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An Understanding of Education in Supporting Cotton Production: An Empirical Study in Benin, West Africa

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Abstract: Benin is an underdeveloped country whose economy is dependent on agriculture, principally cotton production. Kandi is a community in the country's northeast region, and is regarded as one of Benin's top four cotton-producing communities. This community has a deficient level of education. The present paper aimed to investigate whether education could contribute to increasing cotton production in Kandi. A questionnaire was distributed to educated, uneducated, and organic farmers in the research area to achieve this goal. A linear regression strategy was applied, with the key components of the research areas being the usage of agricultural chemical inputs (pesticides and fertilizers), miscellaneous factors, and the level of education of farmers. The data collected were utilized to compare the different groups polled (educated and uneducated farmers). Organic farmers are used in this paper as a model of suitable agriculture development in the study area. The key finding is that primary education affects agricultural production. Solutions are presented with a focus on organic farmers.

Keywords: education; farmer; cotton production; Benin

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1. Introduction

Cotton is by far the most widely used textile fiber in the world. With yearly production estimated at approximately 25 million tonnes or 110 million bales in more than 75 nations. Cotton's social and economic value worldwide cannot be overstated [1]. Cotton is primarily grown for its fiber, and is utilized as a primary material in the textile industry. Around a third of the world's cotton production is exported.

In Africa, agriculture is one of the primary sources of foreign exchange in cotton-producing countries [2–5]. This sector employs around 6 million people in West Africa [6]. As the cotton sector is expanding globally, the problems raised by this activity undergo enormous variations depending on the different agro-ecological, economic, political, and climatic conditions. The fact remains that cotton cultivation constitutes intensive agriculture in terms of production inputs such as energy, water, and chemical input (fertilizers and pesticides). The use of chemical input dominates the cotton sector in Africa. Cotton cultivation productivity is negatively impacted by the excessive use of chemical inputs that are not under proper control. Hence, farmers' misunderstanding of chemical inputs could result from their lack of education.

Education in agricultural development has been reaffirmed since Schultz's work in 1964 [7]. Farming skills and productivity can be improved through education concerning chemical input and agricultural machines [8]. Thus, assessing the implications of cotton production and examining the most effective management strategies for these impacts must be contextualized [9–12]. The theoretical justification for anticipating a positive link between farmer education and cotton yield comes from related agricultural productivity work, which could be for a variety of experimentally supported causes. Numerous research projects [13–22] have established that education is crucial in agriculture. According to [23,24], with improved access to the knowledge provided by education, educated farmers should be able to pay for and acquire higher-quality inputs and products, implying that education can help improve cotton growing and selling, and enable farmers to be more self-sufficient. Due to their enhanced decision-making abilities, more educated farmers typically favor riskier production technologies with greater returns, since they can appropriately evaluate the indicated opportunities and dangers [14,25,26]. Technical education expands farmers' knowledge and information through training and coaching, ensuring practical pesticide application and thus yield improvement. The authors of [14,26–28] all assert that education enhances farmers' decision-making abilities and enables them to become more efficient resource managers. Following technical education, pesticide and fertilizer applications are optimized. According to existing research [29,30], agricultural technical education may affect farmers' projected usefulness.

The premise is that education enables farmers to adapt more successfully to the imbalance generated by technological advancements [31,32]. Additionally, data indicate that farmers who want to invest in their agricultural enterprises are more receptive to future training [33]. Education enhances a person's capacity for utilizing and adopting new technology. The findings confirm that the higher the amount of education, or the type of education, the more concerned farmers will be about external social and environmental sustainability issues. As the respondents' level of education increased, their concerns about government assistance declined dramatically, indicating that educated farmers desire less economic assistance and are less concerned about the advent of government assistance. In [14], it was indicated that education and experience had a favorable effect on farmers' output efficiency. If a farmer has a better education level, his capacity to cope with harsh farming conditions and achieve greater efficiency may be increased.

Given the growing understanding of the magnitude of the issues related to chemical inputs in agriculture and education, an international regulatory framework has been built to mitigate the harmful effects. The authors of [26] have neatly grouped these effects into the following categories for understanding the role of education: (1) Education by helping farmers make better use of information for finding solutions to problems and for the efficient management in the allocation of resources. (2) Not only does education help farmers use existing information more competently, but they also have better access to required information. (3) Educated farmers are more likely to adopt new technologies or products early because of their access to information and their ability to distinguish between promising and unpromising innovations.

Some studies show that farmers' knowledge of agrochemicals should be an essential factor. For example, it has been shown that some farmers do not know how to use agricultural chemical inputs. The existing research on farmers' education mainly focuses on middle-income countries such as China, India, Pakistan, and others [30,34–38].

In Benin, about 95% of cotton lint production is exported, representing 80% of export earnings, and significantly improving the national trade balance [39]. Cotton planting is the primary source of income for farmers, and an essential part of Benin's economy [40]. Cotton cultivation in Benin is also an industry with high pollution risks, and cotton cultivation comprises nearly 96% of the chemical input used [41]. The urgent problem to be solved in Benin is the misuse of chemical input caused by the lack of farmers' education. Due to the strategic agricultural sector stimulus program, which aims to improve yields, there is increased chemical input in agriculture to control pests and weeds. However, emerging countries do not pay attention to farmers' education [42].

Previous studies in Benin have shown how chemical inputs destroy the environment, although some studies have predicted a better future for chemically based agriculture [40,43]. It has been argued that a crop production system that does not rely heavily on chemical inputs, but that nevertheless produces a good yield, ensures environmental sustainability; e.g., the

Integrated Pest Management (IPM) approach [43,44]. This could ensure Benin's sustainable agriculture (cotton) development. Cotton production in Benin seems to be on the classical "pesticide treadmill", in which heavy reliance on synthetic pesticides works well for several years and then, in the end, proves to be disastrous [42].

Farmers' access to information and education may affect their use of cotton chemical inputs. In this study, farmers' education refers to the primary education received at school, distinct from farmers' training. Based on the lack of research about the impact of education, or farmer's education alone, on the study area, and because few studies have focused on farmer education in underdeveloped countries, mainly in African countries, this paper aims to contribute towards this knowledge gap and to understand whether farmer's education may contribute to the production of cotton. The paper conducted a questionnaire survey in the Republic of Benin, with the aim of (1) identifying the main factors affecting cotton production; (2) investigating whether primary education has a positive impact on cotton production; (3) providing policy recommendations for the future development of Benin's cotton planting industry.

The following describes how the paper is organized: The "Introduction" section provided an overview of the situation concerning the importance of cotton in Africa, including the study area, as well as a reminder of the critical role of education in agriculture; the "Materials and Methods" section includes a schematic overview of the research framework, as well as information about the study area, data collection, and the various analyses used, with a focus on hypothetical relationships. In the sections "Results" and "Discussion", the former includes empirical results and analysis, and the latter presents a discussion based on the ideas learned from examples. The "Conclusion" section outlines specific policy implications, analyzes flaws, and gives recommendations for improving the existing state of agricultural production.

2. Materials and Methods

2.1. Study Area

In the Alibori department's center, Kandi (Figure 1) is located in the cotton basin's agro-ecological zone. It covers 3421 km^2, or almost 13% of the department's total area. The terrain is formed by a sandstone plateau cut by the Sota and Alibori valleys, the town's two major rivers. There are certain hills constructed of hard rocks such as granite and quartzite, and the area has a Sudanese climate, with a rainy and a dry season. In the study area, the climate is defined by precipitation ranging from 0.1 to 245 mm, and temperatures ranging from 16 to 35 °C. Kandi features a unique form of tropical ferruginous soils with leached hylomorphism that favors cotton growing at the edaphic level. The study area is considered among the top four of the largest cotton-producing communities in the Republic of Benin. In the study area, agricultural production between 2017–2018 was estimated at 55,744 tonnes. The vast majority of people in the study area are agricultural producers, and only a small number are formal business people. Agriculture, animal husbandry, trading, transportation, and, on occasion, hunting and fishing, sustain the economy of the Kandi village.

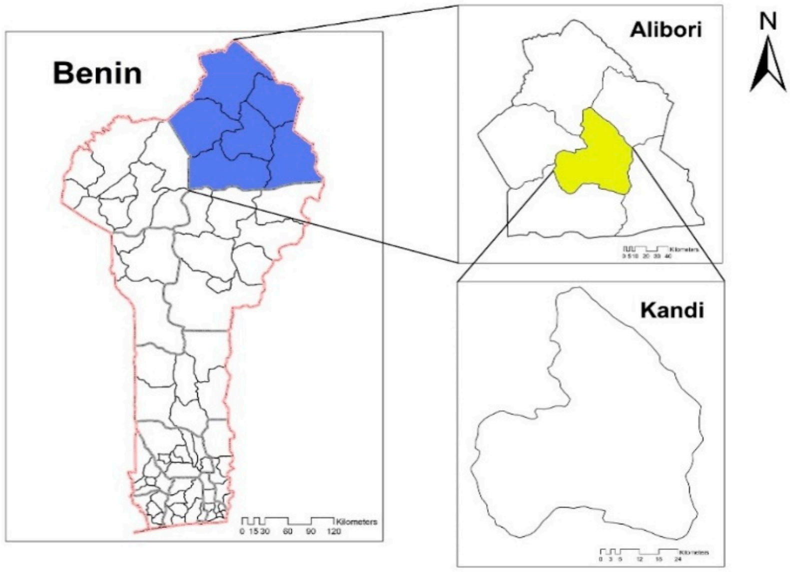


Figure 1. Map of the study area.

According to the National Institute of Statistics and Economic Analysis of Benin, the population of Kandi in 2018 was 206,988; Table 1 shows the literacy and education level of the Kandi community in general. Kandi's education level is relatively poor, and all education indices are well below the global average. Kandi, for example, has a literacy rate of only 25.9%, which is significantly lower than the global average (86.47%).

Table 1. Literacy and education of the community.

Indicators	Kandi
Literacy rate for ages 6 years and over (%)	25.9
Adult literacy rate (15 years and over) (%)	20.7
Adult literacy rate (15 years and over) in the French language (%)	19.7
Adult literacy rate (15 years and over) in the national language (%)	3.8
Net enrollment rate (6–11 years) (%)	33.8
Secondary school enrollment rate (12–19 years) (%)	18.6

2.2. Research Method

2.2.1. Research Framework

In the department of Alibori, mainly in the Kandi community, the most dangerous risk factor in cotton production is the farmers' improper handling of chemical inputs due to having no proper control (education). In the cotton production chain, chemical inputs are only a part. Several factors in combination are required for more profitable products, such as chemical inputs, agricultural machinery, and the farmers, all of which are essential for production. Indeed, the development of agriculture without the contribution of farmers' education has accelerated the misuse of chemical inputs by farmers in the study area, reducing the use of machines for agriculture and directly impacting revenues. There is then a direct link between the factors of cotton production and farmers' education. This means it is necessary to consider the status of farmers when it comes to agricultural production.

The framework of the present study (Figure 2) is formed of four primary statuses, according to the design considerations: the research framework exposes the current state of the study area and projects an idea of the type of farmers that would be suitable. Based on information from several different studies in the literature [6,38,43–45], four types of farmers were identified that coincide with the different farmers in the study area. For this reason, the study framework considers these four cases of farmers. Improving the use of agricultural chemical inputs and agricultural machinery and, consequently, increasing agricultural production, could be possible in the study area. To establish how, we used the research framework below:

- The uneducated farmers are the first status. This status refers to a farmer who lacks education or understanding and act via their instincts.
- The second status pertains to farmers who are educated. In this situation, farmers with primary education are assumed to be conscious of their actions and enhance their production.
- The organic farmers comprise the third category. This model of the farmer is only exposed to technical practices, in this case, to boost production.
- The fourth classification is that of future farmers. In this scenario, the focus is on emergent farmers. It is a combination of educated farmers and organic farmers. It suggests that farmers with basic education skills mixed with professional training in growing organic cotton would be suitable for production in the study area.

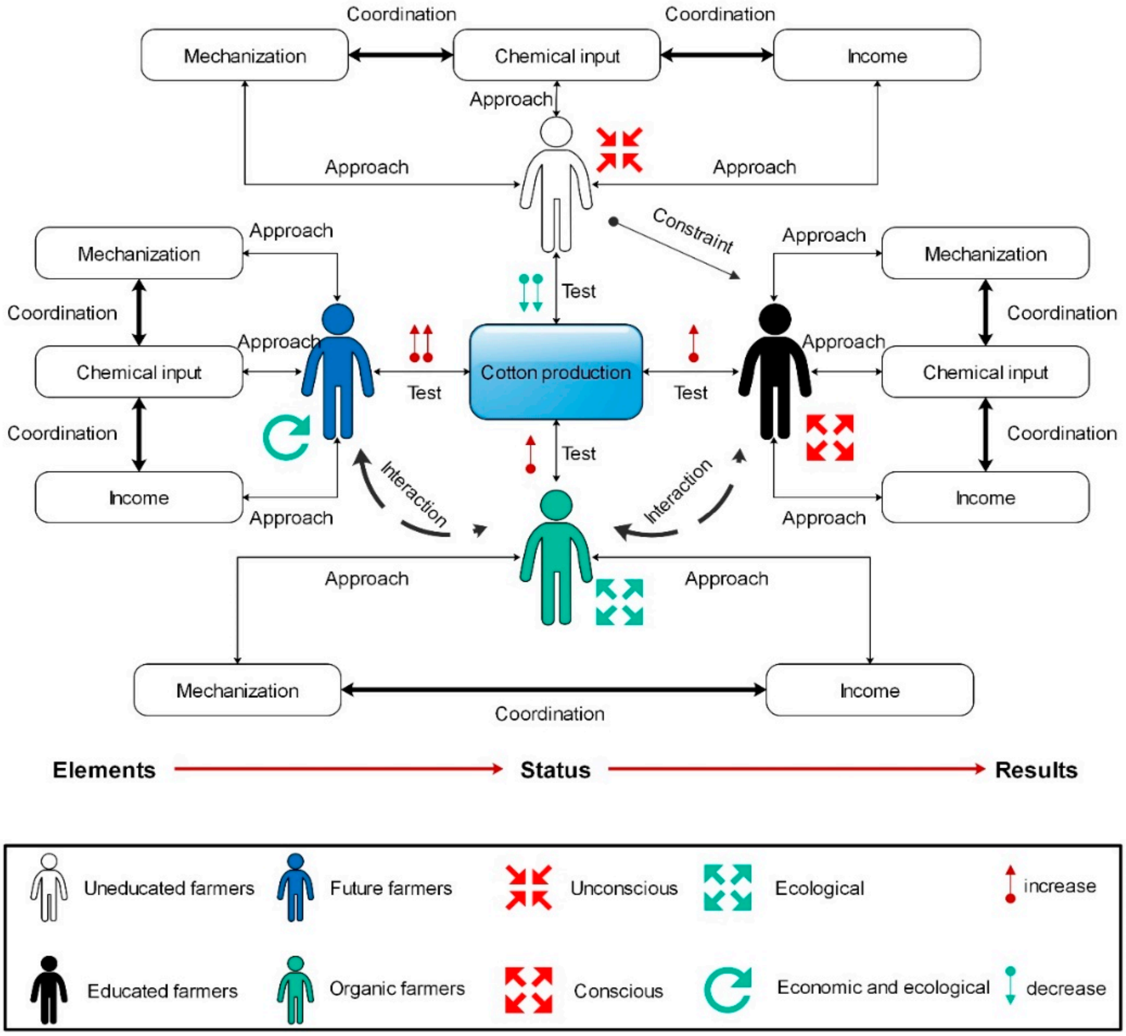


Figure 2. Research framework based on the study area.

2.2.2. Questionnaire Survey and Sampling

All categories of farmers were asked to complete a questionnaire consisting of 25 questions. The questionnaire survey took place from January to February 2021. The questionnaire was divided into three sections. Basic information such as gender, age, and residence was gathered in the first section. Section two focused on education status, which included the level of schooling, personal farmers' linguistic competency, income, and productivity. The third section was focused on behavior and perception questions, such as "how are you supposed to apply chemical input, monthly or daily?", and questions regarding impression on chemical input, use of agricultural machines, and so on. The questions were posed in French as well as in other Benin traditional languages. The Table 2 presented the characteristics of the sample used. The questionnaire survey used a face-to-face guided questioning technique to collect information.

Table 2. Characteristics of the sample used.

Surveyed District	Total Number of Households	Number of People Surveyed	Percentage (%)
Angaradebou and Thya	14,845	360	2.42
Sonsoro	11,408	125	1.09
Dowari (Tissarou)	10,381	125	1.20
Total	36,634	610	4.71

For this study, cotton farmers are the study's observation units. Due to the significant number of farmers in the Kandi commune Figure 3 (Sonsoro, Angaradebou, Tissarou, Thya). A total of 610 producers were chosen randomly (having received public school education or not receiving any form of education). Subsequently, 125 farmers in each community were chosen at random. The 110 additional organic farmers were dispersed across Kandi. Organic farms were not included in the primary analysis. This paper uses organic farmers to explore further options. Each producer was randomly questioned to compare and build an expectation that training farmers would help better agriculture.

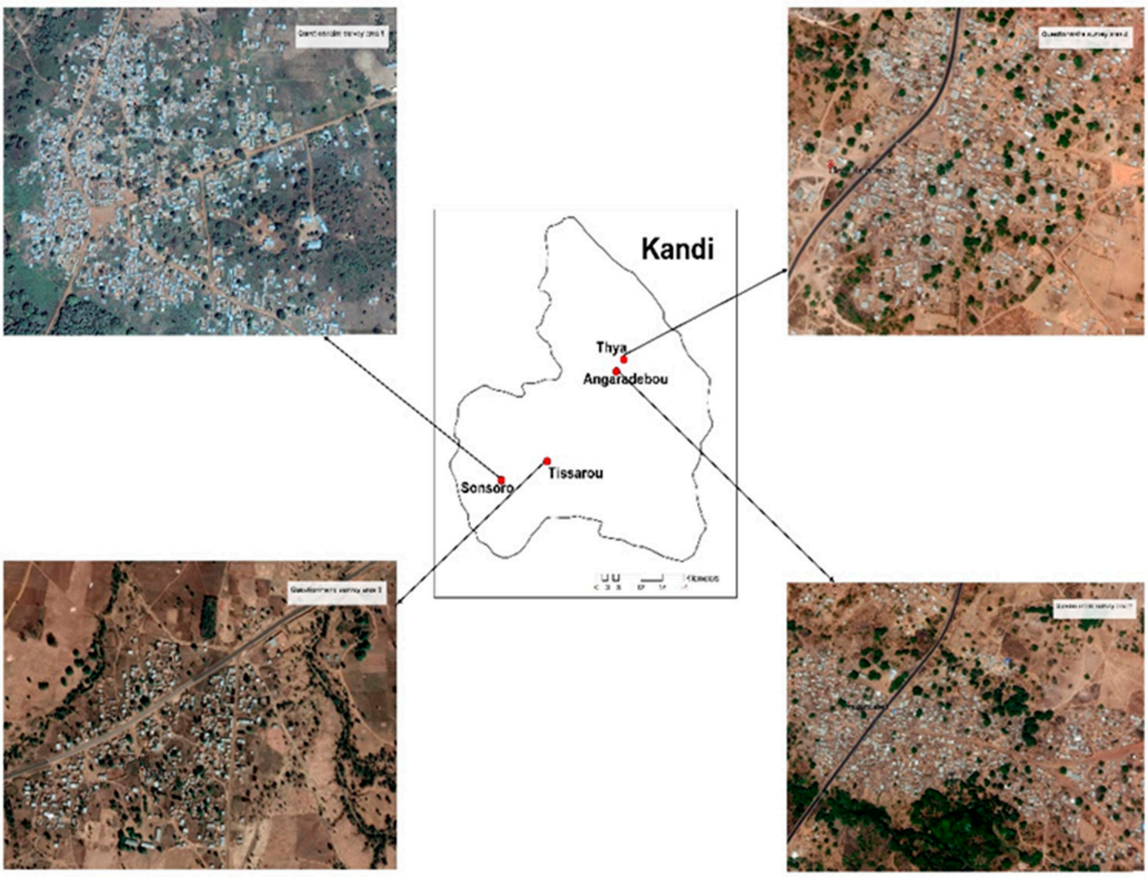


Figure 3. Location of survey farmers.

2.2.3. Statistical Analysis

To determine whether or not there is a relationship between the use of chemicals and the level of education, we conducted a preliminary matching analysis to establish a first preliminary approach. The data were divided into two groups: the group of educated farmers and the group of uneducated farmers, and the data were then evaluated further. An initial statistical analysis stage was completed, followed by a second stage. A thorough investigation was then conducted to see whether or not education may be beneficial to agricultural production. According to our hypotheses, the production in the study area would be influenced by several influencing factors. When it is necessary to use two or more independent variables to explain changes in the dependent variable, multiple linear regression (least squares) analysis methods should be used. Commonly, four econometric models are employed to describe decisions about the adoption of agricultural advances; the linear regression model, and the Logit, Probit, and Tobit logistic regression models. The Tobit model (censored standard regression model) allows for the censoring of data regarding the intensity of adoption to be accounted for by assuming that the determinants and effects of the determinants are identical for both probability and the intensity of adoption [46]. That is not the purpose of this investigation. This article chose the linear regression [47,48] method to analyze the effect of education on agricultural production and, consequently, on farmers in the Kandi community. Consider the following regression equations:

$$\text{LnY} = \beta_0 + \beta_1 LnNPK + \beta_2 LnPE + +\beta_3 LnIP + \varepsilon \tag{1}$$

$$\text{LnY} = \beta_0 + \beta_1 LnNPK + \beta_2 LnPE + +\beta_3 LnIP + \beta_4 EL + \varepsilon \tag{2}$$

Equation (1) was applied to uneducated farmers, whereas Equation (2) was applied to educated farmers. Consider Y as a farmer's cotton production per hectare. *NPK* refers to the amount of fertilizer used per hectare by farmers. Pesticide use by farmers per hectare is noted as *PE*. *EL* defines the number of years of schooling for each farmer, and is considered a dependent variable. The years of study as preparation years were not included in the model since they were deemed insignificant. Uneducated farmers have no education, so it is impossible to measure their education. The model did not include the prior years of education since they were deemed insignificant. In the model, *NPK* and *PE* are not included in *IP*. *IP* is miscellaneous; it includes additional costs such as transportation and agricultural labor. The study only used variables that most affected cotton production in the study area. The relationship between production and the various indicators mentioned above is explained by these equations. The elements that contributed were identified based on observations collected in the various study regions. β_0 represents a constant term, β_1, β_2, β_3, β_4 represent the regression coefficients, and ε represents the error term. In the following section, the obtained results are compared between the various groups who participated in the survey.

3. Results

3.1. Matching Analysis

From Figure 4a,b, it is noted that the education level of educated farmers impacts pesticides and fertilizer use. In this analysis, the significance of R^2 is equal to 1. A result under 0.1 can be considered as any relation available between two variables. Educated farmers (Figure 4a), from the viewpoint of pesticide use and education level, exhibit a matching correlation R^2 near 1, at 0.2924. Figure 4b shows the matching between the fertilizer use and education level of educated farmers, and the R^2 is 0.2402, again close to 1. Figure 4c,d show the 95% confidence ellipse between these two variables.

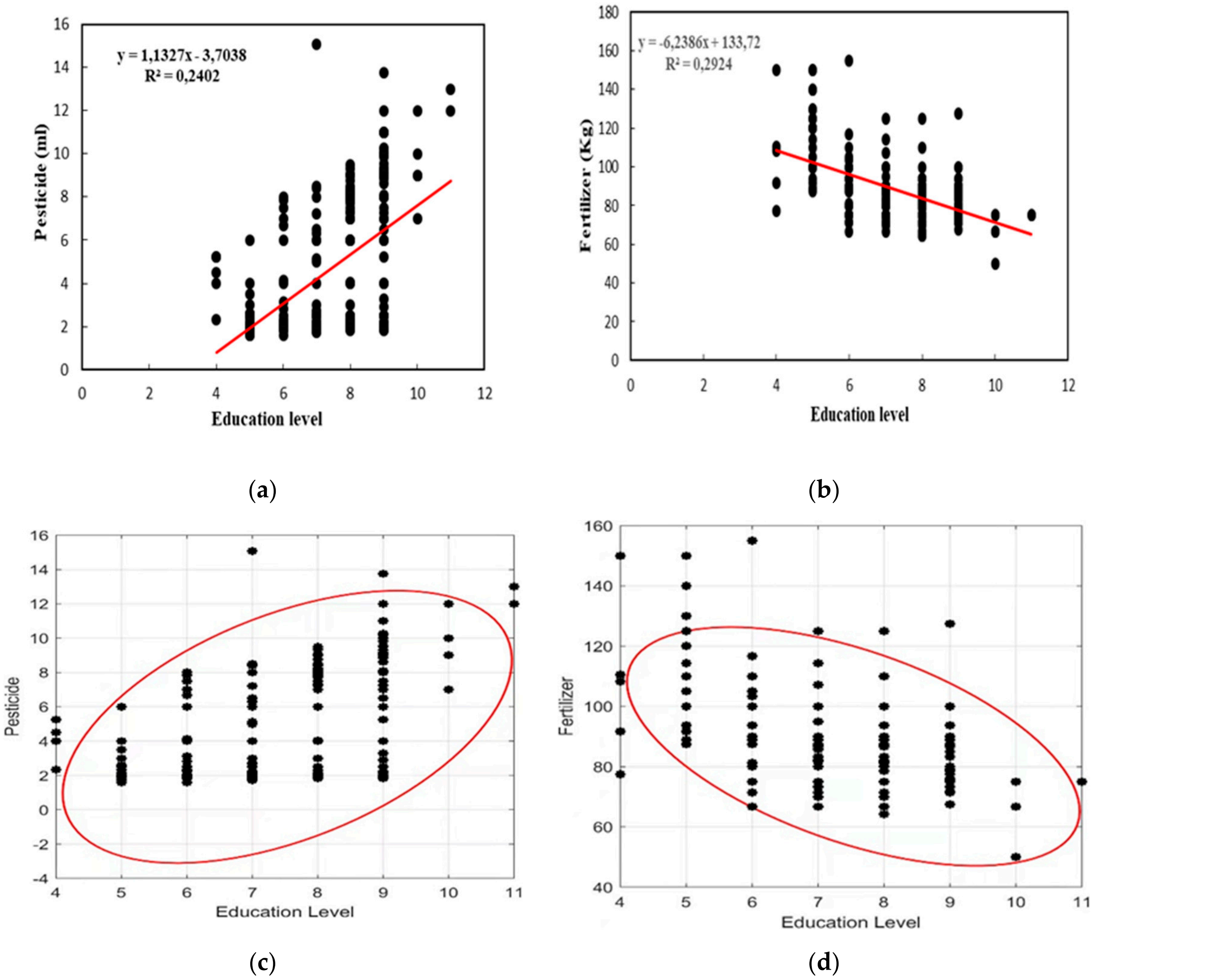


Figure 4. Matching correlation analysis and 95% confidence ellipse between chemical input and education level. (**a**) Matching between pesticide use and education level. (**b**) Matching between fertilizer use and education level. (**c**) Pesticide use and education level 95% confidence ellipse. (**d**) Fertilizer use and education level 95% confidence ellipse.

3.2. Model Results of Different Samples and Variables

The model was significant at the 0.05 level. Hence the model's results can and should be considered. All *p*-values were less than 0.05; however, the EL probability value was significantly larger than 0.05, and the coefficient was not high. Table 3 summarizes the different variables and coefficients for uneducated farmers. The coefficients for agricultural chemical inputs, pesticide and fertilizer, were 0.04157 and 0.04401, respectively, whereas the coefficient for miscellaneous (IP) was 0.04636. According to Table 4, the equivalent of Table 3 but for educated farmers, pesticides had a coefficient of 0.51862, fertilizer of 0.51957, and miscellaneous (IP) of 0.01710.

Table 3. Uneducated farmers.

Variables	Coefficient	Std. Error	t (Values)	Prob.
Pesticides	0.04157	0.016998	3.053828	0.0025
Fertilizer	0.04401	0.014413	2.445679	0.0152
Input	0.04636	0.010166	4.561067	0.0000
Constant	−5.08677	0.211007	−24.10708	0.0000
R^2	0.95637			
Adjusted R^2	0.95565			
Prob(F-statistic)	0.00000			

Table 4. Model for educated farmers.

Variables	Coefficient	Std. Error	t (Values)	Prob.
Pesticides	0.51862	0.015328	3.383339	0.0008
Fertilizer	0.51957	0.011502	4.517286	0.0000
Input	0.01710	0.006578	2.600665	0.0099
EL	0.00109	0.002045	0.536860	0.5919
Constant	−4.65266	0.055221	−84.25506	0.0000
R^2	0.99740			
Adjusted R^2	0.99735			
Prob(F-statistic)	0.00000			

3.3. Farmers Perception

According to the survey conducted for this research, 76% of educated farmers have adequate basic knowledge of chemical inputs and can utilize them correctly, healthily, and effectively. On the contrary, more than 60% of uneducated farmers do not know how to apply chemical inputs correctly, which significantly limits the favorable advantages of chemical inputs to cotton planting (Figure 5a). In addition, whether farmers are educated also affects their attitude towards the protection of their safety. For instance, 88.4% of educated farmers use protective wear when treating the field, and the remaining 11.6% of educated farmers do not use protective clothing due to the lack of money to purchase them, but are aware of their importance. In contrast, 81.2% of uneducated farmers admit they do not use protective clothing when treating fields with agricultural chemical inputs, leaving just 18.8% that use protective clothing (Figure 5b). Some farmers, mostly those that are uneducated, ignore the importance of the use of protective clothing. These farmers are not interested in wearing protective clothes, arguing that the use of protective clothing is a waste of money.

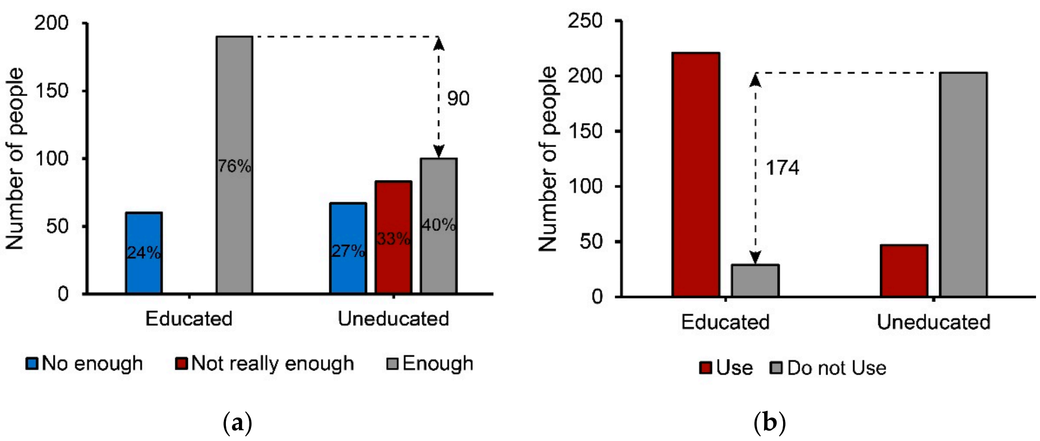
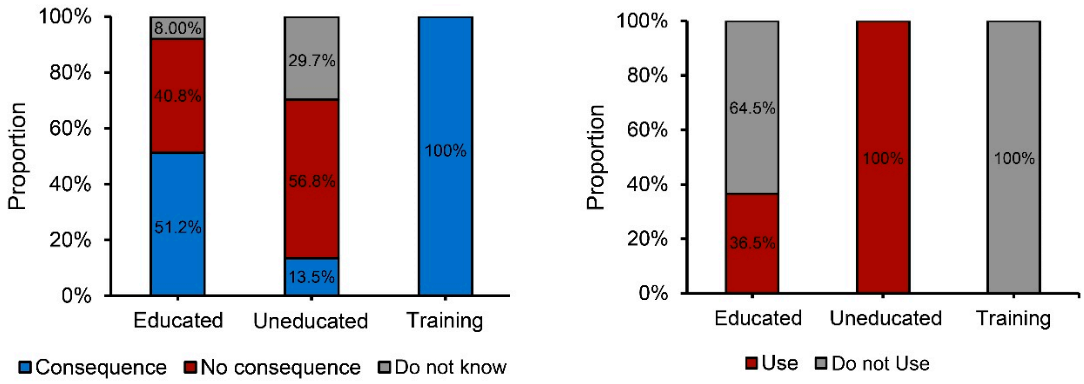


Figure 5. Perception of farmers on the effect of education linked to the use of agricultural chemical inputs. (**a**) Basic knowledge of farmers using agricultural chemical inputs. (**b**) Self-protection of farmers using chemical inputs.

3.4. Training Effect

A simple comparative study was performed to obtain more information on the farmers' thought processes. During the survey, it was discovered that there was a group of farmers who had received specific training from non-governmental organizations (NGOs) to encourage them to grow organic cotton. As a result, the survey investigated farmers who grew cotton without using pesticides (Figure 6).



(**a**) (**b**)

Figure 6. Perception of different cotton farmers on the use of chemical input. (**a**) Understanding of the adverse effects of chemical inputs. (**b**) Use of cotton chemical inputs in food crops.

Organic farmers unanimously agreed that chemical inputs harmed the environment (Figure 6a). When asked whether there is a consequence to utilizing chemical input, 51.20% of educated farmers responded affirmatively; 8.03% responded that they were unsure of a consequence. According to 40.77% of educated farmers who utilize chemical input, there is no harmful impact on the environment. In comparison, 14.45% of uneducated farmers believe that chemical input has negative consequences; 56.81% presume that using chemical input has no negative consequences, and 29.74% are unsure whether the use of chemical input has negative consequences. Similarly, it is important to mention that not all farmers have the same understanding based on their schooling.

Furthermore, 64.5% of educated farmers stated that they do not use chemical input when cultivating cotton for food crops, while 36.5% claimed that they do. In contrast, all uneducated farmers indicated that they use cotton chemical input to grow food crops, while all organic farmers said that they do not use chemical input (see Figure 6b).

4. Discussion

The first stage of the research, "matching analysis", demonstrates correlations between agricultural chemical input/consumption and farmer education. However, the association between education level and farmers' usage of chemical inputs is not strong. The confidence ellipses we constructed also confirm that farmers within this education range may have a positive impact concerning the use of chemical inputs.

Compared to Table 3, Table 4 had more significant coefficients. The coefficient of educated farmers for chemical input suggested that educated farmers are more likely than uneducated farmers to use chemical input exceptionally well. For the miscellaneous factors (IP), the coefficient (0.01710) for educated farmers was also lower than the coefficient (0.04636) for uneducated farmers for the input variable; this suggests that educated farmers invest less than uneducated farmers. Since the goal of cotton production emphasizes the economy, education positively affects the miscellaneous factors. Agricultural production is positively impacted; for each 0.00109, education brings on different variables, such as fertilizer, pesticide, and miscellaneous. It is evident from analyzing the results provided by the model, based on the comparison of the coefficients, that educated farmers can spend less money, use chemical inputs more cheaply, and, as a result, improve productivity.

4.1. Determinants of Organic Cotton Cultivation

Water scarcity for agricultural purposes is a typical occurrence in many nations. In the study area, irrigation is a severe problem in that it is almost non-existent. That makes the study areas suitable for cotton cultivation because cotton is a crop that does not need water when germinating [44].

Even in regions with abundant rainfall during the wet season (it is impossible to grow cotton in the wet season), cotton may have edaphic water shortages during dry seasons. Organic farming attempts to maximize the use of farm resources and to utilize natural resources sustainably. Active water retention, collection, and storage are crucial strategies, particularly for organic crops. Organic farmers know that improving the soil's water retention and infiltration is vital before applying fertilizer [44]. According to some international research, the main elements that influence the need for irrigation are crop selection and a suitable cropping system [49]. As a result, gaining more expertise in various sectors allows farmers to adopt more profitable practices and improve their quality of life. There is a strong argument in the literature that education plays a more prominent role in modern agriculture than in traditional agriculture [50–55].

Instead of using chemicals, organic farmers utilize animal manure. This method combines agricultural and livestock systems. Cropping in this scenario offers feed for animals through grass and nitrogen-binding legumes, leys (improved fallow with seeded legumes, grasses, or trees), weeds, and crop leftovers. Animals graze under trees or on stubble, providing draught and manure for crops, while saving cost [44,56].

In Thailand, for example, an experimental farm keeps pigs and hens, a vegetable garden, and a fish pond. Animal excrement is used to make fertilizer, fish feed, and biogas. The biogas facility also receives crop and human waste. The biogas generator's liquid effluent and solid leftovers are utilized in the fish pond and the garden. The positions of the garden and pond are rotated regularly; such wastes from one serve as nutrients for the other [57]. Organic cotton would be a suitable answer for Benin because no hazardous chemicals would be used, ensuring that soil would not be harmed and air pollution reduced [39].

4.2. Policy Implications

Faced with the challenge of farmer education and, as a result, the development of suitable cotton production, the impacts of education will be much more significant if Benin's development actors successfully implement the right policies. Governments and non-governmental organizations (NGOs) participating in the agricultural sector promote pesticide application techniques and agricultural technical agents' training to supervise cotton producers' regarding the use of chemical pesticides made available to them.

The government of Benin may advocate a system of industrial education that blends teaching, research, and manufacturing. That will be demonstrated primarily through a greater emphasis on the transmission of practical knowledge and the acquisition of practical skills and capacities (in terms of agricultural chemical inputs, cultivation techniques, among others). For that, the government's schooling system should carefully regulate the practical instruction of Beninese agricultural colleges. Regular schools should also provide space and courses that encourage young people to participate in agricultural activities. For instance, general education secondary schools in Benin may incorporate these metrics into their courses. Through classroom instruction and hands-on training, children of all ages can acquire theoretical knowledge and practical skills. They may swiftly adjust their duties upon graduation from primary or secondary school, and some of them could develop into exceptional farmers. In addition to having specific technical and operational management capacities, they will be able to obtain better economic rewards than ordinary farmers, which will aid in developing agriculture in Benin.

First, the government should adopt incentive programs to entice farmers to join agricultural cooperatives and reinforce agricultural cooperatives' functions to increase the usage of organic fertilizers. Second, the government should investigate how to offer more farmers actual subsidies for organic fertilizers. Subsidies at a lower cost should promote organic fertilizers rather than chemical fertilizers. Third, the government's current rural land policy should be strengthened to encourage more farmers to manage larger farms. It is necessary to pursue a policy of attracting potential farmers capable of managing larger farms.

Due to the near-complete lack of mechanization in Beninese agriculture, the government and development actors in the country, such as non-governmental organizations, can reward farmers who attend sessions, pass various exams, and obtain satisfactory results by providing them with agricultural machinery. Additionally, the Beninese government might encourage current farmers (those who cannot return to school and lack academic abilities) to attend periodic instruction or practice sessions. To fully grasp this concept, it would be prudent to begin on a modest scale, such as a district or town.

Agriculture development is contingent upon a certain level of agricultural education. Agricultural producers require only essential agricultural expertise to operate in agricultural production circumstances. Cotton production development in Benin requires scientific and technological expertise, critical for agricultural development. However, if Beninese cotton is to thrive worldwide, the Beninese government must act rapidly to implement solutions and provide systematic instruction and training to farmers; otherwise, success and conquest of huge international markets would be difficult. Apart from increasing production, education is required to mechanize Beninese agriculture, particularly in Kandi. Farmers' education has little effect on the use of agricultural machinery because mechanization will promote large-scale production and increase the quality of agricultural products, which will require further education and/or training for farmers. Benin's mechanized agriculture would enable and promote access to agricultural machinery by significantly enhancing agricultural workers' output. Figure 7 is a framework of a possible agricultural enforcement.

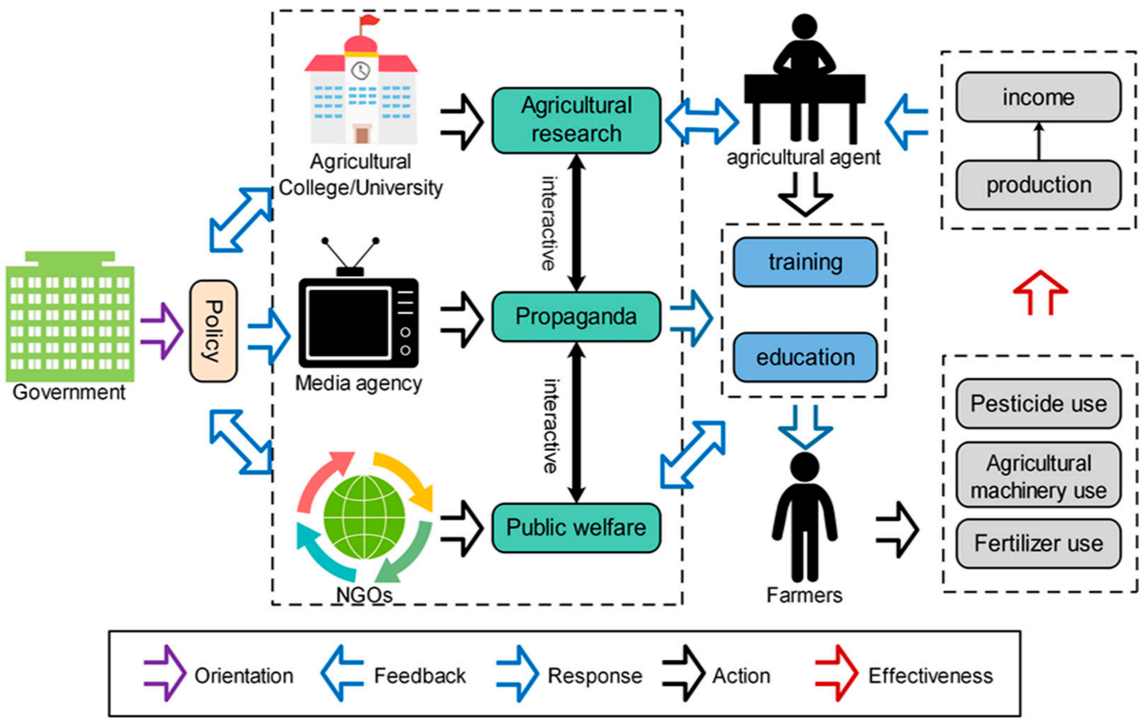


Figure 7. Possible agricultural enforcement measures.

4.3. Limitations and Outlook

This study examines the influence of farmer education on the usage of chemical inputs and miscellaneous factors on the effects of cotton output. This document could serve as a foundation for further research on cotton growing in Benin, particularly Kandi. The paper aimed to investigate whether education could contribute to increasing cotton production in

Kandi. The study does not investigate how education can increase the usage of chemical inputs or how much chemical input educated farmers should use when growing cotton.

Cotton production appears to be influenced by different elements in different places or countries. Certain factors, such as irrigation and farmer age, were not found as factors impacting cotton production in the study area. Conventional farmers in the study area, on either side, do not have easy access to irrigation. Furthermore, conventional cotton cultivation requires less water. Cotton is a plant grown in the dry season to avoid rainwater contact.

In contrast to previous research in Benin [6,39], this study focuses on elements that directly influence individuals, such as the economy and pesticide use, because these are the most obvious characteristics in the study area. Cotton production is also influenced by the environment and other external or internal factors such as plowing hours; the soil status and the temperature also have an impact. Due to a shortage of technical equipment in the study area, data collection for certain aspects is limited.

The usage of agricultural machinery was not included as a variable in our approximated estimates since farmers do not widely use agricultural machinery in Benin in general, and in the study area in particular. Farmers utilize conventional equipment. Agriculture mechanization is a big issue in Benin, including Kandi. Benin's agriculture is traditional and insecure. In Benin, farmers cultivate the soil with a hoe and a plow. The labor force heavily relies on physical strength, requiring hand tools such as the hoe and the plow to accomplish various cultivation activities. These technologies, particularly in a tropical setting, have implicit energy and potential yield restrictions. These approaches significantly reduce the amount of land cultivated per household. They impede agricultural operations and reduce the effectiveness of critical actions such as weeding, which may result in decreased yields.

This study is neither focused on the direct usage or effect of agricultural chemical inputs, nor is it exhaustive in its examination of all economic scenarios. The research is based on a comparison of how large nations manage farmer education to arrive at a credible conclusion. Additionally, the study is based on questionnaires that collected qualitative and quantitative data directly from farmers; this implies the presence of some erroneous data that has been deleted or processed.

Cotton production, however, is not limited to educating farmers about the usage of chemical inputs in the Kandi community. Numerous other factors affect cotton production in this community, either directly or indirectly. Future research could focus on the environmental impact of chemical inputs or the influence of agricultural microcredit on cotton output in Benin, and the participation of various national agricultural political sectors and non-governmental organizations. More research might examine the possibilities of adopting organic cotton, which has the potential to be the future of Beninese agriculture and farmer behavior and capacity building for improved agricultural productivity in Benin. More research could also focus on how education affects chemical use in Benin. Additional agricultural production models, including education, can be investigated to delve further into the numerous issues surrounding agriculture and the environment, while also helping farmers expand their agricultural economy. Future studies should not be limited to Kandi or other communities. However, they should also be conducted nationally to achieve a broader reach and a larger sample size to tackle additional problems.

5. Conclusions

In total, 610 farmers were chosen to complete a questionnaire to determine whether primary education obtained in school may impact cotton production in Benin, specifically Kandi. The processing of data demonstrates that education has a positive impact on the numerous variables affecting cotton production, notably the usage of fertilizers and pesticides, the miscellaneous contribution of farmers to cotton farming in Kandi, and, as a result, cotton production. The utilized linear regression model yielded data that allowed for a comparison between educated and uneducated farmers. Finally, the favorable education outcomes reported in the analyses support Schultz's theory that education is essential in agriculture.

The study suggests a policy solution to address the issue and bring about more beneficial changes in cotton production in Benin, specifically in Kandi. Formal education with practical skills will be much more profitable. However, it should be noted that education's contribution does not guarantee that all agricultural problems will be solved; instead, it is merely a considerable improvement.

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