



Investigating the leading drivers of organic farming: A survival analysis

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ABSTRACT: *This research evaluated farmers' decisions to adopt organic farming. It was first introduced by developed countries to minimize environmental impacts originated by intensive use of synthetic fertilizers and pesticides to enhance production yield. Although, organic farming offers environmentally sound methodologies for crop production, but Asian farmers are reluctant to adopt organic farming. In this study, a survival analysis (SA) was employed to determine the reasons for and the time is taken by farmers to adopt organic agriculture. This research studied the farmers' goals, agricultural policies, and attitude towards risk, as covariates in the survival analysis. A multiple criteria decision-making method based on the Analytic Hierarchy Process was used to evaluate the farmers' goals. Data were collected from agricultural farms located in three districts in Punjab, Pakistan. A questionnaire was used to collect empirical evidence. This study reported that the farmers' goals were crucial to their acceptance of organic farming; furthermore, young farmers and farmers with risk-inclined attitudes were more prone to adopting organic farming. The study also determined that change in policy and introduce special package for organic agriculture can encouraged the adoption of organic methods.*

Key words: farming method, organic farming, yield, farmer attitude, survival analysis.

Investigando as principais formas de impulsionar a agricultura orgânica: uma análise de sobrevivência

RESUMO: *O objetivo do presente estudo é avaliar as decisões dos agricultores de adotar a agricultura orgânica. Foi introduzido pela primeira vez por países desenvolvidos para minimizar os impactos ambientais originados pelo uso intensivo de fertilizantes sintéticos e pesticidas para aumentar o rendimento da produção. Embora a agricultura orgânica ofereça metodologias ambientalmente corretas para a produção agrícola, os agricultores asiáticos relutam em adotar a agricultura orgânica. Neste estudo, uma análise de sobrevivência (SA) foi empregada para determinar os motivos e o tempo que os agricultores levam para adotar a agricultura orgânica. Esta pesquisa estudou os objetivos dos agricultores, as políticas agrícolas e a atitude em relação ao risco, como covariáveis na análise de sobrevivência. Um método de tomada de decisão de múltiplos critérios com base no Processo de Hierarquia Analítica foi usado para avaliar os objetivos dos agricultores. Os dados foram coletados em fazendas agrícolas localizadas em três distritos de Punjab, Paquistão. Um questionário foi usado para coletar evidências empíricas. Este estudo descobriu que os objetivos dos agricultores eram cruciais para aceitação da agricultura orgânica; além disso, jovens agricultores e agricultores com atitudes inclinadas ao risco eram mais propensos a adotar a agricultura orgânica. O estudo também determinou que a mudança na política e a introdução de um pacote especial para a agricultura orgânica podem estimular a adoção de métodos orgânicos.*

Palavras-chave: método de cultivo, agricultura orgânica, produção, atitude do agricultor, análise de sobrevivência.

INTRODUCTION

Organic agriculture has become a hot issue in debates linked with environmental protection, health foods, sustainable natural resources, and social welfare. The rapid growth of the world population has threatened food availability (BURTON et al., 2003). To cope with this problem, farmers were using

external inputs such as fertilizer and pesticides to increase crop yield (GODFRAY et al., 2010). These inputs hurt human health, besides damaging the environment and the entire ecosystem (AUERBACH, 2013); that's why public authorities were encouraging farmers to take up environmentally friendly practices, one of which was organic agriculture (ABDULAI & HUFFMAN, 2005). Organic agriculture relied on

agronomic, biological, and other natural resources that could not harm local conditions or needs (BAKER & MOHLER, 2015). So, trend of organic agriculture adoption has been increasing continuously since past few years. Countries in Oceania (Australia, New Zealand, Pacific island groups) have 17.3 million hectares of land and are currently the world leaders in organic agriculture, contributing to 40% of world organic production (DADI et al., 2004). This was followed by Europe, America (Latin America, North America, & The Caribbean), Asia, and Africa, each with 11.6, 9.8, 3.6, and 1.3 million hectares of land and contributing 27%, 22%, 8%, and 3% of world organic production, respectively (WILLER & LERNOUD, 2016). Pakistan was also considering adopting organic agriculture because of its environmentally sound results (DE SOUZA FILHO et al., 1999). First it was able to reduce the pressure on import of farm inputs and can also export organic product more specifically China via China Pakistan economic corridor (CPEC) (AKRAM et al., 2019b). Secondly government wanted to tackle the human health, soil degradation and environment challenges through organic farming (AKRAM et al., 2019a). For this reason, country established a Directorate of Organic Farming in 2008 to facilitate small-scale farmers and improve organic farming. Later, the Directorate has renamed the National Institute of Organic Agriculture with a new scope that included training farmers, applying new technologies, using bio fertilizers and bio pesticides, and increasing awareness of organic farming (KIEFER, 1988; LANCASTER, 1992). The rapid growth of organic farming has been evident for quite a while. Even after ten years of organic farming in Pakistan, the rate of adoption was still shallow compared to its neighbouring countries (AKRAM et al., 2020). The total area of organic agriculture in Pakistan was 51304 ha in 2017, which made up only 0.1% of the total agricultural land in Pakistan. Although, this area was 11.7% more than last year, and launched a system that registers organic farming practices used by traders and organic farmers, and hitherto, more than 5,000 farmers and agricultural students have been trained in organic farming practices (<http://www.parc.gov.pk/index.php/en/nioa-achievements>) but was still lower than its potential (WILLER & LERNOUD, 2019).

Different studies investigated different parameters to adopt organic farming (FEDER & UMALI, 1993; GARDEBROEK, 2006). In general, previous studies on adoption attitude have neglected considering the implementation time period of organic agriculture and the effect of time-sensitive elements

(RIGBY et al., 2001; DE COCK, 2005; GENIUS et al., 2006; ISIN et al., 2007; MZOUGH, 2011). In addition, the diffusion approach did not consider the question of why a farmer would adopt organic farming before other farmers (BURTON et al., 2003). An alternative technique called survival analysis (SA) could be used to investigate the diffusion aspect and decision-making aspects inorganic agriculture adoption (KNOLL et al., 2018). This method broke down cross-sectional and time-variation information mutually in a dynamic structure (MCWILLIAMS & ZILBERMANFR, 1996). SA allowed the researchers to determine why farmers embraced organic agriculture, the time limit to embrace this type of agriculture, and the variables that caused impact on perceived time variables. SA has taken into account the deviation in explanatory variables between time and farmer; and therefore, enabled the collective study of diffusion and adoption (SGROI et al., 2015; MEIER et al., 2015; REGANOLD & WACHTER, 2016; SCHRAMA et al., 2018; FROEHLICH et al., 2018).

This examined the adoption of organic farming in Pakistan using the SA approach. The main aim of the study was to evaluate the impact of farmer's attributes, views, and attitude, cultivation arrangement, outputs, and efficiency of farm supervision, and different external variables on organic farming adoption. This study will add to the body of knowledge in this field by employing a SA analysis to prove that farmers' goals are a significant aspect of explaining conversion decisions. It explored the influence of farmer's approach and opinion on the adoption of organic agriculture and presents the farmers' preferences of risk in one model. In addition, the effect of organic policy during the adoption period is also examined. Another input of this paper is the consideration of a random control function, which described the adoption of all organic farm data that has never been considered previously. Comprehensively, this study is a new addition to the rare literature on organic adoption duration and, more specifically, focuses on a lesser-studied country, Pakistan.

The rest of this article is ordered as follows: Part 2 explains the influential factors impacting organic farming adoption; Parts 3 and 4 present the theoretical framework and empirical application, respectively; and Part 5 presents the results and defines the conclusion of the study.

Factors that lead to the adoption of organic farming

Several articles have been published on variables that affect organic farming adoption (PADEL & LAMPKIN, 1994; RIGBY et al., 2001; KNOWLER

& BRADSHAW, 2007). Some emphasized on the modification of organic farming (RIGBY et al., 2001; ULLAH et al., 2015; FROEHLICH et al., 2018). Conversely, this study introduced new dimensions of organic farming by reviewing the latest studies, their application of methods, and target populations (Table 1). The most important variables that may affect the adoption decisions of farmers towards organic or conventional agriculture were determined by reviewing the prior literature according to the guidelines below:

Farmer' personal attributes: age, gender, marital status, education, etc.

Structural management of farm: size of farm, location, fertility, farm mechanization, etc.

Operational management of farm: irrigation source, crop rotation, use of inputs, etc.

External variables: information source, size of market, government policies, subsidies, input cost, output prices, conversion cost, etc.

Farmer's opinion and approach: farmer's approach towards the environment, lifestyle,

Table 1 - Review of Previous studies.

Method of Analysis	Sample Size	Region	Study
Bayesian Logistic Growth Model	16	The Netherlands	Gardebroek and Jongeneel (2004)
Bayesian Spatial Durbin Probit Model	600	Ireland	Läpple and Kelley (2014)
Binary Choice Model	CF=388 OF=143	Czech Republic	Mala and Maly (2013)
Binary Logistic Regression	100	Pakistan	Ullah et al. (2015)
Decision Tree Modeling	CF=12 OF=9	Austria	Darnhofer et al. (2005)
Dynamic Linear Programming		Denmark	Acs et al. (2007)
Endogenous Switching Regression Model	386	Ghana	Kleemann et al. (2014)
Empirical Switching Regression Model	247	USA	Kuminoff and Wossink (2010)
Focus group	61	USA	Hanson et al. (2004)
Linear programming simulations	685	Belgium	Kerselaers et al. (2007)
Investment under uncertainty		Germany and Austria	Musshoff and Hirschauer (2008)
Logit Regression Model	CF=45 OF=150	Bangladesh	Sarker et al. (2009)
Logistic Regression Analysis	172	Thailand	Thapa and Rattanasuteerakul (2011)
Multi-disciplinary approach(chi-square test)	OF= 29	South Africa	(Niemeyer and Lombard, 2003))
Multinomial Logit Regression	CF=134 OF=38 IP= 71	France	Mzoughi (2011)
Multinomial Logit Regression	CF=118 OF=28	USA	Anderson et al. (2005)
Multinomial Logit Regression	CF=696 OF=284	Norway	Koesling et al. (2008)
Multiple regression analysis	OF=65	Nepal	Kafle (2011)
Option Theory	CF=167 OF=80	USA	Kuminoff and Wossink (2005)
Ordered Probit Model	CF=118 OF=44 PF= 75	Greece	Genius et al. (2006)
Ordered Probit Model	254	Spain	Calatrava-Requena and González (2008)
Probit Model	CF=107 OF=20	Turkey	Isin et al. (2007)
Theory of Planned Behavior	CF=4593 OF=230	Latvia and Estonia	Kaufmann et al. (2009)

recognition from rural society, environmental and health hazards, etc.

The variables studied in this research are listed in table 2. These have been commonly used to explain the adoption of organic agriculture and their impact on adoption decision. Highly educated young women have a higher tendency to adopt organic farming. Conversely, more seasoned farmers with important informal organizations are less inclined to adopt organic farming. Family farms have more tendencies to convert, including farmers with their own land, farmers with an easy source of irrigation, and farmers with fertile soil. A farmer's personal attributes may also affect his or her conversion to organic farming. Besides, farmers that are well aware of environmental issues, healthy food, and the degradation of soil, are also more likely to adopt organic farming. Moreover, these kinds of farmers are well informed about economic variables and new trends in farming, such as the use of electronic gadgets, including smartphones, the Internet, etc. This study also explained the vital role of government policies, subsidies, and the premium price of organic products as influential variables in organic farming adoption

MATERIALS AND METHODS

According to the literature review conducted in this study, five categories of factors affected the decision to adopt organic farming. These categories were the farmer's personal attributes, the structural management of the farm, the operational

management of the farm, external variables, and the farmer's opinion and approach. The farmer's goals and intentions were also considered as a new addition to the previous literature, specifically in Pakistan. Therefore, this study employed Principal Component Analysis (PCA) used to summarize the farmers' opinion and approach and group them into components while AHP was employed to evaluate the goal and intentions of the farmer as a multi-condition decision-making method to evaluate farmers' goals, to which the study proved that these measures area standard variable of survival analysis (SA).

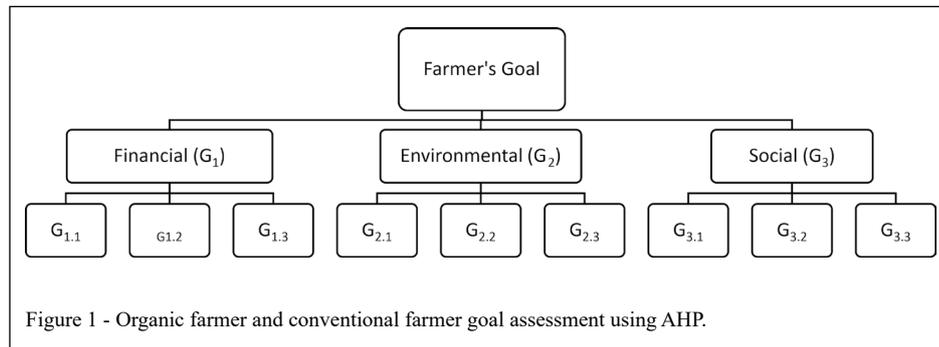
The analytic hierarchy process (AHP)

As stated earlier, it was assumed that the farmer's goal could be a vital element in the decision to adopt organic farming (DE COCK, 2005). However, collecting data about the overall significance of each farmer's goals was complex. A previous research explained that AHP offered multi-criteria decision-making in specific situations (SAATY, 1977). To assist in decision-making, AHP allowed the researcher to evaluate every goal of the farmer. As part of the AHP analysis, a survey was conducted among farmers who were asked to rate different goals on a scale according to their priorities, as shown in figure 1. The main goal was then categorized into three groups, which included financial, environmental, and social. Then, each category was further split into three sub-categories.

The goal's weight or comparative significance was obtained from conducting a matching assessment. To make these assessments and to decide

Table 2 - Impact of different variables on the decision to adopt organic farming.

Variable	Impact direction	Variable	Impact direction
Education	Positive	Risk-averse	Negative
Age	Negative	Farming experience	Negative
Farm size	Negative	Farmer lives in an urban area	Positive
Other economic activity	Positive	Home to farm distance	Negative
Attitude towards conversion	Positive	Soil analysis	Positive
Consideration of degradation of soil	Positive	Use of information technology	Positive
Irrigation facility	Positive	Neighbor Organic farm	Positive
Soil fertility	Positive	Agriculture conference	Positive
Family labor	Positive	Concern for human health	Positive
Hired labor	Positive	Government Or external support	Positive
Information source	Positive	Access to credit	Negative
Protection of the environment	Positive	Food safety	Positive
Farmer organization	Positive	Social contact	Negative
-----Source: Elaboration based on literature review-----			



the significance of inclinations for every choice, a scale of 1 to 9 was used (SAATY, 1980). By comparing each goal to all other goals, the comparative significance of each goal was attained with the help of the matrix in Equation (1) for each farmer (k).

$$A_k = \begin{bmatrix} a_{11k} & a_{12k} & \dots & a_{1nk} \\ a_{21k} & a_{22k} & \dots & a_{2nk} \\ \dots & \dots & a_{iik} & \dots \\ a_{n1k} & a_{n2k} & \dots & a_{nnk} \end{bmatrix} \quad (1)$$

Where a_{ijk} denoted the output of every individual by comparing goal (i) with a goal (j). The two basic characteristics of the square matrix were: i) the main diagonal value was taken as one ($a_{ijk} = 1 \forall i$) for all factors, and (ii) all other factors confirm the reciprocal paired assessment (If $a_{ijk} = x$ then $a_{jik} = \frac{1}{x}$). If the preferences of each decision-maker were precisely the same, then, it must also be confirmed that $a_{ihk} \times a_{hjk} = a_{ijk}$ for all, i, j , and h . This statement indicated that the value was assumed to be a relevant comparison when the weight specified to each goal was done using a fully coherent decision maker $a_{ijk} = w_{ik} / w_{jk}$ for each i and j . Therefore, this matrix could be rewritten as the matrix in Equation (2):

$$A_k = \begin{bmatrix} \frac{w_{1k}}{w_{1k}} & \frac{w_{1k}}{w_{2k}} & \dots & \frac{w_{1k}}{w_{nk}} \\ \frac{w_{2k}}{w_{1k}} & \frac{w_{2k}}{w_{2k}} & \dots & \frac{w_{2k}}{w_{nk}} \\ \dots & \dots & \frac{w_{ik}}{w_{jk}} & \dots \\ \frac{w_{nk}}{w_{1k}} & \frac{w_{nk}}{w_{2k}} & \dots & \frac{w_{nk}}{w_{nk}} \end{bmatrix} \quad (2)$$

Therefore, if the decision-makers' assets of impeccable dependability hold, the n weight w_{ik} for every goal could effectively be decided from the value $n(n-1)/2$ for a_{ijk} . Disappointingly, impeccable dependability, it was very rare, where individual subjectivity assumes an essential part in assessing the paired evaluation. There was a little bit of undependability existing in the matrix ($A_k = a_{ijk}$), so another method was suggested to evaluate the weight vector closest to the real weight vector of the

decision-maker. The two kinds of possibilities were the main eigenvector and the geometric mean, which Saaty (1980; 2003) also recommended for closely evaluating real weight. Different authors recommended alternative methods as well; LAININEN & HÄMÄLÄINEN (2003) recommended regression-based analysis while another study recommended the goal program (BRYSON et al., 1995). However, there was still no consensus as to which method was better (FICHTNER, 1986). Since all standards met the above weight estimation requirements, this study adopted the geometric mean method (AGUARÓN & MORENO-JIMÉNEZ, 2000; BAUMANN et al., 2007). Using this method, assigning a weight for every goal of the farmer was done as per Equation (3):

$$w_{ik} = \sqrt[n]{\prod_{i=1}^n a_{ijk}} \forall i \quad (3)$$

Here, the w_{ik} variable was utilized in the SA analysis as a covariate. AHP was initially considered for personal decision making. However, it was quickly stretched into an effective way of examining group decisions (EASLEY et al., 2000). In order to compare the weights of goals among conventional and organic farmers, the preferences of the group should be considered. Therefore, the corresponding weight of each farmer (w_{ik}) among the farmers was obtained to get the weight combination for each goal (w_i). The accumulation method should take place by a previous study (FORMAN & PENIWATI, 1998), which stated that the most appropriate way to evaluate personal weights (w_{ik}) in the context of collective social decision-making is the geometric mean, where the AHP analysis output is summarized using w_i , as given by Equation (4):

$$w_i = \sqrt[m]{\prod_{k=1}^m w_{ik}} \forall i \quad (4)$$

Survival Analysis (SA)

Survival analysis was also known as duration modelling or duration analysis in the field

of economics, which included the length of time of a session or the time period of a scene or the duration for an event to happen. The session begins at the entrance into a state and ended at a moment when the new state arrives. As stated above, SA was applied to determine the adoption factors of organic farming in addition to the time (t) likelihood of a farm to adopt the organic approach because they do usually not adopt the method at a specific time. It was expected that the end of an occasion or the act of going into another state will occur only once for each individual (When an incident occurs multiple times, a multi-level model for frequent or repeat incidents should be applied (for more detail, see (Box–Steffensmeier and Zorn, 2002; Steele, 2008)).

The Theory of Probability was a foundation of the SA analysis. The Theory could focus on the probability of the ending or the probability of turning into another state instead of focusing on the time period of a session. A hazard function was utilized in the SA analysis in place of the probability distribution estimation in order to determine probability.

Suppose a random variable to evaluate the span of the session was denoted as (T) and similarly suppose (t) was an insight of (T). Therefore, the time span observed for everyone comprises a series of data (t_1, t_2, \dots, t_n). So, the function $f(t)$, as per Equation (5), must be continuous probability distribution estimation (PDE) of the earlier specified random variable T . The cumulative density estimation (CDE) was used to determine the probability distribution of the time period variable.

$$F(t) = \int_0^t f(s) ds = \Pr(T \leq t) \quad (5)$$

It was demonstrated that the specific value was bigger than the probability of the random variable (T). However, the study was more interested in determining the probability of the length of the time span (t) for the survival analysis. The paired cumulative distribution estimation (PCDE), also known as survivor estimation, assesses this probability, and this was given by Equation (6):

$$S(t) = 1 - F(t) = \int_t^{\infty} f(s) ds = \Pr(T > t) \quad (6)$$

The session begins at the entrance into a state and ended at a moment when the new state arrived.

Considering the probability that the spell lasts until, where closures or changing to a new state within a short duration of time was given by Equation (7):

$$\Pr(t \leq T < t + \Delta t | T \geq t) \quad (7)$$

The hazard function was determined based on this probability or the degree of the hazard, which determines the rate at the time $T = t$ by which a period was finished, which specified that it survived up to

time t . It was meant that the adoption probability of organic methods at a time was signified by the hazard function because it was not adopted before t . This hazard function was given by Equation (8):

$$\begin{aligned} h(t) &= \lim_{\Delta t \rightarrow 0} \frac{\Pr(t \leq T < t + \Delta t | T \geq t)}{\Delta t} \\ &= \lim_{\Delta t \rightarrow 0} \frac{F(t + \Delta t) - F(t)}{\Delta t S(t)} \quad (8) \\ &= \frac{f(t)}{S(t)} \end{aligned}$$

The mathematical relationship between the functions $f(t)$, $F(t)$, $S(t)$ and $h(t)$ were given by Equation (9):

$$h(t) = \frac{f(t)}{S(t)} = \frac{\left(\frac{dF}{dt}\right)}{S(t)} = \frac{\left[\frac{d(t-S)}{dt}\right]}{S(t)} = \frac{\left(-\frac{dS}{dt}\right)}{S(t)} = -d \ln S(t) / dt \quad (9)$$

In addition to the period length, a group of descriptive variables that included both economic and non-economic variables might have some effect, so the duration distribution was modified by including other explanatory variables in SA. Therefore, the hazard function must be defined again and must be re-formulated to capture the uncertainty in these variables. Therefore, the new hazard function was given by Equation (10):

$$h(t, x, \theta, \beta) = \lim_{\Delta \rightarrow 0} \frac{\Pr(t \leq T < t + \Delta | T \geq t)}{\Delta} \quad (10)$$

Here, the unidentified factor vector X was expressed with β , which was an explanatory variable that may comprise time-changing and time-constant variables, whereas the limitation vector θ illustrates the hazard rate function of the distribution. The hazard function $h(t, x, \theta, \beta)$ can be divided into two parts upon the addition of explanatory variables. The first factor included the hazard to be determined by the attributes of the subject $g(x, \beta)$. The benchmark hazard function $h_0(t)$ was the second factor and is equivalent to the hazard while all covariates are zero. Consequently, it did not rely on any individual qualities. This factor reflected the pattern of hazard rate changes over time.

The semi-parametric Cox hazard model was employed in order to evaluate the SA(COX, 1972). The semi-parametric Cox model has been extensively used to analyse survival data in order to determine the impact of descriptive variables on the hazard ratio. However, the semi-parametric model could be less effective than the parametric model in terms of utilization of material given by the data (D'EMDEN et al., 2006). In particular, efficiency could be very little (EFRON, 1977). Furthermore, when utilizing this model, the study was able to obtain robust results. In addition, the assessments of variable characterization

were practical but with little consideration of the real state of the benchmark hazard function.

In this case, the benefit of a semi-parametric approach was that no presumptions were made about the state of the hazard estimation. According to the Cox-proportional hazard model, the period of every individual from the sample data was expected to have its own hazard estimation $h_i(t)$, which can be written as Equation (11):

$$h_i(t) = h(t; x_i) = h_o(t) \exp(x_i \beta) = h_o(t) \exp(\beta_1 x_{i1} + \dots + \beta_k x_{ik}) \quad (11)$$

Accordingly, the log form of Equation (11) was given by Equation (12):

$$\log h_i(t) = a(t) + \beta_1 x_{i1} + \dots + \beta_k x_{ik} \quad (12)$$

Where the benchmark hazard function $h_o(t)$ was self-assertive and unspecified and cannot be negative. Additionally, $a(t) = \log h_o(t)$. The coefficient β was translated as a steady comparative impact of x on the restrictive likelihood of finishing a period. It was the required attribute of the individual in the population that demonstrates the comparative hazard function such that the ratio $\frac{h_{it}}{h_{jt}} = \exp[\beta_1(x_{i1} - x_{j1}) + \dots + \beta_k(x_{ik} - x_{jk})]$ of substances i and j were constant with time t , and so $h_o(t)$ with drawn.

COX (1972) introduced a method based on the partial probability function, which wiped out the obscure baseline hazard $h_o(t)$. In this manner, the bit of the probability function that contains hazard-dependent information promptly was eliminated. Likewise, this part of the function represents the censored time period. In view of the time period of every individual i . t_i . $i = 1 \dots n$, the partial log probability can be written as Equation (13):

$$PP = \prod_{i=1}^n \left[\frac{e^{\beta x_i}}{\sum_{j=1}^n Y_{ij} e^{\beta x_j}} \right]^{\delta_i} \quad (13)$$

Where the indicator variable is δ_i ; if t_i was censored, the value of δ_i will be zero. Otherwise, if t_i was uncensored, the value δ_i will be one. Therefore, if $t_j \geq t_i$ then $Y_{ij} = 1$ or if $t_j < t_i$ then $Y_{ij} = 0$. The maximization problem to exploit the partial probability function could be written as Equation (14):

$$\log PP = \max_{\beta} \sum_{i=1}^n \delta_i [\beta x_i - \log(\sum_{j=1}^n Y_{ij} e^{\beta x_j})] \quad (14)$$

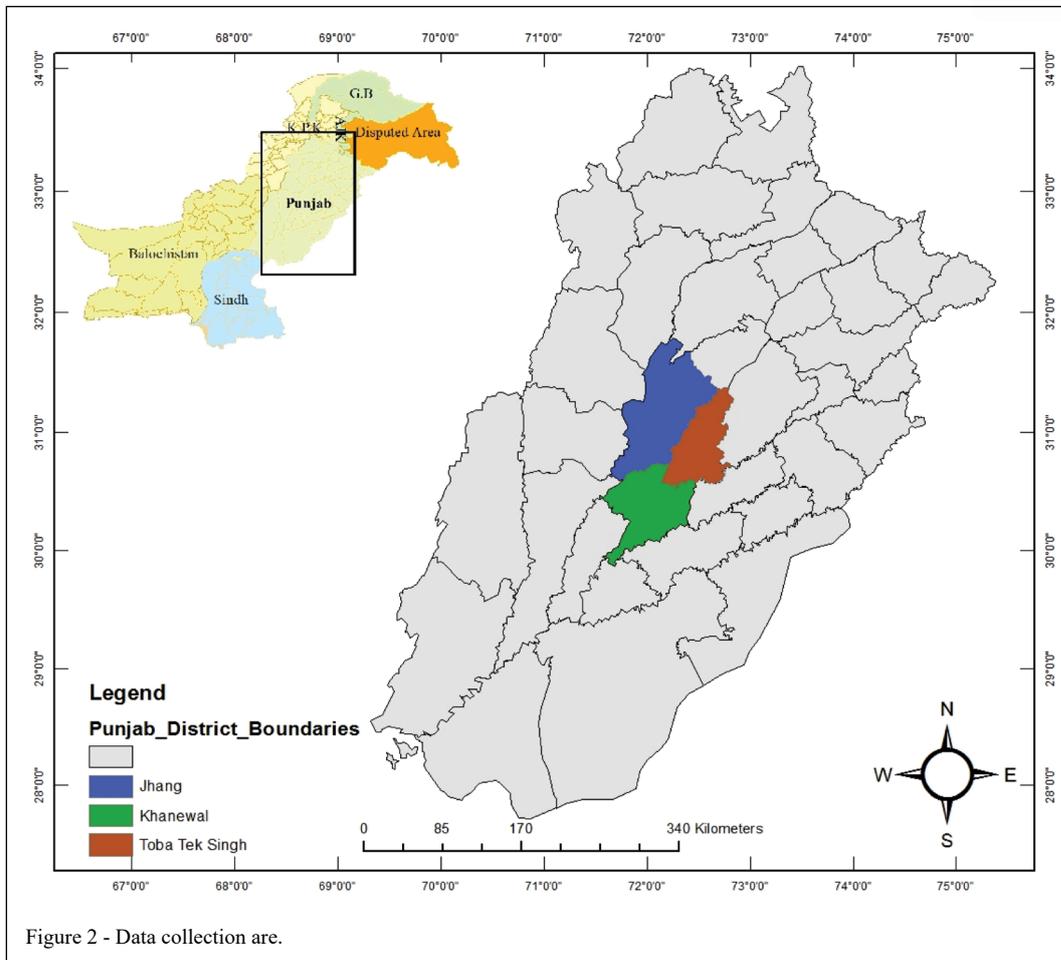
Empirical application

This study was conducted using data collected from Toba Tek Singh, Khanewal, and Jhang, three of the central districts in the Pakistan province of Punjab (Figure 2) and played vital role in organic farming (AKRAM et al., 2019a). These specific districts were determined according to groups such as organic farmers, villagers, and growers and other principal stakeholders' following consultation. The organic farming project taking place in Lok Sanjh

also informed this choice of districts. A stratified sampling technique was adopted to identify 400 farmers, both conventional and organic, across the three regions. The farmers' names were listed in alphabetical order and numbered. The stratified random sampling technique was adopted to select the sample household, to ensure that every household had an equivalent probability of being selected for the study, irrespective of farm size. As a means of closely identifying conventional farmers, proximity was defined as the fundamental criteria. The final dataset comprised information obtained from 148 organic farmers and 153 conventional farmers. A farm household leader survey was performed to collect data during the period September 2018–February 2019 in cooperation with the Lok Sanjh Foundation. A questionnaire was developed to acquire data regarding farm structure and management, family characteristics, farmer's opinions and practices, and input and output data.

Comprehensive data on farmer's personal attributes, opinion and approach, farm's economic and physical aspects, and other factors influencing the decision to adopt organic methods were collected. Data gathered about the family and personal attributes of the farmer (P_i) included age, marital status, number of schooling years, farmer or family member with a university degree, members of the family, or closeness of family, and companions to the farmer's home. Data on the structural management of the farm (S_i) comprised the size of the farmland, land tenure arrangements (The study area includes three kinds of farmland arrangements i.e. ownership, fixed rent, and sharecropper), and type of soil, farm mechanization, and farm distance from farmer's house, location of the farm, and accessibility to the market. The factors that reflected the farm operational management (M_i) were the cultivation method adopted, crop rotation, analysis of soil, input use, external labour, availability of family labour, irrigation source, power source, per hectare cost, profitability, and the share of farm income out of the total income of the family. The influence of external variables (E_i) consisted of information source and accessibility to the Internet, being a member of any agricultural organization, size of the market, government policies, subsidies, input cost, output prices, conversion cost, and availability of financial aid such as loans or other supportive projects.

Information about the farmer's opinion and approach (O_i) regarding organic farming was collected by asking the farmers a series of questions based on a Like rt scale (0 to 10). These questions involved organic farming, environmental issues,



approach towards risk, utilization of chemical or hazardous inputs, governance of problems, economic agent's opinion about organic approach, benefits to the farmer when changing over, and other queries. Broad data on this issue was accumulated, so, as mentioned earlier, the accessible data was summarized to narrow down the measurements using PCA. The subsequent components as an independent variable were utilized in a successive phase in SA.

Data about the farmers' goals (G_i) (The primary and secondary goals were divided into two distinct priorities: the first was combined by an agro-economics faculty in a university, and the second was explained by the staff of organizations working for organic farming), was gathered by probing farmers to use a scale of 1 to 9 to compare different goals in paired form. dummy variable was also employed by taking a value of 1 after the year 2008 to indicate the year in which the National Institute of Organic Agriculture was established (otherwise, a value of zero was used) (BURTON et al., 2003).

KIEFER (1988) stated that SA needs an exact start time to calculate duration. In this study's scenario, time was designated as the date by which the farmer began to oversee holding ALLISON (1995) provided a simple answer to solve the random censor issue, which is to use the covariate of time of entry in the regression.

RESULTS AND DISCUSSION

The data of numerous variables were collected in order to evaluate the opinion and approach of the farmer in which PCA was used in three steps. Initially, PCA was employed for the variables that evaluated the farmers' perceptions of society's attitudes regarding organic agriculture. The pertinent components of this variable were "Commercial prospects"(C1) and "Social prospects" (C2) (Table 3). The subsequent PCA was used to determine the motivation of the farmer to adopt organic farming. The resulting components were "Domestic and foreign aspects" (C3), "Financial incentive" (C4) and "Personal

Table 3 - Principal Component Analysis of Farmer's opinion and approach.

-----Perception of an economic agent's approach towards organic agriculture-----			
Variable	Commercial prospect (C1)	Social prospect (C2)	
Consumer	0.841	0.043	
Retailer	0.737	0.141	
Financial institution	0.713	0.139	
Other farmers in the region	0.634	0.142	
Farmer's Union	0.240	0.795	
Membership of agriculture organization	0.107	0.733	
Household member	0.140	0.634	
-----Cronbach's alpha:0.71 Rotation: Varimax KMO: 0.71 Bartlet: 134.84 [0.00] Variance explained: 52.3%-----			
-----The motivation of farmer to adopt organic methods-----			
Variable	Domestic and Foreign (C3)	Financial incentive (C4)	Personal Inspiration (C5)
Foreign market has a positive aspect	0.818	0.047	0.131
The domestic market has a positive aspect	0.695	0.119	0.213
There is an economic facility to adopt organic farming	0.199	0.839	-0.089
Expensive input is used in conventional farming	-0.219	0.719	0.399
Appropriate channel diversification	0.397	0.510	0.028
Organic farming helps improve household health	0.144	0.026	0.831
Healthy food produce leads to personal satisfaction	0.211	0.066	0.610
-----Cronbach's alpha: 0.65 Rotation: Varimax KMO: 0.65 Bartlet: 95.22 [0.00] Variance explained: 62.01%-----			
-----Farmer's understanding of organic farming-----			
Variable	Perception of organic products (C6)		Future sustainability (C7)
Soil fertility is improved with organic farming	0.778		0.224
Conventional products are not as good in quality as organic products	0.644		0.164
Organic agriculture creates a good image for the farm	0.578		0.111
Conventional products are not as healthy compared to organic products	0.386		-0.013
Organic products are sold at a premium price to compensate for their lower yield	0.186		0.851
Organic farming has economic viability	0.415		0.789
The risk is high in organic farming due to yield variation	0.439		-0.594
Organic farming is not as hectic as conventional farming	0.077		0.510
-----Cronbach's alpha:0.585 Rotation: Varimax KMO: 0.68 Bartlet: 149.97 [0.00] Variance explained: 45.96%-----			

inspiration" (C5). The last PCA was employed to determine the farmers' personal understanding of organic agriculture concerning "Organic product" (C6) and "Future sustainability" (C7).

As mentioned above, AHP permitted the use of geometric mean to assign weights to the primary and secondary goal of every individual (farmer). Table 4 listed the weighted summary results for the farmers' three primary goals, which indicated that the financial goal (WG1) was a top priority, while environmental (WG2) and social goals (WG3) were on the second and third priorities with aggregated weights of 78.40%, 13.80%, and 7.80%, respectively, for conventional farmers. This order applied to the organic category as well, but environmental and

social goals were more closely related rather than an economic goal.

Figure 3 showed the weighted outcome of the secondary goals. As observed, conventional and organic farmers have different comparative weights. It's important to point out that organic farmers gave more attention to encouraging environmentally sound practices, while conventional farmers care more about water and quality of the soil. The comparative weight proportions for the primary and secondary goals of every farmer were summarized in table 5. As stated above, these goal proportions were later used as covariates in the SA.

Different SA models were assessed using different variable combinations obtained from the

Table 4 - Aggregated weights of the farmer's goal (Conventional & Organic).

	-----Financial Goal (WG ₁)-----		----Environmental Goal(WG ₂)----		-----Social Goal (WG ₃)-----	
	Conventional	Organic	Conventional	Organic	Conventional	Organic
Geometric mean (Aggregate weight)	0.784	0.457	0.138	0.371	0.078	0.172
Arithmetic mean	0.741	0.445	0.139	0.364	0.120	0.191
Trimmed mean*	0.819	0.356	0.117	0.316	0.064	0.169
Variance	0.054	0.031	0.010	0.021	0.013	0.012
Median	0.810	0.446	0.143	0.318	0.061	0.159

*Calculated by discarding the 25% highest and lowest values.

survey. A stepwise forward technique was used for the final variable list in the SA estimation. It means the selection criteria consist of three methods i.e. forward, backward, and bidirectional eliminating methods. This selection criterion was first proposed by EFROYMSON (1960). Table 6 showed the list of all variables for organic and conventional farmers included in the SA model. The model estimation results were shown in table 7, where the null hypothesis (all coefficients are mutually equal to zero) was rejected at 5% level of significance.

The existence of local officials was considered as information sources, and this led to the escalation of the hazard function, which includes reducing the necessary time to adapt. This finding was in agreement with the results of (RIGBY et al., 2001) and (LÓPEZ & REQUENA, 2005), which explained that the source of information accessibility was a highly essential component in determining adaptation.

Results also showed that farmers that were inclined towards risk were more likely to adopt organic agriculture. DE COCK (2005) confirmed this result, indicating that organic farmers usually have less care of risk than conventional farmers. SERRA et al. (2008) also reported similar findings that organic farmers were prone to taking risk than their conventional counterparts. The current study also reported that a problem in receiving loans increased the farmers' conversion to organic farming. This was because organic farmers generally belong to smaller-scale farms that faced more problems accessing loan facilities which lead them to convert organic farm due to their low ability to afford higher input cost compared to conventional farmers. This result opposed the argument credit limit decreasing conversion rate finding of RIGBY et al. (2001) and LAMKIN (1994), which explained that the essential institution obstacles to

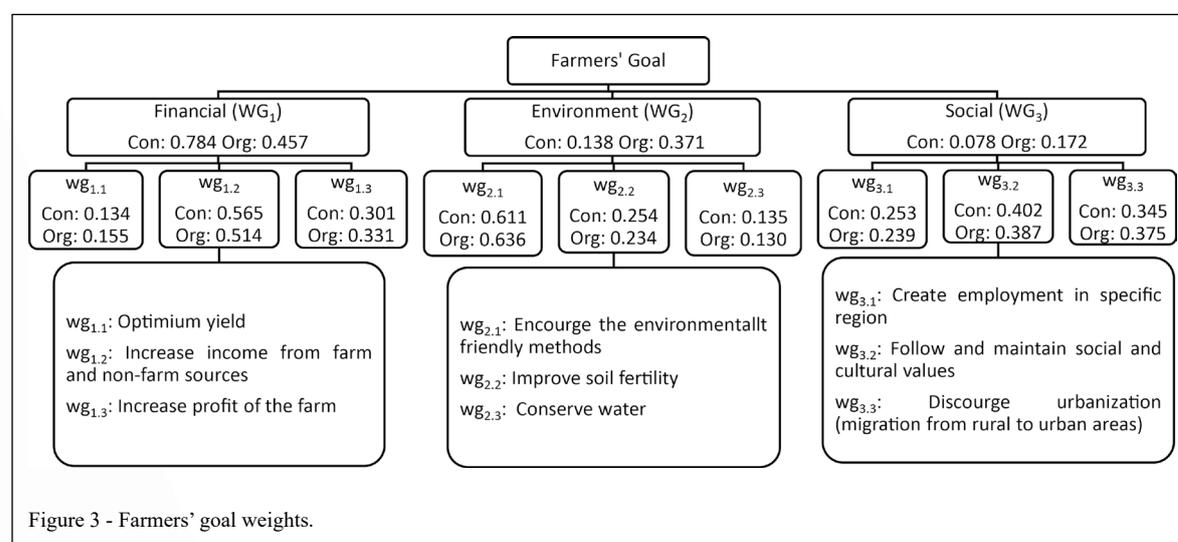


Table 5 - Comparative weights of primary and secondary goals included in SA.

Variable	Description	-----Organic-----		----Conventional----	
		Mean	Std. dev.	Mean	Std. dev.
WG ₂ /WG ₁	Comparative weight between "Environmental and Financial" goals	4.71	5.36	9.63	10.36
WG ₁ /WG ₃	Comparative weight between "Financial and Social" goals	0.89	1.09	4.41	19.49
WG ₂ /WG ₃	Comparative weight between "Environmental and Social" goals	0.24	0.10	0.13	0.34
Wg _{1.1} /Wg _{1.2}	Comparative weight between "Optimum yield and Increase farm & non-farm income"	0.92	0.95	0.75	1.43
Wg _{1.1} /Wg _{1.3}	Comparative weight between "Optimum yield and Farm profit"	0.48	0.58	0.94	3.11
Wg _{1.2} /Wg _{1.3}	Comparative weight between "Increase farm & non-farm income and Farm profit"	2.74	2.49	2.99	2.44
Wg _{2.1} /Wg _{2.2}	Comparative weight between "Encourage environmentally friendly methods and Improve soil fertility."	1.76	2.68	1.93	4.08
Wg _{2.1} /Wg _{2.3}	Comparative weight between "Encourage environmentally friendly methods and Conserve water"	1.01	0.96	1.08	1.71
Wg _{2.2} /Wg _{2.3}	Comparative weight between "Improve soil fertility and Conserve water "	1.67	2.33	1.96	2.20
Wg _{3.1} /Wg _{3.2}	Comparative weight between "Create employment opportunities in the specific region and Follow and maintain social and cultural values."	3.83	2.60	3.30	3.59
Wg _{3.1} /Wg _{3.3}	Comparative weight between "Create employment opportunities in the specific region and Discourage the urbanization (migration from rural to urban areas)"	6.90	5.99	4.27	4.33
Wg _{3.2} /Wg _{3.3}	Comparative weight between "Follow and maintain the social and cultural values and Discourage the urbanization (migration from rural to urban areas)"	2.45	2.14	2.71	3.45

organic farming conversion were the denial of loans and insurance to the farmer.

As anticipated, it was reported that farms with no canal irrigation facility were more prone to adopting organic farming compared to their counterparts. The reason behind this phenomenon was the irrigation cost in that area, so the yield was lower than other areas, as described in other studies (NEERA et al., 1999; MARTINI et al., 2004; VALIZADEH et al., 2014). These studies explained that productivity varied according to region. It was difficult for small farmers to afford higher input cost to obtain higher yield in conventional farming, so they focused on organic farming to reduce input cost. Farmers with other sources of income apart from farm income will probably have more chances to adopt organic farming. This finding was backed by that of Peters (1994) and (HANSON et al., 2004), which explained that diversification in the source could play a vital role in pushing farmers to adopt organic farming compared to farmers with only a single source of income (from the farm). These outcomes were in line with the statement that organic farmers often engaged in different kinds of activities, which diminish the hazard from conceivable yield misfortunes. Farmers whose choices were assumed dependent on business reasons were found to engage in lower risk.

The finding of past studies also showed that the positive behaviour and attitude of the farmer towards organic agriculture resulted in a short time to convert. The individuals that have faith and a positive view of social operator's inorganic farming concur that unsafe synthetic inputs toward humans should be banned and perceived organic items as being healthier than non-organic items. These people have more tendency to change over. RIGBY et al. (2001) and DARNHOFER et al. (2005) also explained that positive behaviour and attitude led to a positive impact on the decision to convert.

The finding of this study showed that young farmers tend to adopt organic farming compared to older ones quickly. RIGBY et al. (2001) and ANDERSON et al. (2005) also reported similar findings. Farmers that were in-charge of farm management were also harder to convert. Past studies also revealed similar findings (BURTON et al., 1999; HATTAM & HOLLOWAY, 2005; HUSNAIN et al., 2017), where organic farmers' land holding was smaller than that of conventional farmers. Therefore, big farmland will take more time to adopt organic farming due to a low hazard.

The dummy variable (before and after 2008) was added to assess the impact of the "National Institute of Organic Agriculture in Pakistan" on the

Table 6 - Variable include in SA model.

Variables Descriptions	-----Organic-----		-----Conventional-----		
	Mean	Std. Deviation	Mean	Std. Deviation	
-----Farmer personal attributes (Pi)-----					
Age of the respondent(Years)	43.20	12.74	45.14	12.71	
Manage holding(Farm)(year)	1992.91	12.56	1990.86	12.71	
Other job apart from agriculture	0.46	0.50	0.39	0.49	
-----Structural management of farm (Si)-----					
Size of the farm (hectares)	5.47	6.06	5.75	10.19	
Farm has the canal irrigation facility	0.64	0.48	0.61	0.49	
-----Operational Management of farm (Mi)-----					
Annual income of the Respondent (PKR)	442450.32	458828.69	592222.34	1082793.47	
-----External variables (Ei)-----					
Source of information	Conference before the start of new season	0.42	0.50	0.33	0.47
	Guidance from govt. authorities	0.18	0.39	0.21	0.41
	Member of any farming organization	0.45	0.50	0.31	0.46
	Has subscription of farming magazines/journals/blog	0.31	0.46	0.24	0.43
Hurdles to get loan (0 = easiest, 10 = most difficult)	Credit difficulty <6	0.51	0.50	0.45	0.50
	Credit difficulty <10	0.44	0.50	0.39	0.49
Price of wheat PKR/KG	35.70	1.22	30.96	1.17	
Dummy Variable 2008	0.16	0.36	0.10	0.30	
-----Farmer's opinion and approach (Oi)-----					
PCA outcome about the perception of economic agent's approach toward organic agriculture	Social prospect	0.73	0.93	-0.11	0.83
PCA outcome about the motivation of farmer to adopt the organic method	Financial incentive	-0.69	1.15	0.17	0.82
PCA outcome about farmer understanding of organic farming	Perception of organic products	0.77	0.83	-0.19	0.92
Attitude toward risk (0 = most risk averse, 10 = most risk taker)	Risk < 6	0.10	0.30	0.39	0.49
	Risk < 10	0.78	0.41	0.50	0.50
-----Do not use pesticides and herbicides in the farm-----		0.88	0.27	0.53	0.20

decision to adopt organic farming. This variable was statistically insignificant, but it still had a positive impact overall. Result showed that the establishment of the institute encouraged organic farming, but its role to promote organic farming has not been enough.

The finding in this study showed that the significance of the environment was a more essential component than the financial aspect when choosing organic practices. Therefore, increasing the weight of the environmental goal compared to the weight of the financial goal will lead to an increased hazard. In addition, a weight increased in the farmer's opinion to practice "environmentally friendly methods"

compared to "conserving water" will reduce the duration to adopt. At the same time, the goal of "creating employment opportunities in specific regions" was inevitable to "discourage urbanization" and thus increasing the possibility of transformation in a shorter period. These outcomes showed that both the dedication of the organic farmer to protecting the environment and employment generation were essential elements to change. Prior empirical studies suggested that organic farming was considered a particularly labour-intensive method of farming (DEMIRYUREK and CEYHAN, 2008). According to this argument, this study showed that creating

Table 7 - Survival analysis (Cox-proportional hazard model using partial likelihood).

Variable	Parameter	Standard error	Hazard Ratio
Comparative weight between "Environmental and Financial" goals	0.734**	0.335	2.147
Comparative weight between "Encourage environmentally friendly methods and Conserve water."	0.246***	0.132	1.313
Comparative weight between "Creating employment opportunities in the specific region and Discouraging urbanization (migration from rural to urban areas)"	0.741***	0.251	2.041
Age of respondent	-0.342***	0.131	0.836
Manage holding(Farm)	0.135**	0.130	1.140
Other job apart from agriculture (0 = No, 1 = Yes)	2.604**	1.015	13.261
Annual income of respondent	0.031 [†]	0.024	1.416
Size of farm	-0.104***	0.106	1.024
Farm has a canal irrigation facility (0 = No, 1 = Yes)	2.015**	0.684	4.631
Guidance from Govt. authorities (0 = No, 1 = Yes)	4.338***	1.428	86.041
Credit difficulty (0 < 6, 1 > 5)	2.324***	0.756	10.134
Price of wheat	1.002**	0.401	2.517
Dummy variable 2008 (0 = before 2008, 1 = after 2008)	4.317	1.614	74.153
Risk (0 < 6, 1 > 5)	2.147**	0.942	10.247
Does not use pesticides or herbicides in the farm (0 < 6, 1 > 5)	1.957***	0.785	10.235
PCA outcome about the perception of an economic agent's approach towards organic agriculture	1.324**	0.510	2.978
PCA outcome about motivation of farmer to adopt organic method	-1.525***	0.550	0.159
PCA outcome about farmer's understanding of organic farming	1.487***	0.491	3.992

Likelihood ratio: 135.126(0.000)/Wald test: 34.345(0.004)/Larange multiplier: 94.735(0.000).

employment opportunities was an essential element for farmers to adopt organic farming; further highlighting the social role of organic farming in Pakistan.

CONCLUSION

This study emphasized the assessment of time to adopt organic farming and the farmers' decisions to convert. A Survival Analysis (SA) was performed for the empirical analysis because it enabled the analysis of decision-making and diffusion characteristics of organic farming. The model was used to evaluate utilizing farm-level information from organic and conventional farmers in Punjab, Pakistan. A survey was performed to collect data during the period of September 2017–February 2018.

The waiting time of the farmer to adopt organic farming was used as a dependent variable in SA. This variable was measured based on the time period of the farmer to start managing the farm in several years. Different explanatory variables were taken into account to signify the farmer's personal attributes, structural management of the farm, operational management of the farm, external

variables, the farmer's opinion and approach, and the farmer's goal and intentions. AHP was used to evaluate the goal where as PCA was used to surmise the opinions and approaches of the farmers.

Many variables were discovered to increase the chances of conversion. Farmers who had started to manage farms in recent years, farmers that did not paid much attention to risk, farmers that wanted to protect the environment, and farmers that wanted to create jobs in their farm tend to adopt organic farming in a shorter duration of time. Farmers that did not have a canal irrigation facility and farmers that have other sources of income apart from agriculture also have higher chances of adopting organic farming. Farmers that get a higher price for their products, farmers that experience issues obtaining loans, and farmers that have other sources of income apart from farming were also more prone to choose organic farming. Finally, the availability of information and guidance from government experts pertaining to policies and guidelines have led to higher acceptance rates. Then again, more established farmers whose choices were basically dependent on financial factors and who were running exceptionally specific and large

farms, have a low probability of adopting organic farming. Inclusively, the outcomes were effective collectively, as they suggested that small scale farmer easy to adopt organic farming or those have small land and participate to other kind of business or job. Large scale farmer or who purely depended on agriculture took more time. Mostly farmer were lay man and they did not have concern to other factors like environment or society, only focused on financial benefit. Study suggested that Government should regulate and market the authentic organic products. Hence, more formal and collective effort required to promote organic farming

This empirical analysis was performed using a semi-parametric methodology; and therefore, still required parameterization of the hazard work. Miss-specification of this model could lead to conflicting outcomes. The outcomes of this study needed to be deciphered cautiously. In order to overcome this constraint, the literature has recently introduced local assessment techniques. Therefore, it was recommended that the findings of this study could be compared to future research employing this alternative method.

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DECLARATION OF CONFLICT OF INTERESTS

We have no conflict of interest to declare.

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