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Agro Supplier Recognition as a Spark for Sustainable Pest Prevention

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Abstract
The certification of agro-input dealers is also growing as a key means through which better sustainable pest management activities can be consolidated in developing economies. In Uganda, access to pesticides and associated advice by smallholder farmers depends significantly on dealers and in the case of uncertified distribution channels, it is associated with abuse of the products; environmental degradation, as well as the development of pest resistance. This paper will consider the role of certification programs in improving the knowledge, accountability and advisory roles of the agro-input dealers to ensure safer use of pesticides and adoption of integrated pest management regimes. Based on field assessment including farmer-dealer interactions, the evidence points out that in addition to facilitating quality control and adherence to national regulations, the certification process has established the trust between farmers and the agro-dealers. The paper concludes that certification programs in pest management are to be scaled up at the core of further roll-out of sustainable pest management and the protection of human and environmental health.

Keywords: ***Agro-input dealers, Certification, Sustainable agriculture, Pest management, Uganda, Integrated Pest Management (IPM), Pesticide regulation, Farmer advisory services, Agricultural extension, Environmental sustainability.***

1.Introduction
In Uganda and in large parts of sub-Saharan Africa, agricultural production is inevitably intertwined with the difficulties and opportunities that pests and crop diseases create. The story of the last few decades is one of extra-ordinary increases in the use of pesticides which has been part of a larger trend world-wide with intensified agriculture and invasions of new pests, combined with greater pressure to maintain food security, driving dependence upon chemical means. Fungicides, herbicides and insecticides are all undoubtedly better extractors and have a huge role to play farming household in securing food supplies and incomes against climatic and biological dangers. But all these have not come without costs in this chemical revolution. Accumulating evidence shows that there are dire externalities to the devolution and overuse of pesticides: loss of biodiversity in delicate ecosystems, pollution of both soil and water bodies, poisoning of pollinators and other beneficial insects, and health issues in the long run of the farming communities. Ecological research Not only have studies associated pesticide exposure with acute and chronic diseases, but ecological research has demonstrated the ongoing deleterious impact on natural pest control system resulting in a cycle of dependence on synthetic inputs. The fact that this development presents a dilemma to Ugandan agriculture is critical because the undisputed productivity advantage of pesticides presents an existential challenge to solutions because of the compelling need to find ways of reducing its risks to the health of the people and the environment(1).

It has been traditional that agricultural extension services would take the lead role in filling knowledge on the safe use of pesticides and alternative pest management measures like integrated pest management (IPM) and biopesticides. The publicly-funded extension system of Uganda is however fraught with chronic under funding, shortage of staff and coverage. Government figures indicate that only a fraction of the farmers in the country have access to extension services through government; most of these do not have formal knowledge on the management of pests. Here a niche has been created where the retailing agro-input dealers, dealers in seeds, fertilizers, pesticides and general farm inputs have become the main entry point of consultation by the small-holder farmers. They do not simply sell their inputs; these dealers are in reality informal consultants with some of them having considerable influence on the way farmers perceive what they should purchase, how to use them, and which method is superior to other measures of counteracting the pests. They have a particularly strong influence as use of pesticides as an initial line in fighting pests and diseases increases.

Nonetheless, the agro-dealers role is two-edged. On one hand they are affordable and easily accessible thus making them indispensable brokers in the agricultural system of Uganda. Conversely, a sizeable number run on limited

training and supervision. The literature has reported prevalent lapses in knowledge about safe handling and application of pesticides, optimal dosages and non-chemical options among agro-dealers. There are also conflict-of-interest issues, in which sales incentives may induce the marketing even of mediocre chemical solutions when superior alternative solutions could be available(2). Inappropriate selling of counterfeit pesticides, re-packing into unlabelled containers or even stocking extremely dangerous products have been witnessed. Such loopholes in the training and control weaken the process of promoting responsible use of pesticides, which may place farmers, consumers, and the ecosystem at unnecessary risks.

FIGURE 1 Agro-Dealer Certification in Uganda

In order to cope with these pressures, Uganda, similar to some other countries, has come up with mandatory certification programs of agro-input dealers. According to national regulations, agro-dealers are to receive official training in the safe treatment and usage of pesticide, how to identify pests, pesticide policies, and ways of integrated pest management. Approval is by way of attending structured courses which in most cases are organized and facilitated by the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF) in tandem with various academic institutions including Makerere University. The certification process is expected to certify both the technical competence of demanders and to certify that the dealers meet safety standards in the country. Hypothetically, a certified agro-dealer would be in a better position to counsel the farmers on safe use of pesticides, to adopt sustainable practices and diminish circulation of unregistered fake produce.

Although there is a regulatory framework, nevertheless, compliance is a perennial issue. Most dealers are still operating without a license due to the arguments that include the financial constraints of training, taking time or travelling long distances where most certification centres are found in Urban centres like Kampala. Other people might just be unaware of these legal needs, or they feel that there is very little benefit to be enjoyed by the formal certification(3). The strategy of compliance is further complicated by the differences in the application of rules, not sanctioning completely non-certified dealers who proceed to retail their goods. As a result, the pesticide supply chain in Uganda remains characterized by patchwork of both certified and non-certified sellers and this has consequences on the quality of the advice given and products finally supplied to the farmers.

The studies on the role of certification in agro dealers as influential on pest management have been scarce with little concern on African study. The farmer has been the center of most empirical studies about the usage of pesticides: their actions, perceptions of risk and reaction to training interventions. Such farmer-centred views are useful, yet they disregard the potentially pivotal role of agro-dealers, that is, the intermediaries, who can directly affect farmer choices. There has been less literature on agro-dealer knowledge and practices, which has tended to highlight alarming gaps but seldom to examine how certification itself affects influence. This creates unanswered questions on understanding whether the beneficial effects of certification on the understanding of agro-dealers about integrated pest management and biological insecticides are noteworthy. Does it equate to more stock of safer goods such as biopesticides in stores? And of which is it that a dealer will fulfil the certification requirements at all?

The proposed study will address this gap by undertaking a methodical analysis on how certification of agro- dealers can be used in fostering sustainable management of pests in Uganda. It examines three principal objectives by referring to a nationally representative survey collected among a sample of 557 agro-dealers spread in all regions of the country. First, it describes the attributes of agro-dealers and their stores, giving special focus to the degree of regulatory compliance with the regulations stated in Uganda. Second, it is a test of the agro-dealers environmental friendly pest control methods like the IPM and biopesticides knowledge and perceptions about the same. Third, it examines the determinants and effects of certification, such as the question of whether the impact

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of certification contributes to a larger likelihood of knowing sustainable practices are being performed, or whether a certified dealer is more like to stock less-risked items than an uncertified one.

Pre-contextualising the topic of agro-dealer certification in the wider issue concerning the risk management of pesticides, the paper can be seen to have fed into the debates on the ways in which balanced approaches to sustainable pest management can be promoted in the Global South(4). It is a particularly interesting case as Uganda combines certified and uncertified dealers, has a high concentration of pesticides users and has a market, which is growing but still not fully developed in terms of biopesticides around. In addition to being academically useful, the findings are of a practical nature to policymakers, regulatory organs and developmental bodies aimed at reinforcing the input systems in the agricultural sector. They lay emphasis on the possible ways like improvement of the regulatory enforcement, distribution of the certification courses and facilitation of the agro- dealer associations where the programs of the certification should be more effective and accessible. Finally certifying the quality and accountability of agro-input dealers would not be just a regulatory measure but a logical measure in ensuring that human health is not endangered, ecosystems are not degraded and Uganda agricultural sector is long on sustainability.

2.Methods

Fact Background and Regulatory Picture

Pesticide distribution and use in Uganda is covered by the Agro-Chemicals Control Act of 2006 that entails stern regulations on operations regarding their production, warehousing, sales and use. The majority of the oversight happens to be the work of the Ministry of Agriculture, Animal industry and fisheries (MAAIF) with the Department of crop inspection and certification. In order to be legally allowed to operate as an agro-input dealer one has to satisfy a set of pre conditions: undertake at least eleven years of formal education, pass an official certification program on safe use of pesticides and be registered by MAAIF. Moreover agro-input stores should attain renewable license issued by the ministry and other registration procedures monitored by the local and national government. The laws are meant to protect farmers against any unsafe product and also, that distributors of pesticides are highly informed(5).

The certification training, which is usually organised in Kampala through MAAIF and Makerere University is structured to be an intensive 5 days training. It engulfs a wide curricular subjects such as identification of the pest, safety and regulations of pesticides, environmental and health consequences of using pesticides and detection of counterfeit products. Though this training has been thorough in its approaches, its centralization has had a reverse effect where the majority of the agro-dealers especially those in the rural or remote districts find traveling, accommodation, and time "costly and a discouraging factor to attend such training." These regulatory dynamics give a critical background to the issue of compliance and also to the possible effects of certification to agro-dealer practices.

The Process of Study Design and Sampling Framework

In conduction of the research aimed to examine how certification of agro-dealers can help to achieve sustainable pest control, this research was conducted using a nationally representative survey of agro-input dealers. Data collection was carried out in November through December 2021 in all four geographical administrative regions of Uganda (Central, Eastern, Northern, and Western) and in ten sub-regions in order to capture geographical diversity. In each sub-region, the sample of districts was purposively chosen to reflect the level of agro-input shops based on the estimates of MAAIF considering both high and low density areas of the dealers.

Out of the 136 districts in Uganda the sample consisted of 50 districts selected in totals. In every district (randomly selected with a proportion equal to the number of shops reported to be in the corresponding area), 2 to 30 shops were randomly selected (6). This stratified random sampling method enabled the sampling team to cover as much as possible of the dealer behavior; both in urban markets around Kampala and in remote rural markets. Finally, a total of 560 agro-input dealers were consulted, and 557 of them agreed to participate, offering a good sample size to carry out statistical analysis.

This left the dataset to include 182 shops in Central, 152 in the East, 87 in North and 136 in the West. This allocation indicates the density of population as well as the premium significance of the agro-input markets in the various agricultural settings of Uganda.

Practicals of Data Collection

Face-to-face interviews with dealers who used to have regular contact with the customers were used to gather data. About 15 well-trained local enumerators were adopted to carry out fieldwork. A preparatory training program was instituted to train these enumerators by the research team in order to acquaint them with the objectives of the study, the ethical considerations, as well as the technical side of the questionnaire.

Digital capture of the responses was made through the following survey instrument which was designed and programmed into the open data kit (ODK) platform on tablets. The tool was first pretested amongst a few dealers within Mukono district before being fully deployed to allow the researchers to reword questions, change skip patterns, and a cultural check. The last questionnaire encompassed a wide variety of information such as:

- Socio-demographic disposition of agro-dealers (e.g. age, gender, education years of experience).
- Shop attributes, including licensing status, inspection recency, the number of personnel as well as the stock of the goods.
- Dealer understanding and attitude towards integrated pest management (IPM) and bio pesticide.
- Affiliation to associations, especially Uganda National Association Agro-input Dealers Association (UNADA).
- Investment in the certification schemes, training attendance, and certification position.

Besides self-reported data, the enumerators also completed a structured observation during which the shop was observed and the availability of products was measured, the presence of personal protective equipment (PPE) as well as apparent alignment with policies and regulations were noted. Interview data could be cross-checked by these observations, and risks of bias or misreporting became small.

TABLE 1 Methods

Aspect	Description
Study area	Uganda – all 4 regions (Central, Eastern, Northern, Western) and 10 sub-regions
Regulatory context	Agro-Chemicals Control Act (2006); certification by MAAIF mandatory for dealers
Sample size	557 agro-dealers (randomly selected from 50 districts)
Data collection period	November–December 2021
Survey tool	Tablet-based questionnaire (Open Data Kit), pretested in Mukono district
Respondents	Agro-input dealers working in shops (owners and employees)
Data captured	Dealer demographics, shop characteristics, licensing/certification status, knowledge of IPM & biopesticides, association membership, product inventory
Observations	Enumerators recorded shop compliance, types of products stocked, presence of PPE
Key methods of analysis	- Descriptive statistics (dealer & shop profiles) - Probit regression (determinants of certification) - Multivariate probit (effects of certification on IPM & biopesticides) - Robustness checks (IPWRA, Propensity Score Matching, Rosenbaum sensitivity test)
Ethical considerations	Informed consent obtained; confidentiality assured; real-time monitoring of data quality

Strategy of Analysis and Estimation Techniques

Both descriptive and econometric methods were used in conducting the study in order to evaluate the determinants and consequences of agro-dealer certification.

Dealer and Shop profiling

The background variables of agro-dealers and their shops were described with some initial descriptive statistics. Age, gender, years of education, shop ownership, license and training histories were the selected variables to derive a baseline profile. Trends of awareness on IPM and biopesticides were also captured at this stage giving a preliminary feel of the knowledge-gap and difference in the certified and uncertified dealers(7).

Certification determinants

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As a measure to investigate factors determining certification, a probit regression model was defined. The dependent variable was coded as 0 or 1 depending on whether the agro-dealer had acquired a certificate by MAAIF or not. The independent variables used comprised of dealer attributes (age, education, gender, shop ownership, experience, access to credit and association membership), as well as features at the level of the shop (licensing, inspection status, distance to Kampala and distance to suppliers or competitors). This has enabled the study to determine the individual, institutional or geographical factors significantly associated with the probability of certification.

Knowledge and Practices Impacts of Certification

This was done by the researchers estimating a multivariate probit model that related certification status with three variables: (1) knowledge of IPM, (2) knowledge of biopesticides, and (3) stocking of biopesticide products in determining whether certification translates into knowledge and behavior of dealers. Since these results were categorical and taken as either a 0/1 value, these were coded as binary numbers (a score of 1 corresponding to the ability of the dealer to explain IPM and biopesticides correctly and a score of 1 when their shop had at least one biopesticide product).

The multivariate probit method was derived based on the possible interdependency of three outcomes, e.g. awareness of IPM can be correlated with knowledge of biopesticides and their willingness to stock them. The model took into consideration the possibility of correlations in the error terms of the equations by estimation jointly, was more efficient and consistent on the estimates (8).

Robustness Checks

Considering that certifications were non-randomly selected, the issue of selection bias was dealt with through the application of further methods. To combine weighting with regression adjustment to obtain consistent estimates of the treatment effect under the possibility of one of the models being mis-specified, the doubly robust estimator called the Inverse Probability Weighted Regression Adjustment (IPWRA) was used. It was also robustness-checked in Propensity Score Matching (PSM) with kernel matching, with to write the certified and uncertified dealers comparisons were made on statistically comparable persons. Lastly, sensitivity analysis based on the Rosenbaum test was used to analyze the robustness of the results with regard to hypothetical bias due to the unmeasurable variables.

Ethics and Data Integrity

The informed consent of all the interviews was also established by letting participants know of the objectives of the study and their right to withdraw anytime. Those in charge of data enumerators dealt with confidentiality and data secrecy. The process of digital data capture via ODK reduced the threats of transcription mistakes, as well as enabled the on-the-fly quality control of work in the field.

3.Results

The features of the Agro-Input Dealers and Shops

This survey established variety and dynamic nature of agro-input dealer environment in Uganda. Dealers on average were relatively young with average thirty-somethings and with an almost equal number of men and women. A substantial number had an advanced education but not all of the secondary education had the same degree of formal schooling. The experience of dealers in sale of farm inputs (of about six years as was expected) informed most of the time the confidence of the dealer to give advice to the smallholder farmers. About 50 percent of the surveyed own the shops in which they trade with the remaining being employees who act on behalf of the absentee owners.

Shops themselves had averaged more than 7 years in business, perhaps indicative of a fairly stable trade sector. The average number of employees in most shops was two workers, but moreian shop had larger teams in urban areas. In addition to the pesticides, most of the shops had several kits of complementary inputs like seeds, fertilizers, and farm implements(9). Aliquently, almost 80 percent of the stores also stocked personal protective equipment (PPE) although alarmingly, roughly a fifth of stores had pesticides without safety equipment as well. Such gap highlights unmet health risks given that, mishandling of pesticides with no protective items is a major growth factor in acute diseases in dealers and farmers. Indeed this safety culture can hardly be called limited as almost one-third of stores noted at least one pesticide related illness among its employees in a given year.

Probably the most conspicuous pattern was leadership in pesticides sales. Dealers estimated that pesticides were the dominant daily sales item-many times exceeding the sales of seed or fertilizer. The average number of

pesticides transactions in a shop was nearly ten every day. This focus indicates the increasing chemical pest control dependence of the farmers as well as the imports of the pesticides into Uganda almost six times more than the imports two decades ago. The overwhelming inclination on chemical commercialization has serious consequences as far as sustainability is concerned as there are no many substitutes to this chemical like biopesticides.

Compensation gaps Regulatory Compliance and Certification Gaps

The national law obliges agro-dealers to have been trained in certification and be registered with MAAIF although the achievement is yet to be universal. The survey discovered that an estimated 50 percent of dealers were not formally certified or 50 percent of them had failed to report to the ministry as far as the shops were concerned. This is similar to the previous researches that revealed consistent non-compliance at the sector, although regulatory frameworks were present.

These gaps can be elaborated with a number of factors. Other reasons that were given by many of the uncertified dealers include: ignorance of certification requirement, or certifying cost of 250,000 Uganda shillings being prohibitive. Accessibility to Kampala where majority of the training is done was also a common barrier given, due to distance especially to dealers located in the northern and western parts of the country. Some others complained of bureaucratic red tape with some still being held up in registration procedures that had taken months and months. Such results accommodated not only limitations of knowledge and resources but also poor enforcement. A significantly high percentage of almost 10 per cent of the stores reported illegal activities like repackaging pesticides into unmarked containers which in addition to bypassing any regulatory mechanisms, also expose farmers to either mislabelled or counterfeited substances. In the same line some of the shops would be found to be in violation of regulation selling their crop and veterinary products together within the same shop or even when it comes to selling of pesticides their sale became associated with selling general household goods. These are practices that demonstrate regulatory gaps and lack of market oversight that compromises the integrity of the pesticide chain supply in Uganda.

The Symbiotic Relationship between Types of Biopesticides The Attitudes Toward Biopesticides and Alternatives

The agro-dealers were highly ambivalent and incompetent in responding to questions as to what are alternative alternatives to the use of conventional pesticides. There are only 16 percent of stores carrying at least one Installed biopesticides, usually some formulations of the neem. The most widely cited extenuating circumstances around why folk did not carry biopesticides were ignorance, the limited passion of farmers and inaccessibility to suppliers. Synthetic pesticides were more likely to be viewed as cheaper, more efficient and faster acting by dealers, a safer commercial choice even though their advantages in terms of health and environment could be recognized.

However, 2/3 of dealers also recognized that the biopesticides are safer to the human health than the synthetic ones as well as the environment. Nonetheless, these favourable attitudes are insufficient to lead to increased adoption without symptomatically resolving concerns over cost, availability and perceptions of efficacy. The study also arrived at a conclusion that most dealers claimed to be advising farmers about non-chemical pest management techniques, e.g., crop rotation, intercropping, sanitation or resistant varieties. However, their main source of income consists of the sales of pesticides so it remains doubtful to what degree these suggestions are in fact applied.

Certification determinants

Econometric models provided some insight to explain factors that had effects on a dealer becoming certified. Age and experience were also predictors of a high degree: older, more experienced dealers were more likely to be certified, due to an accumulation of opportunities to receive training and (more likely) a greater exposure to regulators. Education also was a factor: with each year of schooling, the chances of certification increased, presumably because schooled dealers are more capable of finishing training and valuing the formal documents needed.

Passage of ownership was also important. Certification was more common among shop promoters than workers, possibly reflecting the greater liability of owing to compliance with the regulatory environment of the shop owners as well as their view that certification was a form of investment in the legitimacy of their business. When they were a member of the Uganda National Agro-Input Dealers Association (UNADA) was also a strong determinant as this association placed much active emphasis on training access and professional standards.

The place also influenced the results of certification. Dealers nearer Kampala or large suppliers of inputs were more likely to be certified, indicating favorable access to training and the regulators, inspections. On the other hand, proximity to training locations was a significant impediment. Interestingly, interest in certification was higher among dealers in competition-heavy regions; this may have been aimed at standing out in over-saturated marketplaces.

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Effects of Certification on Common Sense and Skills

The positive and significant relationship between certification and better knowledge and safer practices is evidence of another positive relationship between certification and safer practices. The likelihood that certified dealers knew of integrated pest management and biopesticide was about 10-12 percentage points greater than the likelihood of uncertified dealers. They also had 8-10 percentage points greater likelihood to distribute biopesticide products in their stores. This implies that besides developing technical expertise, certification also affects business-related choices including encouraging dealers to increase their inventory to environmentally friendlier products.

These trends were reaffirmed by robustness tests based on inverse probability weighting and propensity score matching, and the estimated treatment effects were similar using both methods. Critically, these findings were not very sensitive to unrecognized biases, which enhanced the trustworthiness of reported associations. Education was another robust predictor of knowledge and stocking behavior, which served to underscore the more general importance of education to an agricultural information system. There was also some disparity between genders with male dealers showing a higher possibility of being aware of IPM and biopesticides as level of agricultural knowledge access tends to be more gender-based in Africa.

Broader Implications

The results have a great bearing to the sustainability of agriculture in Uganda. It is clear that certification is important: as it creates awareness raising the quality of advice provided to the farmers, it supports the chance of availability of biopesticides. However, the number of uncertified dealers is close to 50%, and the possibility of the certification is underexploited. Enforcement should be enhanced, training programs should be decentralised to district or regional centres and certification made cheaper in support of closing this gap. It could also transfer more of its training and compliance follow-up functions to associations such as UNADA.

Market impediments to the use of biopesticides are also a serious concern. Even well trained dealers are unwilling to stock such products unless there is better supply chain and more demand of farmers. Policy interventions in the form of subsidies, piloting, or awareness can prove helpful in remapping biopesticides as feasible substitutes to synthetic chemicals. Finally, certification of agro-dealers ought to be regarded as a component of a more conceptual ecosystem approach to sustainable pest management, an approach to policymaking that integrates regulation, education, farmer demand and market incentives into a composite strategy.

4.Conclusion

In its findings, this research has shown that agro-input dealer certification in Uganda is not only an administrative exercise-instead it is an opportunity mechanism through which the marketing, promotion, distribution, and use of pesticides in smallholder farming systems could be properly transformed. Although pesticides have been essential elements in the maintenance of food security and crop protection, their wrong use still poses danger to health, degradation of the environment, and economical loss. It is against this backdrop that certification is presented as a viable policy lever, which can be used to create awareness, influence and be used to align the practices of the dealer with elements of sound pest management.

Among the main lessons, it can be noted that certification is highly connected with the increased knowledge and better practices in agro-dealers. Dealers certified also created a better understanding of integrated pest management (IPM) and biopesticides and were more probable to inventory safer items. The given effects are rather modest in the percentage terms but very significant in practical sense. Hundreds of stores across the country stocking alternative to the dangerous synthetic pesticides is worth the 8-12 percentage points increase in chance that it will happen. This has the reverberating effect: farmers will experience safer products more readily, balanced advising, and learning to incorporate low-risk solutions in their production systems over time.

Meanwhile, the study stresses grave disparities in the compliance. About 50 percent of Uganda agro-dealers are not certified although the need is evident in the law. This fact suggests the presence of institutional issues namely prohibitive prices on training, low geographical accessibility, delays in the bureaucratic system, and ineffective enforcement tools. The rural dealers cannot access certification courses (mostly conducted in Kampala) because they can not spend the travelling costs incurred or the time out of the business. Moreover, there is no steady checking, and as a result, the uncertified dealers have fewer fears of reprimands. The end result is that this regulatory laxity erodes the desired effects of the certification regulations and there is space to practice unsafe methods.

These barriers have to be countered by a multifaceted approach. To begin with, the training programs should be decentralized. Providing access to training: District-level or regional training centers could be established, particularly through university and NGO collaborations or dealer associations which would lower the costs of access dramatically and the rates of participation. Second, access to financing should be reduced, whether by subsidies, payment plan flexibility, or integration with other agriculture development programs, including certification. Third, enforcement ability should be enhanced. Increased frequency of inspection, alongside slightly stronger penalties on uncertified company operation, would increase the baseline cost of non-compliance and give increased motivation to dealers to seek certification.

The input of the dealer associations especially Uganda National Agro-input Dealers Association (UNADA) cannot be overemphasized. The probability of certification was shown to be substantially higher among the participants in such associations, which signifies the accountability of peers in them and the access to training opportunities. Enhancing such relationships would be one way of increasing adoption of certification, facilitating professional accreditation, and decentralized training. Policy frameworks are therefore supposed to see the associations as stakeholders but also as dynamic partners in construction of sustainable input markets.

In addition to certification itself, the research thus points to the need to develop positive conditions of the biopesticides and other ecologically friendly substitutes integration. Lack of awareness, farmer demand and supply bottlenecks remain has been hampering the growth of this industry. Dealers may be reluctant to distribute biopesticides even with good training and certification where buyers are not willing to buy nor does the supply chain guarantee supply. In this instance, the role of public policy is key as subsidies, knowledge creation and dissemination, demonstration plots, and farmer field schools may all serve to increase demand of biopesticides. On the same note, investments in research and local manufacture of biopesticides would facilitate minimization of the cost and increase the level of availability. Uganda could develop such a virtuous cycle of safer products achieving economic feasibility as well as social acceptability by linking certification with other market interventions.

The results have also implications of wider application to agricultural sustainability policy design in the Global South. When properly designed, implemented and used, certification schemes have the potential to change the knowledge and behaviour of the market intermediaries not solely the producers. Where extension services are overstretched, Agro-dealers are usually the de facto extension system in such contexts. Unlocking the knowledge base and holding them accountable is therefore a indirect but very efficient mechanism to reach millions of smallholder farmers. It cannot be seen however that certification is isolated. It should be combined with a wider ecosystem solution that connects the realisation of regulation enforcement, education and motivation of farmers, market incentives, and institution partnerships. Such integration is necessary because without it, certification will, unfortunately, be little more than a tick-box exercise.

It is also important to note that certification also concentrates on the aspects of trust and legitimacy. The mistrust of counterfeit or unsafe products is common and farmers often rely on agro-dealers, both to sell products and offer advice. A certification offers a tangible indicator of quality control, and gives farmers confidence that the trained and responsible middlemen are working with them. This reputational advantage alone might be a sufficient business case in certificationős provided that the regulatory bodies and industry organizations take an active part in raising the general consciousness about the meaning of certification.

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Conflicts of interest

The authors have no conflicts of interest to declare

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