

# Assessing global good agricultural practices standard adoption: insights from fruit and vegetable farmers in Pakistan

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## Abstract

This study examines the challenges Pakistani farmers face in adopting global good agricultural practices (GGAP) and highlights the limitations in infrastructure and cost-based clauses. A questionnaire based on GGAP's fruit and vegetable module version 5.0 was

developed and validated by the Department of Environmental Sciences, Government College University, Faisalabad. This was a survey-based study of 15 farmers divided into 5 groups according to their annual farm turnover. The findings of the study indicated that, although the basic paperwork requirements of GGAP were implementable, clauses related to capital investment and technical record-keeping were not. Results showed that 90-100% of farmers considered risk assessments, training, and documentation on their farms. However, 42-56% of clauses related to record-keeping, installation, visual presentation, and infrastructure development, and 24-37% of clauses related to external testing, health, safety, and hygiene were declared not implementable. The study revealed a need for adapting GGAP standards to Pakistan's unique agricultural conditions, suggesting the development of localized standards for more practical implementation. The study's findings highlight crucial insights for policymakers and stakeholders in the agriculture sector and suggest the need for target strategies to overcome implementation barriers and optimize the adaptation of Global GAP in Pakistan that would help to increase exports of agricultural commodities.

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## Introduction

Pakistan's agriculture is crucial for gross domestic product and holds great potential in various industries (Azam and Shafique, 2017). The country adopted multiple international standards, like global good agricultural practices (GGAP), YUM good agricultural practices, McDonald's good agricultural practices, ISO 9001, hazard analysis and critical control points, and ISO 14001, to access global markets. These certifications are essential for international trade. There has been an increasing demand in recent years to ensure food safety and security (Yadav *et al.*, 2023).

GGAP was initially established as Europe Good Agriculture Practices in 1997 and renamed in 2007 (Nabeshima *et al.*, 2015). This standard, critical in global food industries, comprises four elements: food safety, environmental safety, animal welfare, and workers' health and safety. GGAP includes a checklist with major musts, minor musts, and recommendations, requiring 100% compliance for major musts and 95% compliance for minor musts, while recommendations have no minimum compliance threshold (GlobalGAP, 2023).

Implementing GGAP certification enables farmers to access high-end markets and achieve better selling prices than non-certified farmers (Tran and Goto, 2019). Despite higher input costs, the overall benefits, including access to new markets, increased productivity, reduced production costs, and stronger agribusiness-producer links, justify the adoption of these standards (Annor *et al.*, 2023).

There are two certification options for farmers: individual (option 1) and group certification (option 2). Group certification

offers benefits like centralized management and lower costs (Narrod *et al.*, 2009). On the other hand, group certifications present challenges, such as the need for a quality management system requiring extra cost, qualifications, and skills (Schuster and Maertens, 2016; Fouilleux and Loconto, 2017). Implementing the GGAP standard is costly, making it unaffordable for small and poor farmers, particularly in developing countries where farmers often lack education and skills (Reardon *et al.*, 2009). Additionally, social and inequality issues may arise due to GGAP standards (Chemnitz, 2007; Asfaw *et al.*, 2009).

Implementing GGAP faces significant barriers in terms of cost and lack of knowledge, particularly in developing countries (Laosutan *et al.*, 2019). Costs are categorized into fixed and running expenses. Fixed costs entail initial investments for certification, such as infrastructure development, training, and establishing new procedures. Running costs, on the other hand, include ongoing costs like residual analysis and annual audit fees for maintaining certifications (Chemnitz, 2007; Kersting and Wollni, 2012).

Pakistani mangoes, popular globally with 160,000 tons exported in 2021, face challenges in meeting GGAP certification requirements for markets like the EU (TDAP, 2021). Implementation hurdles include a lack of awareness, high costs, and conflicts with local laws, often leading to fake compliance. Irshad *et al.* (2021) systematically explored the factors influencing the adaptation of GGAP certification among Pakistani farmers. They discovered that enhanced educational attainment and financial literacy significantly elevate the likelihood of certification adaptation. The primary barrier identified was the substantial investment required for compliance. Additionally, complexity in understanding GGAP requirements and requisites further deterred adoption. Their study highlighted that larger farmers and those with enough credit were more inclined toward certification. GGAP certification not only facilitates market access but also motivates farmers to increase farming practices. The study also underscored the pivotal role of entities like the Ministry of Food, Agriculture, and Livestock, the Pakistan Horticulture Development and Export Company, and the Agri Business Support Fund in promoting certification adoption.

Keeping in mind the importance of GGAP adoption standards and farmers' local conditions, the present study was conducted to identify the constraints involved in adopting GGAP standards in the generic conditions of Pakistan. Moreover, it aimed to collect recommendations for solutions to the hurdles in implementing this food safety standard.

## Materials and Methods

### Survey execution

A survey was conducted in 2017 through physical visits using a questionnaire detailed in *Supplementary Annexure 1*.

### Selections of respondents

A total of 15 farms were selected for the survey (Table 1). Respondents' age was at least 35 years old, graduates, and in top management (owners and farm managers) with 3-5 years of experience.

### Questionnaire development with details

A questionnaire was developed based on clauses from all farm base, crop base, and fruit and vegetable (F&V) modules version 5.0. It was developed and validated by the Department of Environmental Sciences, Government College University, Faisalabad (*Supplementary Annexure 1*). Responses were declared on a 1-5 scale (1: strongly agree; 5: strongly disagree). Strongly agree indicated ease of implementation, while strongly disagree suggested very difficult or impossible implementation, especially in the context of Pakistan. Not applicable meant those clauses that were not applicable.

### Survey procedure

Physical visits were made to agricultural farms to conduct interviews in local languages like Urdu, Panjabi, and Saraki. Responses were evaluated for implementability under Pakistani conditions. After the completion of these surveys, the signature and seal of the company were obtained to ensure the authenticity of the surveys.

### Data of certified farmers and population selection

In 2017, 51 farms were certified, as shown in Table 1. The majority of farms were from Punjab province and certified against the F&V module; therefore, we selected Punjab province and the F&V module for this study. Overall, 15 farms were selected (Table 2). To create a homogenous population, we selected certified, ex-certified, and other farms that had been in the process of certification. Five groups were made based on annual turnover; each consisted of three farms.

### Questions types

Questions in the survey were asked as the clause sequence of the F&V module of GGAP. These questions were divided into eight groups.

### Risk assessments

There are 11 types of risk assessments that need to be conducted. In this section, questions were only concerned with paperwork for conducting a risk assessment. All required risk assessments are explained in *Supplementary Annexure 1*.

### Training and competency

GGAP emphasizes the training and competency of farm workers in a safer and more hygienic way. Farmers were queried about their ability to train workers in different areas like chemical handling, first aid, health and safety (H&S), *etc.* All requirements

**Table 1.** Data of currently certified farms against global good agricultural practices in Pakistan.

Province	Number of certified farms	Scope	Major products
Khyber Pakhtunkhwa	7	Fruit and vegetable	Peach and different vegetables
Sindh	8	Fruit and vegetable	Mango, potato, and different vegetables
Baluchistan	1 (it is another site of a farm located in Punjab)	Fruit and vegetable	Different vegetables
Punjab	35	Fruit and vegetable	Citrus, mango, and different vegetables

regarding training and competency are explained in *Supplementary Annexure 1*.

### Record keeping

GGAP prioritizes detailed recording of farm activities. Farmers were asked about their ability to establish and maintain a recording system covering all aspects, *e.g.*, sowing, fertilizer application, sales, *etc.* All required records are explained in *Supplementary Annexure 1*.

### External testing

To ensure food safety, GGAP encourage third-party testing. The respondents were asked about their ability to conduct these tests, *e.g.*, water analysis, soil analysis, maximum residue level (MRL) analysis, *etc.*, from authorized and certified labs. All required tests are explained in *Supplementary Annexure 1*.

### Installation and visual presentation

To get a GGAP certification, some items need to be installed and visually displayed. Farmers were asked whether they could install these requirements, *e.g.*, a reference system permanently, display warning signs for hazardous materials, make visible accident procedures, *etc.* All required requirements are explained in *Supplementary Annexure 1*.

### Documented procedures and policies

Some documented procedures, plans, and policies are needed to implement GGAP. There is a possibility to make these documented procedures, *e.g.*, accident and emergency procedures, the procedure for washing protective clothing, a waste management plan, *etc.* All required procedures and policies are explained in *Supplementary Annexure 1*.

### Health and safety and hygiene

GGAP considers and gives supreme importance to worker health, safety, hygiene, and food safety. For this purpose, GGAP has developed rules and regulations to implement workers' health,

safety, and hygiene. Farmers were asked if it was possible to arrange suitable protective clothing for all workers, visitors, and subcontractors and provide H&S and hygiene training to workers. All required procedures and policies are explained in *Supplementary Annexure 1* in relevant questions.

### Infrastructure and implementation

To implement GGAP in a true sense, special infrastructure needs to be developed according to various clauses of GGAP. Questions were asked to the farmers about whether they could develop infrastructure and implement all the requirements of GGAP, *e.g.*, if they could provide clean food storage areas, designated rest areas, hand washing facilities, and drinking water, and if they could force subcontractors to work with the rules and regulations of GGAP. All requirements regarding infrastructure and implementations are explained in *Supplementary Annexure 1*.

In this survey-based study, questions were asked of the farmers (developed from clauses of the GGAP standard), and responses were noted on the questionnaire (*Supplementary Annexure 1*) provided to the respondents. Respondents gave their opinion by keeping in mind the generic conditions of Pakistan. From the responses given by the respondents, we concluded whether the clause was truly implementable or not.

### Statistical analysis and data processing

In this study, answers were quantified as percentages, categorizing responses into agree/strongly agree (implementable) and disagree/strongly disagree (not implementable). This distinction helps determine the feasibility of activities for farmers, and results are interpreted and presented on a percentage basis. The mean values of all three members of each group were calculated while considering the standard error. Descriptive statistics were used, and Statistix 8.1 software (Informer Technologies, Los Angeles, CA, USA) was used for statistical analysis. Similar questions across modules are combined to drive comprehensive conclusions. The responses that resulted in strongly agree and agree indicated they were implementable, while the responses that resulted in disagree and strongly disagree suggested they were not implementable.

**Table 2.** Data of the population selected for the study.

Group #	Annual turnover PKR (million)	Product category	Name of company	Farm size (acres)	District and province	Certification option	Current status
1	<50	Vegetables	Dimah Agri Farm	30	Gujranwala, Punjab	Option 1	Started the process but did not complete
			DSL Farms	33	Patokey, Punjab	-do-	-do-
			Cheema Agri Farms	36	Gujranwala, Punjab	-do-	-do-
2	51-100	Vegetables	Abbasid Agri Farms	42	Lahore, Punjab	Option 1 with multisite	Certified
			Kasuria Agri Farms	56	Kasur, Punjab	Option 2	Ex-certified
			Muhammad Hussain Kazmi Agri Farm	63	Chinot, Punjab	-do-	-do-
3	101-200	Fruits	Sargodha Mandarin	86	Sargodha, Punjab	-do-	-do-
			Al Rafique Enterprises	97	-do-	-do-	Certified
			Chase International	102	-do-	-do-	-do-
4	201-500	Fruits	Lutfabad Fruit Farm	230	Multan, Punjab	Option 1	-do-
			Khichi Fruit Farm	295	Vehari, Punjab	-do-	Ex-certified
			Khand Zari Farm	320	Muzaffargarh, Punjab	-do-	Ex-certified
5	>500	Fruits	Roshan Enterprises	412	Sargodha, Punjab	Option 2	Certified
			ABAgrGrow	506	-do-	-do-	-do-
			5Ps Enterprises	610	-do-	-do-	-do-

PKR, Pakistani rupee; -do-, as above.

## Results

### Farmer responses

#### Risk assessments

Figure 1A reveals that all the farmer groups showed a significant positive response to conducting risk assessments; they showed a strong willingness to comply with the relevant clauses of GGAP. All the farmer groups showed almost similar results. Group 1 declared that 60.61% of clauses are very easy to comply with, while 36.36% of clauses were declared to be complied with with little effort. Only groups 1 and 2 declared some clauses (3.03% and 9.1%, respectively) as not applicable. The remaining farmer groups (3-5) declared that all the clauses related to risk assessments are either easy to comply with or require little effort. Overall, the majority of responses by farmers' groups favored easy compliance with clauses related to risk assessment with minimal or no difficulty.

#### Training and competency of workers

Figure 1B shows that, like risk assessments, farmer groups again showed similar responses, *i.e.*, positive responses to worker training and competency with no opposing views. Group 2 had the highest ease of application (53.85%), followed by group 1 and group 4 (<40%). Only a small percentage (7.69%) in groups 1 and 2 reported challenges in meeting standard requirements, and no difficulties in training or competency clauses were noted.

#### Recording keeping

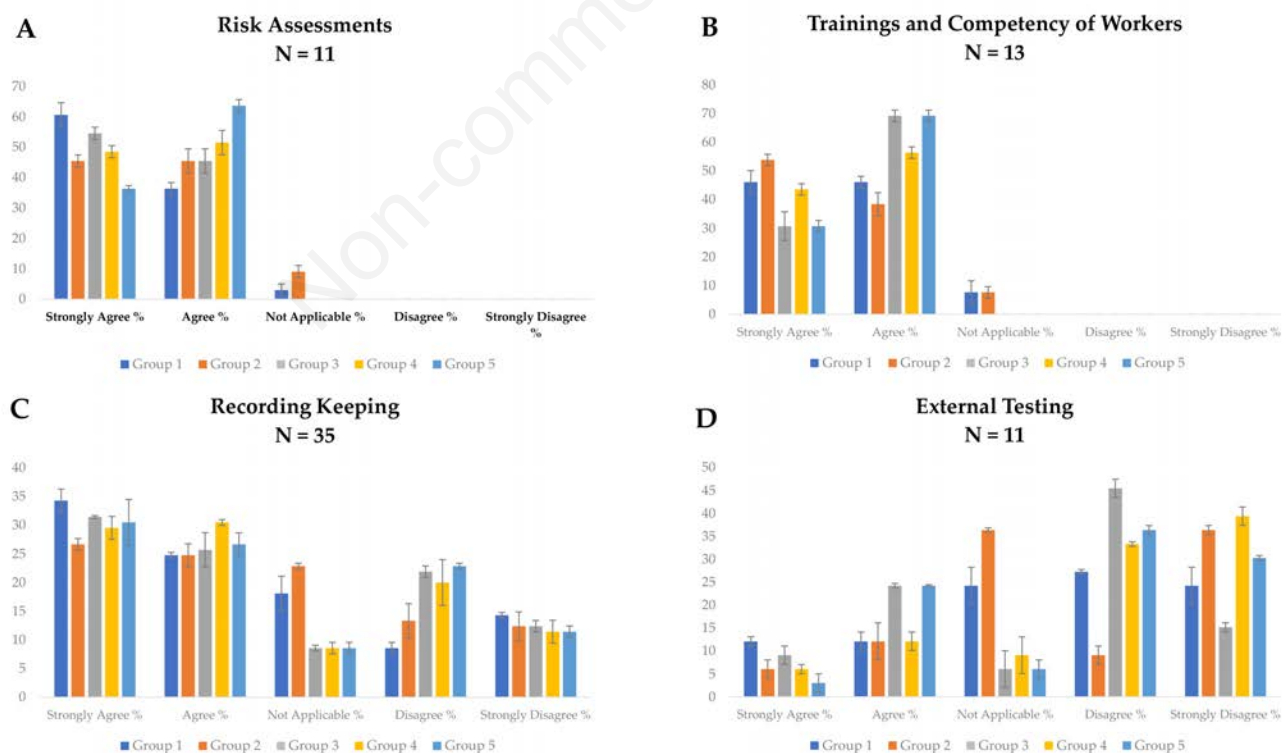
Figure 1C reveals that farmer groups responded differently to clauses related to record-keeping. Group 1 showed a high ease of compliance (34.29%), whereas group 2 was less inclined (26.67%). Group 4 showed greater motivation (30.48%) for easy-to-comply clauses as compared to groups 1 and 2 (24.76%). Group 5 showed the highest percentage of clauses that were difficult to comply with (22.85%), whereas group 1 showed the least difficulty (8.56%). Group 1 was most reluctant to comply with clauses (14.29%), while groups 4 and 5 showed the least reluctance (11.43%). Other groups fell between these extremes.

#### External testing

Figure 1D illustrates farmer responses to clauses related to external testing. Group 3 showed the highest percentage of clauses difficult to comply (45.45%) and impossible (15.16%), while group 2 had the lowest (9.09%) difficult and (36.37%) impossible clauses to comply. Regarding commitment to external testing, group 3 was the most favorable, with 9.09% of clauses related to external tests considered easy to comply with and 24.24% with little effort. Groups 2 and 4 were less inclined, indicating only 6.06% of tests as easy and 12.12% with little effort. Other groups' responses fell between these extremes.

#### Installation and visual presentation

Figure 2A shows farmer responses to clauses related to installation and visual presentation. Most farmer groups favored these clauses, but a significant number of farmer groups found them challenging or opposed them. In group 1, 36.67% of clauses were



**Figure 1.** Representing farmer responses in percentages against risk assessments (A), training and competency of workers (B), recording keeping (C), and external testing (D).

found easy to comply with, and 26.67% required minor efforts for compliance, while 23.33% of clauses were suggested as difficult, and 13.33% were found impossible to comply with. In group 2, 30% of clauses were spotted as easy to comply with and 20% required some effort, but 36.67% were difficult and 13.33% were found to be impossible to comply with. Group 3 declared 20% of clauses easy to comply with and 40% with little effort. The results of the remaining groups were in between these values.

### Documented procedures and policies

Figure 2B shows farmers' generally positive responses towards compliance with clauses related to documented procedures and policies, with few impracticality concerns. In group 1, 43.21% of clauses were declared easy to comply with, 28.4% needed little effort, and only 7.40% of clauses were found challenging. Group 2 declared 18.5% of clauses as not applicable, while most were found to be complied with with ease or with little effort. Group 3 reported that 55.76% of clauses require minimum effort to comply and 40.74% are easy, with no difficulty noted. Groups 4 and 5 also showed similar positive results.

### Health and safety and hygiene

Figure 2C summarizes farmers' responses to health, safety, and hygiene clauses. Group 5 found them the most challenging (41.67% impossible and 25% difficult), while group 2 had the highest positive responses (20.83% easily to comply and 25% that required little effort). Group 2 showed easy-to-comply clauses (25%), followed by groups 2, 1, 5, and 4. For clauses that required little effort, groups 1 and 2 had the highest responses (25%), with

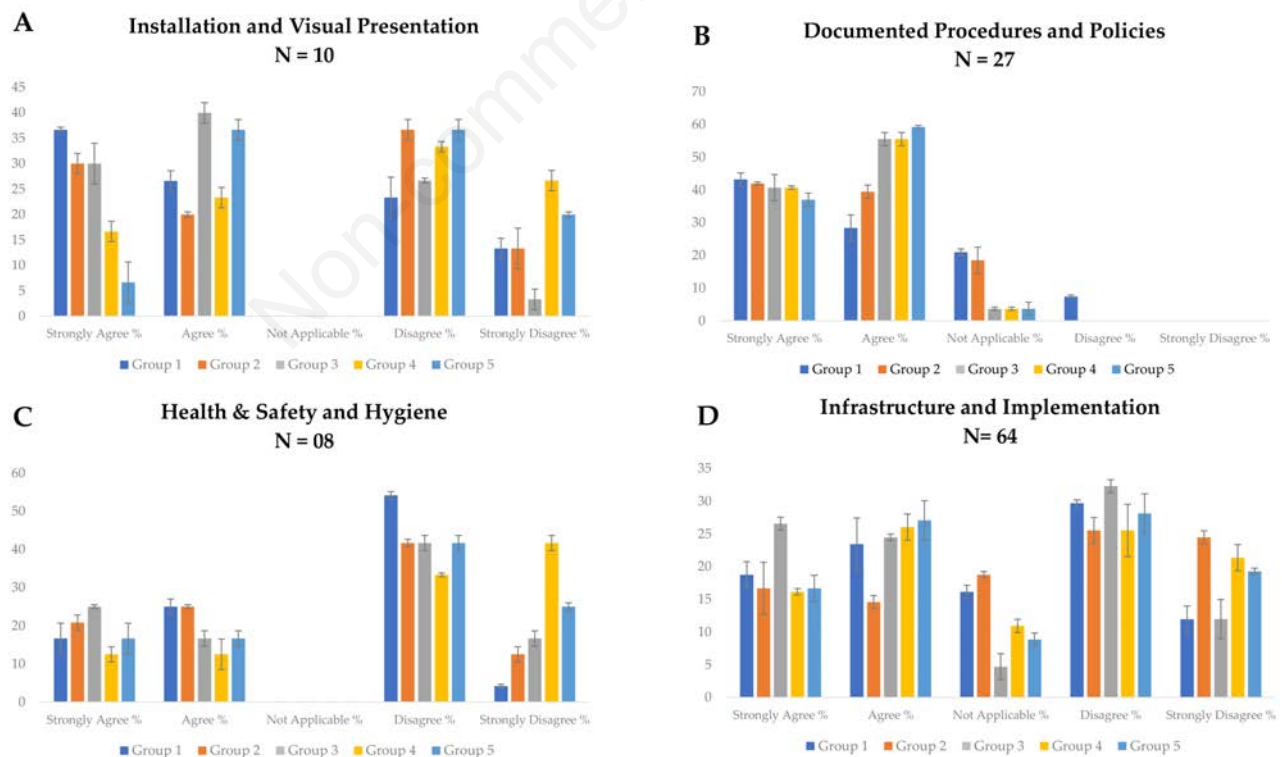
groups 3 and 5 at 16.67% and group 4 at 12.50%. Group 1 found 54.17% of clauses difficult, the highest, while group 4 had the lowest responses (33.33%). Groups 2, 3, and 5 found 41.6% of clauses difficult. In terms of impossibility, group 4 led, followed by groups 5, 3, 2, and 1. Overall responses for difficult or impossible clauses were more significant than easy to comply with or comply with some effort ones.

### Infrastructure and implementation

Figure 2D shows varying responses to infrastructure and implementation clauses. All groups had mixed reactions, with about half the clauses considered compliant and others as difficult or impossible. Group 3 had the most positive findings: 26.56% of clauses were declared easily compliant, 24.48% required little effort, and it had the least impossible clauses (11.98%). In contrast, group 2 had the highest rate of impossible clauses (24.48%). Group 3 rated 32.29% of clauses as difficult, while groups 2 and 4 rated the fewest (25.52%) as difficult. Farmers equally rated clauses as either easily doable/doable with some effort or difficult/impossible.

### Declaration of clauses as implementable and not implementable driven by farmers' responses

To broaden the scope of this research work, farmers' responses were categorized into implementable for strongly agreed and agreed and non-implementable for strongly disagree and disagree. This categorization reflects farmers' feasibility of implementing the standard's clauses. The overall results are as follows.



**Figure 2.** Representing farmer responses in percentages against installation and visual presentation (A), documented procedures and policies (B), health and safety and hygiene (C), infrastructure and implementation (D).

### Risk assessments

Figure 3A shows that all farmer groups positively responded to clauses related to risk assessments, with none considering any clause unimplementable. Groups 3, 4, and 5 reported 100% clauses as implementable. Group 1 had a 96.97% compliance rate, with 3.03% of clauses considered not applicable. Group 2 declared 90.9% of clauses as implementable, though 9.1% of clauses were declared not applicable. Overall, there was a strong positive response towards implementing clauses related to risk assessments.

### Training and competency of workers

Figure 3B revealed that farmers from various groups showed high compliance with clauses related to workers' training and competency. Groups 3, 4, and 5 declared 100% implementation. Groups 1 and 2 also responded positively, with 92.31% of clauses declared as implementable and 7.69% marked as not applicable.

### Recording keeping

Figure 3C shows various responses from farmer groups regarding the implementation of clauses related to record-keeping. Group 1 reported 59.05% of clauses as implementable, 18.10% as not applicable, and 22.85% as not implementable. Group 2, the most reluctant, found 51.43% of clauses implementable, 22.86% not applicable, and 25.71% not implementable. Group 3 declared 57.14% of clauses as implementable and 34.29% of clauses as not implementable. Group 4 considered 60% of clauses implementable, 8.57% of clauses were not applicable, and 31.4% of clauses were declared not implementable. Finally, group 5 declared 57.1% of clauses as implementable, 34.28% as not implementable, and 8.5% as not applicable.

### External testing

Figure 3D shows responses from farmer groups for external testing. Group 3 was the most positive, declaring 33.33% of clauses implementable. The least positive group was group 4, declaring 72.73% of clauses as not implementable. Group 1 reported 24.24% of clauses as implementable, while groups 3 and 5 found 33.33% and 27.27% of clauses implementable, respectively. Group 2 had the highest rate of clauses considered not applicable (36.36%).

### Installation and visual presentation

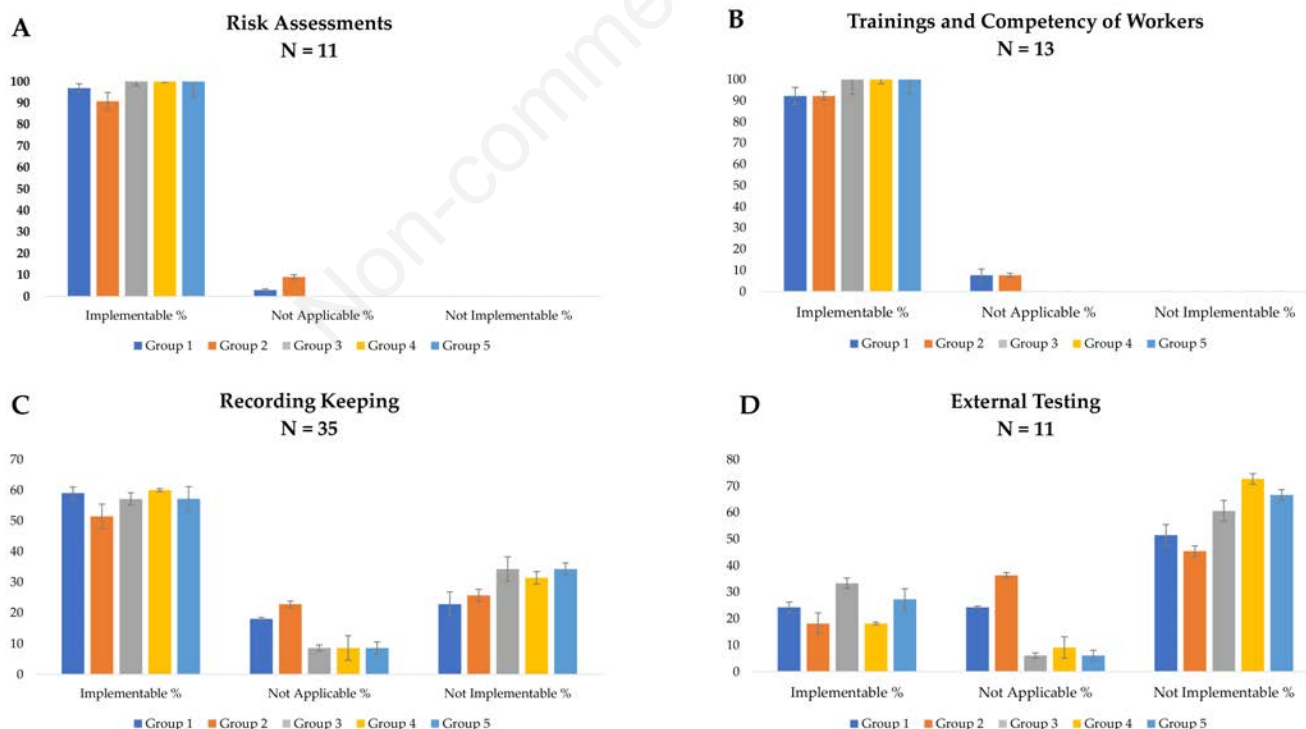
Figure 4A indicates levels of compliance among farmer groups with installation and visual presentation requirements. Group 3 led in implementable clauses (70%), followed by group 1 (63.34%), and group 2 (50%). Groups 4 and 5 had lower compliance rates at 40% and 43.33%, respectively, and also reported the highest percentages of not implementable clauses (60% and 56.67%). Groups 3, 1, and 2 showed more positive responses towards the implementation of these clauses.

### Documented procedures and policies

Figure 4B shows that farmers across all groups mostly found clauses related to documented procedures and policies implementable. Groups 3, 4, and 5 had the highest implementable rate at 96.3%, followed by group 2 (81.49%) and group 1 (71.61%). Group 1 reported 20.99% of clauses as not applicable, the highest among the groups. In addition, only 7.4% of clauses were considered not implementable by farmers in group 1.

### Health and safety and hygiene

Figure 4C shows farmers' responses to the feasibility of clauses



**Figure 3.** Declaration of clauses as implementable and not implementable driven from farmers' responses against risk assessments (A), training and competency of workers (B), recording keeping (C), and external testing (D).

related to health, safety, and hygiene, indicating a significant number of clauses were found not implementable. Group 4 rated 75% of these clauses as not implementable, followed by group 5 (66.67%), groups 3 and 1 (both 58.33%), and group 2 (54.17%). In terms of implementable clauses, groups 1, 2, and 3 found 41.67%, 25.83%, and 41.67% of these clauses implementable, respectively, while groups 4 and 5 found only 25% and 33.3% implementable, respectively. Notably, none of these clauses were found not applicable.

### Infrastructure and implementation

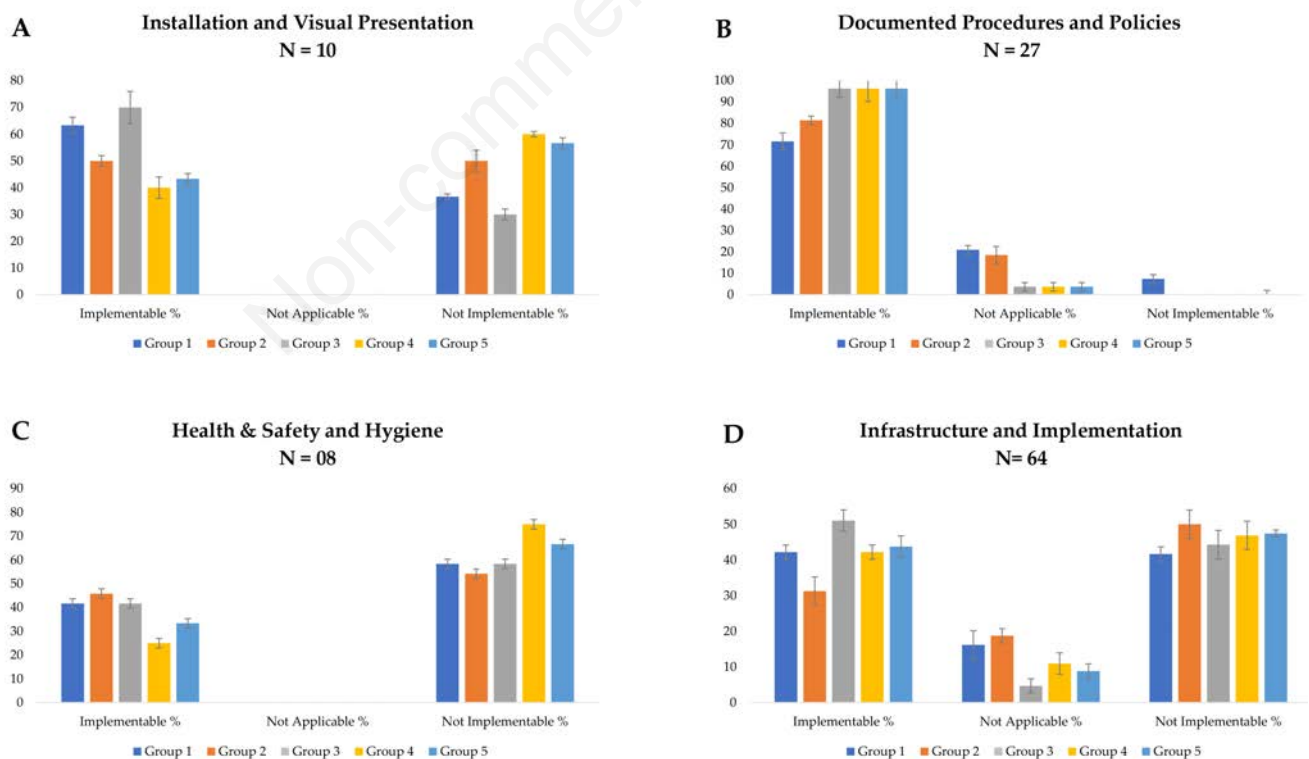
Figure 4D shows farmers' responses to infrastructure and implementation clauses. In group 1, 42.19% of clauses were found implementable, and 41.46% were found not implementable. Group 2 found 50% of clauses not implementable and 31.2% not implementable; group 3 reported 51.04% of clauses as implementable and 42.27% as not implementable. Groups 4 and 5 found 42.19% and 43.75% of clauses implementable, respectively, but 46.87% and 47.40% were found not implementable. A significant number of clauses were considered not applicable by all groups.

## Discussion

The study aims to identify challenges in implementing the GGAP standard in Pakistan. Farmers indicated that document-related clauses, requiring little or no funds, were generally easy to implement and often declared implementable. Conversely, clauses that needed more effort and funds were typically considered not implementable.

A pivotal finding is the correlation between literacy and the successful implementation of GGAP standards. Farmers with access to literate personnel, including educated family members, demonstrated greater ability and capability in managing GGAP-related documentation and risk assessments. A survey was conducted on farmers' ability to assess 11 types of risk assessments and to create management plans. It was found that the availability of literate personnel (farmers, managers, and owners) made these clauses implementable as compared to illiterate farmers. Limited research knowledge exists on this topic, but Niemiec and Komorowska (2019) explored GGAP risk assessments and standard operating procedures. Kersting and Wollni (2012) found a 33% likelihood of GGAP adaptation among educated farmers. This supports the findings of this study, which found that educated workers enable farmers to conduct risk assessments. However, more clarity is needed in implementing management plans for risk assessments and hazard analysis (Niemiec and Komorowska, 2019).

Preparing documented policies and procedures annually was relatively easy for farmers, as they usually have a graduate person in the family. It was because all the clauses were declared implementable except for the 7% answers of the farmers in group 1. A few farmers' responses were not applicable because they were not involved in such activities, and the respective clauses did not apply to them. Macheke *et al.* (2013) and Niemiec and Komorowska (2019) stated that food safety standards like GGAP require different documented procedures and policies for operations. It has been reported that education plays a positive role in GGAP implementation (Kersting and Wollni, 2012; Asfaw *et al.*, 2009). Most of the paperwork, such as procedures, risk assessments, and instructions, was found to be prepared and displayed during internal audits of



**Figure 4.** Declaration of clauses as implementable and not implementable driven from farmers' responses against installation and visual presentation (A), documented procedures and policies (B), health and safety and hygiene (C), infrastructure and implementation (D).

different farms (Loconto and Dankers, 2014). Hence, available literature confirms our finding that if farmers have an educated workforce, they can easily implement all the clauses of GGAP related to documented procedures and policies. Our study indicates that financial constraints significantly impact the implementation of GGAP standards. Clauses that required minimum financial input were more readily adopted by farmers. This is consistent with broader literature, which often cites financial limitations as a mature hurdle in the implementation of the standards (Asfaw *et al.*, 2010; Macheke *et al.*, 2013). Testing, mandatory for GGAP certification, was seen as implementable by farmers for low cost and efforts like soil and water testing. However, high-cost tests like MRL analysis and microbial water testing were challenging to implement. The limited number of ISO-17025-certified labs in Pakistan further complicated testing, leading to only 18-33% of farmers considering these tests implementable, while 45-72% found them not implementable. Literature indicates that compliance costs, including external testing, are major barriers to adopting standards like GGAP, especially for smallholder farmers in developing countries (Chemnitz, 2007; Macheke *et al.*, 2013; Ngenoh *et al.*, 2019). Niemiec and Komorowska (2019) also reported nonconformities in external testing like water testing for microbes in their study, and hence these findings support the outcomes of our study.

The study assessed farmers' responses to display and installation requirements, finding 40-70% implementable and 30-60% not implementable. This variation was due to the task of identifying pesticides being easier than installing and maintaining reference systems in Pakistan's generic conditions. Challenges included the theft of reference materials like wooden or iron blocks, common due to unfenced fields and easy public access. Responses favoring easy installation were high, while those requiring expenses and maintenance had more negative responses. Schuster and Maertens (2016) noted that the food safety management system involved high fixed costs for such installations. Niemiec and Komorowska (2019) similarly found noncompliance in farms regarding warning signs and emergency procedure visibility, according to the findings of our study. Implementing health, safety, and hygiene clauses in GGAP, which require protective clothing and equipment, incurs high costs, especially affecting larger farmers with more workers. Small farmers with fewer workers find it easier to comply due to lower costs. However, workers often take time to adapt to protective clothing and may lack confidence in implementing health, safety, and hygiene rules. Social norms also play a role, as protective clothing, often in Western styles, is not well received in the generic conditions of Pakistan. This led to 25-45% of clauses being implementable and 55-75% not, with some choices not applicable. The feasibility of certain clauses varies between small and large farmers due to fundability and cost differences. The study found a need for infrastructure development to implement GGAP clauses, with varying responses from farmers based on their farm size and resources. Building washrooms was costly but feasible for large farmers with existing structures. Large farms also needed worker toilets in multiple areas. Farmers could build a pesticide room, but they required guidance for GGAP compliance. Easy tasks like wildlife management were generally agreed upon (30-50%), while those requiring specific infrastructure were declared difficult (43-50%). Previous research supports these findings; Kersting (2013) emphasizes the need for new or improved infrastructure for GGAP certification, and John (2013) highlights the substitutional cost involved. Niemiec and Komorowska (2019) identified funds as a major barrier, especially for small and poor farmers (Narrod *et al.*, 2009; Nicetic *et al.*, 2010). All these findings support the results of

this research. The study also highlights the importance of training in GGAP implementation. Farmers typically provide training to their workers either formally or informally, but they do not maintain training records. They often utilize sales representatives from fertilizer and pesticide companies for training. Such practices make these clauses implementable. Literature indicates that worker training programs are crucial for obtaining food safety certifications like GGAP (Chiputwa *et al.*, 2015). Exporters and donors organize these trainings, helping farmers afford the costs associated with GGAP adaptation (Kersting and Wollni, 2012). Niemiec and Komorowska (2019) corroborated these findings, confirming the feasibility and implementation of conducting worker training.

The study revealed that farmers could maintain records like sowing, fertilizer application, cleaning, post-harvest treatments, *etc.*, often due to having graduate family members and preexisting cost records. Records requiring special equipment and interrelated with other factors like traceability, *etc.*, were only partially implementable. The cost involved records like external testing, which was challenging. Various studies confirm the necessity of in-depth record-keeping for GGAP (Asfaw *et al.*, 2010; Macheke *et al.*, 2013). While farmers are generally aware of the importance of record-keeping (John, 2013), Kersting and Wollni (2012) reported that about 33% of responses declared record-keeping a hurdle. Niemiec and Komorowska (2019) observed nonconformities in records, especially regarding pesticides, fertilizers, irrigation, and traceability, highlighting the need for technical knowledge and equipment. These findings align with the outcomes of our study.

Teddy *et al.* (2019) examine the same challenges as compared to Pakistan in policy implementation in South Africa, focusing on the role of government, resources, and sociocultural factors. They found the complexity of policy execution across different countries and sectors. Studies indicate significant health benefits from adopting GGAP (Asfaw *et al.*, 2010; Laosutsan *et al.*, 2019) and risks like chemical poisoning from not using protective clothing (Roitner-Schobesberger *et al.*, 2008). Niemiec and Komorowska (2019) reported many nonconformities due to the lack of protective clothing, and John (2013) highlighted the substitutional cost involved in ensuring health, safety, and welfare standards. These findings cooperate with the study results. The findings emphasize the necessity of a gradual and customized approach to implementing GGAP standards in Pakistan. This approach mirrors the successful adoption seen in Japan, Chile, Kenya, and China, where customized versions like Japan GAP, Chili GAP, Kenya GAP, and China GAP have been developed. These customized standards allow for a more feasible and effective integration of GGAP principles, considering the unique agricultural, economic, and social context of each country. Customization facilitates a more manageable transition for farmers, especially in resource-constrained settings, by aligning with local practices and capacities (Nabeshima *et al.*, 2015). Therefore, adopting a similar strategy in Pakistan could enhance the adaptation and implementation of GGAP standards, ultimately leading to improved agriculture practices and food safety outcomes.

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## Conclusions

The study concludes that adopting GGAP for Pakistan-specific conditions is necessary due to the illiteracy and cost barriers. It was seen that documents, records, and low-cost clauses were found implementable, and on the other hand, clauses that needed costs to be implemented were found not implementable. This suggests



developing local, feasible standards with initially lenient clauses, progressively guiding farmers towards stricter compliance. This approach, benefiting true food safety standards implementation, could also apply to similar contexts in other developing countries facing comparable challenges with GGAP implementation. The study's findings highlight crucial insights for policymakers and stakeholders in the agriculture sector and suggest the need for target strategies to overcome implementation barriers and optimize the adaptation of GGAP in Pakistan, which would help to increase exports of agricultural commodities.

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Online Supplementary Material:

Supplementary Annexure 1. RESEARCH SURVEY FOR PHD PROJECT UNDER TITLE "Customization of International Food and Environmental Safety Standards to address Food and Environmental Safety Issues in Pakistan".