



# Is farming a belief in Northern Ghana? Exploring the dual-system theory for commerce, culture, religion and technology

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## ABSTRACT

Rice production encountered several challenges, especially among rural farmers in Northern Ghana. The current debate encompasses the belief of cultural norms and religious values as the right theory for the sustainability of agriculture. The belief in abstracts is prioritised to the adoption of improved rice. This paper examined the value attached to traditional rice varieties as a result of societal beliefs, and theoretically underpinned by the Dual-system hypothesis. The finding from three ethnic and religious groups through a survey indicates heterogeneity in the results but also demonstrates the factual importance of culture and religion. This paper, therefore, proposes a new way of categorising farming; as a business and a belief and that policy stream aim at small scale, rural farmers with belief peculiarities needs to adopt cultural and religious strategies to promote adoption.

“While the urban people viewed the world as a “Global Village” with a faster transition of commerce, culture, religion and technology. The rural folks perceived the interconnectivity as an approach of imposing other beliefs and lifestyles on their generation unborn. This thought has exacerbated the poverty and hunger of the less privileged rural farmers. Although, the growing debate for diffusing agricultural technology as a panacea for rural economy development path is far advanced. The belief in culture and religion restrict rural farmers to small scale production of employing hoe, cutlass and traditional seed. The wisdom of technology is critical to culture and religion” [1].

## 1. Introduction

Many studies focused on socio-economic factors as the reason for the low adoption of improved rice varieties [see Refs. [2,3] and the few pieces of research that investigates social norms adopt the traditional economic theories [4]. Previous findings indicate that natives attached more significant value to culture and religion relative to agricultural technology. This paper presents descriptive statistics of socio-economic, and specific cultural and religious values in Northern Ghana to indicate the substantial value farmers attached to societal norms in the adoption of improved rice varieties. The findings are discussed in line with Dual system theory to indicate whether farmers considered farming as a belief (cultural and religious beliefs) or as a technology that could improve

output. This research is motivated by the remarks of the indigenous people such as “*nothing is better than what our ancestors’ practice for 1000s of years*” when invited to adopt agricultural technology [5].

Ghana spent about \$450 million in 2010 on rice importation and the agenda to eliminate the exorbitant cost of rice importation by 2016 failed [6]. Among the strategies put in place to deal with the identified challenge, the Government of Ghana (GoG) employed the mechanism to promote accessibility and affordability of improved rice. The focus has been the Northern part of Ghana, where levels of poverty and illiteracy are high, coupled with the potential of the area to produce rice to enhance the development of the economy of Ghana. Northern Ghana is “*the food basket of Ghana*” with over 65% of the people engaged in farming [7,8]. Farmers increase rice production through the expansion of cultivated areas and with insignificant adoption of technology [6]. The custodians of the land are Mole-Dagbani, Gurma and Guan. These people are the indigenes and occupied over 90% p of the land. The current production level of rice in Northern Ghana is 64% of the national figure. The region is championing low adoption of improved rice (less than 40% adoption rate). The GoG estimated that at least 70% adoption of rice in Northern Ghana could reduce poverty and hunger and further place the country as a net exporter of rice [9]. Many kinds of research which aim at rectifying why the low adoption rate in Northern Ghana dwelled on politics, social and economic factors. This paper investigates the work of Murray [10], who noted that culture and religion affected food consumption uniquely prepared from crops of Genetically Modified

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Organisms (GMOs). Based on Murray [10], and Lee [11] findings, cultural and religious values could influence the consumption and production of improved rice varieties/non-traditional rice, especially in Northern Ghana where the lives of the people living are defined by culture, tradition and religion.<sup>1</sup>

Looking at the research investigating the effect of culture and religion on the decision to participate in projects, Lee [11], and Lekhanya [13] observed that regardless of the area, technology adoption diffusion is influenced by ethnic and clan members. While Lekhanya [13] noted that entrepreneurs are profit-minded and risk reducers. The culture of participating entrepreneurs induced the adoption of social media technology to improve the business network. Profit and risk are not prioritised against the wish of society. This informs that social media technology that could yield optimal profit are ignored for not satisfying societal norms in South Africa.

Furthermore, Lee [11] noted that farmers in Volta Ghana adoption decision are based on the decision of others. Clan head and co-operative members' decision on the adoption of agricultural technology directly affected the decision outcome of individual farmers. Farmers do not consider adoption as a sole decision as they believed their action is likely to affect the general society. The stated studies are looking at culture and religion research with technology adoption. However, there is still a limited study on specific cultural and religious values in a rural setting that relate to specific important crop. This research explores how rice farmers value their culture and religion. Furthermore, the paper finds out whether farming is a profession or a belief and the results explained with the Dual-system theory.

## 2. Literature review

The effort to ensure that improved ideas and technology spread through various communication channels to the target beneficiaries is the focus of many researchers. This is doubtless, as Foster-McGregor, Nomaler [14] stated that the invention of technology has little impact on economic growth if the technology is not widely distributed and used. Societal norms of culture and religion could inversely underpin the low adoption of agriculture inventions by influencing farmers' decision.

### 2.1. Concept of social-norms

People behave per acceptable action of a reference group [15]. The group could be a social group (i.e. social norms) or legal group (legal norms). Norms involve assessing a person's character of what he does and what the person is supposed to do about group conduct. Groups have expectations from individual members. Groups have social action to the positive and negative behaviour of people. A positive attitude is praised while a negative behaviour attracts sanctions or disapproval of membership. The society holds members responsible for their behaviour, and members have a conduct expectation from each other. Norms involve the expectation of a group from members, defining the boundaries of a group and show the groups working principles [16].

The societal expectation of individuals who classified themselves as members acquire knowledge for belongingness [16]: individual behaviour and attitude are guided by group regulation. Individuals' behaviour are formed based on societal principle and subsequently used by people for judgement when deciding on their own. People's perception and attitude are mostly controlled by the group. There is usually no significant difference between a group norm and an individual attitude. Variation of group norms and individual social attitude suggest

<sup>1</sup> The dominant religions are Islam, Christianity and Traditional in descending pattern with less one per cent belong to no religion see 12. Ghana Statistical Service, P.a.H.C. *Government of Ghana. 2010.2010* [cited 10th August 2018; Available from: [http://www.statsghana.gov.gh/docfiles/2010phc/Census2010\\_Summary\\_report\\_of\\_final\\_results.pdf](http://www.statsghana.gov.gh/docfiles/2010phc/Census2010_Summary_report_of_final_results.pdf).

deviation of the individual behaviour from group regulation. Social norms have to do with the expectations and beliefs of social groups [17, 18].

The copied behaviour of Individual (*descriptive norm*) or "ought to do" attitude (*injunctive norm*) aid people fit in society [19]. Norms have no origin while others traced them to the religious, cultural and legal origin. Presently, an individual's actions and inaction are to some extent influenced by the family, community, and social group, governmental and economic organisations that they are associated with. Boserup, Kanji [20], and Russo [21] noted that women's economic participation differ from one society to the other based on culture and religion. Some cultures perceive the replacement and use of machinery in their harvesting processes instead of women power as somewhat undermining their cultural values within the region. Societies maintained such practice as valuable social norms and disapproval of technology change are emphasised [22,23]. Admittedly, culture and religion are a vital component of social norms and affect technology development. Social norms which capture cultural and religious behaviour called *sustained behaviour* of a person resist the change intervention of scientific behaviour [24].

### 2.2. Culture and religion

Culture in Ghana is characteristically defined by a group of people who are identifiable with a common language, customs and tradition [25]. The standard values within the tribe make the group an ethnic [see Ref. [26]. Lack of cultural values and qualities of ethnic groups disqualifies persons associated with such ethnicity even if given birth by a member of such a group. The idea behind an ethnic group is the members' identity and culture in that group. Ethnic identity is similar within ethnic groups and assumed to be different across ethnic groups [25,27]. Culture and ethnicity are used interchangeably, the shared societal values, customs and norms that stemmed from national, regional or community level are common attributes in Northern Ghana. Invariably, those shared beliefs and behaviour affect the decision of individuals in the subgroup as members intend to conform to the societal norms [28].

Like any other country, it is difficult to separate culture from religion in Ghana. Some people believe in a supernatural being together with their dead fathers. Contextually, religion is a complete set of rules and regulations that are designed as beliefs and practices for a common sacred God or gods [29]. Bergunder [30] noted that religion aims at unifying members in the moral community of Church, Mosque or Deity. Invariably, it changes people decision through leadership and values. The practices and beliefs are things accepted and forbidden to those who agree to be part of the society through rituals, spirits or myths. Culture and Religions are robust and long-lasting symbols which regulate the actions of people and motivate them in a unique and realistic pattern in conception and problem solving [31].

In Ghana, people belong to tribes but equally actively involved in Christianity, Islam and Prima-indigenous norms that govern their practices. People believed in a supernatural being and their ancestors, and also obey their chiefs and religious leaders. Farmers are not exceptional, poor yield as punishment and bumper harvest as reward comes from the supernatural or gods. Farmers from different cultural and religious background could have different beliefs, connection and faith concerning farming practices and the adherence, to societal norms. The situation which presents agricultural technology vis-à-vis social norm valuation could best be explained by the Dual-system theory.

This paper extends technology adoption factors to include four cultural variables (*Cultural Restriction, Consultation of Gods, Chief's Approval and Ancestor's Approval*) and four religious Values (*Religious restriction, Religious leader's Approval, Destiny and God's blessings*).

#### 2.2.1. Cultural restriction and consultation of gods

Different cultural groups identified Mondays, Thursdays and Fridays as forbidden days for farming. It is believed that farmers who violate the

cultural rule by engaging in farming activities are punished by the gods of the land. Farmers indicate that the seven working days in a week is reduced to four. Also, it's a practice in Northern Ghana that, farmers must consult the gods to take any decision whether farming or trading. Farmers were allowed to indicate the number of times they needed to consult their gods before taking the adoption decision. These numbers range from one to six, with very few indications of zero.

### 2.2.2. Ancestor's and chief's approval

Traditionally, chiefs and ancestors are intermediaries in decision making in Northern Ghana. The position of the chief significantly influences the decision of the subordinate. Also, the forefather of a clan or family plays a critical role in decision making. Farmers were asked to indicate whether the approval/disapproval of the chief and or ancestors influenced their adoption decisions to which most of them answered affirmatively.

### 2.2.3. Religious restriction and religious leader's approval

The survey data collected indicated that Sundays, Saturdays, Fridays and Thursdays are considered holy days to the religious denominations in Northern Ghana. Aside farmers indicating that Imams, Pastors and Priest's decision influenced theirs in the adoption of agricultural technology, religion conjunctively restricts farming activities to a maximum of five days a week.

### 2.2.4. Blessing of god and destiny

Some farmers perceive high yield as a blessing from God and not the right combination of inputs or the adoption of technology. Others concluded that destiny is fixed and whatever was destined will not be changed. Farmers asked to state their positions about the beliefs and their effect on adoption decisions. A significant number of them indicated that the two beliefs are real and authentic.

## 2.3. Decision-making and dual-system theory

Farmers' decision to adopt improved seed is critical to the development of an agrarian country like Ghana. The behavioural choice concept that could explain farmers' situation when considering two different systems is the theory of *Dual-system*. Agriculture technology is an automatic fast pace conscious system, and norms are human-controlled slow movement and unconscious system. According to both Samson and Voyer [32], and Godinho, Prada [33], the automatic system (functional in developed countries) dominate in decision making in a situation of time pressure, distraction, positive attitude and cognitive business. However, the human-controlled system which operates in rural countries is more functional. A decision-maker shall be held accountable to his superiors, and there is a personal gain in whatever decision a person takes. The automatic system generates an impression of more comfortable and more straightforward ideas. Questions are substituted for challenging ideas (heuristic), and personal judgement deviates from the standard logic or desirable social norms leading to cognitive bias [34, 35].

Dual-system works in parallel and not in a sequence. The system has gained grounds in the field of behavioural and rural studies, though it has undergone some refinement. [see Ref. [36]. Farmers accepting to system two poses some resistance to system one which is mindreading considered to be automatic and fast. Some researchers argued that in decision-making, modular view in terms of perception is far better than direct social perception. Accepting system two as the modular perception, calls for the extension of direct social perception cope [see Ref. [37]. According to Alter, Oppenheimer [38], metacognitive is analysed to find the reasoning of overcoming intuition. The reasoning of human beings which operates with intuition, effortless and fast is known as system one. The output of the system one is controlled by system two characterised by analytical, slow and deliberate thinking. Research experiment indicates that system 2 derives the reasoning from

metacognitive experiences. Does system 2 (human system) control system one the automatic fast paced system (agriculture technology) in Ghana?

## 3. Data and method

This paper used survey data collected from January to April 2019 from rice farmers in Northern Ghana. The data covers socio-economic, demographic and social norms factors. The focus groups are three ethnic groupings: *Mole-Dagbani*, *Gurma* and *Guan* who belong to at least one of the three religious' faiths: *Christianity*, *Islam* and *African Traditional Religion (ATR)*. The cultural variables tested are consultation of gods, days culture restricts farming, approval of chiefs and approval of ancestors. The four religious variables tested are approval of religious leader, days religion restricts farming, destiny and God's blessing.

A total of 464 rice farmers participated in the field survey. A statistical inferential sample size large enough for analysis is  $\geq 30$  [ see Ref. [39,40]. To ensure religious representation at the various ethnic groups and to achieve the statistical inferential sample size of at least 30 for each religion in each ethnic group led to the sample size of 464.<sup>2</sup> The sample size varies across the different ethnic and religious groups because of the population difference.

This research recruited rice farmers who participated in the survey in the following manner. Firstly, three ethnic groups (Mole-Dagbani, Gurma and Guan) in Northern Ghana were purposively considered. The research team contacted extension officers in three of the five regions, namely: Northern region, which is dominated by Mole-Dagbani, North-east region for Gurma ethnic group and Savannah region for the Guans. The extension officers assisted the team in identifying potential respondents as they are well acquainted with the community entry procedure, the location of the farmers and the appropriate time of meeting the farmers. After identifying potential respondents (rice farmers based on ethnic groupings), the farmers were stratified based on the three religions earlier categorised, to ensure proportionate religious selection and representation. Finally, the research used simple random sampling technique to select rice farmers from each ethnic groups (regions).

This paper aims at finding out how farmers association with societal beliefs affects their technology adoption decision. It is a cultural practice in Northern Ghana that, farmers often consulted gods several times before accepting or rejecting something. Both culture and religion prevent farming in specific days. Farmers were asked to respond to identified practices (*taboos*) and religious values that affect farming activities and technology decisions. Participants provided several days used for the consultation of gods and how that together with, cultural and religious restriction affected their adoption decisions. The other five variables (chief approval, ancestors' approval, religious leader approval, destiny and God blessing) were Likert-scaled: One being strongly disagreed, two, three, four and five being disagreed, indifferent, agreed, and heartily agreed respectively [41].<sup>3</sup>

There was no missing data for the observation considered, hence the need to analyse achieving data saturation. The analysis was done based on a cultural and religious group. Quantitative variables such as age, acres, consultation of gods, days restricted by religion were analysed using ANOVA while the analysis of the binary variables was done using Chi-square test. This analysis is in line with Morris, Henley [42], Anezakis, and Demertzis [43], which separates parametric e from non-parametric variables to rectify significant parameters.

<sup>2</sup> The sample size for religion is 460. Four observations are eliminated for incomplete responses.

<sup>3</sup> The likert-scale variables are dichotomised 41. MacCallum, R.C. et al., *On the practice of dichotomization of quantitative variables*. Psychological methods, 2002.7(1): p. 19.

#### 4. Results

Appendix reports the summary statistics (bar chart in percentages) of social norms variables for 464 rice farmers who participated in the survey. Mole-Dagbani and Guan rice farmers consult gods for adoption decisions at most six times and Gurma five times (see Fig. 1). Some farmers, 28% of Mole-Dagbani and 23% of Guan tribes consult gods at least four times while 25% consult the gods twice in Gurma communities. Rice farmers in Mole-Dagbani (19%), Gurma (12%) and Guan (13%) do not consult gods before deciding to adopt improved rice varieties. The large proportion of rice farmers who consult gods in their adoption decisions points to the significance of that practice within their culture. About 82% of Mole-Dagbani rice farmers 86% of Gurma rice farmers, and 91% of Guan rice farmers mentioned the number of days' culture restricts farming. An insignificant number of farmers say culture does not restrict farming days. Rice farmers who indicate zero for both the consultation of gods and days restricted by culture for farming are inactive participants of cultural rules and are usually persons with education.

Furthermore, most of the respondents in Gurma and Guan ethnic groups agreed that ancestors' approval of agricultural technology plays a critical role in their adoption decisions. Also, Mole-Dagbani were indifferent on such cultural practices. In all the three ethnic groups, very few representations strongly disagreed on the importance of ancestors' approval. According to Ibrahim [44], chiefs and sub-chiefs in Mole-Dagbani are mighty persons, and their subordinates sometimes follow their instructions without question. Over 60% of the farmers strongly agreed that the chief's approval of modern technology carries weight in Mole-Dagbani communities relative to 9% and 8% in Gurma and Guan communities, respectively. Though some farmers considered the factors not to be crucial in taking adoption decision, majority of the respondents strongly agreed that the cultural practices identified significantly influenced the current level of rice adoption in Northern Ghana. The modal number of days religion restricts farming is four for Mole-Dagbani and Gurma. However, the facts indicate those holy days are essential in their life and does not prevent them from doing their farming activities.

Most Christians and Traditionalists disagreed that their religious leaders' approval of agricultural technology does influence their adoption decisions (see Fig. 2). Thirty-three per cent of Muslims who participated in the survey was uncertain about the effects of an Imam's approval of agricultural technology on his followers. Responses for destiny and the blessing of God through favourable climatic conditions seemed to be the same. Over 80% of the farmers in all the religious faith either agreed or strongly believed in destiny and God blessings. The percentage of farmers who agreed or disagreed on the various factors only gave a clue to the quantum of people thought. Econometric meaning drafted from the data through the implementation of ANOVA and Chi-square deduced the significant variable results (see Tables 1 and 2).

The first descriptive results are supplemented with some statistical findings for culture and religion. The results are classified based on culture and religion, and each category comprised of three clusters. The goodness of fit of the models is high. The cohesion results for two clusters in each category was low supplement with weak goodness of fit relative to better in the case of three clusters for culture and religion. The test is done in conformity to cluster assumption standard [see Refs. [45, 46]. The significant difference of the Chi-square results among the tribes and the religious denominations support the employment of the three clusters.

##### 4.1. Cultural analysis

Participants' characteristics, farm-related profile and cultural practices are tested for differences among the ethnic groups (see Table 1). The Chi-square test indicates an insignificant difference between

**Table 1**  
Statistics for cultural variables.

Variables	Ethnicity			Total
	Mole-Dagbani	Gurma	Guan	
Age <30 years (%)	33.2	42.3	28.3	35.2
Age 31–60 years (%)***	38.1	31.4	46.0	37.9
Age 60+ years (%)***	28.7	26.3	25.7	26.9
Farm acreages ***	285.2	250.3	330.9	320.2
Education (%)***	17.8	23.8	14.3	17.3
Household size	6.7	5.7	8.6	7.9
Farm income in GHc***	324.6	535.0	745.3	443.4
Farming Experience (years)***	26.3	18.3	17.6	24.7
Extension service (%)	14.6	24.6	17.9	21.6
Credit access (%)	27.4	35.2	35.6	30.4
Consultation of gods***	3.4	3.0	3.8	3.4
Restriction by culture***	3.6	4.0	4.1	3.9
Chief's approval (%)***	73.5	27.5	36.1	35.6
Ancestors approval (%)***	41.5	37.7	38.3	38.9
Observation	192	117	155	464
Observation %	41.4	25.2	33.4	

Note: All variables in percentages are tested with Chi-square and otherwise for ANOVA. Legend: \*\*\*, \*\* and \* represent 0.01, 0.05 and 0.1 significant levels respectively.

**Table 2**  
Statistics of religious variables.

Variables	Religion			Total
	Christianity	Islam	Traditional	
Age <30 years (%)***	32.4	31.4	16.5	21.7
Age 31–60 years (%)***	43.1	43.4	51.1	46.5
Age 60+ years (%)***	24.5	25.2	32.4	31.8
Farm acreages ***	342.6	250.8	261.8	263.6
Education (%)	46.7	32.6	23.6	36.5
Household size ***	2.0	7.0	5.0	6.0
Farm income in GHc ***	743.5	334.6	543.6	544.6
Farming Experience (years)	17.6	13.3	26.7	18.8
Extension service (%)***	25.7	22.7	11.4	23.8
Credit access (%)	24.6	12.6	16.6	19.5
Restriction by Religion***	2.1	2.3	2.4	2.3
Religious leader (%)	23.3	31.7	39.4	29.5
Destiny (%)***	82.4	73.7	84.7	78.5
God blessing (%)***	92.5	77.5	73.6	85.5
Observation	128	232	100	460
Observation (%)	27.8	50.4	21.7	

Note: All variables in percentages are tested with Chi-square and otherwise for ANOVA. Legend: \*\*\*, \*\* and \* represent 0.01, 0.05 and 0.1 significant levels respectively.

age<30 but a significant difference ( $p < 0.01$ ) for the other age groupings. Most farmers engaged in rice cultivation and aged between 30 and 60 years for Mole-Dagbani and Guan and below 30 for Gurma. All the tribes have a small number for the aged. This suggests high involvement of the youth in agriculture as observed by Ref. [47]. Farmers in Mole-Dagbani tribe devote small space of land (13.9%) for the cultivation of non-traditional rice. Gurma ethnic group used at least 32.2% farm acreages to grow improved rice varieties. Furthermore, Guan has the highest acreage of rice (330.9 as mean), and Mole-Dagbani had the lowest mean acreage of 285.2 (see Table 1).

The results for education though significant at 99% confident suggest a higher level of illiteracy in Northern Ghana and especially in rural settings. Farmers in Gurma communities have the highest literacy rate of 23.8% relative to the national adult literacy rate of 79% [12]. The high illiteracy rate informed this survey, which was conducted in the various local languages for a better understanding of the questions. Farm income accrued from improved seeds varied significantly (i.e.  $p < 0.01$ ) across the ethnic groups. Mole-Dagbani had the lowest improved rice income (mean = 324.6) with high farming experience (mean = 26.3). This is in line with the findings of William, George [48], Alidu, Tanko [49] who

noted that farmers with vast experience are not encouraged to participate in agricultural technology project and are likely not to adopt.

All four cultural factors are significantly different ( $p < 0.01$ ) among the ethnic groups. Over 90% of farmers among Guans expressed that, the consultation of the gods for at least once affect their adoption decision (see Fig. 1). None of the three ethnic groups indicates an agreement of less than 80% for the days' culture restrict farming and consultation of gods. Averagely, farmers in Northern Ghana consults gods three times before taking adoption decisions (see Table 1). Furthermore, Culture restricts farming three days in a week. This suggests a significant number for consultation of gods and farming days considered forbidden. Approval of chief (27%) and ancestors approval (37%) for Gurma is low whiles, most of the farmers were indifferent (see Fig. 1). The figures only indicate significant low levels relative to the other groups. Mole-Dagbani had the highest level of agreement (73.5%) for chief approval because of the powers of the traditional rulers of the kingdom [50]. The corresponding figure for ancestors' approval (41.5%) suggests a strong linkage between chiefs' approval and that of ancestors' approval.

#### 4.2. Religious analysis

Table 2 reports decision support of religious variables affecting agricultural technology. Unlike the case of age in the ethnic groups, most of the farmers in the traditional religion (32.4%) are older relative to Islam and Christianity. Furthermore, traditional religion recorded the lowest level of farmers who are less than 30 years. This suggests the spread of Christianity and Islam among the younger generation relative to their forefathers' religion. Again, all religions have a high number of farmers within the age of 30–60 years. Islam had the lowest acreages (average = 250.8) used for the cultivation of improved rice crop. This could be linked to the low acreages for Mole-Dagbani as they are dominated by the Islamic religion in Northern Ghana and the vice versa is the truth for Gurma and Guans.

The Christian religion had a low household size (average = 2) but earned high income from rice production (average = 743.5). The high income suggests the high price attached to non-traditional rice [51]. Large household sizes for Muslims and Traditionalist depicts the acceptance to practice polygyny among themselves. This research expects farmers who adopted improved rice seed to have more access to extension services. However, farmers who belong to the Traditional religion under their high income could adopt agriculture technology than Mole-Dagbani, which had a low level of extension service (11.4%). Farmers who belong to the Traditional religion believed traditional agricultural practices and do not participate in modern farm training which includes the work of extension officers.

Aside the approval of the religious leader, all the religious values are significantly different at one percent level. A significant number of the farmers either agreed or strongly agreed that days such as Sunday, Friday, Thursday and Saturday affect their decision regarding the adoption of improved rice varieties. Christianity recorded the lowest for days restricted by religion (mean = 2.1), Islam for destiny (73.7%) and Traditional for the blessing of God (73.6%). Farmers who strongly disagreed, disagreed or are indifferent to the significant religious variables of belief in destiny and God's blessings are less than 30% for the three religious faiths. Though cultural factors seem highly connected to agricultural adoption decision, religious factors equally plays a major role.

#### 5. Discussion and conclusion

The interaction between social norms (culture and religion) and the decision to accept agriculture technology could better be explained using the Dual-system theory. Decision making is an individual choice. However, the behaviour of individuals are shaped by the environment and the society the person lives. In a rural area like Northern Ghana, people lifestyle are either defined by the ethnic group (culture) or the

faith (religion). People make societal norms as a system and the system control agricultural technology.

#### 5.1. Discussion

Prior research used different behavioural feelings, cognitive and ambiguous phrases to represent system one and two. For instance, self-control and automatic reaction, automatic and heuristic, suppression and self-regulation, among others [see Ref. [52]. This paper considered automatic regulation (agriculture technology) as system one and self-control (culture and religion) as system two. The paper positioned agriculture technology, such as improved rice seeds as a necessity and not an option for developing countries. Rural nations are characterised with Thomas Malthus population philosophy in which food is arithmetically progressing and the inhabitants geometrically growing. Culture and religion changes e with time. Generations change norms to suit their time, and some norms serves history and no longer practiced. The quest is to examine what drives the systems and which system is dominant in Northern Ghana?

The human control system encompasses practices of consultation of gods, restriction of the farming day by culture or religion, chiefs and ancestors approval, destiny and God blessing. A significant number of farmers in both categories indicate that norms affect the farming decision and farmers do not only consider the benefit connected to the system one before taking their decision. A situational sanction could apply for deviating from societal rules; farmers are likely to reject agriculture technology unwillingly. Agriculture technology is accessible to farmers through the government of Ghana, but the thinking and mindset oriented by culture and religion inversely affect the application [11].

The significance of the cultural and religious factors regarding the effect of adoption decision illustrates that rice farmers do attach more value to the rules and regulation governing the society. Farmers exhibited awareness of improved rice varieties and its benefits, however, adopted the seed because of either the chief or the pastor's approval (human control system). Those who did not grow high yielding rice varieties gave a reason of ancestors' rejection of the crop. Though some farmers expressed interest and testified to the benefits of improved varieties (self-regulated system), they refused to adopt it due to contrary disbenefits of the crop to their faith.

#### 7. Conclusion

The paper aimed to find out how rice farmers in Northern Ghana are associated with cultural and religious believes at the expense of technology adoption. The study dwelled on rice farmers from Northern Ghana due to the low adoption of improved rice varieties, coupled with the high proportion of rural farmers and the long history of culture and religious experiences. The research employed descriptive statistic and qualitative analysis to explain farmers' adoption behaviour vis-à-vis social norms and the extent to which the results fit the Dual-system theory.

In conclusion, there is evidence to suggest that Northern Ghana rice farmers are believers and not professionals. Contrary societal values neutralised policy that dwelled on the merit of agricultural technology. Hence, farmers resort to participating in the cultivation of non-traditional rice varieties through the implementation of valuable agricultural policy strategies. Farmers value traditional lawmakers who act as pillars sensitising people about the compatibility of modern technology to rural norms and the neutrality of agricultural technology to change of social codes.

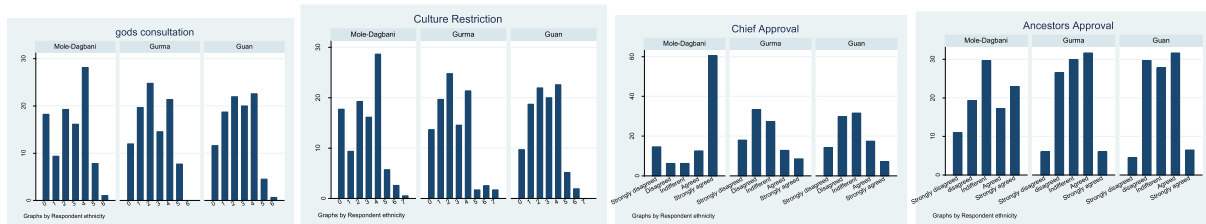
Mole-Dagbani and Islam are critical groups in Northern Ghana. The fact that, they are the majority with high resistance to accepting improved varieties implies that, when their egos change in favour of modern technology, then minority groups could follow suit. Previous recommendation for improving education in rural areas is critical. The high rate of illiteracy left farmers with only the understanding of culture

and religion. Therefore, supplementing education with the neutralisation of traditional values and human faith are the impetus to improving technology adoption.

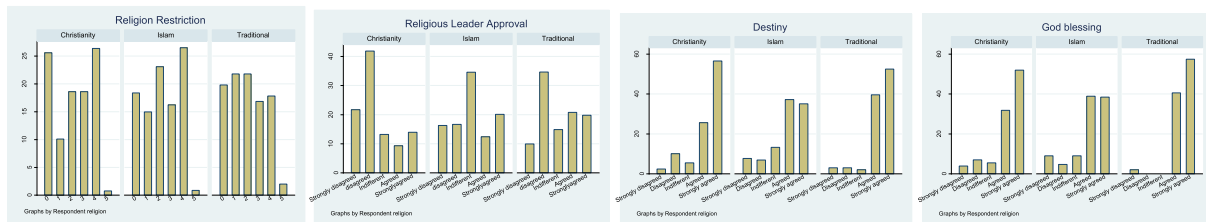
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**Appendix**



**Fig. 1.** Cultural variables affecting adoption decision.



**Fig. 2.** Religious variables affecting adoption decision.2

**Appendix A. Supplementary data**

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.techsoc.2020.101339>.

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