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Farmer's Innovation and Adopter Categories: Inhibitors and Characteristics: A Review

Chiamaka Glory Ojiako-Chigozie

Department of Agricultural Economics and Extension, Chukwuemeka Odimegwu Ojukwu University, Igbariam Campus Anambra State, Nigeria.
Corresponding Author E-mail: glorychiamaka286@gmail.com

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ABSTRACT: In a social system, individuals do not all adopt an innovation at the same time. Instead, it is a gradual process in which some people are more likely to adopt the innovation before others. The adoption of innovations is influenced by many factors. Innovation is essential for progress, but it faces many challenges. Researchers have discovered that early adopters of an innovation have different characteristics compared to those who adopt it later. Therefore, when promoting an innovation to a target population, it is important to understand the inhibitors that impede progress and the characteristics of the target population that may help or hinder the adoption of the innovation. Adopter categories are an efficient way to classify members of the system based on their innovativeness. These categories make it easier to describe the members of the system. In this study, we discuss a standard method for categorizing adopters and the characteristics of different adopter categories.

Keywords: Innovation; adopters; farmers; technology
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INTRODUCTION

Innovation is the process of creating new and useful applications from original and creative ideas. It involves much more than simply changing from one well-established practice to another, as it requires significant imagination, breaking with established ways of doing things, and creating new production capacity. For agriculture, innovation means new ideas, methods, practices, or techniques that provide sustained increases in farm productivity and income. These innovations can come from agricultural research stations or farmers themselves (FAO, 2019).

Moreover, Farmer innovation refers to the dynamics of indigenous knowledge and how farmers develop new ways of doing things, new technologies, or ways of organizing work using their resources. These local innovations may be developed by individuals or groups within farming communities and are considered Something new that has been started within the lifetime of the farmer, not inherited from their parents. This broad terminology can refer to the discovery of a completely different way of doing something or the modification of an existing technology (Gebre, 2019).

However, Farmers who have been trained by extension workers may also be recognized as innovators when they are dealing with incoming knowledge or technology by improving it, regardless of their sex, wealth status, or age. Local knowledge/innovations are commonly socialized and shared easily unless it is a marked mechanism of livelihood for the individual. Another important dimension of the concept of "farmer innovation" is that it embraces not only technological innovation but also new ways of managing livelihoods in general, including networking, communication, institution-building, information management, marketing, planning, and resource access

(Gebre, 2019). According to McKinsey (2019), 84% of farmers say that their future success depends on innovation. Innovation allows farmers to stay relevant in the farming business and plays an important role in economic growth. The ability to resolve critical problems depends on innovations, and especially developing countries need it more than ever. Farmers who have developed or are testing new ways of land husbandry that combine production with conservation are known as innovative farmers. Thistle-Praxis (2018) explains that innovative agriculture is ensuring that new models of farming and agricultural production are evolving and bringing fresh approaches to the way's food is grown and distributed. These methods provide avenues for more economies and regions to keep up with emerging trends and meet the demands of modern living, guaranteeing sustainably produced food.

Innovativeness

Innovativeness is the criterion used to categorize adopters. According to Malcolm, (2019) innovativeness refers to the degree to which an individual farmer adopts new ideas earlier than other members of society. However, innovativeness in farming means developing or trying out new ideas without the support of formal extension services. It can also refer to farmers' discovery and implementation of completely new agricultural practices (ground-breaking innovation) or the introduction of new practices that increase the effectiveness of already existing ones (incremental innovation) (FAO, 2019). Collaboration with other farmers and agricultural research centers can enhance the capacity for innovation. Participation in non-farming activities can also stimulate innovativeness. Several factors can impact farmers' decisions regarding the adoption of new technology, some of which relate to the technology itself, while others relate to farmers' characteristics.

The usefulness of the technology, its complexity, and the effort required to learn how to use it are among the factors that can affect farmers' expectations about its benefits. The easier it is to use a new technology, the less uncertainty about its advantages in terms of improved performance (Gebre, 2019). Certainly, Developing and sharing agricultural innovation, such as connecting farmers to weather information, has proven to be an efficient way to help farmers stay in business. McKinsey, (2019) found that innovation is crucial, especially for farmers who cannot afford to rent expensive machinery like tractors. Building mini-alternatives to expensive machinery that can be leased and paid for in affordable installments can aid productivity and efficiency. Similarly, inventing minicoolers or refrigerators to preserve fresh perishable harvests beyond their original short life span can be very beneficial to farmers. For instance, Late Mohammed Bah Abbah, an innovator from Northern Nigeria, successfully extended the lifespan of farm produce like tomatoes from the regular three days to 21 days using a simple earthenware "pot-in-pot" technology, which he retailed at an inexpensive rate to local farmers. Meanwhile, Farmers' innovativeness involves trying out new but value-adding agricultural or natural resource management practices using their knowledge and wisdom to increase productivity while recognizing the importance of indigenous knowledge (IK). Innovative farmers are those who act on IK and/or outsiders' knowledge by conducting informal experiments and making the knowledge more usable or better fitting to their realities (Steward, 2020).

A promising transformation has already started in Africa's farmlands, where farmers are increasingly using innovative approaches and scientific research, combined with traditional knowledge, to increase productivity, diversify crops, boost nutrition, and build climate resilience (FAO, 2019). Farmers' innovativeness is responsible for up to 85% of all economic growth.

Characteristics of innovation

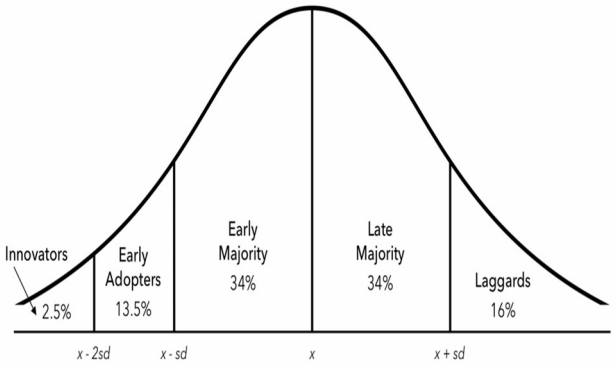
Innovation adoption varies in speed and can be influenced by several factors. According to Grace (2017), five main characteristics of innovation determine how quickly it will be adopted. The first characteristic is relative advantage, which refers to how much better an innovation is compared to what was used previously. The second is compatibility, which refers to how consistent innovation is with the values, experiences, and needs of potential adopters. The third is complexity, which refers to how difficult an innovation is to understand and use. The fourth is trialability, which refers to how easily an innovation can be experimented with on a small scale. The fifth is observability, which refers to how visible the results of an innovation are to others. An innovation that is perceived as more advantageous, compatible with social values, easy to understand and use, can be experimented with on a small scale, and has visible results, will be adopted more quickly. For instance, a pre-emergence weedicide was preferred over a postemergence weedicide because it stopped weeds from growing, while the latter was used after the emergence of weeds, incurring some damage to the crop.

On the other hand, innovations that lack these traits will take more time to be adopted. For example, beef production is not compatible with cultural values in India, and piggery is not adopted by Brahmins and Muslims due to cultural differences. Similarly, changing the variety of a particular crop is not as complex as shifting from crop production to poultry production. Innovation adoption is influenced by how well an innovation aligns with the

values, needs, and experiences of potential adopters, as well as how easy it is to understand, use, experiment with, and observe its results.

Adoption categories

Adoption categories, as explained by Rogers and cited in Harshita (2020), are classifications of members in a social system based on their innovativeness. Innovativeness refers to the degree to which an individual adopts new ideas earlier than others in their social system. It's evident that people don't adopt new ideas simultaneously; some adopt ideas immediately, while others take longer, and some never adopt an idea at all (Heba et al., 2019). Rogers also developed the innovation adoption curve, as cited in Ayisi (2022), to classify users based on their willingness to accept new technology or ideas. The curve follows a bell-shaped pattern and is helpful in categorizing individuals into five adopter categories, as described. The measure of innovativeness in an individual, as determined by the time they adopt an innovation, falls on a continuous scale. To categorize innovativeness, the time of adoption (x) is compared to the average time of adoption, and standard deviations (sd) are used to partition the innovativeness variable into five categories. This creates a normal curve with a standardized percentage of respondents in each category. Figure 1 displays the normal frequency distribution, divided into the following adopter categories: Innovators, Early adopters, Early majority, Late majority, and Laggards.



Rogers (2003).
Figure 1: Adopter categories based on innovativeness

Innovators: (Venturesome)

The innovators belong to the early adopter category defined by Ayisi (2022). They are the first ones to embrace new ideas, technologies, or innovations. Innovators constitute a small percentage of the total adopter population, which is almost 2.5 percent. They are typically young and come from the highest social class. Innovators are naturally inclined towards taking risks and get excited about the possibilities of new ideas. They are always eager to try new things, to the extent that their venturesome attitude almost becomes an obsession. Innovators' interest in new ideas leads them out of their local circle of peers and into more diverse social relationships. They usually have substantial financial resources and the ability to understand and apply complex technical knowledge. Innovators are willing to accept occasional setbacks when new ideas prove unsuccessful (Ayisi, 2022).

Adopters (Respect)

The early adopters are highly respected by their peers as they are considered to be an important part of a social system (Palm,2020) Early adopters are the second category of people who adopt innovation faster after the innovators. They make up approximately 13.5 percent of the total adopter population. Change agents often seek this group to act as local missionaries to speed up the diffusion process. Because early adopters are not too far ahead of the average individual in innovativeness, they serve as role models for many other members of a social system. Early adopters are highly influential people within any social system and can be regarded as community adoption leaders. They are quick to try out tried ideas in their situation, and they are typically well educated, have more financial stability, higher social status, a reasonable approach to risk, and are more socially forward than other adopters. The early adopter knows that to continue to earn the esteem of colleagues and maintain a central position in the system's communication network, he or she must make judicious innovation decisions. Early adopters decrease uncertainty about a new idea by adopting it and then conveying a subjective evaluation of the innovation to near-peers through interpersonal networks. In one sense, early adopters put their stamp of approval on a new idea by adopting it.

Early Majority: (Deliberate)

Heba et al. (2019) described the Early Majority as a group that adopts new ideas just before the average member of a social system. This group is also known as "deliberate." The Early Majority is the third group that appears in the adopter category. They seldom hold leadership positions, but they provide "interconnectedness" in the system's networks. Their motto is "Be not the first by which the new is tried, nor the last to lay the old aside." The Early Majority makes up 34% of a social system, and they tend to be less affluent and less tech-savvy than early adopters.

According to Harshita (2020), the Early Majority are often referred to as "neighbors and friends" from whom the majority of farmers seek information. They value highly the opinions of their neighbors and friends, as this is their main

source of status and prestige. They associate mainly with people in their community. They are informal resources rather than early adopters and innovators and cannot afford to make hasty or poor decisions. However, they attend extension meetings and farm demonstrations. In many cases, they are not formal leaders in the association but are less active in formal groups than early adopters. They have medium-high social and economic status. They read a few more farm journals and bulletins than the average and are slightly above average in age, education, and farming experience (Heba, 2029).

Late Majority: (Skeptical)

Individuals known as the Late Majority do not participate in as many activities outside their community as those who adopt innovations earlier. They also read fewer papers, magazines, and bulletins than the early adopters, and take fewer leadership roles. Although they form a significant part of formal organizational membership, their participation in such groups is generally less. The Late Majority tends to have less education and be older than the early adopters (Ayisi, 2022). They adopt new ideas just after the average member of a social system and only when they feel that it is safe to do so. This group makes up 34% of the social system, and they are typically less affluent and more orthodox. They are skeptical about innovation and have below-average social status. They will only adopt an innovation after almost everyone else has done so, and they are influenced primarily by peer pressure. Individuals in the Late Majority category often conduct thorough research on a new product before adopting it. They want to see pictures or videos of people using the product, and they only trust tried and tested solutions, thus failing to take risks. (Eriksen, 2021)

Laggards: (Traditional)

Palm (2020), refer to Laggards as those who are the last to adopt innovations in a social system. They tend to be traditional in their values and are often isolated from the rest of the community. Laggards have a strong attachment to the past and interact primarily with people who share traditional values. They are suspicious of change agents and reluctant to embrace new products or technologies (Ovwasa, 2021). Approximately 16 percent of individuals in a social system are considered Laggards. They are typically older, have the lowest social status, and are often financially challenged. They have little to no opinion leadership and tend to stay in touch only with their family and close friends. Laggards are not influenced by peer pressure and base their decisions on what has been done in previous generations. Laggards' acceptance of a new product or technology is often viewed as a sign of its decline. They do not read farm magazines or bulletins and participate the least in formal organizations, cooperatives, and government programs (Heba et al, 2019).

The S-shaped curve of adoption and normality

The S-shaped curve in (Figure 2) depicts the adoption of an innovation over time and resembles the "learning curve" proposed by psychologists. Individuals adopt innovations in an ordered sequence and can be categorized into five adopter categories based on when they begin using a new idea. The distribution of adopters closely approaches normality and may be partitioned by the mean and standard deviation. The last 16% to the right of the mean are the laggards, while the innovators are located to the left of the meantime of adoption minus two standard deviations. The bell-shaped curve shows the number of individuals adopting each year, while the S-shaped curve shows the data cumulatively (Martins, 1996).

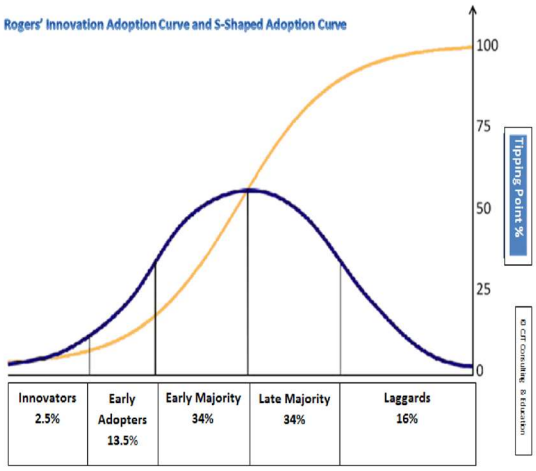


Figure 2: S-shaped curve. (Martins, 1996)

Characteristics of adopter categories

According to Van, 2021 a large body of research has been conducted on variables related to innovativeness and summarized under three headings: socioeconomic status, personality values, and communication behavior.

Socioeconomic status

There is no significant difference in age between earlier adopters and later adopters. Some diffusion studies show no relationship, while a few suggest that earlier adopters are younger, and others indicate that they are older. However, earlier adopters tend to have more years of formal education and a higher social status than later adopters. Social status is determined by factors like income, wealth, and occupation (Ayisi, 2022).

Prestige and self-identification with a social class evidence suggests that earlier adopters are not only of higher status but are also more likely to experience upward social mobility. They may be using the adoption of innovations as a way to achieve even higher levels of social status. Additionally, earlier adopters tend to have larger units, such as farms, schools, and companies, than later adopters. In short, socioeconomic status and innovativeness are closely linked. It is difficult to determine whether innovators innovate because they are richer or whether they become richer because they are innovators. However, some new ideas are costly to adopt and require a large initial outlay of capital. Only wealthy individuals or organizations may be able to adopt these innovations. The innovator who adopts early usually gains the greatest profits.

This financial advantage can contribute to their wealth (Greiner, 2013). As a result of this process, innovators tend to become richer while laggards become relatively poorer. Innovators take risks that can be avoided by later adopters who do not want to deal with the high degree of uncertainty associated with innovations. Although wealth and innovativeness are highly related, economic factors alone cannot explain innovativeness. For example, while agricultural innovators tend to be wealthy, many rich farmers are not innovators.

Personality variables

Personality variables that are associated with innovativeness have yet to receive much research attention, primarily due to difficulties in measuring personality dimensions in diffusion surveys. The following generalizations have been made about personality traits that are commonly found in earlier adopters (Van, 2021):

Empathy

Earlier adopters tend to have a greater ability to empathize with others than later adopters. This is an essential quality for an innovator since they need to think counterfactually, be imaginative, and take on the roles of different individuals to exchange information efficiently with them. Innovators must project into the role of individuals outside of their local system, such as innovators in other systems, change agents, scientists, and R&D workers (Dawood, 2022).

Dogmatism

Earlier adopters have a greater ability to deal with abstractions than later adopters. Dogmatism is the degree to which an individual has a relatively closed belief system that is strongly held.

Rationality

Earlier adopters tend to exhibit more rational behavior than later adopters. Rationality is the ability to use the most effective means to reach a given end.

Intelligence

Earlier adopters tend to have higher intelligence than later adopters.

Attitude towards change

Earlier adopters tend to have a more favorable attitude towards change than later adopters.

Coping with uncertainty and risk

Earlier adopters tend to be better able to cope with uncertainty and risk than later adopters.

Attitude towards science

Earlier adopters tend to have a more favorable attitude towards science than later adopters. This is because innovations are often the product of scientific research.

Fatalism

Earlier adopters tend to be less fatalistic than later adopters. Fatalism refers to the degree to which an individual perceives a lack of ability to control their future. Individuals are more likely to adopt an innovation if they have more self-efficacy and believe that they control their future, rather than thinking that the future is determined by fate.

Aspirations

Earlier adopters tend to have higher aspirations (such as formal education, higher status, and occupations) than later adopters.

Communication Behaviors

The following are the generalizations based on the research:

Early adopters tend to be more socially involved than late adopters.
Early adopters have more connections in their social network, meaning they are more linked with others than late adopters.
Early adopters tend to be more cosmopolitan than late

adopters. They have more external networks and travel often to engage in activities beyond the limits of their local area.
Early adopters have more exposure to change agents than late adopters.
Early adopters have more access to mass media communication channels than late adopters.
Early adopters have more access to interpersonal communication channels than late adopters.
Early adopters tend to be more proactive in seeking information about innovations than late adopters.
Early adopters have more knowledge of innovations than late adopters.
Early adopters possess a higher degree of opinion leadership than late adopters. The relationship between innovativeness and opinion leadership depends on the social norms of the system. In a system that favors change, opinion leaders are more innovative.

Inhibitors of adoption

Innovation is vital to tackle challenges and take advantage of opportunities, but many obstacles can hinder progress. Inhibitors of adoption refer to both the actual and perceived risks associated with farmers' implementation and participation in adoption. They act as catalysts that speed up the rate of adoption among individuals and influence and impede farmers' adoption. A related study conducted by Ovwasa, (2021) suggests that resistance to adoption could be due to the mismatch between farmers' objectives and those of the change agents. For instance, while farmers in developing countries may expect high yields with minimal labor input, the extension organization may anticipate increased yields per acre. Erhun, (2015) confirmed that under conditions of limited rainfall in northern Nigeria, traditional mixed cropping was more rewarding than the recommended modern monocultural practices. In another related study, Giovanna, (2017) argues that the reluctance of farmers to adopt new technological 'packages' may be a sign of creativity rather than backwardness. He notes that in Bangladesh and Bihar, traditional rice varieties and bamboo tubewells outperformed the new rice varieties or steel tubewells Introduced by change agents. These findings underscore the importance of understanding how research contributes to adapting technological packages to specific agroclimatic and sociocultural situations. Closely related to these findings, Eriksen (2021) has discussed change-inhibiting factors inherent in both traditional societies and the structure and functions of the bureaucratic mechanism within the change agency.

Cultural factor

The cultural factor can inhibit change, as traditional values, beliefs, norms, and attitudes can affect innovation. For instance, an attempt to introduce an improved seed program in India failed because borrowing or buying seed was considered a disgrace or a sign of poor management. The village farmer took pride in growing enough food to support their family and using the surplus as seed. Similarly, a hybrid corn was initially adopted in a Mexican project, but it was later rejected due to the perceived inferior quality of the corn dough. On the other hand, a new rice variety was adopted by farmers in Sierra Leone because it was found to be superior to the traditional variety in terms of texture and quality, according to Giovanna et al (2017).

Social factors

Social factors can inhibit change due to social structure, relationships, class, authority, political units, and factions. In many traditional societies, informal exchange and reciprocity are social imperatives that promote social integration but can also constrain innovation and productivity. For example, a person who accumulates wealth but fails to share it with their kin during weddings and funerals may face heavy criticism and ostracism (Erhun, 2015)

Psychological factors

Psychological factors can hinder change due to communication problems, individual and group motivation, and the nature of perceptions. For instance, according to Ovwasa, (2021), a community development program in Nigeria failed because the villagers had suspicions and negative perceptions of the government authorities. Moreover, traditional communities often view gifts negatively. For example, in Zululand, paying a high price for medical facilities is considered prestigious.

Economic constraints

Farmers face economic constraints that prevent them from acquiring the necessary inputs for trials and adopting innovative approaches in their agricultural Practices. The economic difficulties encountered by farmers go beyond the affordability of inputs and include access to credit, market fluctuations, and overall financial stability. The inability to obtain essential inputs not only impedes the initiation of trials but also hinders the potential scale-up of successful innovations. This financial cycle becomes a significant hurdle, restricting the realization of the full benefits of agricultural innovations. To address this issue,

Bureaucratic mechanism

The bureaucratic mechanism within the extension

organization can hinder innovation and creativity. Some change agents, including foreign experts, may not have sufficient knowledge about the local conditions in villages, but they still assume that the strategies that work well in Western countries can be easily applied in developing countries.

Attributes of an innovation

The qualities of an innovation that influence how it is perceived by potential buyers and its adoption rate are known as its attributes. The attributes of innovation can play a crucial role in determining its adoption rate. For instance, Rogers (2003) noted that the speed at which an innovation is adopted depends largely on the nature of the innovation itself. The five key attributes that universally determine the rate of adoption of an innovation are: (1) its comparative advantage over other options, (2) its compatibility with the social norms and production patterns of the target group, (3) its simplicity or ease of understanding, (4) its trialability or the ease with which it can be experimented in small amounts, and (5) its observability. Research has also indicated that, almost without exception, the early adopters tend to be more progressive, have higher income and wealth, possess higher education, tend to be key functionaries, are more cosmopolitan, and if they are farmers, operate larger farms. Conversely, those with opposite characteristics tend to be later adopters (Dawood, 2022).

Social system

In any given social system, the diffusion of innovation usually follows a particular pattern. Typically, a small group of innovators, who have enough resources to take risks and fewer factors inhibiting change in the social system, initiate the adoption. These innovators usually obtain information through mass media or extension services. Soon after, a larger group of influential people (early adopters) imitate these highly innovative individuals, but only after they are convinced of the innovation's potential benefits. Following this stage, the innovation spreads quite fast, often through word of mouth, until the majority of people have adopted it. Finally, the poor, less informed, and most isolated individuals, known as laggards, are usually the last to adopt the innovation (Dawood, 2022).

Knowledge

Despite the vast amount of knowledge available on adoption behavior, adoption, and diffusion research is still limited to developed areas of the world. This is a major drawback, as many policymakers and extension professionals have adopted the classical adoption and diffusion model without adequately modifying it to suit the different socio-cultural and economic realities in developing countries. One of the problems with the classical adoption model is that it assumes that conditions in research centers are the same as those among the clientele groups. For instance, in most developed countries, farmers are reasonably literate and well-informed about scientific agricultural research findings. Additionally, the types of machinery and permanent farm structures that exist in technology development centers are identical to those on the clientele's farm operations. Unfortunately, this is often not the case in developing countries, as there is often a wide disparity between conditions in the research center and what happens in farmers' operational environments. Many arguments have been made for the recognition of these differences when implementing the classical adoption and diffusion model in developing countries (Greiner, 2013).

Conclusion

Adopter categories refer to the different classifications of members within a system based on their innovativeness. This refers to the extent to which an individual or unit adapts to new ideas earlier than other members of the system. Over time, adopter distributions tend to follow an S-shaped curve, eventually approaching normality. The continuum of innovativeness can be broken down into five adopter categories: innovators, early adopters, early majority, late majority, and laggards. These categories are based on two characteristics of a normal distribution - the mean and the standard deviation. Each category has its dominant attributes, which are as follows: Innovators are venturesome, early adopters are respectful, the early majority is deliberate, the late majority is skeptical, and laggards are traditional. The differences between the categories are significant and are discussed in terms of socioeconomic status, personality variables, and communication behavior.

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