# A Study on Analysis of Factors Responsible for Adoption and Non-adoption of Green Technologies in Rice Based Ecosystem

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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

The present study was conducted in Trichy and Madurai district of Tamil Nadu. From each district two blocks were selected. Thus, the total sample size of 240 were selected for the present investigation. Nature of technology (RBQ = 89.29) was the foremost factor governing the adoption of green technologies in technology and cultivation factor, social recognition (RBQ= 75.46) was the primary factor in social factors. Premium price (RBQ=72.58) was the foremost marketing factor followed by subsidies and schemes (RBQ= 73.37) as the paramount economic factor governing the adoption and non-adoption of green technologies as perceived by the farmers. Improvement needs to be done in accessing information by farmers. Most of the farmers felt complexity in the use of

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agricultural invention. This could be rectified by participatory technology development approach where farmers also a part of technology development. The farmers need to be provided with the knowledge of market demand for the produce, which will help the farmers to get more income and wastage of the produce will also minimized.

*Keywords: Green technologies; farming practices; rice based ecosystem; social factor; technological factor; marketing factor; adoption and non-adoption.*

## 1. INTRODUCTION

Globally, agriculture is the most audacious imperative. Agriculture is the process of growing plants and trees as well as domesticating animals in order to provide food, fodder, fibre and other desired items. The use of resources in a sustainable manner prevents the degradation of the environment. [1]. Clear, inexpensive, and pollution-prevention methods that address both social and economic issues make up eco-friendly legislation [2]. Environment friendly pesticides, often known as green or ecological pesticides, are less harmful to the environment and animal health. Eco-friendly agricultural technology for appropriate food production would be essential for guaranteeing food security, enhancing human health and restoring and conserving the environment for the benefit of future generations. It might be desirable to moderate farming practices that are sustainable in all aspects of development. This eliminates the dismay of future cultivation and secures adequate food production in the following decades despite the fact that modern agricultural practices do not appear to be sustainable. For more than two billion people in Asia and hundreds of millions in Africa and Latin America, rice (*Oryza sativa* L.) is the most important food. By 2020, the world's yearly rice production must expand from the current 560 to 750 million tonnes in order to feed the continuously growing population of these regions [3]. Common rice diseases are primarily handled by planting fungicide-treated seeds and applying fungicide to the field, which destroys the naturally present ecological balance [4]. Utilizing environment friendly management techniques may help to prevent environmental pollution and boost rice output. A concurrent study was conducted to determine the factors responsible for adoption and non-adoption of green technologies in Madurai and Trichy districts of Tamil Nadu. In the light of the above mentioned facts, the effectiveness of various eco-friendly management techniques to control rice disease was evaluated to determine the factors for successful crop production.

## 2. METHODOLOGY

### 2.1 Factors Responsible for Adoption and Non-adoption of Green Technologies

The various factors that influence the adoption and non-adoption of green technologies were identified with the help of previous studies, literatures and based on expert opinions. The gathered factors were studied under various dimensions like technology and cultivation, social, as well as marketing and economic factors. Based on the farmer's opinion, they were asked to provide their response and rank these among the several factors in each dimension. Rank Based Quotient (RBQ) developed by Sabaratnam [5] was adopted to rank the factors influencing adoption. The rank given by the farmers were analyzed.i.e. the number of farmers who gave the particular rank were used for calculation of RBQ. The formula for RBQ calculation is as follows

$$RBQ = \frac{(f_i)\,(n+11) \times 100}{N_n}$$

Where,
$f_i$= frequency of farmers for $i^{th}$ rank of constraints parameters
N = number of farmers
n = number of ranks

### 2.2 Factors Responsible for Adoption and Non-adoption of Green Technologies

The factors governing adoption and non-adoption of Trichy and Madurai districts were classified into four types and are listed as follows: technology and cultivation, social, as well as marketing and economic factors. The factors were considered as the perceived responses of the farmers. Subsequently the factors were analysed using the rank-based quotient and discussed accordingly. The data regarding the factors governing adoption and non-adoption of green technologies were collected, analyzed and presented in the following Tables 1, 2, 3, and 4.

## 3. RESULTS AND DISCUSSION

### 3.1 Technology and Cultivation Factors

The results of technology and cultivation factors responsible for adoption and non-adoption of green technologies is presented in Table 1.

Table 1 indicates that Nature of technology (RBQ = 89.29) was the foremost factor governing the adoption of green technologies as perceived by the famers. The easy understanding of implementation of technology is very much needed in the current scenario. The complexity in understanding and implementation of technologies may lead to its failure and non-adoption.

Labour intensity (RBQ= 83.79) was the second most important cultivation factor as perceived by the farmers, that govern the adoption of green technologies. With acute labour shortage existing in farming sector due to various reasons, labour intensity gains importance in decision making regarding adoption of green technologies. Labour intensive technologies tend to push the farmers towards non adoption, since it may have social and financial implications on the whole. In most cases, farmers adopting green technologies, prefer use of family labour thereby reducing the cost.

Table 1 also revealed that Availability of raw materials (RBQ= 82.92) was one of the most important cultivation factors governing the adoption of green technologies as perceived by the farmers. Most of the inputs involved in green technologies are known to be produced locally by the farmers themselves and that, attach importance to raw materials. The readily available raw materials ease their work and also saves time and cost for the farmers.

Farm size (RBQ = 74.88) was revealed to be the fourth most important factor governing the adoption and non-adoption of green technologies as perceived by the farmers. Success and spread of any technology in our country is largely dependent on farm size due to the nature of land fragmentation. Though it may not have specific implications on adoption of green technologies, the perception is that large land holding farmers naturally tend to readily adopt technologies on a small scale due to the availability of land resources. The cushion of splitting the land for different purposes among the big farmers may facilitate this perception. Hence farm size is also

perceived as one of the important factors governing the adoption of green technologies by the farmers. This results are in contrast to the findings of Mozzato et.al. (2018).

Table 1 also reveals that Maintenance cost (RBQ= 68.54) was the fifth ranked factor governing the adoption and non-adoption of green technologies as perceived by the farmers. There are various technologies that may require a once off investment and continue to deliver benefits throughout the cropping period. If any technology requires continuous investment of money and resources throughout the cropping period, the farmers may rethink and reconsiders their decision about implementing it. This may explained the reason behind maintenance cost being considered as a factor governing adoption and non-adoption of green technologies by the farmers.

It can be deduced from Table 1 that Time consumption (RBQ= 63.54) was the sixth ranked factor governing the adoption and non-adoption of green technologies, as perceived by the farmers. In the context of the present study, time consumption is considered as the delay in observability of the outcome set to be delivered by the technology. Irrespective of how beneficial the technology may prove to be in long term, the farmers believe in change that could be observed in the field. Hence the time consumed by various green technologies to produce favourable results that could be observed, might play a role in decision making of the farmers regarding its implementation. This would explain the reason behind time consumption being perceived as one of the factors for adoption and non-adoption of green technologies by the farmers.

Table 1 also shows that the Knowledge on bio fertilizers and bio pesticides (RBQ=62.13) was perceived as the seventh ranked factor governing the adoption and non-adoption of green technologies by the farmers. Bio fertilizers and bio pesticides form an integral part of green technologies as they essentially form the alternative for chemical fertilizer and pesticides. The famers tend to decide on adoption based on their knowledge as they may be able to compare the relative advantage of green technologies over the existing ones.

Rainfall and change in seasonal cycle (RBQ= 59.13) and severity of pests and diseases (RBQ=51.2) were the least ranked factors governing the adoption and non-adoption of

green technologies as perceived by the farmers. Considering the context of the present study, it could be understood that seasonal changes in pest and disease incidences had similar effects in decision making irrespective of whatever the technology might have been. These results are in accordance with the findings of Vo Hong Tu et al. [6].

## 3.2 Social Factors

The Social factors responsible for adoption and non-adoption of green technologies is analysed and presented in Table 2.

Table 2 reveals that Social recognition (RBQ= 75.46) was the foremost factor governing the adoption and non-adoption of green technologies as perceived by the farmers. Social recognition had become a larger part of life in villages and essentially a by-product of the stigma that exists in the society. Irrespective of financial motives, recognition among their peers will drive the farmers towards implementation of certain things. There are instances where a farmer trying to go back to basic principles and following green agricultural practices are being looked up to  as an inspiration and getting due recognition. Hence social recognition may push a farmer towards deciding on adoption or non-adoption of the green technologies.

Connectivity with scientists and officials (RBQ= 75.38) was the second highest factor governing the adoption and non-adoption of green technologies as perceived by the farmers. The farmers tend to follow the conventional farming practices involving chemicals due to its observable benefits and by general practice of use. When they possessed better contact with the extension officials and scientists, the farmers tend to have positive attitude towards adopting the technologies advised by them. It may be due to the improvement in awareness and knowledge regarding the green technologies, under the influence of contact with the extension personnel and scientists.

Wide social network (RBQ= 74.70) and Social prestige (RBQ= 73.38) were the last two ranked factors governing adoption and non-adoption of green technologies as perceived by the farmers. Wide network is all about maintaining healthy communication with fellow farmers and sharing information between themselves. This may also result in improvement of their awareness and knowledge about the green technologies, subsequently governing their decision making towards adoption and non-adoption of it. Social prestige may push the farmers towards showing their individuality amongst their peers by implementing green technologies, though not common among them.

**Table 1. Technology and cultivation factors responsible for adoption and non-adoption of green technologies n=240**

| S.No. | Factors | Rank based quotient | Rank |
|---|---|---|---|
| I | **Technology and cultivation factors** | | |
| 1 | Nature of technology | 89.29 | I |
| 2 | Labour intensity | 83.79 | II |
| 3 | Availability of raw materials | 82.92 | III |
| 4 | Farm size | 74.88 | IV |
| 5 | Maintenance cost | 68.54 | V |
| 6 | Time consumption | 63.54 | VI |
| 7 | Knowledge on bio pesticides and bio fertilizers | 62.13 | VII |
| 8 | Rainfall and change in seasonal cycle | 59.13 | VIII |
| 9 | Severity of pests and diseases | 51.21 | IX |

**Table 2. Social factors responsible for adoption and non-adoption of green technologies n=240**

| S.No. | Factors | Rank based quotient | Rank |
|---|---|---|---|
| 1 | Social recognition | 75.46 | I |
| 2 | Connectivity with scientists and officials | 75.38 | II |
| 3 | Wide social network | 74.70 | III |
| 4 | Social prestige | 73.38 | IV |

## 3.3 Marketing Factors

Marketing factors responsible for adoption and non-adoption of green technologies is analysed and presented in Table 3.

Table 3 reveals that Premium price (RBQ=72.58) was the foremost marketing factor governing the adoption and non-adoption of green technologies as perceived by the farmers. The growing brand value of organic produce in urban markets is a positive sign and attracts the farmers towards adoption of green technologies. The farmers who are already affected by fluctuating prices for their produce in the market, relish the opportunity to fetch premium price through branding of their organic produce. The prospects of farmers choosing green technologies for certification and branding subsequently fetching premium price is always improving. Hence this might be the reason why farmers perceived premium price as the most important marketing factor governing the adoption and non-adoption of green technologies.

It is evident from Table 3 that Change in consumer demand (RBQ=71.54) was the second highest ranked marketing factor governing the adoption and non-adoption of green technologies. As the economy of people is improving, there is a major shift in the consumer demand towards organic products owing to the awareness about health benefits and sustainability. The consumers who form the major chunk of consuming branded products are gradually moving towards labelled organic products. As consumer preference is changing and owing to the growing demand, farmers are motivated to decide on implementing the green technologies and ensure supply of good quality organic produce in the market. Hence this might be the reason why change in consumer demand was perceived as one of the most important marketing factors governing the adoption and non-adoption of green technologies by the farmers.

Table 3 implies that Good returns (RBQ= 69.42) was the third highest ranked marketing factor governing the adoption and non-adoption of green technologies, as perceived by the farmers. Good returns could be understood in the context of better net income, since the expenditure incurred in inputs when green technologies were implemented tends to be lesser comparatively. Thus, the final returns may still be adequate, irrespective of the gross output. Hence good returns from output was perceived as one of the important marketing factors governing the adoption and non- adoption of green technologies by the farmers.

Table 3 also shows that Price fluctuation (RBQ=67.50) was the fourth highest ranked factor governing the adoption and non-adoption of green technologies, as perceived by the farmers. Price fluctuation is a common occurrence in most agricultural markets and tends to influence the decisions of farmers regarding choice of crop and sowing season in many cases. Similarly, in a few cases, it may also push the farmers towards changing their decisions on the type of farming they take up. Though not in all cases, it was understood that price fluctuation was perceived by some farmers to be one of those factors governing the adoption and non-adoption of green technologies.

Lack of surety about markets (RBQ= 63.04) and Delay in price settlements (RBQ=61.29) were the lowest ranked marketing factors governing the adoption and non-adoption of green technologies as perceived by the farmers. In a few case, the absence of exclusive markets for organic produce in most cases and lack of avenues in existing markets may demotivate the farmers. Though delay in price settlement was not an exclusive issue pertaining to green technologies the farmers may consider it before decision making in few cases. These two factors contribute a little in decision making towards adoption and non-adoption of green technologies by the farmers.

**Table 3. Marketing factors responsible for adoption and non-adoption of green technologies n= 240**

| S. No. | Factors | Rank based quotient | Rank |
|---|---|---|---|
| 1 | Premium price | 72.58 | I |
| 2 | Change in consumer demand | 71.54 | II |
| 3 | Good returns | 69.42 | III |
| 4 | Price fluctuation | 67.50 | IV |
| 5 | No sure Markets | 63.04 | V |
| 6 | Delay in price settlements | 61.29 | VI |

**Table 4. Economic factors responsible for adoption and non-adoption of green technologies n= 240**

| S. No. | Factors | Rank based quotient | Rank |
|--------|---------|---------------------|------|
| 1 | Subsidies and schemes | 73.37 | I |
| 2 | Credit facilities | 68.54 | II |
| 3 | Labour cost | 51.20 | III |
| 4 | Input cost | 49.08 | IV |

## 3.4 Economic Factors

The results of Economic factors responsible for adoption and non-adoption of green technologies is analysed and presented in Table 4.

The Table 4 revealed that Subsidies and schemes (RBQ= 73.37) was the foremost economic factor governing the adoption and non-adoption of green technologies as perceived by the farmers. Subsidy played a major role in implementation of many programs and successfully disseminated innovations among the farming community. It is considered as an incentive for the farmers to encourage them for adoption on a trial basis. When financial security is available in the form of subsidies, the farmers may be motivated to try out green technologies alike any other agricultural technology. When specific schemes are introduced to promote the use of green technologies, there is every chance for the farmers to be aware, possess knowledge and avail input under the same. Hence it could be understood that subsidies and schemes was being perceived as the most important factor for the adoption and non-adoption of green technologies by the farmers.

Credit facilities (RBQ= 68.54) was the second highest ranked factor governing the adoption and non-adoption of green technologies as perceived by the farmers. Availability of credit at the right time is very important for the scheduling of farming activities, irrespective of the type of farming being followed. Especially in the context of the present study, it was understood that the farmers expected credit facilities since they are implementing practices different from the conventional way and it requires some additional support. This may explain the reason why credit facilities may govern the adoption and non-adoption of green technologies by the farmers.

Labour cost (RBQ=51.20) and Input cost (RBQ=49.08) were perceived as the least ranked factors governing the adoption and non-adoption of green technologies by the farmers. In the context of the present study, input cost may be considered minimal in the case of the implementation of green technologies. While the preference towards labour still remained within the family, labour cost not a factor, especially in decision making. The problem of input cost was also minimal, considering the nature of inputs used and procurement locally. Hence it could be understood that input and labour cost were the least governing factors in adoption and non-adoption of green technologies by the farmers. The findings are in accordance with Anbuoli [7].

## 4. CONCLUSION

Among the factors governing the adoption and non- adoption of green technologies by the farmers, nature of technology, social recognition and subsidies and schemes were the major factors. Complexity of utilizing the technology would reduce its appeal and purpose and may decline over a shorter period. The information access to the technology needs improvement and the technologies could be reinvented into a more simplified approach, evading complexity in all the farm visits and trainings. It may enable them to demand better price from the market forces and improves the chance of better returns for the farmers. Utilizing the positive environment prevailing regarding preference of the urban population towards sustainable products, better price should be ensured by channeling the market demand in the right direction. This will in turn, encourage more and more farmers to gradually utilize green technologies on their farms.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

## REFERENCES

1. Reijntjes C, Haverkort B, Bayer A. Farming for the future: An introduction to low external input and sustainable agriculture, London. Macmillian Press; 1992.

2.  Darling B, Suji, Satish Kumar AM. Study on adoption of Eco-friemdly technologies and their constraints. Plant Archives. 2020; 20(1).
3.  Saranraj P, Stella D. Fungal amylase - A review. Journal of Microbial Research. 2013;4(2):203-211.
4.  Devi PI, Solomon SS, Jayasree M. Green technologies for sustainable agriculture: Policy options towards farmer adoption. Indian Journal of Agricultural Economics. 2015;69 (902-2016-68343): 414-425.
5.  Sabaratnam N, Awan IU, Qadir J. Improving synthetic fertilizer use efficiency through bio-fertilizer application in rice. Gomal University Journal of Research. 2013;29(2):32-38.
6.  Vo Hong To, Nguyen Duy Con, Yoshifumi Takahashii, Steven W. Kopp and Mitsuyasu Yabe. Modelling the factors affecting the adoption of eco-friendly Rice Production in the Vietnamese Mekong Delta. Cogent Food and Agriculture. 2018; 4(1).
7.  Anbuoli P. Factors influencing coconut cultivation and marketing in Madurai district Tamil Nadu. Adalya Journal. 2019; 8(12).