadequate and insufficient at the disposal of input agencies, lack of fund for purchase of new machines and inputs and high price of happy seeder. Also, more than half of the adopters (52.50 %) found lack of awareness, training/capacity building to be the most serious constraint, thus scoring rank VI with mean score of 2.36. The next serious problem identified by the farmers was regarding lack of skilled mechanic for repairing the machineries and unavailability of spare parts of happy seeder, securing rank seventh. These findings were in line with Derpsch and Friedrich [18], Aga Khan report [16], DWR report [8] and Pradhan et al. [6].

Problem of the lack of attention of mass media ranked VIII with total mean score of 1.60, as only 17.50 per cent of the respondents considered it to be a serious problem. Also, only 18.75 per cent of the adopters of CA considered hardening of upper layer of soil as a problem while none of them considered it to be a most serious problem, thus this issue ranked ninth in the list with mean score of 1.16. The next in the list with rank tenth was lack of extension literate on CA, which was considered as a serious problem by only 13.75 per cent of farmers. It was also found that, none of the respondents found lack of fellow farmers co-operation to be a constraint in adopting CA. The findings of Singh et al. [19], Singh (2004), Bisangwa [9] and Bhan and Behera [7] are also similar with the above findings.

4. CONCLUSION

With the changing climate, declining soil fertility and decreasing ground water, there is alarming threat to sustainability of agriculture which will have vigorous impact on the natural resources, agricultural production and food quality. Impact of this would be greatly seen on the poor, under privileged and marginal farmers living in adverse situation. Therefore, a technology, which is technically feasible, economically viable and ecologically permissible and aims at sustainable development with reduced cost of cultivation need to be adopted and CA is one of the best option to achieve this motive. However, even after witnessing numerous benefits of CA, its adoption is mere and has been restricted to developed countries. In state Madhya Pradesh, despite of having adequate knowledge about this technology, its adoption rate is very slow, as the farmers are afraid of adopting it and are still using traditional practice of farming such as ploughing of field, burning the residues, mono-cropping, etc. The probable reasons for slow adoption rate and in developing countries like India, may be lack of awareness about this technology among farmers, its complexity in comparison to conventional agriculture, high cost of happy seeder and its unavailability. Thus, it can be concluded that, the pros of conservation agriculture technology need to be effectively imparted among stakeholders, so it can be widely adopted by the farmers.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. United Nations, D.o.E.a.S.A., Population Division. World Population Prospects 2019: Highlights. (New York, NY: UN Department of Economic and Social affairs); 2019.
2. FAO. Conservation Agriculture; 2019. Available:http://www.fao.org/conservation-agriculture/overview/what-is-conservation-agriculture/en/ (accessed August 2019).
3. FAO. Food and Agriculture Organization of the United Nations; 2014. Available:http://www.fao.org/ag/ca/6c.html
4. Jat ML, Malik RK, Saharawat YS, Gupta R, Mal B, Paroda R. Proceedings of regional dialogue on conservation agricultural in South Asia, New Delhi, India, 1-2 November, 2011. APAARI, CIMMYT, ICAR. 2012;32.
5. Hengxin L, Hongwen L, Xuemin F, Liyu X. The current status of conservation tillage in China. In: T. Goddard, M.A. Zoebisch, Y.T. Gan, W. Ellis, A. Watson and S. Sombatpanit (eds) No-Till Farming Systems. Bangkok: World Association of Soil and Water Conservation (WASWC). Special Publication. 2008;3:413– 428.
6. Pradhan P, Verma A, Kumar M. Need of conservation agriculture in India: Sustainability. International Journal of Current Microbiology and Applied Sciences. 2018;7(1):2319-7706

7. Bhan S, Behera UK. Conservation agriculture in India – problems, prospects and policy issues. International Soil and Water Conservation Research. 2014; 2(4):1-12.
8. DWR Report. Mitigating adverse effects of climate change through adoption of conservation agriculture-based technologies in MP. ICAR-Directorate of Weed Research Report. 2017;6-12.
9. Bisangwa E. The influence of conservation agriculture adoption on input demand and maize production in butha buthe, Lesotho. MSc Thesis, University of Tennessee, Knoxville; 2013..
10. Novas S. Climate change adaptation measures in agriculture: a case of conservation agriculture for small-scale. farmers in kalomo district of Zambia. Phd Thesis (published), Department of Environmental and Geographical Science, University of Cape Town, South Africa; 2015.
11. FAO. Save and grow, a policymaker's guide to sustainable intensification of smallholder crop production. Food and Agriculture Organization of the United Nations, Rome. 2011;116.
12. FAO. Food and Agriculture Organization of the United Nations; 2012. Available:http://www.fao.org/ag/ca/6c.htm
13. FAO. Investing in Sustainable Crop Intensification: The Case for Soil Health. Report of the International Technical Workshop, FAO, Rome, July. Integrated Crop Management. Rome: FAO. 2008;6. Available:http://www.fao.org/ag/ca/.
14. Albertina, Barbito. How conservation agriculture help to alleviate poverty. PhD Thesis (Published). A Universidade Católica de Moçambique, South Africa; 2013.
15. Aggarwal PK, Joshi AK, Jat RK. Climate Smart village program in Madhya Pradesh for enhancing food, nutrition and economic security; 2016.
16. Aga khan Rural Support Programme Report. Sustaining Soil Health with Conservation Agriculture. 2016;32-34.
17. Theodor F, Rolf D, Amir K. Overview of the global spread of conservation agriculture. Field Actions Science Reports. 2012;6.
18. Derpsch R, Friedrich T. Global overview of CA: No-till adoption. World Congress of Conservation Agriculture. 4th World Congress on Conservation Agriculture New Delhi, India. 2009;4 – 7 February 2009.
19. Singh A, Virk HK, Brar SS. Studies on source of information and constraints for the adoption of zero tillage technology among the adopters and non-adopters under the Punjab Conditions. Zero tillage – the voice of farmers. 2003;49-52.

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