***Original Research Article***

**Do non-economic factors can overcome the mindset barriers in adoption of Sustainable Agriculture?**

**Abstract**

Conservation agriculture (CA) is a set of practices widely promoted to increase the productivity along with conserving soil through crop rotation, reduced tillage and mulching. The research explored the constraints to CA adoption through pre-tested schedule from 180 respondents from Purnea district of Bihar. Though the farmers described many benefits in adopting but the adoption level among the farmers varies significantly due to the constraint factors responsible for the adoption of CA. It has been difficult to scale up conservation technology because these social variables have not been taken into account in upscaling methods. The ramifications of these findings are examined and solutions to combat farmers' decision inertia are suggested. A multifaceted strategy is needed to encourage rational decision-making in the use of CASI technology by the farmers.

**Keywords:-** Barriers, Factors, Non-Economic, Sustainable Agriculture.

**Introduction**

Farm management decisions made by farm households have a significant impact on the adoption and adaptation of new technologies and their subsequent performance on farms. Behavioural economics tools and techniques are increasingly being applied to analyze decision-making in the realm of agriculture (Lagi et al., 2015), farm management and the environment (Mills et al., 2017). The application of behavioural economic principles as a tool for stakeholders and policymakers in designing economic policy programs for sustainable and effective practices is drawing attention from researchers in agriculture. Despite the introduction of numerous good agricultural technologies, acceptance rates vary among farmers and the adoption rates are frequently lower than expected as individual has well-defined preferences and unbiased expectations and beliefs and they make optimal decisions on the basis of these beliefs and preferences, implying infinite cognitive and will powers. In practice, however, decision-making is influenced by a range of non-economic factors and people frequently act irrationally. Applying this expertise will improve the provision of extension services and the supplementary assistance that farmers require to increase the adoption and effectiveness of innovative farming systems. Economic utility maximization assumptions have served as the foundation for farm-household decision analysis for decades; however, failure of neo-classical economics to completely explain individual choices has prompted consideration of other possibilities. The use of behavioural economics in describing human behaviour has been discovered in recent studies on consumer behaviour, finance and policy (Samson, 2014; Kahneman, 2011).

One of the most serious and potential threat to global agriculture and food security continues to be climate change. The poverty of farmers in the area was exacerbated by other challenges such as labour migration, expensive inputs and low productivity. The use of better managerial techniques and cutting-edge technology can reduce labour requirements while simultaneously saving time, money, energy and other resources. By improving farmer decision-making, farms are likely to be better managed and more resilient, which will benefit farm-households. But in reality often only a relatively small number of factors actually contribute to a decision (Gigerenzer and Gaissmaier, 2011). Farmers' and service providers' behaviour is influenced by behavioural characteristics (including personal, social and cognitive factors) and these factors may limit or facilitate the adoption of Conservation Agriculture Sustainable Intensification (CASI) technologies. CASI technologies were found to be a low-cost and high-income technology; however its beneficial effects were not extended to farmers all over the country. Therefore, the research is specifically carried out to investigate the underlying behavioural component impeding the adoption of CASI technologies in Bihar in order to capture this nuance in the decision-making behaviour of the farmers.

**Methodology**

*Data and Descriptive statistics*

The research is carried out using primary data collected from the farmers of four villages namely Diwanganj and Srinagar of Purnea East block and Basantpur and Dogachi of Kasba Block in Purnea district of Bihar to study the non- economic factors responsible for the adoption of Conservation Agriculture (CA) technique by the farmers. The data was sampled from 180 farmers, of which 86 farmers were categorized as Adopter farmers and 94 farmers as non- adopter farmers of CA Technology with the help of Snow Ball sampling technique. The study was conducted during the period of 2021-22.

Five-point Likert type scale (Likert, 1932) was used primarily to document the responses of the farmers on the perspectives of non-economic factors that has impact on the decision making behavior of the farmers. This scale constituted various assertions and participants were asked to indicate how much they agree or disagree with the provided statement. Here, all the assertions taken together indicated a certain aspect of the attitude toward the subject, making them inextricably tied to one another (Singh, 2006). The response continuum of 1 indicated Strongly Disagree, 2 as Disagree, 3 as undecided or Neutral, 4 as Agree, and 5 as Strongly Agree with the statements. While the factors such as attending training on CA, member/ participant of any group/cooperative were answered as “0” indicating “No” and “1” indicating “Yes” and the factor i.e. participation of household head in decision making” was scored as 1 indicating decision made by only husband, 2 indicating mainly by husband and 3indicating both husband and wife.

Further, Mann-Whitney *U* test was used to compare the behavioural differences between CA Adopters and Non-Adopters. This test was used to see whether a significant difference existed in level of satisfaction/ agreement in the variables included between adopters and non-adopters in the process of decision making on the adoption of CA. The Mann–Whitney *U* test is a non-parametric test which is equivalent to t- test that determines whether the two independent samples are from same population or not. It requires an ordinal level of measurement and is more powerful than the median test since it uses the ranks of the cases. *U* signifies how often a value from the first group comes before a value from the second group when values are arranged in ascending order. (Conover,1980).

A standard statistical software package, SPSS Inc. version 23, was used to analyse the results. In the first step, descriptive statistics was used to evaluate the response frequencies, median, minimum and maximum values. Then non-parametric test (Mann–Whitney U-test) was applied to compare the significant factors of the observed variables across the two groups. The focus of this analysis was to pinpoint those independent variables which best predict adoption decisions by the farmers. Factors considered were self-efficacy measures, collective efficacy measures, social support, environmental perception, information seeking behaviour, attitude of the farmers, participation in committee/groups and training needs access to information.

**Results and Discussion**

The research covers potential success factors and different individual and collective motivations for adopting conservation agriculture, it also points to a series of barriers and problems. Adopters and non-adopters were asked about the relative importance of several factors when deciding to adopt CA, as well they were asked about the relevance of the same factors when deciding to adopt CA in future. The answers to the questions were scored on 5-point Likert Type Scale with 1 being the least significant and 5 being the most crucial. The results are presented in Table 1.

Mann-Whitney *U* test indicated that among all the variables, the variables that has significant impact on decision making by the farmers whether to adopt the technology on CA or not included obtaining assistance or support needed to adopt CA, prepared to take out loans to secure funds, trying to overcome the challenges in adoption, knowledge on CA technology, training attended on CA and member or participant of any groups or associations as the p-value =0.000 <0.05 whereas willingness to take risk to try new technology on their farm is less significant as the p-value =0.001 <0.05. The variables that do not differs significantly in decision making between adopters and non-adopters include access to information (p-value =0.182 >0.05), getting information on the advantages and disadvantages of using ZT machines (p-value =0.851 >0.05), reducing drudgery for both male and female (p-value =0.621 >0.05), Extension services used by farmer (p-value =0.160 >0.05) and participation of household head in decision making on farming, allocation of farm resources and investments, household expenditure, adoption of new farm technologies and attending training/ exposure visit/ meetings (p-value =0.720 >0.05). The farmers actively participating in awareness and training programmes inculcates the habit of being innovative and are more likely takes risk to adopt CA techniques on their farm. On the other hand, non-adopter group of farmers could not take decision to adopt the technology due to their poor decision making and risk bearing ability.

**Table1: Summary descriptive statistics and Mann–Whitney *U*-test.**

|  |  |  |  |
| --- | --- | --- | --- |
|  **Particulars** | Adopter (n=86) | Non- Adopter (n=94) | Mann-Whitney *U* test p-value |
| Median | Min. | Max. | Median | Min. | Max. |
| Access to Information  | 3.57 | 1 | 5 | 3.43 | 2 | 5 | 0.182 |
| Assistance to adopt CA | 4 | 3 | 5 | 3 | 1 | 5 | 0.000 |
| Ready to opt for loans  | 4 | 2 | 5 | 2 | 1 | 4 | 0.000 |
| Persistent to overcome challenges  | 4 | 2 | 5 | 4 | 1 | 5 | 0.000 |
| Keen to get information (advantages and disadvantages) | 5 | 3 | 5 | 5 | 4 | 5 | 0.851 |
| Talked to Service Providers to plant some farm with ZT machine | 5 | 3 | 5 | 2 | 1 | 5 | 0.000 |
| Willingness to take risk with new practices | 3 | 2 | 5 | 3 | 1 | 4 | 0.001 |
| Reduces drudgery  | 5 | 4 | 5 | 5 | 4 | 5 | 0.621 |
| Extension services used  | 3 | 1 | 5 | 3 | 1 | 5 | 0.16 |
| Sufficient knowledge on CA  | 4 | 3 | 5 | 2 | 1 | 4 | 0.000 |
| Member of Farmers'/ Cooperative/any committee | 1 | 0 | 1 | 0 | 0 | 1 | 0.000 |
| Training attended on CA | 1 | 0 | 1 | 0 | 0 | 1 | 0.000 |
| Participation of household head in Decision making  | 2.33 | 2 | 3 | 2.17 | 2 | 3 | 0.720 |

Table 2 represents the overall measures adopted by the farmers in the decision making as per the behavioural economic theory to know the measures that has direct and significant relation in deciding to adopt CA on their farms. The null hypothesis (Ho) for such measures states that the distribution of the measures is same across the two categories of farmers and the alternate hypothesis (H1) states that the distribution of such measures is not same across the two categories of the farmers.

The self-efficacy measures of the farmers comprises of believing to overcome objections and negative feedback from family and neighbours, able to manage weed problems on the farm, willingness to take risk, able to pay service providers and to take loans to adopt CASI technology on the farm. Environmental perceptions of the farmer includes position and size of land not hindering the ZT machines, difficulty in obtaining ZT machine, non-uniform seeding leading to low quality and yield and doubts about yield gains with the CASI technology. Information seeking behaviour of the farmer consists of asking information on advantages and disadvantages of using ZT machines, asking Service Providers, neighbours or leading farmers to plant some area with ZT machine. Behavioural attitude of farmer such as willingness to take risk and expand farming activities using new agricultural technology; impulsive nature and planning too far ahead; and satisfaction with the present practices followed. Goals and Aspirations of the farmers included importance of adopting CASI by the family for soil health, profitability, reducing drudgery as well as providing options for other activities and employment. Duality features included CASI method saves time and labour; reduces drudgery for both male and female; increases profit, yield, weed, disease, water infiltration; improves plant vigour, soil quality, cropping intensity; environmental friendly as well as good market output. Personal/individual attributes of farmer comprise of practicing methods of their ancestors, willing to try new practices and approaches, take opinion of other family members, uses latest seed and chemicals, leadership nature, sharing knowledge and work with other farmers, desire to leave legacy of farm etc.

As for self-efficacy measures, environmental perceptions, information seeking behavior, behavioural attitude, goals and aspirations of the farmers, duality in nature, and personal/individual attributes Mann- Whitney U test p-value is found to be less than 0.05 (p- value=0.000<0.05), the null hypothesis is rejected and alternate hypothesis is accepted stating that the distribution of these measures is significantly different among adopter and non-adopter farmers. Therefore, these factors significantly affect the decision-making process of the farmers and has crucial role to play in adopting any new technology introduced by the researchers and the farmers are more likely to adopt CA if these measures remained favourable to them.

The collective efficacy measures of the farmers include forming group and working together to adopt CASI, resolving conflicts with neighbours about sowing and obtaining the necessary resources for sowing as well as sowing their land collectively at the same time by the service providers (p-value =0.844>0.05). Social support included the support from family, neighbours, leading farmers, Government or other extension services, local input suppliers and local NGOs/FPOs/FCs on the idea of adoption of CASI Technology (p-value =0.100>0.05). Outcome expectations and expectancies of farmer comprised of reducing labour use and risk associated with crop, achieving higher yield, better soil quality and plant vigour as well as having more time for other activities and employment apart from farming (p-value =0.385>0.05). As for these measures Mann- Whitney U test p-value is greater than 0.05, null hypothesis is accepted and alternate hypothesis is rejected. Therefore, collective efficacy measures, social support and outcome expectations and expectancies of the farmers do not play significant role in decision making and the distribution of these variables is same across the two categories of farmers i.e. adopters and non-adopters. The farmers are less likely to take into account thse measures while adopting CASI technology even though it could be highly profitable as well environmental friendly.

Table 2: Summary descriptive statistics and Mann–Whitney *U*-test.

|  |  |  |  |
| --- | --- | --- | --- |
| Particulars | Adopter(n=86) | Non- Adopter(n=94) | Mann- Whitney *U* test p-value |
| Median | Min. | Max. | Median | Min. | Max. |
| Self-efficacy measures  | 4.08 | 3 | 5 | 3.08 | 2 | 4 | 0.000 |
| Collective efficacy measures  | 4.20 | 2 | 5 | 4.20 | 4 | 5 | 0.844 |
| Social support  | 4.00 | 3 | 5 | 4.00 | 3 | 4 | 0.100 |
| Environmental perceptions  | 2.50 | 2 | 5 | 3.67 | 3 | 4 | 0.000 |
| Information seeking behaviour  | 5.00 | 4 | 5 | 3.00 | 2 | 5 | 0.000 |
| Outcome Expectations and Expectancies  | 4.57 | 4 | 5 | 4.57 | 4 | 5 | 0.385 |
| Behavioural attitude  | 3.00 | 2 | 4 | 2.67 | 2 | 4 | 0.000 |
| Goals and Aspirations  | 3.80 | 3 | 4 | 4.00 | 3 | 5 | 0.000 |
| Duality in nature | 3.50 | 3 | 4 | 3.38 | 3 | 4 | 0.000 |
| Personal/individual attributes  | 3.50 | 3 | 4 | 3.08 | 2 | 4 | 0.000 |

Figure 1 represents the source of information utilized by adopter and non-adopter farmers on different aspects of crop production, livestock production, new technologies (varieties, methods and techniques), marketing of agricultural products and prices of products. It was found that CA adopter farmers obtain 6.38 per cent information from their own experience or other family members, 7.45 per cent information from neighbours, 23.40 per cent information from extension staff, 17.02 per cent with the used of radio, 22.34 per cent by watching television, 10.64 per cent from farmer’s organization and 12.77 per cent information by the use of internet. While in case of CA non adopter farmers, 19.77 per cent information was obtained from their own experience or other family members, 17.44 per cent information from neighbours, 15.12 per cent information from farmer’s organization and internet sources each, 12.79 per cent by listening to radio, 11.63 per cent by watching television and only 8.14 per cent from extension staffs. The word of mouth plays huge role in transferring information from one person to another and could be more effective way to persuade the non-adopter farmers to take decision in favour of adoption of new technology.

**Fig.1.** Information channel used by adopter and non-adopter farmers.

**Conclusion**

The adoption behaviour of farmers in Bihar varies across socioeconomic classes and is not always intended to boost earnings. To increase the adoption of effective technology, there is a need for additional research on behavioural variables. Farmer decision-making is complicated because it involves a complex interplay of socio-cultural variables, individual decision-making and personal conduct and attitude. It has been difficult to scale up conservation technology because these social variables have not been taken into account in upscaling methods. The ramifications of these findings are examined and solutions to combat farmers' decision inertia are suggested. A multifaceted strategy is needed to encourage rational decision-making in the use of CASI technology by the farmers. Key suggestions include raising awareness, offering technical assistance, reducing risk perception and establishing favourable policy incentives. Peer influence, monitoring and evaluation and farmer-to-farmer learning may also play significant roles in promoting uptake and guaranteeing the long-term sustainability of CASI practices. The region may take steps towards attaining sustainable intensification and resolving the problems of the farmers confront by putting these recommendations into practice.

**References**

Conover, W.J., 1980. Practical Nonparametric Statistics, 2nd ed. John Wiley & Sons, New York.

Gigerenzer, G., Gaissmaier, W., 2011. Heuristic decision making. *Annual Review of Psychology* **62**: 451–482, [http://dx.doi.org/10.1146/annurev-psych-120709- 145346](http://dx.doi.org/10.1146/annurev-psych-120709-%20145346).

Kahneman, D., 2011, Thinking fast and slow, Penguin Random House, UK.

Lagi, M., Bar-Yam, Y., Bertrand, K.Z. and Bar-Yam, Y., 2015. Accurate market price formation model with both supply-demand and trend-following for global food prices providing policy recommendations. *Proceedings of National Academy of Sciences,* USA, **112**: 6119–6128.

Likert, R., 1932. A technique for the measurements of attitudes. *Archives of psychology.* **140**(22): 5-55.

Mills, J., Gaskell, P., Ingram, J., Dwyer, J., Reed, M. and Short, C., 2017. Engaging farmers in environmental management through a better understanding of behaviour. *Agriculture and Human Values*, **34**: 283–299.

Samson, A. and Voyer, B., 2014. Emergency purchasing situations: Implications for consumer decision-making. Journal of Economic Psychology, **44**: 21-33.

Singh, Y.K., 2006. *Fundamental of research methodology and statistics*. New Age International Publishers, New Delhi, ISBN: 978-8-12-241886-6.