Analysis of factors affecting of fertilizer micro-dosing techniques among cereal smallholder farmers in Central Plateau Region of Burkina Faso

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Abstract

Soil fertility was the major factors limiting agricultural production in Burkina Faso. The socioeconomic, institutional and technological characteristics affecting the adoption of "micro-dosing" technique were analyzed in this paper. The study was conducted in Oubritenga province in Burkina Faso. Data were collected from 247 cereal smallholder farmers chosen from the AGRA- microdose beneficiaries' project. It concerned socio-economic, institutional and technology characteristics data and information on the use of micro-dosing technique in the province. The data were analyzed using descriptive statistics and multi regression model. It was found that the highest awareness was on extension agents (63.53%) and that adoption rate was low, that is 42.52% of the surveyed households. The results of multi regression model indicate that farming experience, affordability, accessibility, trialability had a positive influence on adoption of micro-dosing technique at 1% of probability level and farm size at 5% of probability level. These results provide insight into farmer behavior in order to improve the production and wide dissemination of food crops such as sorghum, millet and maize.

Keywords: Microdose; Adoption; Smallholder farmers; Burkina Faso.

Analyse des facteurs influençant les techniques de microdosage d'engrais chez les petits exploitants Céréaliers de la Région du Plateau Central au Burkina Faso.

Résumé

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La fertilité du sol est l'un des principaux facteurs limitant la production agricole au Burkina Faso. Les caractéristiques socio-économiques, institutionnelles et technologiques affectant l'adoption de la technique de microdose ont été analysées dans cet article. L'étude a été menée dans la province d'Oubritenga au Burkina Faso. Les données ont été collectées auprès de 247 petits exploitants céréaliers sélectionnés parmi les bénéficiaires du projet AGRA-microdose. Les données ont été analysées à l'aide de statistiques descriptives et d'un modèle de régression multiple. Il a été constaté que le mode de sensibilisation le plus élevé concernait les agents de vulgarisation (63,53 %) et le taux d'adoption était faible, soit 42,52 % des ménages interviewés. Les résultats du modèle de régression multiple indiquent que l'expérience dans la production, l'accessibilité, la disponibilité, la trialabilité (la capacité à tester la technique microdose avant de s'engager pleinement) avaient une influence positive sur l'adoption de la technique microdose avec un niveau de probabilité de 1 %, et la taille de l'exploitation avec un niveau de probabilité de 5 %. Il est donc recommandé que le gouvernement et les parties prenantes du programme développent davantage de stratégies (subventions, disponibilité en temps opportun d'engrais de qualité) visant à encourager l'adoption de la technique de microdose. Cela est essentiel pour augmenter la productivité céréalière.

Mots-clés : Microdose ; Adoption ; Petits Exploitants ; Burkina Faso.

Introduction

The physical and sufficient availability of cereals to meet the needs of populations remain a challenge for agricultural policies. These challenges are poor access to irrigation water, expensive inputs and equipment, non-accessibility of improved seeds, land tenure insecurity, limited knowledge and capacity of producers of cereal, poor transportation, limited access to credit for farmers, erosion, insufficient storage facilities, low quality of fertilizer and low soil fertility (MAHF, 2016).

The fertilizer microdose involves the application of small affordable quantities of inorganic fertilizer with seed at planting time, or as top dressing 2 to 3 weeks after emergence (International Crops Research Institute for the Semi-Arid Tropics, ICRISAT, 2012). Farmers apply 4 to 6 g of NPK fertilizer and 2 g of Urea in or near the seed hole at the time of planting.

According to ROGERS (2003), adoption is a decision to go on sustained and full use of an innovation as the best course of action until something new or better is available, and rejection is a decision not to adopt an innovation. Furthermore, the adoption of micro-dosing

technique is a self-decision of smallholder farmer to practice that technology after awareness.

The broad objective of the study was to determine the adoption of fertilizer micro-dosing technique by cereal smallholder farmers in Central-Plateau Region of Burkina Faso. The specific objectives were to: (i) describe the socio-economic characteristics, institutional affiliation and technological related characteristics of smallholder farmers in the study area, (ii). determine the sources of awareness and rate of adoption of fertilizer micro-dosing technique by smallholder farmers, (iii). determine the socio-economic, institutional and technological factors influencing the adoption of fertilizer micro-dosing technique among the smallholder farmers.

The finding of the study would provide knowledge of the level of adoption of fertilizer micro-dosing technique among the smallholder farmers and useful information for development planners and policy makers, leading to planning and designing more appropriate intervention and extension programmes for sustainable participation of smallholder farmers on the basis of demand driven approach development. It would also avail the AGRA as the sponsor of the programme an opportunity to x- ray the adoption of fertilizer microdosing technique by smallholder farmers.

I. Material and method

I.1. Study Area

The study was conducted in Central-Plateau region in Burkina Faso in 2022. The study site was at Oubritenga province. Central Plateau Region is located at Latitudes 12° 40‘0” N and Longitudes 1° 19‘60” W. The total population preview is estimated 978,753 with the average density of 80.9 persons per square kilometer. About 94 % of the population are farmers and 2.4% are fishers and livestock farmers (National Institute of Statistic and Demographic, NISD, 2017). Oubritenga province has seven (7) rural Communes: Dapelogo, Loumbila, Absouya, Nagreongo, Zitenga, Ziniaré and Ourgou- manega (NISD, 2017). In 2020 the population of Oubritenga province was 342,574 (NISD, 2017). The precipitation varies between 600-800 mm and the annual mean temperature is 28.7°. The soil in the region is ferruginous, not fertile and eroded. The climate is Sudano- Sahelian and the raining season is from June to September (MAHF, 2016).

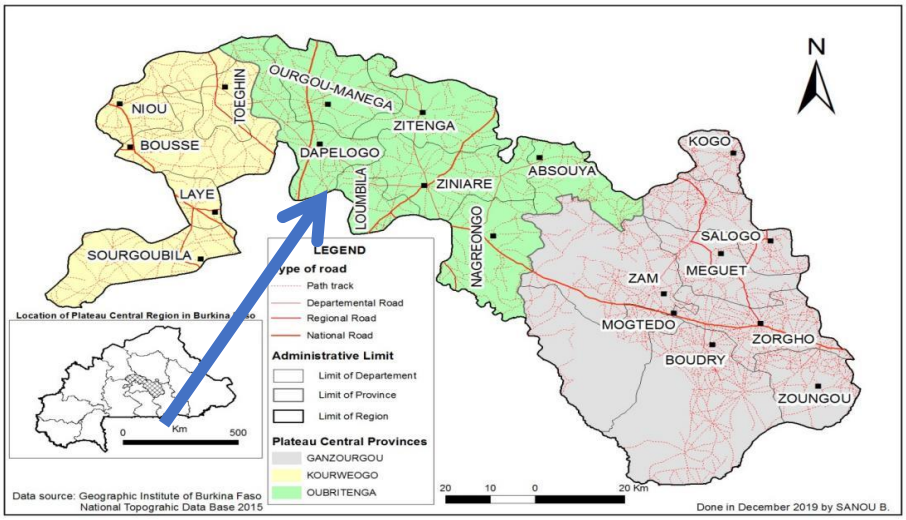

Figure 1: Map of Central Plateau

Burkina Faso is divided into 13 Regions. The first stage involved purposive selection of one Region which was the Central Plateau. The region was selected because AGRA Region showing study area ; Source: SANOU (2019)

I.2. Sampling Technique and Sample Size

Multi-stage sampling was used in selecting smallholders 'farmers in the study area for data collection. Burkina - microdose project was implemented in it. The second stage was purposive selection of one province. Thus, Oubritenga province was selected. This province was selected because of its intensity of involvement in the AGRA-microdose project. The microdosing project has started in 2009 and ended in 2014. The total number of the beneficiaries of the project was 277 in 2009 and increased to 2,440 farmers in 2014.

In the third stage, four (4) rural communes in Oubritenga province were purposively selected because they are AGRA- microdose project implemented rural communes. The selected rural communes of Oubritenga province were Absouya, Loumbila, Dapelogo and Nagreongo. In the fourth stage, two villages were randomly selected in each rural Commune from the AGRA- microdose project implemented villages. Therefore, eight (08) villages in Oubritenga provinces were selected randomly. In the fifth stage, smallholder farmers (being AGRA- microdose project beneficiaries) were selected by balloting using Slovin's formula to determine the sample size. According to ABDURRAHMAN *et al.* (2016), Slovin's formula as applied to

sample size is based on an assumed 5% margin of error. In other words, 95% confidence and applying finite correction factor from rural respondent in the study area.

The Slovin‘s formula is given as:

$$N_0{}^0 = \frac{N}{1+N(e^2)}$$

Where:

N_0: sample size;

e: 0.05 margin on error;

N: population size.

A sampling size was 248 applying 10% of ratio (NEUMANN, 1994). Primary data were collected through use of a questionnaire instrument administered to the respondents by four (04) trained enumerators.

I.3. Analytical Techniques

The data was analyzed using Descriptive statistics for specific objectives i, ii and Multiple linear regression model for objective iii. All of these were done with aid of the Statistical Package for the Social Sciences (SPSS) version 25.0 and STATA version 15.0.

The multiple regression model is represented as follows:

Y_f = the implicit form of the multiple regression model is represented as follows:

$Y_f = \alpha + b_1x_1 + b_2x_2 + \cdots\cdots\cdots + b_nx_n \ldots\ldots\ldots 1$ (3)

Where: Y_f =.Adoption of micro-dosing,

b = slopes of the regression

$x_1 \ldots\ldots x_n$. = the socio-economic, institutional and technological factors influencing the adoption of the micro-dosing technique among the smallholder farmers; independent variables.

&= constant

With the independent variables of this model:

X_1 = age (years),

X_2 = sex (dummy: 1=female and 0=male),

X_3= educational level (number of years of formal education),

X_4= household size (number),

X_5= total farm size (Ha),

$X_{6=}$ farming experience (years),

$X_{7=}$ membership of cooperative (years),

$X_{8=}$ extension visits (number of visits),

$X_{9=}$ access to credit (FCFA and convert in dollar US),

$X_{10=}$ compatibility (dummy) variable (dummy: 1=positive and 0=otherwise).

$X_{11=}$ affordability (dummy) variable (dummy: 1=positive and 0=otherwise).

$X_{12=}$ accessibility (dummy) variable (dummy: 1=positive and 0=otherwise).

$X_{13=}$ trialability (dummy) variable (dummy: 1=positive and 0=otherwise).

I.4. Operationalization, Definition and Measurement of Variables

This involves the definition of concepts and operational variables that were utilized for analysis in this study. They include the following:

I.4.1. Independent variables

I.4.1.1. Socio-economic characteristics

Age: It has been documented that young people are likely to take more risk than older farmers (YABI *et al.,* 2016). Farmers' age is related to the adoption of technology.

Head of household: There has been an assumption that the head of the household is the primary decision maker and gender difference is found to be one of the factors influencing the adoption of new technologies (CRISTINA *et al*., 2013).Therefore, it was hypothesized that the head of household is positively related to the adoption of fertilizer Micro-dosing technique (BAKAYOKO *et al*., 2011).

Sex: It refers to universal biological characteristics that differentiate males and females (CRISTINA *et al*., 2013). It was measured as a categorical variable (dummy) coded with 1 if female and 0 if male. Sex of household head looks at the role played by the individuals in

providing households needs including acquisition of food. In Africa the land tenure is the real problem in farming.

Education: Education is generally considered an important variable that could enhance farmer's acceptance of new technologies. The assumption was that adoption increases with more years of schooling. It was measured as a continuous variable (number of years of formal education the smallholder had)

Household size: This is the total number of people that reside within the same house. The study postulated that households with a larger proportion of economically active household members would adopt microdosing technique. It was measured as a continuous variable, that is the total number of members in a household.

Farm size: this is the total land area cultivated by the respondents. The total land cultivated was recorded in hectares (in Ha as a continuous variable). Farm size was therefore expected to influence and increase willingness to invest in microdosing technique (SABA *et al*., 2017).

Farming experience: This was measured in terms of the number of years since a respondent started farming on his own. The experience of a farmer is likely to have a range of influences on adoption (SABA *et al*, 2017).

I.4.1.2. Institutional variables

Access to credit: This refers to amount of money received from either formal or informal credit sources. It was measured as a categorical variable by asking farmers if they had access to credit. Adoption was expected to be high among smallholder farmer with access to credit compared to those without.

Membership of cooperative: Smallholder farmer belongs to a number of formal and informal organizations. These may, influence the attitude of members towards fertilizer micro-dosing adoption technique. The fact that a farmer belongs to a farmer organization positively influence the adoption of micro-dosing. Being membership of cooperative was measured as dummy variable with a yes or no answer and the duration of being in cooperative was allowed the researcher to know the level of experience in community participation.

Extension visits: Agricultural extension service constitutes a driving force for any meaningful agricultural development. The relationship between agricultural extension agent and the farmer is an important

determinant in improving yield and income of the farmers as well as in improving livelihood (CHIKEZIE *et al.*, 2012). Micro-dosing adoption was expected to be higher with increased extension visits.

I.4.1.3. Technological variables

Compatibility: It is the degree to which innovation is perceived as consistent with the existing values, socio-cultural norms, past experiences and needs of farmers. It was measured as a categorical (dummy) variable (dummy: 1=positive and 0=otherwise).

Affordability: Any new technology perceived to have positive benefits is likely to be highly adopted. The technology is it high profit or more benefit, using few quantities of fertilizer. It was measured as a categorical (dummy) variable (dummy: 1=positive and 0=otherwise).

Trialability: it is the degree to which a potential adopter can try something out on a small scale first before adopting it completely is a major determinant of technology adoption (Doss, 2003). Technology is easy to experiment (it has a hard time using) (trialability) categorical (dummy) variable with yes (1) or no (2) answer.

I.4.2. Dependent variable

Adoption of micro-dosing: Adoption of a technology depends on its own characteristics, farmer‘s socio-economic conditions and those of the production environment (KAM, 2013). The technology of micro-dosing is sowing 4g of NPK 14-23-14 and seed in the same hole or sowing 4g of NPK 14-23-14 two weeks after germination and 2g of urea 46%. It was measured as a categorical (dummy) variable with yes (1) or no (2) answer.

I.4.3. Expected outcomes

Yield: It was measured by the number of bag (100kg) of crops harvested in the 3 years under microdosing technique per hectare.

Incomes: Income: It refers to the amount of money an individual earns from his or her means of livelihood (both farm and non- farm income) and or by working for others who may require his or her labour (goods/services) in exchange for wage or salary. This income was calculated from all their livelihood sources.

Level of living: According to ABDULLAHI (2020), level of living refers to the number of daily meals, health care and living condition. In order words, the term level of living is considered to be the quality of

goods and services consumed by the farmer and his household. The expectation was that the level of living of smallholder farmers would be higher than those of farmers who abandoned fertilizer micro-dosing technique.

II. Results and Discussion

II.1. Socio-economic Characteristics, Institutional Affiliation and Technological Related Characteristics of Smallholder Farmers in the Study Area

3.1.1 Farm size of smallholder farmers'

The result in Table 1 reveals that the mean farm size of smallholder farmers' across the study areas was about 3.52 hectares farm sizes which was below 5 hectares. This shows that majority of smallholder farmers were subsistence farmers and engaged in small-scale farming. Crop production is done on highly fragmented lands and could easily be carried out on the available farmland without much stress of renting land which may translate to additional cost. Small farm size may favour the adoption of technology especially in the case of an input-intensive innovation such as a labor-intensive or land-saving technology. The finding agrees with SISSOKO *et al.* (2018) who found also that the mean of farm size of farmers in Mopti, Koulikoro and Segou under micro-dosing practice was relatively small (2.7 hectares) which represent the total mean farm size of millet and sorghum farmers.

3.1.2 Farming experience of smallholder farmers'

The result in Table I reveals that the mean of the study was 30 years of farming experience. This means that smallholder farmers had relatively many years of farming experience. This provides an advantage for the adoption of fertilizer micro-dosing technique since these farmers were likely to understand the technique of micro-dosing technique based on the several years of experience in farming. Based on this it can be argued that smallholder farmers would be able to take useful and favourable decisions as regards the adoption of fertilizer micro-dosing technique. The finding corroborates with that of CONRAD and MEIKE (2015) who found that the mean year of farming experience for micro-dosing smallholder farmers in Zimbabwe was about 28 years.

Table I: Socioeconomic characteristics of smallholder farmers

Province	Oubritenga	
Variable	Frequency	Percentage
Farm size		
0.1-1.0	72	28.8
1.1-2.0	50	20
2.1-3.0	32	12.8
3.1-4.0	26	10.4
4.1-5.0	57	22.8
> 5.0	13	5.2
Total	250	100
Mean	3.52	
Std. Dev	2.938305	
Farming experience		
5-14	11	4.6
15-24	63	26.1
25-34	84	34.9
35-44	57	23.7
45-54	16	6.6
≥ 55	10	4.1
Total	241	100
Mean	30	
Std. Dev.	11.6	

Source: Field Survey, 2021

II.2. Institutional Characteristics of Smallholder Farmers

II.2.1. Membership of cooperative by smallholder farmers

The finding in Table II reveals that about 36.1% smallholder farmers are member of cooperatives in Oubritenga province. The mean of number of years being in cooperative associations was 11. This implies that when farmers are belonging to 'cooperatives, they could attract collaboration, support and aid partnerships from external agents. Such social organizations may provide a platform for exchange of ideas and sharing experience about fertilizer micro-dosing technique including other new technology and farm practices. Farmers' cooperatives were expected to serve as a link between the farmers and other institutions that serve farming communities, such as social institutions, research centers, input manufacturers and agro-dealers, microfinance banks, processors of farm products, marketing agencies, regional markets and accessing loans and mutual help from their cooperatives. The finding corroborates with ABDULLAHI (2020), who found that the more

farmers participate in cooperatives, the better chances of increased production and enhanced incomes. Thus, the implication of fertilizer micro-dosing technique dissemination to smallholder farmers in groups may largely increase impact on community level of living because of the advantage of group dynamics since members get to benefit from pooled resources.

II.2.2. Access to credit of smallholder farmers'

The result in Table II reveals that majority (96.4%) of the smallholder farmers had no access to credit in the study area. Most of those who had access to credit (3.6%) obtained their credit from farmers'cooperatives (66.7%), microfinance banks (22.22%), and friends (11.11%). The implication is that the majority of the smallholder farmers could not get capital to buy farming input and tools, and this could affect negatively the adoption of fertilizer micro-dosing technique. This is in line with that of RADDA (2015) who found that majority (77.9%) of the respondents of his study area had no access to credit and respondents lacked enough capital to adopt the drought tolerant maize varieties. In terms of the quantum of credit obtained by smallholder farmers in the study area, the result of the finding in Table II shows that the mean of credit (loan) obtained by smallholder farmers in a study area was about 11,933.3 CFA ($ 20.57 US). This shows that the credit amounts obtained by the majority of smallholder farmers was small for supporting their cost of production and to cover fertilizer micro-dosing technique. Therefore, this could have affected fertilizer micro-dosing technique adoption. ISSA (2016) similarly found that majority (78.5%) of crop farmers got a credit of or less than NGN 100,000 ($ 172.41 US).

II.3. Technological Characteristics of Smallholder Farmers

II.3.1. Compatibility

The result in Table II shows that 97.6% of smallholder farmers said that fertilizer micro-dosing techniques as compatible with their past experiences, culture and other socio-cultural believes. This means that the smallholder farmers accepted the technology in the study area. This is consistent with WANDJI *et al.* (2012) who stated that, the characteristic of the technology plays a critical role in adopting decision process.

II.3.2. Affordability

The result in Table II shows that 85.4% of smallholder farmers observed that fertilizer micro-dosing technique as affordable. This implies that the technology was readily affordable and not costly. The study of BIELDERS and GÉRARD (2015) shows that the application of 20 kg ha^{-1} of diammonium phosphate instead of 200 kg ha^{-1} recommended to smallholder farmers by micro-dosing reduced input cost and investment risk while increasing crop yields. Accordingly, the application of fertilizer micro-dosing technique appealed to smallholder farmers because of the good return on investment, low financial risk, low cash outlay and low workload required.

II.3.3. Accessibility

The result in Table II reveals that 84.3% of smallholder farmers observed that fertilizer micro-dosing technique as accessible. This implies that a large number of smallholder farmers can access extension agent office easy to get more information about fertilizer micro-dosing technique and extension agent can reach smallholder farmers village or farms. According to SISSOKO *et al.* (2018), the fertilizer micro-dosing technique was accessible to the poor farmers having low-incomes because of the reduced capital cost in fertilizer and distance to extension service. Thus, it could be supporting the intensification of agriculture in the Sahel.

II.4. Sources of Awareness and Rate of Adoption of Fertilizer Micro-dosing Technique by Smallholder Farmers

II.4.1. Sources of awareness of fertilizer micro-dosing technique

The results in Table III show that Smallholder farmers were mostly aware of fertilizer micro-dosing technique through extension agents and NGOs by 63.53% and 34.51% respectively. The least sources of awareness were radio (1.96%) and field days (1.96%).The finding implies that extension agent had probably used better channels and tools of communication to transfer the knowledge on fertilizer micro-dosing technique to smallholder farmers. Acquisition of information about a new technology could be another factor that determines adoption of technology. The decision to adopt a new technology could also be influenced by observing the practices and innovations of other farmers. Farmers in Africa typically cited other farmers as their most trusted and reliable source of information (ROGERS, 2010; MAGNAN *et al.*, 2015), and one's decision to adopt a new technology is positively

affected by the experience of others (TODO *et al*., 2012). It enables farmers to learn the existence as well as the effective use of technology and this facilitates its adoption. Therefore, it can be concluded that smallholder farmers were sufficiently aware of fertilizer micro-dosing technique in the study area.

Table II: Institutional Affiliations of Smallholder Farmer

Province	Oubritenga	
Variable	Frequency	Percentage
Cooperative societies		
Membership	91	36.1
Non-membership	161	63.9
Total	252	100
Years of membership		
1-10	50	56.2
11-20	30	33.7
21-30	9	10.1
Total	89	100
Mean	12	
Std. Dev	7.4	
Amount received (CFA)		
Less 100000	246	96.5
100000-299999	5	2
300000-599000	2	0.8
Over 600000	2	0.7
Total	255	100
Mean	11933.3	
Std. Dev.	98505.3	

Source: Field Survey, 2021

II.4.2. Rate of adoption of fertilizer micro-dosing technique components

The result in Table IV shows that the majority of smallholder farmers adopted fertilizer micro-dosing technique components by 92.57%, 95.92%, 95.81% for improved seeds, plowing, sowing respectively. The least adopted components technology was mineral fertilizer application being 42.52%. The higher adoption rate for improved seeds, plowing, sowing as components of fertilizer micro-dosing technique could be because smallholder farmers participated in field school

activities, demonstrations and all the extension agent's trainings on fertilizer micro-dosing technique and the practices on their farms.

The use of cereal (Espoir variety of maize, Sariasso 14 of sorghum), improved seeds resulted in getting high crop yields, less diseases and more profit as well as being a source of income, savings and financing of other off-farm activities. Also, the variety may give a higher crop output due to its tillering effects. The study of YEGBEMEY *et al*. (2014) showed that the performances of farmers' maize yield under microdosing technique who used the improved seeds were suitable strategy for adapting to climate change.

Also, the result in Table IV revealed that 95.92% of smallholder farmers in study area adopted farm plowing. Perpendicular plowing combined with microdosing technique or recommended dose was reported to be less profitable (International Development Research Center, IDRC, 2014). This means that micro-dosing guidance led to increase in the yield. In the study area, majority (97.1%) of smallholder farmers understood and sowed mineral fertilizer through micro-dosing technique. The sowing could be done through the mixture of mineral fertilizer and seed during sowing or applying of mineral fertilizer in microdosing technique two weeks after germination. Nonetheless, applying fertilizer after sowing in order to minimize nitrogen leaching from the rooting zone is recommended (SANOGO *et al.*, 2020).This assumption is supported by SABA *et al.* (2017) and SANOGO (2020) who revealed that sowing in May has a negative and significant influence on the average crop yield compared to June. Indeed, the time required to apply fertilizer micro-dosing on one hectare is approximately similar to the time required to sow the same area; that require same labour for sowing seed and mineral fertilizer as a mix. The low rate of application of mineral fertilizer in Oubritenga province (42.52%) could be linked to non-availability of mineral fertilizer as it usually was not timely supplied, its low quality and also the high cost. Indeed, the major input in the practice of fertilizer micro-dosing technique is the mineral fertilizer, without which micro-dosing technique can't be practiced. This implies that the rate of adoption of fertilizer micro-dosing technique depends on the availability of mineral fertilizer. TRAORÉ *et al.* (2018) found that the application of mineral fertilizer by farmers on millet and sorghum is limited because of the low fertilizer on these crops which is explained by the ratio of high mineral fertilizer cost compared to millet and sorghum selling cost. The

use of mineral fertilizers improves soil productivity, but access is limited to small-scale producers (SABA *et al*, 2017).

II.5. Socio-economic and Technological Factors Influencing the Adoption of Fertilizer Micro-dosing Technique Among the Smallholder Farmers

The multiple regression model gave an R^2 of 0.68 in Oubritenga province. This implies that the independent variables specified in the model actually contributed up to 68% at explaining the variations in the adoption of fertilizer micro-dosing technique in the study area. This shows that the variables fit the model. Some variables were found to significantly influence adoption of fertilizer micro-dosing technique ($P<0.1$, $P< 0.01$ and $P< 0.05$) in the province.

II.5.1. Socio-economic characteristics influencing adoption of fertilizer microdosing technique

The result in Table V shows that only the coefficients for farm size ($t=1.71$, $P<0.1$), farming experience ($t=3.25$, $P<0.01$) were the socio-economic variables that had significant influence on adoption of fertilizer micro-dosing technique. It implies that these variables were strong determinants on adoption of fertilizer micro-dosing technique.

The positive value and significance (1.71) of the farm size of smallholder farmers shows that farm size has positively influenced the adoption of fertilizer micro-dosing technique in Oubritenga province. This finding supported that of RADDA (2015) who reported that the size of farm positively and significantly influenced the adoption of drought tolerant maize for Africa (DTMA).

A positive and significant relationship was similarly found between years of farming experience and adoption of fertilizer micro-dosing technique ($t=3.25$, $P<0.01$). This implies that farming experience was among factors that influenced the adoption of fertilizer micro-dosing technique activities. Thus, a unit increase in the farming experience led to an increase in the adoption of fertilizer micro-dosing technique. This result is supported by the finding of ABDULLAHI (2020) who reported that farming experience had positive coefficient (0.0243912) and was significant at 1% probability level; therefore, farming experience significantly influenced the participation of farmers in WAAPP activities.

Table III: Technological related characteristics to respondents by province

Technological characteristics	Oubritenga			
	Yes		No	
	Freq	%	Freq	%
The production system is compatibility with existing habits and values	247	97.6	6	2.4
The technology is Affordable	217	85.4	37	14.6
The technology is using little quantity of mineral fertilizer	`	94.9	13	5.1
The technology is accessible	214	84.3	40	15.7
The maintenance of technology is available	192	75.6	62	24.4
The technology is easy to experiment (trialability)	220	86.6	34	13.4
The expertise of extension/advisory agents	217	85.4	37	14.6

Source: Field Survey, 2021

II.5.2. Technological factors influencing adoption of fertilizer micro-dosing technique

In Oubritenga province, affordability (t=3.10, P<0.01), accessibility (t=3.41, P<0.01) and trialability (t=2.96, P<0.01) were found to significantly influence adoption of fertilizer micro-dosing technique (Table V). These variables were high determinants of the adoption of fertilizer micro-dosing technique among smallholder farmers.

Table IV: Sources of Awareness and Rate of Adoption of Fertilizer Micro-dosing technique

Awareness of Micro dose	Oubritenga			
	Freq Yes	%tage	Freq No	%tage
Media	5	1.96	250	98.04
Neighbors	11	4.31	244	95.69
NGOs	88	34.51	167	65.49
Extension agents	162	63.53	93	36.47
Field visits	7	2.75	248	97.25
Field's days	5	1.96	250	98.04
Rate of Adoption of Micro dose				
Improved seeds	187	92.57	13	6.44
Plowing (soil preparation)	188	95.92	8	4.08
Sowing	183	95.81	8	4.19
Mineral fertilizer application	108	42.52	146	57.48

Source: Field Survey, 2021

Affordability was found to be positive and highly significant (t=3.10, P<0.01) influencing adoption of fertilizer micro-dosing technique in Oubritenga province. This result is consistent with the smallholder farmers' perception on affordability of fertilizer micro-dosing technique which was found to be very high in both provinces. This implies that smallholder farmers perceived that the fertilizer micro-dosing technique was cheaper than the traditional technique. For example, the application of 20 kg ha-1 of diammonium phosphate instead of 200 kg ha-1 recommended to smallholder farmers reduces input cost and investments risk while increasing crop yields (BIELDERS and GÉRARD, 2015).

The coefficient for accessibility was positive (t=3.41, P<0.01) and significantly influenced adoption of fertilizer micro-dosing technique at 1% level of probability. This means that the less the distance to fertilizer micro-dosing technique, the more its adoption. A farmer perceived an innovation as more advantageous than its recommended dosage technique because of the easy accessibility. Indeed, the more the technology is far from farmers, the less the adoption. Technology adoption heavily relies on the farmers' accessibility to good-quality and appropriate information. Technology adoption heavily relies on the farmers' accessibility to good-quality and appropriate information. This finding is in line with MURENDO and WOLLNI (2015) who reported that micro-dosing training increased the probability of using fertilizer and adoption of micro-dosing. Fertilizer application training should be a core component of the extension messages to stimulate farmers to use fertilizers.

Table V: Factors influencing the adoption of fertilizer micro-dosing technique.

Variable/Province	**Oubritenga**		
	Coefficient	**Standard Error**	**T-value**
Constant	18.269	1.802	10.14
Sex	2.469	2.889	0.85
Age	-0.256	0.201	-1.27
Educational level	5.835	4.149	1.41
Household size	-0.016	0.303	-0.05
Farm size	0.839*	0.492	1.71
Farming experience	0.519***	0.16	3.25
Years of membership	-1.898	3.427	-0.55
Extension visits	-7.422	5.032	-1.47
Amount of credit	-2.359	4.714	-0.5
Compatibility	1.937	6.216	0.31
Affordability	23.165***	7.478	3.1
Accessibility	23.370***	6.85	3.41
Trialability	23.348***	7.883	2.96
F-Value	117.63***		
Prob > F	0.000		
R-squared	0.68		

Source: Field Survey (2021) Note: * and ** and *** significant at 10%, 5%, and 1%, respectively

A positive and significant relationship was found between trialability and adoption of fertilizer micro-dosing technique in Oubritenga province ($t=2.96$, $P<0.01$). This implies that trialability was strongly among factors that influenced the adoption of fertilizer micro-dosing technique. Therefore, any increase in trialability led to increase in probability and intensity of fertilizer micro-dosing technique among the smallholder farmers in study area. This means that the fertilizer microdosing technique is easy to experiment and has not been a time-wasting procedure.

The hypothesis that the socio-economic, institutional and technological factors have no significant influence on the adoption of fertilizer micro-dosing technique among smallholder farmers was therefore rejected and the alternative hypothesis was accepted.

Conclusion

The objective of the study was to determine the adoption of the fertilizer micro-dosing technique by cereal smallholder farmers in the Central-Plateau Region of Burkina Faso, addressing the significant challenges of low soil fertility and limited agricultural productivity. It can be concluded that the rate of adoption of the fertilizer micro-dosing technique in the study area was 42.52%, which is low. The majority of smallholder farmers were aware of the micro-dosing technique, with extension agents serving as the primary source of this awareness. The socio-economic variables that significantly influenced the adoption of the fertilizer micro-dosing technique in Oubritenga Province included farm size ($t=1.71$, $P<0.1$) and farming experience ($t=3.25$, $P<0.01$). These findings highlight the need for targeted interventions that consider the socio-economic characteristics of farmers to enhance the adoption of agricultural innovations and ultimately improve food security in the region.

Recommendations

Based on the findings of this study, the following recommendations are made:

i. It was found that the rate of adoption of mineral fertilizer was 42.52% in Oubritenga province, this is low. It is therefore recommended that the government and stakeholders of the programme should develop more strategies (subsidy, timely availability of quality fertilizer) aimed at encouraging adoption

of fertilizer micro-dosing technique. This is vital for increasing cereal productivity.

ii. Extension agents and NGOs were found to be the major source of awareness of fertilizer micro-dosing techniques. It is therefore recommended that these sources should be made more available by providing effective professional training for extension agents on the dissemination of fertilizer micro-dosing techniques.

iii. It was found that the socio-economic, institutional and technological factors influenced the adoption of fertilizer micro-dosing technique among the smallholder farmers. This implies that change agents in the study area should continue to pay attention to these variables by sensitizing and reinforce the capacity of smallholder farmers.

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