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Investigating the Level of Adoption and Perception Towards Irrigated Wheat Production in North Shawa Zone, Oromia Regional State, Ethiopia

Marsimoy Ajema Sima[1], Teferi Taye Aduna[1]

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ABSTRACT

Background: Agriculture serves as the backbone in Ethiopia. However, at present, the country's population is not self-sufficient in food because their farming system is rainfed dependent. The main objective of the study was investigating the level of adoption and perception of irrigated wheat production in the study area.

Methods: This study combined a qualitative and quantitative research approach with a descriptive research design and a cross-sectional survey type. Multi-stage sampling techniques were also used in the study to choose sample households. Both primary and secondary data were employed. Statistical Package for Social Science Version 20 was utilized to analyse the data using simple descriptive statistics.

Result: The majority of smallholder farmers expressed dissatisfied with the extension services and access to credit services, access to necessary inputs and irrigation facilities provided by the government. The overall level of adoption of irrigated wheat producers was low in the study area. Therefore, the study recommends that regular input supply system and development of modern irrigation schemes should be done so as to increase wider adoption of the program in the study area.

Key words: Adoption, Descriptive, Farmers, Irrigated wheat.

INTRODUCTION

Around 75% of the world's population lives in rural areas and three-quarters of them living based on agriculture. Agriculture contributes a significantly higher percentage of national revenue and employment in today's middle and low-income countries (Barrett *et al.,* 2022). Nonetheless, low economic activity and high rates of poverty are frequently seen in rural areas (Galvao *et al.,* 2020). Thus, one of the most effective strategies for reducing extreme poverty, promoting shared prosperity and ensuring food security is agricultural development (Viana *et al.,* 2022).

Wheat is among the most important staple food crops and a major diet that is consumed by over 2.5 billion people globally (Bentley *et al.,* 2022). It is the most widely grown crop in the world, with estimated 217 million hectares under cultivation. It is the second most produced grain after maize in the world (FAOSTAT, 2022). Wheat is one of the most important cereal crops of the world due to its wide adaptability to various agro-climatic and soil conditions (Joy *et al.,* 2021).

However, wheat has low yield in developing countries, particularly in Sub-Saharan Africa. Sub-Saharan Africa produced a total of 7.5 MT on a total area of 2.9 Mha accounting for 40 and 1.4% of the wheat production in Africa and at global levels respectively. As a result, increasing wheat production and productivity is crucial for meeting global wheat food demand and thereby mitigate the impacts of food shortage and rising food prices (Alemu, 2024).

The Ethiopian economy is closely linked to the agricultural sector, which accounts for 34.1% of the GDP, 79% of export earnings, 79% of the workforce and 70% of raw materials (Asrat *et al.,* 2022; Gebremariam and Ying, 2022). The sector is diverse, comprising both subsistence and commercial farming practices. This includes the cultivation of a wide range of crops across different farming systems and agro-ecologies (Geleta *et al.,* 2024).

However, the country's agriculture is mainly dependent on rainfall and small scale with low agricultural productivity (Kifle *et al.,* 2022). In fact, the agricultural production growth in the country is less than the population growth rate (Regasa *et al.,* 2021).

To ensure food requirement, the expansion of agricultural growth and achieving food security through irrigation is an alternative option (Ozkan *et al.,* 2022).

[1]Department of Rural Development and Agricultural Extension, College of Agriculture and Natural Resource, Salale University, Fiche, Ethiopia.

Corresponding Author: Marsimoy Ajema Sima, Department of Rural Development and Agricultural extension, college of Agriculture and Natural Resource, Salale University, Fiche, Ethiopia.
Email: marsimoyjema2017@gmail.com
ORCID: https://orcid.org/0009-0008-2260-3124

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According to Belay *et al.* (2019), wheat is the second most important food crop in Ethiopia, next to maize. Wheat is produced by 4.58 million smallholder farmers on 1.80 million hectares of land with an annual production of 5.78 million tons and average productivity of 3.05 ton/ha (Abera *et al.,* 2022). This average productivity is much below the research yield and the global average (Fischer *et al.,* 2022). This is because only smallholder farmers who cultivate farms less than one hectare and using only rainfed agriculture (Isinika *et al.,* 2022).

In Ethiopia, 4.9 million smallholder farmers rely on wheat for employment, contributing to 20.2% of total production and 12.2% of the harvested area (1.9 million ha). Regionally, the largest wheat production comes from Oromia (57-58% of national output), followed by Amhara (28-32%), SNNP (8%) and Tigray (3-6%) (USDA, 2022).

In many parts of the country, traditional irrigation was practiced for a long period of time. However, traditional irrigation practices were insufficient for ensuring consistent and high crop yields (Hassen and Borana, 2024). As a result, the Ethiopian government is aware of the homegrown economic reform and the irrigated wheat initiative, which can be used to make the country self-sufficient. As a result, Ethiopia produced 8.2 million tons of wheat in 2022, setting a new record (Effa *et al.,* 2023). Thus, irrigated wheat production with appropriate technologies can improve wheat yield, water productivity and nutrient utilization (Tiruye *et al.,* 2022).

Oromia is one of the largest regional states in the country in terms of arable area and irrigated wheat production (Alemu and Tolosa, 2022; Atinafu *et al.,* 2022). Based on the land and water potential the government is highly given priority for irrigated wheat production in the region. One of the Oromia Zones with significant irrigation potential is North Shawa (NSHZAO, 2022).

For the success of the irrigated wheat production, investigating the level of adoption and perception towards irrigated wheat production are critical issues. North Shewa Zone has enormous irrigation potential which is the opportunity for successfully implementing government initiatives of irrigated wheat production. Small-scale farmers, that practice rain-fed farming by employing traditional technology, adopting a low input and low output production system and harvest a very low yield (Wondim *et al.,* 2020). Therefore, this study was aimed at investigate the level of adoption and perception towards irrigated wheat production in North Shawa Zone of Oromia. The point of emphasis in this research is to find out the level of adoption and perception towards irrigated wheat production. But as far as the knowledge of the researchers, no research has been done on the level of adoption and perception of irrigated wheat production in the study area. Understanding the level of adoption and perception towards irrigated wheat production is vital in promoting irrigated wheat production in order to enhance adoption of its production in the study area in particular and in Ethiopia in general.

MATERIALS AND METHODS

The study was carried out at North Shawa Zone of Oromia Regional State Ethiopia during 2022/23 offseason under farmers' condition. North Shawa Zone is located at 112 km North of Addis Ababa (Finfinne), the capital city of Oromia and Ethiopia. This zone is located between 1,000 and 3,500 meters above sea level. According to Game and Korecha (2015), it lies at a latitude of 9°482 N and a longitude of 38°442 E. In 2022, the zone had a total population of 1,523,743, with 1,466,103 residing in rural areas (730,266 males and 735,837 females). Over 90% of the population lives in rural areas, while the remainders are urban residents (NSHZFEDO, 2022). The main economic activities in North Shewa zone are mainly focused on mixed farming and the major agricultural crops include wheat, maize, teff, barley, bean, pea, enset, sorghum, coffee, potato, tomato, onion, cabbage, banana and others (NSHZAO, 2022) (Fig 1).

The research design defines the what, where, when, how much and the methods used in an inquiry or study (Kothari, 2004). Since all relevant data was gathered at one time, a cross-sectional survey type and a descriptive study design were used. In this study mixed research approach was adopted, because which involves both quantitative and qualitative research methods. The target population of the study was the smallholder growers of irrigated wheat crops in selected districts of North Shewa Zone. Multi-stage sampling procedure will be employed to select the sample. The sample size for collecting data through household survey is determined by using the sample size determination formula proposed by Cochran (1977) method. Determine the required sample size at 95% confidence level.

$$no = \frac{Z^2pq}{e^2} = \frac{(1.96)^2\ (0.5*0.5)}{(0.05)^2} = 384$$

Both primary and secondary data were used in this investigation. While secondary data was gathered from published information on irrigated wheat production, primary data was gathered from study participants. To achieve the stated purpose of this study, quantitative and qualitative data required was collected from primary and secondary sources.

To identify the level of adoption and perception towards adoption of irrigated wheat production in the study area, simple descriptive statistics like frequencies, percentages, mean and standard de*via*tion were employed. Farmers' perceptions on the adoption of irrigated wheat production were measured using a Likert scale (1-5) *i.e.* stands for the negative response strongly disagree to the positive response strongly agree. Farmers were ranked as never-adopted, low adopters, medium adopters and high level adopters, respectively, based on their scores. Raju, (2019), the mean score below 0.25, 0.26 to 0.50, 0.51 to 0.75 and 0.76 up to 1.00 was considered as non-adopters, low-adopter, medium-

adopter and high-adopter respectively as illustrated by given four rank-ordered response options.

RESULTS AND DISCUSSION

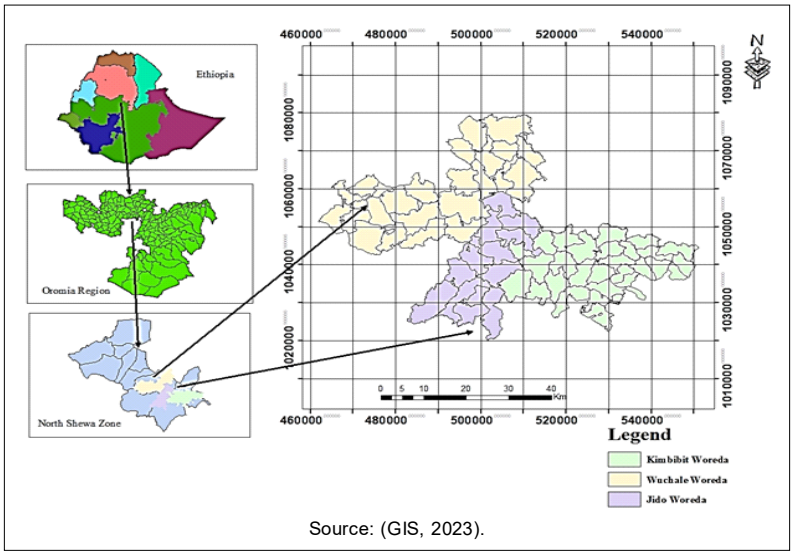
According to Damianus *et al.* (2022), the mean score below 4.20-5.00 was considered as strongly agreed/very high, the mean score from 3.40 up to 4.09 was considered as agreed/high, the mean score from 2.60 up to 3.39 was considered as neutral/moderate, the mean score from 1.80 up to 2.59 was considered as disagree/low and the mean score from 1.00 up to 1.79 was considered as strongly disagree/very low as illustrated by Comparison bases of mean of score of five point Likert scale instrument.

Depend on this, the mean score and standard deviation of farmers perception on the irrigated wheat production was most effective than rainfed was 3.28 and 1.43 respectively in the study area. This finding indicates that, the perception of smallholders in the study area was neutral and they perceived moderately to the statement in the study area. Similarly, the analyses result depicted that, the mean score of farmers perception on the satisfaction on access to extension service given by DA was 2.67. This shows that, the satisfaction of farmers on access to extension service given by DA in the study area was moderate (Table 1).

The result of the study indicated that the mean score of smallholder farmers on access to credit service and access to necessary inputs for irrigation wheat production was 2.3281 and 1.9297 respectively in the area. The result of the study revealed smallholder farmers in the study area was disagreed on access to credit service and access to necessary inputs (for irrigation wheat production) in the area and the perception of farmers was low to the statements (Table 1).

The analyses result revealed that the mean score of smallholder farmers on Positive perception of irrigated wheat production practices and access technical training on irrigated wheat in the study area was 3.32 and 3.19 respectively. Meaning that, the perception of farmers on the positive perception of irrigated wheat production practices and access technical training on irrigated wheat was neutral/moderate in the study area (Table 1).

Concerning the statements made on access to irrigation facilities from government, respondents were



Source: (GIS, 2023).

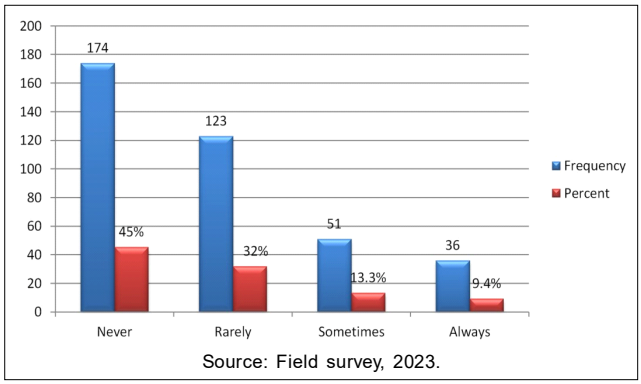
Fig 1: Map of the study the study area.

Table 1: Perception of farmers towards irrigated wheat production.

Variables	Mean	Std. dev
Irrigated wheat production was most effective than rainfed	3.2891	1.43703
There were satisfaction on access to extension service given by DA	2.6719	1.51809
There was access to credit services in the area	2.3281	1.42218
There was access to necessary inputs(for irrigation wheat production)	1.9297	1.18421
Positive perception of technology on the irrigated wheat production	3.3281	1.44766
There was access technical training on irrigated wheat	3.1927	1.50520
There was access to irrigation facilities from government	2.3125	1.32312
There was scarcity of water source for irrigated wheat production	3.9141	1.36744
Government initiative motivate me to produce irrigated wheat	3.4505	1.52015
The capacity of wheat yields is good than rainfed	3.1927	1.45043

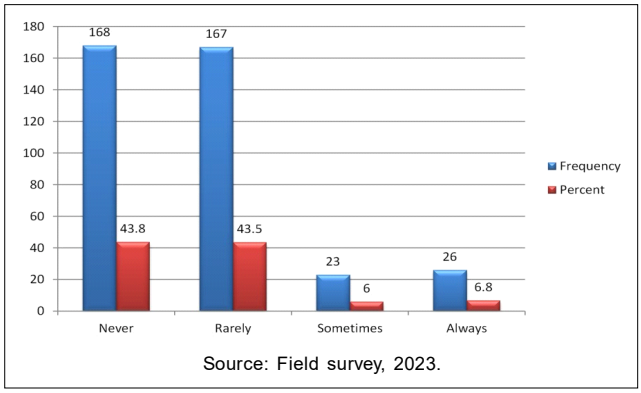
disagreed to the statement with mean score and standard deviation 2.31 and 1.32 respectively. Meaning that, the access to irrigation facilities provision from government for irrigated wheat production was low in the study area (Table 1).

The result of the study specified that the mean scores of smallholders on the scarcity of water source for irrigated wheat production, government initiative motivate us on irrigated wheat production this year and the capacity of wheat yields is good than rainfed in the study area was 3.39, 3.45 and 3.19 correspondingly. The result revealed that farmers were agreed to the statements and they were highly perceived on the statements. That means in the study area, there was water scarcity during irrigated wheat production. But, the government initiative motivates farmers to produce irrigated wheat as well as the capacity of wheat yields is good under irrigation than rainfed in the study area (Table 1).



Source: Field survey, 2023.

Fig 2: Field preparation.



Source: Field survey, 2023.

Fig 3: Beds and channel preparation and clearing.

The level adoption of irrigated wheat production practice was measured by computing adoption scores for recommended technologies. Based on the computed adoption scores, the respondents were asked to rate their level of adoption on the given technology practices with four response categories. The values for each response category were 0 to 25 for non-adopters, 0.26 to 0.50 for low adopters, 0.51-0.75 for moderate adopters and 0.76-1 for high adopters of the given major technology packages.

The study shows that, 174(37%) had never-adopt field preparation for irrigated wheat production technology. Also, 123(32%) had rarely adopters, 51(13.3%) had medium adopters and 36(9.4%) had high adopters of field preparation for irrigated wheat production (Fig 2). The mean score of adoption was found 0.29 which implies low adoption of farmers on field preparation for irrigated wheat production in the study area (Table 2).

It was found that majority 168(43.8%) and 167(43.5%) of the respondents were never adopters and rarely adopters of beds and channel preparation and clearing for irrigated wheat production (Fig 3). The mean score of adoption was found only 0.25 which indicates non-adopters of beds and channel preparation and clearing for irrigated wheat production (Table 2). Key informants revealed that farmers in the area didn't prepare channel timely and properly. This leads to unnecessary waste of irrigation water and used for what is required in the area.

The study result indicated that 187(48.7%) of the respondents were never used high yielding varieties of wheat seed for irrigated wheat production. Also, 101(26.3%) were rarely used high yielding varieties of wheat seed for irrigated wheat production in the study area (Fig 4). The mean score of adoption was found only 0.28 which indicates

Table 2: Level of adoption score of irrigated wheat production technology practices.

Irrigated wheat production technology practices	N	Mean	Std. deviation
Field preparation: Prepare the land to fine beds and channels	384	.29	.323
beds and channels	384	.25	.280
Use of high yielding varieties of wheat seeds	384	.28	.326
Right time of sowing	384	.32	.311
Use of row planting technology	384	.24	.292
Right time of watering	384	.19	.273
Organic manure and fertilizer application	384	.22	.256
Seed treatment	384	.19	.272
Soil treatment	384	.33	.356
Weed management	384	.34	.4183
Right time of harvesting and storage	384	.25	.311
AD. Level	384	.2634	.15121

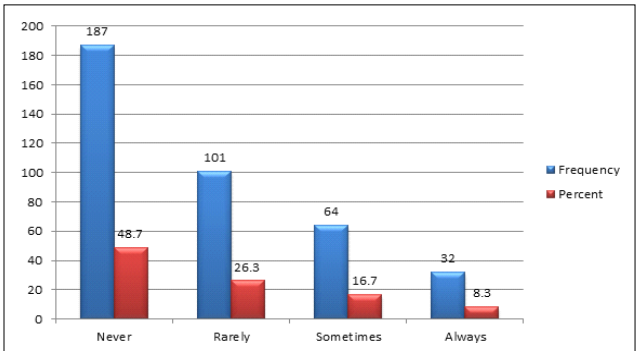
low level of adoption high yielding varieties of wheat seed for irrigated wheat production in North Shawa Zone (Table 2). This finding is inconsistent with Salokhe Shubhangi (2025) that farmers eagerly anticipate introducing new technologies for farming, extension, processing and marketing agricultural produce.

It is evident from (Fig 5) that most of the farmers were sowing wheat crops during 1st week of December to the 3rd week of January. This exposes farmers to crop failure when the spring rains enter early as they do not wait for the sowing season. The data result depicted that 39.6% of the farmers were not sowing irrigated wheat crop during recommended time of sowing. Mean score of adoption was found 0.32 which shows low level of adoption of right time of sowing irrigated wheat in the study area (Table 2).

The result (Fig 6) revealed that, 49% of the respondents were never adopted and used row planting technology for irrigation. Similarly, 34.1% of the respondents were rarely used irrigated technology for irrigated wheat production. The mean score of adoption was 0.24 which indicates non-adopters of row planting technology (Table 2). The results of key informant interview indicate that, currently wheat row planting was practiced manually and the application method is more labor intensive. As a result, at planting time three man-powers was required, which means the first person is making a row, the second putting seed in the row and the third one is applying fertilizers. It was a labor-intensive practice because of this; those households with more active labor force relatively are more adopters of the technology.

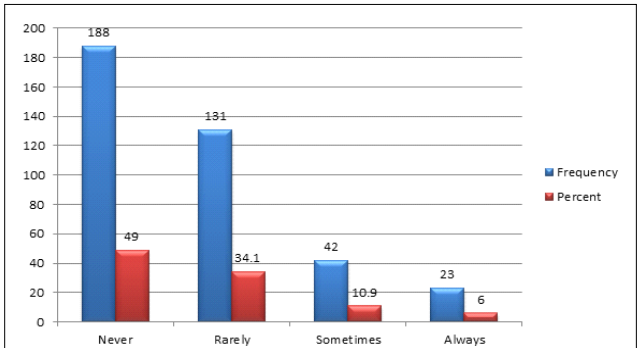
It is revealed from (Fig 7), 61.2% of the respondents were never used right time of watering in irrigated wheat production. As a result adoption level of right time of sowing was found to be non-adopter in the study areas with an adoption score of 0.19. It is evident from (Fig 8), 187 (48.7%) and 145 (37.8%) of smallholder farmers were never and rarely used organic manure and fertilizer application as recommended rate respectively. This finding indicates that, almost half (48.7%) of irrigated wheat producers were never used the organic manure and fertilizer application for irrigated wheat production as recommended. The mean score of adoption was 0.22 which shows non-adopter adoption of recommended organic manure and fertilizer application for irrigated wheat production in North Shawa Zone (Table 2). The time of wheat planting and the variety selection have important impact on better crop output (Godara and Kumar, 2022).

Fig 9 reveals that 345 (89.8%) of the respondents had never treated seeds before sowing for irrigated wheat production in the area. This indicates that almost all irrigated wheat producers does not adopted seed treatment practices. The mean adoption score was 0.19, reflecting a



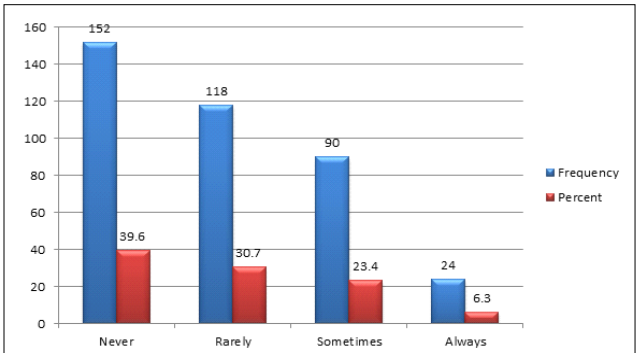
Source: Field survey, 2023.

Fig 4: Use of high yielding varieties of wheat seeds.



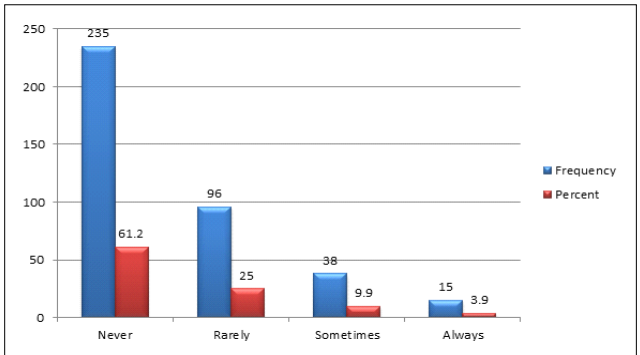
Source: Field survey, 2023.

Fig 6: Use of row planting technology.



Source: Field survey, 2023.

Fig 5: Right time of sowing.



Source: Field survey, 2023.

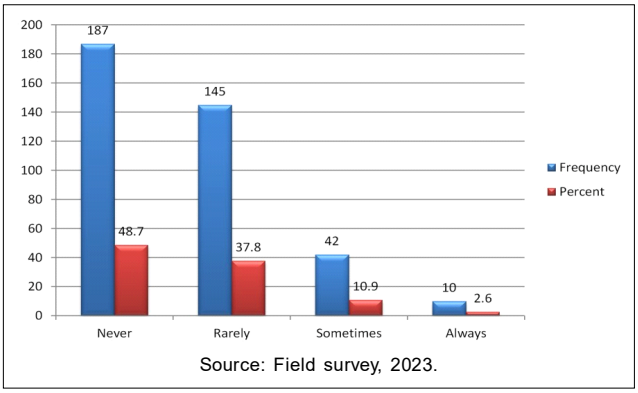
Fig 7: Right time of watering.

lack of adoption. Abate (2018) indicates that the wheat initiative successfully made certified seeds and fertilizers accessible to farmers, thereby increasing their uptake.

The result of the study depicted that, 181(47.1%) of the respondents were never used soil treatment during irrigated wheat in the study area (Fig 10). The mean score of adoption was 0.33 which shows low-adopter of soil treatment for irrigated wheat production in the area. It is evident from the below (Fig 11), 210 (54.7%) of irrigated wheat growers were never adopted weed management for yield increment in the study area. This finding indicates that more than half of farmers in the area does not adopted weed management during irrigated wheat production. The mean score of adoption was 0.34 which shows low-adopter level of adoption of weed management for irrigated wheat production in the area (Table 2). Key informants clearly indicated that many herbicide groups were used and this indicates that farmers are applying herbicides that are provided in the market without knowing real source of herbicides. This makes the loss of yield and quality of wheat.

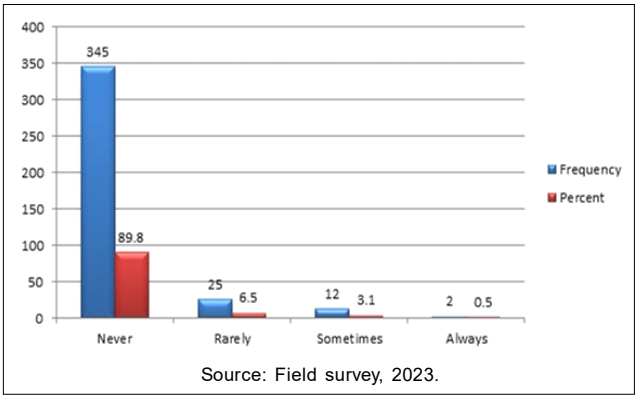
As indicated in the (Fig 12), about 53.1% of the respondents were never used right time of harvesting and storage of wheat in the study area (Fig 12). In the study areas almost more than half of the respondents replied they never used right time of harvesting and storage. This makes high loss of production and productivity due to harvesting and storage related problems in the area. The mean score of adoption was 0.25 which shows non-adopter level of adoption of right time of harvesting and storage for irrigated wheat production in the area (Table 2).

Therefore, the main finding is that the level of adoption of irrigated wheat production technology is low in the study area as the majority is fall in the low actual adoption index category which is 0.26 mean score. This revealed that the extent (level) of irrigated wheat production technology in the study area is low which needs the capacity development of the irrigated wheat growers so as to bring them to high adoption level in irrigated wheat production technology.



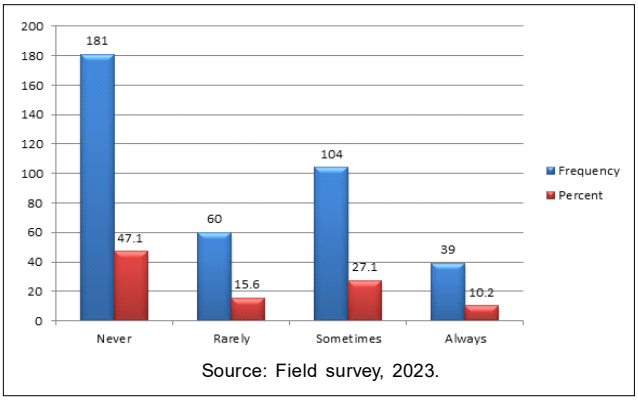
Source: Field survey, 2023.

Fig 8: Organic manure and fertilizer application.



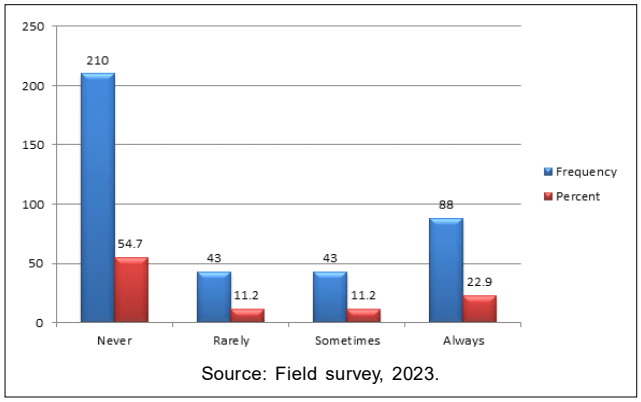
Source: Field survey, 2023.

Fig 9: Seed treatment.



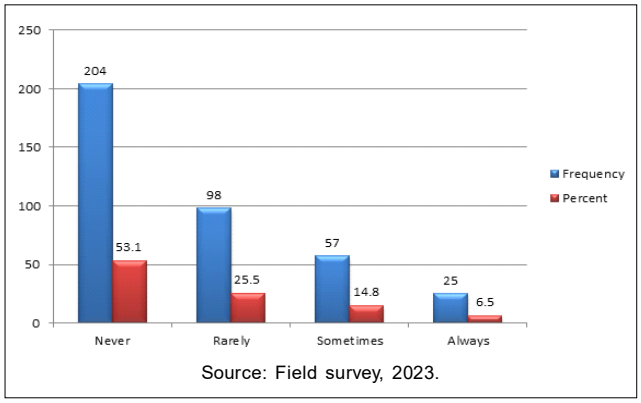
Source: Field survey, 2023.

Fig 10: Soil treatment.



Source: Field survey, 2023.

Fig 11: Weed management.



Source: Field survey, 2023.

Fig 12: Right time of harvesting and storage.

CONCLUSION

The study concludes that, majority of farmers in the area was non-adopters of irrigated wheat production. Farmers were strongly disagreed on irrigated wheat production was most effective than rainfed. Farmers were strongly disagreed on access to extension service given by DA, access to credit service, access to necessary input, access technical training on irrigated wheat and access to irrigation facilities. The study also concludes that the level of adoption of irrigated wheat production is low in the study area. Therefore, it is advisable to search and organize the internal and external projects thereby applying the participatory approaches to irrigated wheat production technologies (practices) to bring the sustainable adoption of technologies. Thus, strong collaboration is needed between Zonal agricultural office, university and research centre so as to increase the wider adoption of irrigated wheat production. To ensure level of adoption and improve irrigated wheat production, it necessary be supported with smallholder farmer friendly, efficient and cost effective. Also, strengthening market linkage; policymakers, researchers and seed enterprise for better orienting investments.

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Disclaimers

The views and conclusions expressed in this article are solely those of the authors and do not necessarily represent the views of their affiliated institutions. The authors are responsible for the accuracy and completeness of the information provided.

Informed consent

All procedures were approved by the Institutional review board at Salale University.

Conflict of interest

The authors declare that we do not have competing interests.

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