sustainability

MDPI

Article

Determinants of Smallholder Farmers' Adoption of Climate-Smart Agricultural Practices in Zomba, Eastern Malawi

Feston Ken Shani [1,*], Mirriam Joshua [2] and Cosmo Ngongondo [2]

[1] Department of Geography, Domasi College of Education, Domasi P.O. Box 49, Malawi
[2] Department of Geography, Earth Sciences and Environment, University of Malawi, Zomba P.O. Box 280, Malawi; mjoshua@unima.ac.mw (M.J.); cngongondo@unima.ac.mw (C.N.)
* Correspondence: fkenshani@gmail.com; Tel.: +265-999-337-223

Abstract: Smallholder farmers in Malawi largely depend on rainfed agriculture, despite climate change posing serious threats to this form of agriculture. The adoption of climate-smart agricultural practices is pivotal in offsetting the effects of climate change on agriculture. Despite the great potential of climate-smart agricultural practices in combating the effects of climate change on agriculture, smallholder farmers' adoption of it remains low. Reasons are varied, suggesting that the factors are largely contextual. This study, therefore, explored the determinants of smallholder farmers' adoption of climate-smart agricultural practices in Zomba, within the framework of the diffusion of innovations. Using a convergent mixed research design, the study purposively selected key informants and randomly selected smallholder farmers. Questionnaires, interviews, and observation guides were used to collect data. Thematic analysis was used to analyse qualitative data, while descriptive analysis was used to analyse quantitative data. Results indicate that only 26% of smallholder farmers have adopted the promoted climate-smart agricultural practices. Compatibility and simplicity are the chief determinants of climate-smart agricultural practice adoption. The majority of smallholder farmers fall under the late majority. Evidence shows that labour and capital intensive climate-smart agricultural practices are less likely to be adopted by smallholder farmers. Implementing agencies, therefore, should first consult the local farmers on the ground to see practices that are already being followed and are suitable before bringing the new ones. This will ensure that the appropriate climate-smart agricultural practices are promoted.

Keywords: adaptation; appropriateness; climate change; compatibility; innovation; uptake

Citation: Shani, F.K.; Joshua, M.; Ngongondo, C. Determinants of Smallholder Farmers' Adoption of Climate-Smart Agricultural Practices in Zomba, Eastern Malawi. *Sustainability* **2024**, *16*, 3782. https://doi.org/10.3390/su16093782

Academic Editor: Iain J. Gordon

Received: 29 February 2024
Revised: 17 April 2024
Accepted: 18 April 2024
Published: 30 April 2024

1. Introduction

Agriculture remains the keystone of Malawi's economy [1,2]. It employs 85% of the labour force, produces one-third of the gross domestic product (GDP), and 90% of foreign exchange earnings for the country [3,4]. Smallholder farmers in Malawi depend on rain [4], which makes agricultural production in the country prone to various impacts of climate change [5,6], leading to low agricultural production. Although climate change poses a major threat to agricultural production and food security in developing countries, climate-smart agriculture (CSA) is critical in addressing such impacts. CSA is a broad term referring to the practice of growing crops and keeping animals that help farmers achieve climate change adaptation, greenhouse gas mitigation, and food security [7]. Six types of CSA practices exist, namely water smart, energy smart, nutrient smart, carbon smart, weather smart, and knowledge smart [8]. Water smart are those practices that improve water use efficiency, such as rainwater harvesting. Energy smart are those practices that improve energy use efficiency, such as zero tillage. Nutrient smart are those practices that improve nutrient use efficiency, such as green manuring. Carbon-smart practices are those practices that reduce GHG emissions, such as agroforestry. Weather-smart practices are those interventions that provide services related to income security and weather advisories to farmers, such as crop insurance and weather-based crop agro-advisory. Knowledge-smart practices are those CSA interventions that use a combination of science and local knowledge, such as improved crop varieties. This entails that there are numerous examples of CSA practices that smallholder farmers use. In this study, the focus was on the growing of maize using CSA practices.

In its efforts, the Government of Malawi has put in place ways of arresting the effects of climate change on agriculture through an agricultural sector-wide approach support program (ASWAp-SP) II [9]. Under ASWAp-SP II, several CSA practices are being promoted to smallholder farmers in twelve districts of Malawi, including Zomba. Despite having various CSA practices, research [6,10–13] indicates that most smallholder farmers have not yet adopted them. There was a gap in our understanding of the CSA practice adoption status and the associated factors, especially in Zomba. Zomba is one of the districts worst hit by the effects of climate change in Malawi [14]. The district has several extension planning areas (EPAs), with diversity in social cultural and environmental factors. This study, therefore, explored factors influencing smallholder farmers' adoption of CSA practices in Zomba. It was hypothesized that smallholder farmers are ready to adopt CSA practices that are appropriate. The term appropriate entails being affordable (cheap), simple (easy to use), and localized (meeting the needs of the smallholder farmers).

The literature indicates numerous issues regarding the determinants of smallholder farmers' adoption of CSA practices worldwide [5,6,11,15–28]. One of the determinants is access to information, which includes extension institutions, weather forecasting information, and the knowledge and/or capacity of extension workers [16,20,24,25,27]. Furthermore, the adoption of CSA practices is hindered by the lack and scarcity of resources such as land, labour, finances, competition for the use of biomass, water, income, and farm inputs [6,15–18,23–27,29,30]. Other studies found that access to markets [11], the lack of markets [27], and market information [26] are necessary for smallholder farmers to adopt CSA practices. These determinants positively and significantly correlate with the adoption of different sets of CSA practices. Again, some smallholder farmers' adoption of CSA practices was affected by the anticipated benefits of CSA practices, as they tended to adopt after seeing their benefits [12]. In the same vein, some smallholder farmers' adoption of CSA practices was found to be determined by exposure to previous harsh weather conditions. These factors helped smallholder farmers build weather expectations and influence the use of CSA practices as adaptive mechanisms [19]. For instance, it was found that smallholder farmers who were previously exposed to early-season and late-season dry spells were more likely to use CSA practices. One implication from this is that immediate weather shocks prompt smallholder farmers to adopt the CSA practices that can offset them. It can be argued, therefore, that most smallholder farmers are not ready to adopt a CSA practice for a climatic hazard they have never experienced before. In addition to that, the farm size [20,24,26], distance between farmers' home and farm location [28], farming experience [21,26], the farmers' education levels [22,26], and the farmers' laziness [27] are critical factors in influencing the adoption of CSA practices.

1.1. The Malawi Agriculture Sector Wide Approach Support Project (ASWAp-SP) II

The Government of Malawi adopted the Agriculture Sector Wide Approach (ASWAp) Support Project, which is in its second phase, referred to as ASWAp-SP II [31]. ASWAp-SP II aims at improving food security and nutrition, increasing agricultural incomes, achieving more than 6% of agricultural growth annually, and ensuring the sustainable use of natural resources [29]. Under one of its sub-components, Integrated Soil Fertility Management, ASWAp-SP II is expected to support the scaling up of CSA practices among smallholder farmers in order to enhance the resilience of agricultural production systems to climatic change shocks [31].

Malawi, as a country, instituted the Malawi Climate Smart Agriculture Alliance (MCSAA) under ASWAp to spearhead and coordinate the scaling up of CSA in Malawi. MCSAA aims to develop and manage a communication strategy to promote the widespread adoption of CSA, coordinate and lead CSA advocacy, and monitor the rollout of CSA [11]. It is important to note that ASWAp-SP I was implemented in all the districts of Malawi, while ASWAp-SP II is being implemented in 12 selected districts only. The districts are Chitipa, Mzimba, Kasungu, Ntchisi, Mchinji, Lilongwe, Dedza, Ntcheu, Zomba, Phalombe, Mulanje, and Thyolo.

In Malawi, the Ministry of Agriculture (MoA) is the lead institution in supporting agricultural development. The MoA is divided into 28 district agriculture development offices (DADOs). The DADOs are the focal points for planning, providing information including technical advice, and the training and supervision of the extension planning area (EPA) staff and farmers. The DADOs are further divided into 154 EPAs. The EPAs are responsible for developing farmers' groups, facilitating farmers' access to credit institutions, and farmers' training. The EPAs are further divided into sections, which are the lowest level of the MoA structure. In most cases, a section covers one village [31]. This study was conducted in one village of one section of Malosa EPA. It was still unknown what influenced the smallholder farmers' adoption of CSA practices in the area. This study has filled this gap.

1.2. Theoretical Framework

This study was guided by the diffusion of innovations (DoI) theory, propounded by Rogers [32]. The theory seeks to explain how people adopt innovations. This study used three main issues of the DoI theory, namely the innovation-decision process, factors determining the adoption of innovation, and adopter categories. Under innovation, Rogers [32] argues that the results of a practice may create uncertainty, which may lead to the adoption or rejection of the said practice. The innovation-decision process has five main stages, namely knowledge, persuasion, decision, implementation, and confirmation (Figure 1). Under the knowledge stage, an individual learns about the existence of innovation and seeks information about the innovation regarding "what the innovation is and how and why it works" [32]. The persuasion stage is when an individual develops an attitude towards an innovation. The attitude can be either negative or positive [32]. This leads to the decision stage, in which an individual chooses to adopt the innovation or not. The implementation stage is where an individual starts using the adopted innovation. In the confirmation stage, an individual seeks support for the adopted innovation. At this stage, the decision to implement an innovation can be continued or discontinued.

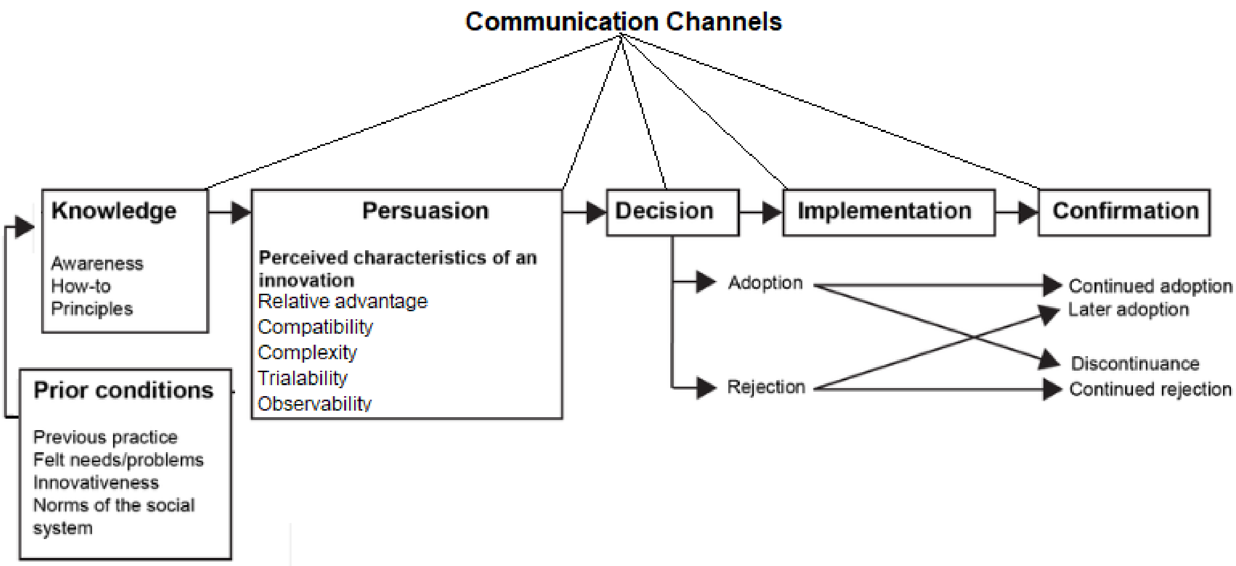

Figure 1. Stages in the innovation-decision process.

The adoption of an innovation is influenced by the relative advantage, compatibility, complexity, trialability, and observability. Relative advantage is the extent to which an innovation is perceived as being better than the idea it replaces [32]. Compatibility is "the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters" [32], in this case, smallholder farmers. Complexity is the extent to which an innovation is perceived as relatively difficult to understand and use [32]. Trialability is the extent to which the innovation can be tested before a commitment to adopt is made. Observability is the extent to which the results of an innovation are visible to others [32]. This is one of the key determinants of the adoption of innovations.

Individuals can fall under categories of innovators, early adopters, early majority, late majority, or laggards, (Figure 2), based on how relatively earlier they are in adopting new ideas than others [32]. For instance, innovators are those who want to be the first to try the innovation. Early adopters are those who demonstrate their understanding of an idea "by adopting it" [32]. Under the early majority falls those who adopt new ideas after others. Under the late majority falls individuals who are sceptical of change and adopt an innovation only after the majority have tried it. Those who are very sceptical of change fall under laggards. These individuals tend to adopt an innovation after seeing its successes elsewhere.

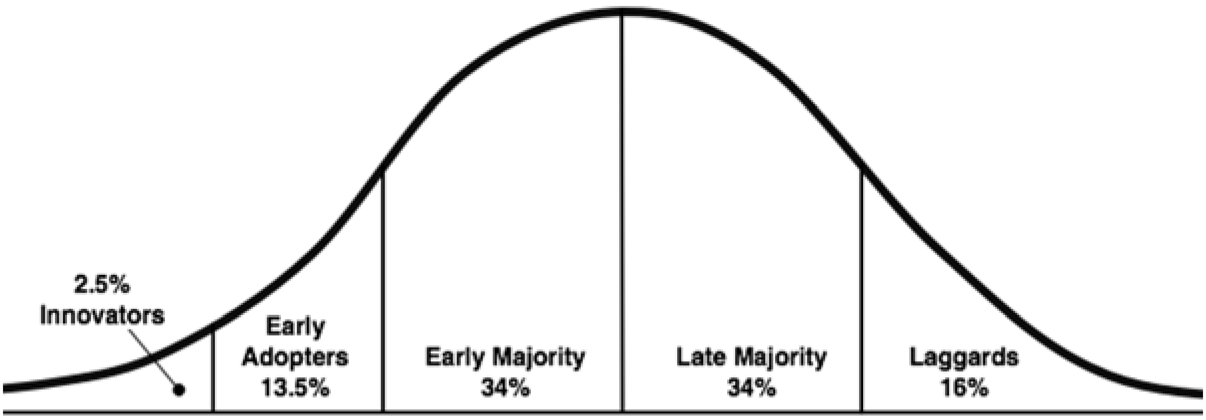

Figure 2. Adopter categories.

2. Materials and Methods

2.1. Study Area and Population

This study was conducted in Malosa EPA in Zomba District. The EPA has 199 villages and 22 sections. Out of the 22 sections, only 2 are implementing the CSA practices under ASWAp-SP II. This study was conducted in Matandani Section, which has two villages, namely Nthiko and Kaju. The focus of this study was on group village (GV) Nthiko, located in Traditional Authority (T/A) Malemia at an approximate latitude of 15°17′ S and longitude of 35°24′ E (Figure 3). The area lies within the Lake Chilwa Basin and has a savanna climate, with the annual rainfall range between 1100 and 1600 mm [33]. It has an average annual temperature between 21 °C and 24 °C [34]. The area experiences prolonged droughts due to low rainfall and increased temperatures [35], whose extremes resulted in the drying up of Lake Chilwa in 1995 [36] and 2018 [35]. The soils in the area are largely sandy loam (41%), loamy sand (26%), and sandy clay loam (17%) [37]. Minor soil types include sand (9%), clay loam (5%), clay (1%), and loam (1%) [37]. Maize, which is the staple food, is the main crop grown in the area.

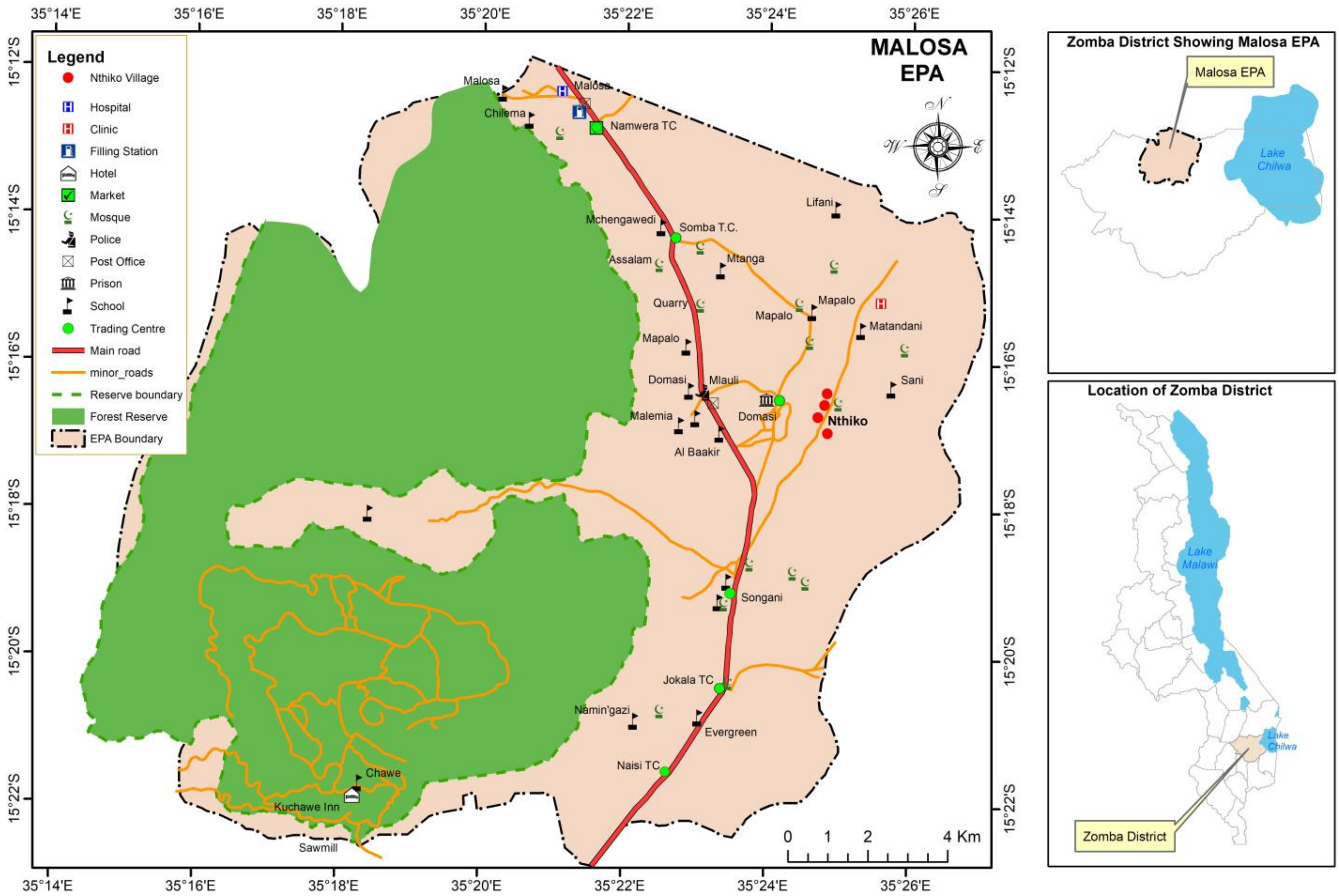

Figure 3. Map showing the study area.

2.2. Research Design

This study adopted a mixed research approach [38], with a convergent parallel design. This was because the study simultaneously collected both qualitative and quantitative data, merged the data, and used the results to understand the research problem clearly [39]. The purpose of using the convergent design was to collect different but complementary data [40]. A comparison of the two methods was achieved by merging the quantitative and qualitative data in a single table for each major topic in order to achieve the same goal. This is in tandem with what Lee and Greene [41] contend that a mixed research design is a complementarity mixed methods study. This study employed a case study approach, powered by a survey, which made it possible to describe numerically the trends, attitudes, and opinions of a population via the study of its sample [42].

2.3. Sampling Design and Sample Size

This study used purposive sampling and simple random sampling procedures. Purposive sampling was used to select the three (3) key informants. Likewise, the research site was purposively selected. On the other hand, simple random sampling was used to select smallholder farmers. The research area had a population of 205 smallholder farming households [43]. This study employed the following formula [44] to calculate the sample size:

$$n = \frac{N}{1 + N(e)^2}$$

In the formula, n is the sample size, N is the total farming households' population, and e is the level of precision. This study adopted a confidence level of 95% and a precision level of 10% in a sample of 205 farming households. The sample was then increased to 70 households, as shown below:

$$n = \frac{205}{1 + 205(e)^2}$$

$$n = \frac{205}{1 + 205(0.10)^2}$$

$$n = \frac{205}{1 + 205(0.01)}$$

$$n = \frac{205}{1 + 2.05}$$

$$n = \frac{205}{3.05}$$

$$n = 67.2$$

Table 1 shows that, in total, this study had a sample of 73 respondents, i.e., 70 smallholder farmers and 3 agricultural experts (Table 2). This agrees with what Field [45] argues, that a sample is a smaller but hopefully representative collection of units from a given population.

Table 1. Sample size of smallholder farmers.

Number of Farming Households	Sample Size (*n*) for Precision (*e*) Level of ±10%
205	67
Additional HH	03
Total	70

Table 2. Key informants.

Title of Officer	Number
Chief agricultural expert	1
District agricultural expert	1
Section agricultural expert	1
Total	3

2.4. Data Collection

This study collected qualitative and quantitative data concurrently. For the qualitative data, the study used semi-structured interviews and field observations. The semi-structured interview guides were used to gather data from three key informants and ten smallholder farmers (Table 3). The ten smallholder farmers were purposively selected for being either adopters or non-adopters of ASWAp-SP II CSA practices. The survey questionnaires were used to collect quantitative data from 70 smallholder farmers.

Table 3. List of qualitative research participants.

Participant Code Name	Sex	Description
Smallholder farmer 1	F	CSA practice(s) adopter
Smallholder farmer 2	F	CSA practice(s) adopter
Smallholder farmer 3	F	CSA practice(s) adopter
Smallholder farmer 4	F	CSA practice(s) adopter

Table 3. *Cont.*

Participant Code Name	Sex	Description
Smallholder farmer 5	M	CSA practice(s) adopter
Smallholder farmer 6	F	CSA practice(s) non-adopter
Smallholder farmer 7	F	CSA practice(s) non-adopter
Smallholder farmer 8	F	CSA practice(s) non-adopter
Smallholder farmer 9	M	CSA practice(s) non-adopter
Smallholder farmer 10	F	CSA practice(s) non-adopter
Key informant A	M	Chief agricultural expert
Key informant B	M	District agricultural expert
Key informant C	M	Section agricultural expert

2.5. Data Analysis

This study used thematic analysis [46] to analyse qualitative data. The quantitative data were analysed using descriptive statistics [47,48], aided by the Statistical Package for Social Scientists (SPSS) version 26 and Microsoft Office Excel 2019 software packages. Data analysis in this study was descriptive, thereby enabling the study to identify the measures of central tendency and dispersion. The data were merged via a side-by-side system [49]. The quantitative results have been reported first, followed by the qualitative findings.

3. Results

3.1. Characteristics of Respondents

This study engaged smallholder farmers of various sexes, ages, marital statuses, occupations, economic statuses, and education levels (Table 4).

Table 4. Characteristics of respondents (n = 70).

Variable	Percentage
Sex	
• Male	14%
• Female	86%
Age	
• Below 50 years old	71%
• Above 50 years old	29%
Marital status	
• Single	47%
• Married	53%
Occupation	
• Farming	74%
• Business	26%
Average monthly income	
• Below MK10,000	71%
• Above MK10,000	29%
Education levels	
• Literate	89%
• Illiterate	11%

This study engaged 60 female smallholder farmers (85.7%) and 10 male smallholder farmers (14.3%). Most smallholder farmers were females because the majority of farming households were female headed. In terms of age, most smallholder farmers (71%) are below 50 years of age, while 29% are above 50 years of age. Among them, 53% were married, while 47% were single. Most of the married smallholder farmers (76%) were females, while 24% were males. However, during the semi-structured interviews, it was discovered that 82% of the married females had part-time husbands, while 18% had full-time husbands. This was because the majority of the marriages were polygamous, and most females in this study were not the first wives in their marriages. Economically, most smallholder farmers (74%) solely depended on farming for a living, while few (26%) relied on employment and business. Again, the majority (71%) of smallholder farmers had an average monthly income of below MK 10,000, while few (29%) had an average income of above MK 10,000. In terms of literacy levels, the majority (89%) of smallholder farmers were literate, and very few (11%) had never attended any formal education.

3.2. Smallholder Farmers' Adoption of CSA Practices

Figure 4 indicates the adoption rate of ASWAp-SP II CSA practices (n = 70).

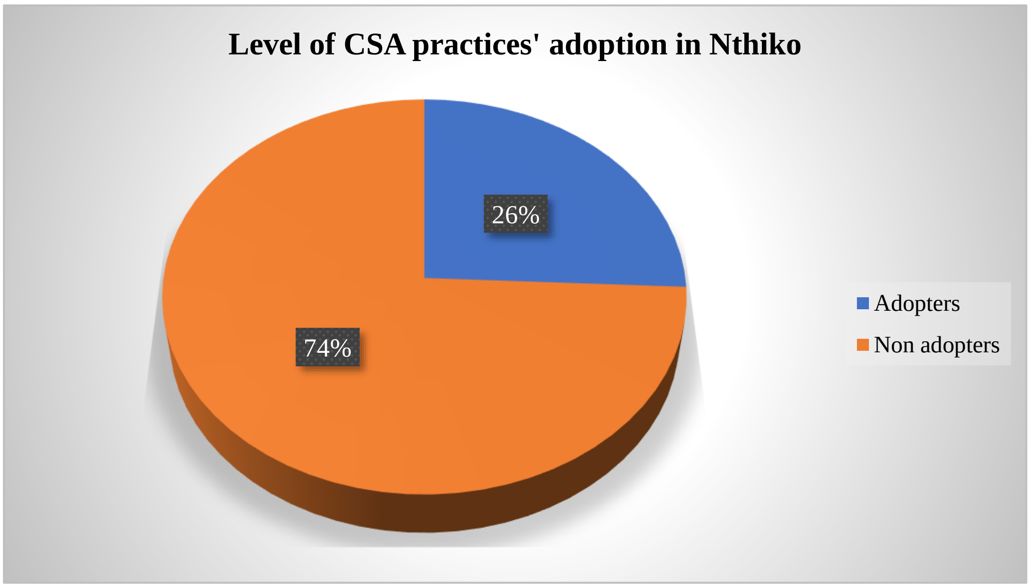

Figure 4. Smallholder farmers' adoption level of CSA practices.

The results indicate that most (74%) smallholder farmers have not yet adopted the CSA practices, while a few (26%) smallholder farmers have. This entails that many smallholder farmers are yet to adopt the CSA practices promoted by ASWAp-SP II. This was also confirmed in the semi-structured interviews, as indicated below:

> *My records show that about 30% of the smallholder farmers in Nthiko have adopted at least one of the CSAs we are promoting... So mostly, they revert to what they already know, thus, traditional practices* (Key Informant A)

In agreement to this, Key Informant C said the following in a separate interview:

> *If I were to assess the current adoption of CSAs by smallholder farmers, you would wonder. The uptake is as low as 25%. This is not as we expected.*

3.3. Factors Influencing the Adoption of CSA Practices

Figure 5 shows the results (n = 18).

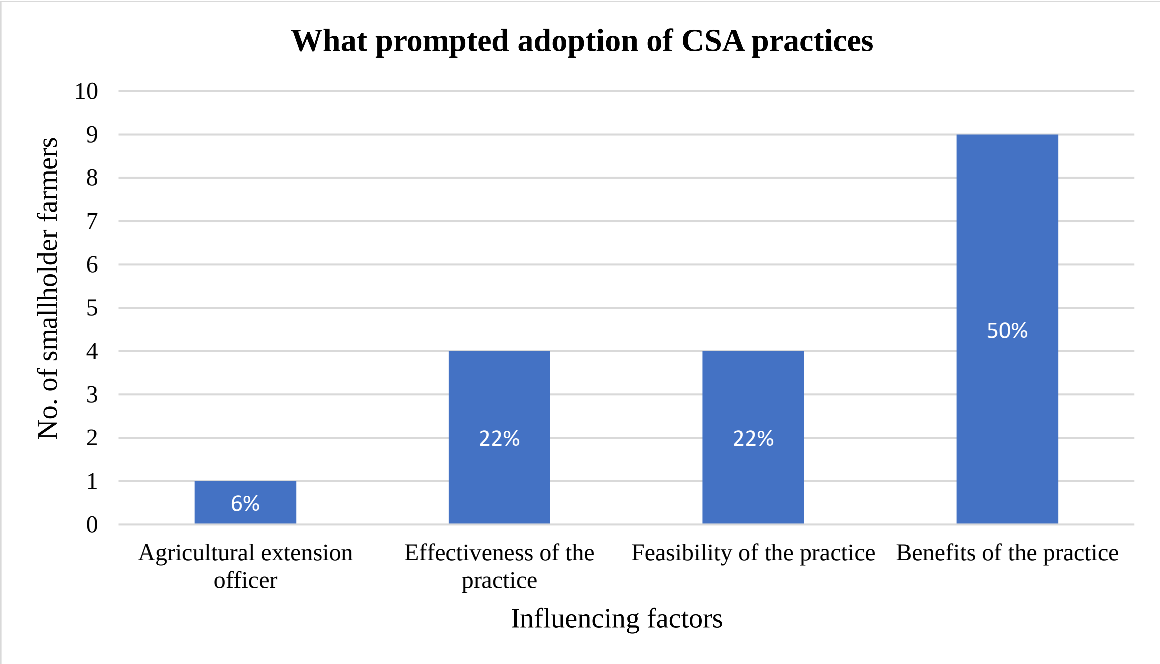

Figure 5. Factors influencing smallholder farmers' adoption of CSA practices.

The results indicate that half (50%) of the smallholder farmers adopted the CSA practice(s) after observing the benefits of the practices, while very few (6%) adopted after being convinced by the agricultural extension officer.

3.4. Challenges with the Adopted CSA Practices

Figure 6 shows the detailed results (n = 18).

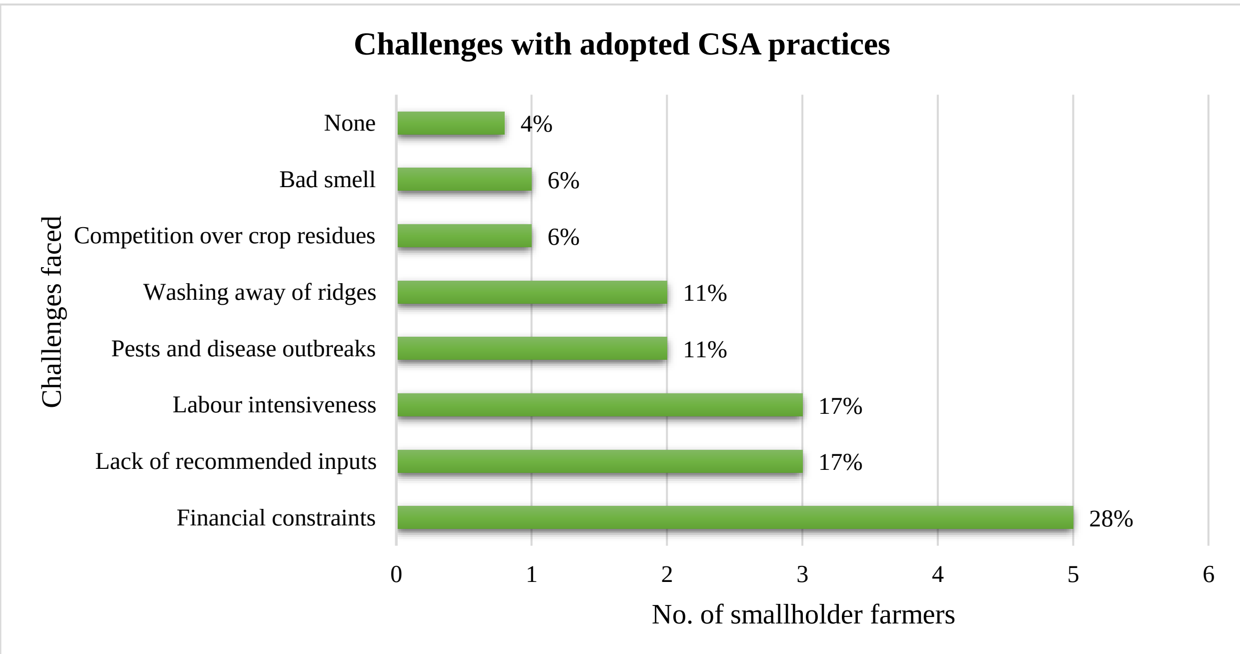

Figure 6. Challenges facing adopters of CSA practices.

The results indicate that the majority (96%) of smallholder farmers faced challenges with the adopted CSA practices, while very few (4%) faced no challenges. The challenges include financial constraints (28%), labour intensiveness, a lack of recommended inputs

(17%), the washing away of ridges, pests, and diseases (11%), bad smell, and competition over crop residues (6%). The following interview substantiates this:

> *Lack of fertiliser and seeds; these are now very expensive. Worse still, zero tillage requires more fertiliser than other systems.* (Smallholder Farmer 1)

During the observations, Smallholder Farmer 1 showed how the same amount of fertiliser is applied to one maize plant in zero tillage, as opposed to three maize plants in conventional farming (Figure 7).

(**a**) Zero tillage (**b**) Other farming

Figure 7. Challenges with adopted CSAs.

In Figure 7, Smallholder Farmer 1 demonstrated how fertiliser is applied to a maize plant in zero tillage. In field a., each planting station has one maize plant spaced 30 cm away from the other station. In field b., each planting station has three maize plants spaced 90 centimetres away from the other station.

On the other hand, some smallholder farmers failed to access the required quantity of maize stalks for implementing some CSA practices, such as zero tillage. This has been confirmed in the following interview:

> *Maize stalks are scarce. People set the stalks ablaze after harvesting. We just do it around the homestead. It's too involving to do the entire field. Again, residues bring worms.* (Smallholder Farmer 2)

In addition to the above, some smallholder farmers lack the necessary farm inputs to implement the desired CSA practices, as echoed in the following interview:

> *We lack farm inputs. The agricultural advisor promised us but we were not given. Only those in positions were given.* (Smallholder Farmer 4)

3.5. Determinants of CSA Practices' Adoption in Nthiko

Smallholder farmers were asked to rate how each of the following factors could determine (for non-adopters) or could have determined (for adopters) their adoption or non-adoption of CSA practice(s). Figure 8 shows the results (n = 70).

Many smallholder farmers reported that the appropriateness (81%) and benefits (67%) of the CSA practices were enough to influence their adoption of them, while few smallholder farmers indicated exposure to previous climatic hazards (3%) as their determinant. This is complemented by the following interviews:

> *I can adopt any CSA practice if I see its benefits and if it is easy to use.* (Smallholder Farmer 3)

Developing this argument, another respondent said the following:

> *A person participates when they see the benefits of something. Without seeing, eee, you fear being carried away and losing your money.* (Smallholder Farmer 5)

In a separate interview, another respondent said the following:

To me, the availability of farm inputs or finances plus access to CSA information services, are enough to enable me to adopt. How can one adopt if they don't know the practice to be adopted? (Smallholder Farmer 4)

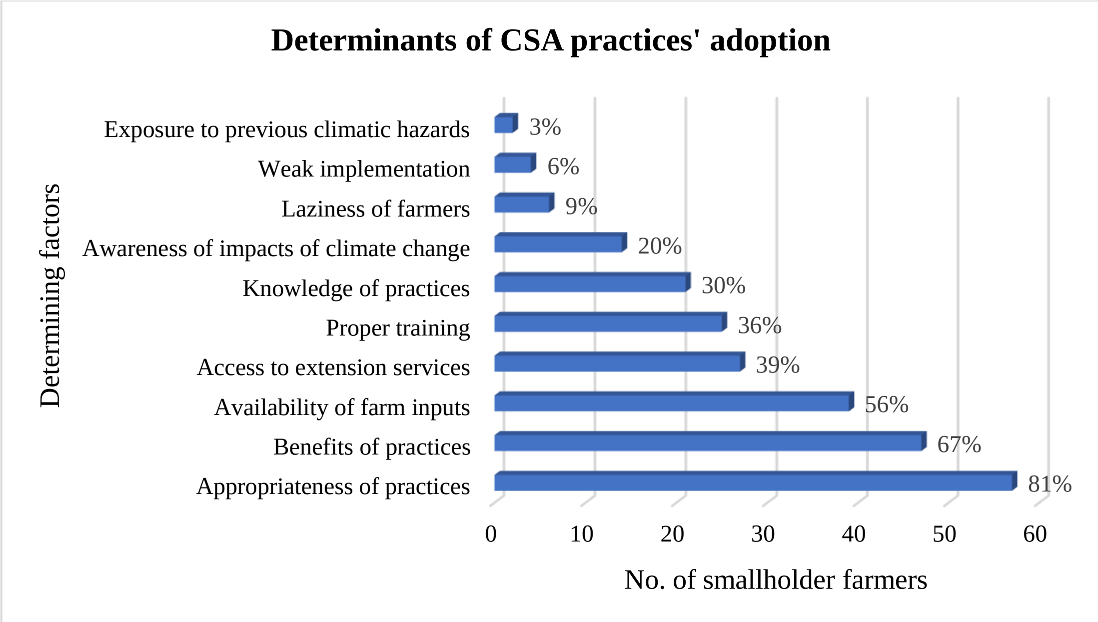

Figure 8. Determinants of CSA practice adoption in Nthiko Village.

4. Discussions

The fact that a few smallholder farmers in Nthiko have adopted the CSA practices corresponds with what was found by Abegunde et al. [50], Amadu et al. [15], Makate [5], Ouedraogo et al. [23], Sardar et al. [26], and Zakaria et al. [28] that worldwide, the uptake of CSA practices by smallholder farmers is very low. The similarity could be attributed to the fact that some basic human behavioural traits are similar worldwide. This entails that most of the smallholder farmers are yet to adopt the CSA practices. This concurs with what the diffusion of innovations theory [51] states that time is a critical factor in determining various human behavioural traits regarding the adoption of an innovation.

The fact that half (50%) of the smallholder farmers adopted the CSA practices after being attracted by the benefits they observed in other adopters' fields confirms what the diffusion of innovations theory [51] contends that observability is pivotal in influencing the adoption of an innovation. This entails that the rewards of CSA practices made a positive impact on their adoption. This study, therefore, recommends that there should be deliberate efforts by the project implementors to locate demonstration fields in focal places of the impact areas. This will ensure that all farmers of the impact area see for themselves the benefits of the CSA practices being promoted and adopt the practices in large numbers.

Furthermore, the trend that some smallholder farmers adopted after seeing the effectiveness of the CSA practice in adopters' fields is evidence enough that smallholder farmers will not adopt any CSA practices, which does not yield the expected results. This concurs with what the diffusion of innovations theory [51] emphasizes under relative advantage and compatibility, that a person will first check if the innovation being promoted is better than the previous one or the one it is intending to replace, and if it is addressing their real needs. In the same way, this relates well with what Kaplinsky [52] contends under localisation that a technology, in this case, a CSA practice, becomes appropriate if it responds to the actual needs of the people. This entails that if the smallholder farmer finds the promoted CSA practice comparatively less effective than the one being practiced, adoption will fail. This study, therefore, recommends that smallholder farmers should first try a potential CSA practice and compare its benefits with previous similar practices before deciding to adopt it. This implies that the best practice will be adopted.

In the same way, the tendency of some smallholder farmers to adopt the CSA practices based on their implementability resonates well with what the diffusion of innovations theory [51] claims that the degree to which an innovation seems easy to understand and use plays a critical role in promoting its adoption. This also agrees with what the concept of appropriate technology [52,53] postulates: that a technology ought to be simple, that is, easy to implement and not demand special skills. This entails that, if a CSA practice is deemed complex to use and implement, the chances of smallholder farmers adopting it will be very low. It can be argued, therefore, that if smallholder farmers will adopt CSA practices, their practicability and simplicity must be guaranteed. Otherwise, persuading smallholder farmers to adopt such a CSA practice would be a nightmare.

The revelation that smallholder farmers faced several challenges with the adopted CSA practices is consistent with what Kitsao [54] found in Phalombe, Nkhotakota, and Dowa that smallholder farmers who adopted CSA practices faced different challenges such as lack of farm inputs and finances, pests and diseases, and competition over crop residues. The similarities in the findings could be attributed to the fact that all the districts are in Malawi; as such, the chances of sharing similar characteristics are high. This study emphasizes that the challenges smallholder farmers face with CSA practices can easily deter potential adopters and encourage the adopters to disadopt the CSA practices as soon as possible. Although the diffusion of innovations theory [51] does not indicate this, it can be argued that, at some point in time, the early adopters may opt to disadopt the CSA practice. This study, therefore, posits that most CSA adopters in Nthiko are early adopters who, at some point, may choose to stop implementing the CSA practice(s) which may turn out to be unproductive.

The disclosure that some CSA practices are fertiliser intensive corresponds with what Wiegel [55] found that input costs on a farm implementing a CSA practice were 50% higher than the cost of a conventional farm of a similar size and crops would be. This is a worrisome situation considering the income levels of most smallholder farmers in Nthiko (Table 4), Malawi, and other developing countries. In fact, during field observations (Figure 8), it was observed that the amount of fertiliser applied to a single maize crop in zero tillage can be applied to three maize crops on a conventional farm. In principle, field a. would need three times the fertiliser to meet the demand of three maize plants, while, in field b., three maize plants would utilise an amount of fertiliser equivalent to one plant in field a. This entails that fertiliser usage in conventional farming to zero tillage is in the ratio of 1:3. This implies that a zero-tillage maize field uses three times the amount of fertiliser a conventional farm can use. It can, therefore, be argued that many smallholder farmers face challenges with the adopted CSA practices due to their capital intensiveness. However, according to agricultural experts, there are some substantial differences in the size of cobs per maize stalk between zero tillage and conventional farms. Nevertheless, considering the education levels of smallholder farmers in Nthiko, it would be difficult for them to understand this explanation from the agricultural expert.

The issue of bad smell emanating from an adopted CSA practice, as faced by one smallholder farmer, concurs with what Wiegel [55] found that smallholder farmers who adopted and implemented organic fertiliser felt discomfort with the bad smell produced by the organic fertiliser. This entails that the bad smell made the smallholder farmers feel more uncomfortable than when using the practices they had used before adopting organic fertiliser. This is consistent with what the diffusion of innovations theory [51] contends that an innovation must be better than the previous or existing ones. This study, therefore, recommends that some improvements should be made to organic manure in order to prevent the bad smell, which may otherwise prevent many smallholder farmers from adopting it. On the other hand, it is critical for smallholder farmers to understand that farming is not a white-collar job. As such, the issue of bad smell from manure should be withstood as they are naturally so. Even inorganic fertiliser production can produce bad smells in their factories. One insight from this finding is that some smallholder farmers (in Nthiko) are more concerned about their status in society rather than what is actually required of them as farmers. For instance, the smallholder farmers may feel ashamed to collect cow dung and other animal droppings for manure, yet they themselves lack money to buy inorganic fertilisers.

The fact that the majority of smallholder farmers (81%) said, to a larger extent, that the appropriateness of CSA practices could determine their adoption resonates well with what is implied by the diffusion of innovations theory [51] under compatibility, that an innovation's rate of adoption will increase when it is proven that the innovation will address the needs of the potential adopters. This entails that no matter how effective the CSA practices could be, if they are not suitable for arresting the effects of climate change on farming, farmers will not adopt them. Likewise, it can be argued that, farmers who have experienced the effects of climate change on their farming are likely to adopt the relevant CSA practices in order to offset the effects in question. Again, this finding is compatible with what Schumacher [53] argues that agricultural technology ought to respond to the real needs of the people. This implies that most smallholder farmers would prefer to adopt a CSA practice which will solve actual problems emanating from the impacts of climate change on their agriculture. This study, therefore, argues that appropriateness is the chief determiner of CSA practice adoption by smallholder farmers in Nthiko. This is because most farmers would want CSA practices that are affordable (cheap), simple (easy to use), and localized (meeting the needs of the smallholder farmers). This agrees with whatSchumacher [53] dubbed "technology of the people, by the people, for the people". One implication from this finding is that most smallholder farmers are ready to adopt a CSA practice, which will help overcome the effects of climate change on their farming without being capital and labour intensive.

The fact that benefits of CSA practices in question determine their adoption corresponds to what Mwandira [12] found that farmers tend to accept and adopt practices, technologies, and innovations when they see the benefits themselves. In the same way, this finding concurs with what the diffusion of innovations theory [51] contests that before taking up an innovation, prospective adopters will first ensure its results are visible and tangible. This entails that if prospective adopters observe the fruits of an innovation on their own, the chances of adopting it will be very high. It can be argued, therefore, that the absence or delay of CSA practice benefits will prevent or delay the likelihood of smallholder farmers adopting the practice. One implication from this finding is that, in order to promote the rate of adoption, the benefits of a CSA practice should be observed in a timely manner, and must surpass those of the existing practices.

The issue of adequate knowledge of CSA practices themselves determining their adoption by smallholder farmers confirms what FAO [30] found that CSA practices are knowledge intensive, hence the need for smallholder farmers to fully comprehend them prior to adoption. This also echoes what the diffusion of innovations theory [51] posits that the process of making a decision to adopt an innovation begins with an individual learning about the what, how, and why of the said innovation. This entails that, if smallholder farmers have adequate knowledge of the CSA practice in terms of what it is, how it works, and why it works, its adoption will be based on an informed decision. This study, therefore, argues that, unless these knowledge gaps are filled in potential adopters, the rate of adoption of CSA practices will remain low.

The fact that farm inputs or finances could determine the adoption of the CSA practices resonates well with what Ouedraogo et al. [23] found that farmers with access to farm inputs, finances, or credit facilities have a high likelihood of adopting CSA practices. This entails that most CSA practices require inputs, which are not cheap or easy to find by most smallholder farmers. This goes against what Schumacher [53] propounds that an appropriate technology should not require huge capital investments, but rather be cheap and affordable. It can be argued, therefore, that the input intensiveness and cost ineffectiveness of most CSA practices can prevent some smallholder farmers from adopting them. This is a worrisome development considering how expensive farm inputs have become over the years, especially since 2022, with the effects of devaluation, recession, and the Russia–Ukraine war. This study, therefore, recommends that there should be a deliberate effort by nations (countries) to subsidize farm inputs or provide credit facilities to smallholder farmers for them to use when implementing CSA practices.

The issue that training is a prerequisite to the adoption of CSA practices cannot be overemphasized. This finding is consistent with what the Centre for Coordination of Agricultural Research and Development for Southern Africa (CCARDESA) [56] arguesthat CSA practices are not just a simple set of practices and technologies that can be easily replicated in every context, but are complex systems that must be understood in connection with climate, weather, soil, the farmers' own socio-economic context, gender dynamics, markets, and regulatory environments. This entails that smallholder farmers who know the CSA practices are likely to adopt them. This correlates well with what the diffusion of innovations theory [51] contends that a prospective adopter of an innovation is supposed to know more about the innovation in terms of what it is, and how and why it operates (works). Such an understanding is necessary to help the smallholder farmers adopt suitable practices in order to solve their climate change challenges. This study, therefore, recommends comprehensive and regular training for smallholder farmers regarding CSA practices fitting their conditions, prior to the promotion of their adoption. It can be argued, therefore, that training smallholder farmers on CSA practices could ultimately promote their knowledge and thus foster adoption.

5. Conclusions

This study observed that several factors influence the adoption of CSA practices by smallholder farmers in Nthiko. The major determinants of smallholder farmers' adoption of CSA practices are appropriateness of the practices (81%), benefits of CSA practices (67%), and availability of farm inputs (56%). Minor determinants include access to extension services (39%), proper training (36%), knowledge of the practice (30%), awareness of the impact of climate change (20%), laziness of farmers (9%), weak implementation (6%), and exposure to previous climatic hazards (3%). The study found that all smallholder farmers are aware of the impacts of climate change on their agriculture, although not all of them have adopted the CSA practices being promoted in order to offset the impacts in their areas. It has been revealed that the majority of smallholder farmers would prefer to adopt a CSA practice, which will solve the actual problems emanating from the impacts of climate change. One implication from this finding is that most smallholder farmers are ready to adopt a CSA practice, which will help overcome the effects of climate change on their farming without being capital and labour intensive. In other words, appropriateness, which entails being affordable (cheap), simple (easy to use), and localised (meeting the needs of the smallholder farmers), determines the adoption. This has confirmed what was hypothesized. We argue that if smallholder farmers are to adopt CSA practices in large numbers, issues of compatibility and appropriateness should be well addressed. Failing which, the same challenges will continue suffocating the efforts of various stakeholders to arrest the effects of climate change on smallholder farming. Some of the implications are that labour- and capital-intensive CSA practices are less likely to be adopted by smallholder farmers, and that some CSA practices being promoted are not better than what farmers are already practicing. One major recommendation is that implementing agencies should avoid imposing practices on smallholder farmers before seeing what they are already practicing. This can be achieved by first consulting the local farmers to see the farming practices already being used and working before introducing the new ones. This will ensure that the promoted CSA practices are appropriate to the climatic realities, needs, and conditions of the targeted area and farmers. This study had two main limitations. Firstly, the study had a relatively small number of respondents due to the adoption of a 95% confidence level and a 10% precision level in a sample of 205 farming households. This made it difficult to find some significant connections in the data. The last one was time constraints, which made it impossible to wait for some respondents who were not available on the data collection days. This denied us an opportunity to hear out their views. Nevertheless, the findings of this study have revealed that, although CSA practices are ideal in offsetting the impacts of climate change on agriculture, their inappropriateness prevents the majority of smallholder farmers from adopting them.

Author Contributions: Conceptualization, F.K.S., M.J. and C.N.; Formal analysis, M.J. and C.N.; Investigation, F.K.S.; Methodology, M.J. and C.N.; Validation, M.J. and C.N.; Writing—original draft, F.K.S. All authors have read and agreed to the published version of the manuscript.

Funding: The study received financial support from Centre for Resilient Agri-Food Systems (CRAFS) funded by the World Bank.

Institutional Review Board Statement: The study was conducted in accordance with the National Commission for Science and Technology (NCST) and approved by the Research Ethics Committee of the UNIVERSITY OF MALAWI (UNIMAREC)—(protocol number P.01/22/114 of 10 March 2022).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The raw data supporting the conclusions of this article will be made available by the authors on request.

Acknowledgments: The study was financially supported by the World Bank funded Centre for Resilient Agri-Food Systems (CRAFS) at the University of Malawi under the Africa Centres Excellence II Additional Funding (ACE_2_AF) programme. We also acknowledge the support rendered by Domasi College of Education, various gatekeepers, research assistants, local people, and co-workers during our study.

Conflicts of Interest: We declare that there is no conflict of interest related to the submitted work.

References

1. Chinsinga, B. The political economy of agricultural policy processes in Malawi: A case study of the fertiliser subsidy program. In Proceedings of the Futures Agriculture Conference on the Political Economy of Agricultural Policy in Africa, Pretoria, South Africa, 18–19 March 2013.
2. Gairhe, J.J.; Adhikari, M. Intervention of climate smart agriculture practices in farmers field to increase production and productivity of winter maize in Terai region of Nepal. *J. Inst. Agric. Anim. Sci.* **2018**, *35*, 59–66. [CrossRef]
3. Government of Malawi. *The Agriculture Sector Wide Approach (ASWAp): A Prioritized and Harmonized Agricultural Development Agenda: 2011–2015*; Ministry of Agriculture and Food Security: Lilongwe, Malawi, 2011.
4. Msowoya, K.; Madani, K.; Davtalab, R.; Mirchi, A.; Lund, J.R. Climate change impacts on maize production in the warm heart of Africa. *Water Resour. Manag.* **2016**, *30*, 5299–5312. [CrossRef]
5. Makate, C. Effective scaling of climate smart agriculture innovations in African smallholder agriculture: A review of approaches, policy and institutional strategy needs. *Environ. Sci. Policy* **2019**, *96*, 37–51. [CrossRef]
6. Murray, U.; Gebremedhin, Z.; Brychkova, G.; Spillane, C. Smallholder farmers and climate smart agriculture: Technology and labor-productivity constraints amongst women smallholders in Malawi. *Gend. Technol. Dev.* **2016**, *20*, 117–148. [CrossRef] [PubMed]
7. Aggarwal, P.K.; Bhatia, G.D.; Joshi, P.K.; Prathapar, S.A.; Jat, M.L.; Kadian, M. Climate smart villages in South Asia. In *Climate Smart Agriculture Learning Platform, South Asia*; Climate Change, Agriculture and Food Security (CCAFS): New Delhi, India, 2013.
8. Khatri-Chhetri, A.; Aryal, J.P.; Sapkota, T.B.; Khurana, R. Economic benefits of climate-smart agricultural practices to smallholder farmers in the Indo-Gangetic Plains of India. *Curr. Sci.* **2016**, *110*, 1244–1249.
9. Hunga, H.G.; Mussa, J.J. Upscaling climate smart agriculture in Malawi. *RUFORUM Work. Doc. Ser.* **2016**, *14*, 217–223.
10. Lipper, L.; Thornton, P.; Campbell, B.M.; Baedeker, T.; Braimoh, A.; Bwalya, M.; Caron, P.; Cattaneo, A.; Garrity, D.; Henry, K. Climate-smart agriculture for food security. *Nat. Clim. Chang.* **2014**, *4*, 1068–1072. [CrossRef]
11. Malawi Climate Smart Agriculture Alliance. Climate-Smart Agriculture Scoping Study. Centre for Environmental Policy and Advocacy (CEPA): Blantyre, Malawi; Available online: https://cepa.rmportal.net/Library/inbox/climate-smart-agriculture-scoping-study/ (accessed on 17 July 2021).
12. Mwandira, W. Climate Smart Technologies for CSA. Available online: https://www.plantagbiosciences.org/people/willies-mwandira/ (accessed on 20 July 2021).
13. Sosola, B.; Gudeta, S.; Akinnifesi, F.; Ajayi, O. Conservation Agriculture Practices in Malawi: Opportunities and Challenges. FAO Regional Conservation Agriculture Symposium, Emperor's Palace, Johannesburg, South Africa, 8–10 February 2011. Available online: https://www.researchgate.net/publication/275886530 (accessed on 31 July 2021).

14. Mearns, R.; Norton, A. (Eds.) *Social Dimensions of Climate Change: Equity and Vulnerability in a Warming World*; World Bank: Rome, Italy, 2010.
15. Amadu, F.O.; McNamara, P.E.; Miller, D.C. Understanding the Adoption of Climate-Smart Agriculture: A Farm-Level Typology with Empirical Evidence from Southern Malawi. 2019. Available online: https://www.sciencedirect.com/science/article/pii/S0305750X19303407 (accessed on 20 July 2021).
16. Chandra, A. Climate-Smart Agriculture in Practice: Insights from Smallholder Farmers, Timor-Leste and the Philippines, Southeast Asia. Ph.D. Thesis, The University of Queensland, Brisbane, QLD, Australia, 2017. [CrossRef]
17. Food and Agriculture Organisation. *Climate Change and Food Security: Risks and Responses*; FAO: Rome, Italy, 2015; ISBN 978-92-5-108998-9.
18. Government of Malawi. *Intended Nationally Determined Contribution (INDC)*; Government Print: Zomba, Malawi, 2015.
19. Katengeza, S.P. Climate-Smart Agriculture in Malawi: Uptake and Opportunities in the Face of Climate Change. Ph.D. Thesis, Norwegian University of Life Sciences, Ås, Norway, 2018. ISBN 978-82-575-1519-5.
20. Knegtel, J. Urban Agriculture: Outsmarting Climate Change? Master's Thesis, Utrecht University, Utrecht, The Netherlands, 2014, *unpublished*. Available online: https://studenttheses.uu.nl/handle/20.500.12932/18916 (accessed on 17 July 2021).
21. Makate, C.; Makate, M.; Mango, N. Farm household typology and adoption of climate-smart agriculture practices in smallholder farming systems of southern Africa. *Afr. J. Sci. Technol. Innov. Dev.* **2018**, *10*, 421–439. [CrossRef]
22. Makate, C. Climate Smart Agriculture and Livelihoods of Smallholder Farmers: Adaptive Management for Environmental Changers. Master's Thesis, Tongji University, Shanghai, China, 2017, *unpublished*.
23. Ouédraogo, M.; Houessionon, P.; Zougmoré, R.B.; Partey, S.T. Uptake of climate-smart agricultural technologies and practices: Actual and potential adoption rates in the climate-smart village site of Mali. *Sustainability* **2019**, *11*, 4710. [CrossRef]
24. Pagliacci, F.; Defrancesco, E.; Mozzato, D.; Bortolini, L.; Pezzuolo, A.; Pirotti, F.; Pisani, E.; Gatto, P. Drivers of farmers' adoption and continuation of climate-smart agricultural practices: A study from north-eastern Italy. *Sci. Total Environ.* **2020**, *710*, 136345. [CrossRef] [PubMed]
25. Partey, S.T.; Zougmore, R.B.; Ouédraogo, M.; Campbell, B.M. Developing climate-smart agriculture to face climate variability in West Africa: Challenges and lessons learnt. *J. Clean. Prod.* **2018**, *187*, 285–295. [CrossRef]
26. Sardar, A.; Kiani, A.K.; Kuslu, Y. Does adoption of climate-smart agriculture (CSA) practices improve farmers' crop income? Assessing the determinants and its impacts in Punjab province, Pakistan. *Environ. Dev. Sustain.* **2020**, *23*, 10119–10140. [CrossRef]
27. Tiamiyu, S.A.; Ugalahi, U.B.; Eze, J.N.; Shittu, M.A. Adoption of climate smart agricultural practices and farmers' willingness to accept incentives in Nigeria. *Int. J. Agric. Environ. Res.* **2018**, *4*, 198–205.
28. Zakaria, A.; Alhassan, S.I.; Kuwornu, J.K.; Azumah, S.B.; Derkyim, M.A. Factors influencing the adoption of climate-smart agricultural technologies among rice farmers in northern Ghana. *Earth Syst. Environ.* **2020**, *4*, 257–271. [CrossRef]
29. Food, Agriculture and Natural Resources Policy Analysis Network. A Comprehensive Scoping and Assessment Study of Climate Smart Agriculture Policies in Malawi. 2014. Available online: https://docplayer.net/50171078-A-comprehensive-scoping-and-assessment-study-of-climate-smart-agriculture-policies-in-malawi-by-the.html (accessed on 20 July 2021).
30. Food and Agriculture Organisation. *Climate-Smart Agriculture Sourcebook*; FAO: Rome, Italy, 2013.
31. Ministry of Agriculture, Irrigation and Water Development. *Malawi Agriculture Sector Wide Approach Support Project II*; Ministry of Agriculture, Irrigation and Water Development: Lilongwe, Malawi, 2017.
32. Rogers, E.M. *Diffusion of Innovations*, 5th ed.; Free Press: London, UK, 2003.
33. Mvula, P.; Kalindekafe, M.; Kishindo, P. Fragment management of the Lake Chilwa basin. In *Towards Defragmenting the Management System of Lake Chilwa Basin, Malawi*; Mvula, P., Kalindekafe, M., Kishindo, M., Berge, E., Njaya, F., Eds.; LIT Verlag: Capetown, South Africa.
34. Chavula, G.M. The Evaluation of the Present and Potential Water Resources Management for the Lake Chilwa Basin. Broadening Access and Strengthening Input Market Systems (BASICS). 2000. Available online: https://www.google.com/url?sa=t&source=web&rct=j&opi=89978449&url=https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=446b11f2b74a97c912feece9aa8ddf7f352332b0&ved=2ahUKEwi9877m4dWFAxXVRPEDHel0DwoQFnoECA0QAQ&usg=AOvVaw3naHJDvntHTO_6Y46D6Hew (accessed on 20 July 2021).
35. Kambombe, O.; Ngongondo, C.; Eneya, L.; Monjerezi, M.; Boyce, C. Spatio-temporal analysis of droughts in the Lake Chilwa basin, Malawi. 2021. *Theor. Appl. Climatol.* **2021**, *144*, 1219–1231. [CrossRef]
36. Njaya, F.J. *Review of Management Measures for Lake Chilwa, Malawi*; UNU-Fisheries Training Programme: Reykjavic, Iceland, 2001.
37. Sagona, W.C.; Kachala, O.; Matete, S.; Jenya, H. Physiochemical properties of soil in selected sites of the Lake Chilwa basin after five years of conservation agriculture practice. *Univers. J. Agric. Res.* **2016**, *4*, 155–164. [CrossRef]
38. Creswell, J.W.; Plano Clark, V.L. *Designing and Conducting Mixed Methods Research*, 3rd ed.; SAGE: Thousand Oaks, CA, USA, 2018.
39. Creswell, J.W. *Educational Research: Planning, Conducting, and Evaluating Quantitative and Qualitative Research*, 4th ed.; SAGE: Los Angeles, CA, USA, 2012.
40. Morse, J.M. Approaches to qualitative & quantitative methodological triangulation. *Nurs. Res.* **1991**, *40*, 120–123. [CrossRef] [PubMed]
41. Lee, Y.J.; Greene, J. The predictive validity of an ESL Placement Test: A mixed methods approach. *J. Mix. Methods Res.* **2007**, *1*, 366–389. [CrossRef]
42. Creswell, J.W. *Research Design: Qualitative, Quantitative and Mixed Methods*, 4th ed.; Sage: Thousand Oaks, CA, USA, 2014.

43. National Statistical Office. *Malawi Population and Household Census*; National Statistical Office: Zomba, Malawi, 2019.
44. Yamane, T. *Statistics: An Introductory Analysis*, 2nd ed.; Harper and Row: New York, NY, USA, 1967.
45. Field, A. *Discovering Statistics Using SPSS*, 2nd ed.; Sage: Los Angeles, CA, USA, 2005.
46. Braun, V.; Clarke, V. Using thematic analysis in psychology. *Qual. Res. Psychol.* **2006**, *3*, 77–101. [CrossRef]
47. Kaur, P.; Stoltzfus, J.; Yellapu, V. Descriptive statistics. *Int. J. Acad. Med.* **2018**, *4*, 60–63. [CrossRef]
48. Fisher, M.J.; Marshall, A.P. Understanding descriptive statistics. *Aust. Crit. Care* **2009**, *22*, 93–97. [CrossRef] [PubMed]
49. Creswell, J.W.; Creswell, J.D. *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*, 5th ed.; SAGE: Los Angeles, CA, USA, 2018.
50. Abegunde, V.O.; Sibanda, M.; Obi, A. Determinants of the adoption of climate-smart agricultural practices by small-scale farming households in King Cetshwayo District Municipality, South Africa. *Sustainability* **2020**, *12*, 195. [CrossRef]
51. Vishwanath, A.; Barnett, G.A. *The Diffusion of Innovations: A Communication Science Perspective*; Peter Lang Inc.: New York, NY, USA, 2011.
52. Kaplinsky, R. Schumacher meets Schumpeter: Appropriate technology below the radar. *Res. Policy* **2011**, *40*, 193–203. [CrossRef]
53. Schumacher, E.F. *Small is Beautiful: A Study of Economics as If People Mattered: 25 Years Later. . .with Commentaries*; Hartley & Marks Publishers: Vancouver, BC, Canada, 1999.
54. Kitsao, E.Z. Adoption of Climate Smart Agriculture (CSA) Technologies among Female Smallholder Farmers in Malawi. Master's Thesis, Norwegian University of Life Sciences, Ås, Norway, 2016, *unpublished*.
55. Wiegel, W.J. Adoption of Organic Farming Systems in Missouri. Master's Thesis, University of Missouri-Columbia, Columbia, MO, USA, 2009, *unpublished*.
56. Centre for Coordination of Agricultural Research and Development for Southern Africa. *Knowledge Product 22: Options for Improving the Adoption of Climate-Smart Agriculture*; CCARDESA: Gaborone, Botswana, 2019; Available online: https://www.ccardesa.org/sites/default/files/ickm-documents/KP22_2020_11_V3_OptionsPaperforImprovingAdoptionofCSA_EN.pdf (accessed on 20 July 2021).