World Journal of Advanced Research and Reviews
eISSN: 2581-9615 CODEN (USA): WJARAI
Cross Ref DOI: 10.30574/wjarr
Journal homepage: https://wjarr.com/

(RESEARCH ARTICLE)

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Assessing the role of technology transfer and participatory technology development on farmers crop yield and income in Shawa village of Zalingei, Central Darfur State

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World Journal of Advanced Research and Reviews, 2024, 23(02), 337–342

Publication history: Received on 01June 2024; revised on 31 July 2024; accepted on 03 August 2024

Article DOI: https://doi.org/10.30574/wjarr.2024.23.2.2083

Abstract

This study is aiming at assessing the role of technology transfer and participatory technology development on farmers' crop yield and income in Shawa village of Zalingei locality during 2022/2023 cropping rainy season. Clustered random sampling technique applied. Demonstration farm was established in an area of 1.5 feddan. Farmers field schools (FFSs) of 25 men and women farmers selected. Participatory Technology Development (PTD) for men and women farmers was also developed in an area of 1.5 feddan. Improved seeds will be grown versus local check. Each treatment comprising NPK fertilizer micro dose (0. 0.3, 0.6 and 0.9 gram/ hole) randomly practiced. Fertilizer micro dose with percentage of 17-17-17 was added and mixed with seeds per hole at planting method. All farmers experienced to practical and theoretical farming of FFSs training in all research technical packages of land preparation, sowing date, seed preparation, seed dressing, thinning, weeding, water harvesting, soil conservation, pests and diseases control, seed production technologies, harvest and post harvest technologies. Results of partial crop budget revealed that all crops finically gave positive net returns. The highest yield kg/ha was obtained by Sorghum Wad-Ahmed 3500, Sorghum Butana with 3250, 3000 kg/ha for sorghum local and G/nut Gibaish, while the lowest yield/ha shown by sesame local (776 kg/ha). Therefore, the highest net returns was recorded by sorghum Butana (SDG 329048), sorghum wad-Ahmed (SDG 295477), sorghum local (SDG 269048) and G/nut Gibaish (SDG 108990). While the lowest net returns was computed by G/nut local with SDG 21,381. Results of marginal analysis revealed that sorghum Butana gave the highest MRR 1230. Results of Participatory Technology Development (PTD) of improved yields against local indicated that, the highest yield obtained by sorghum Wad-Ahmed and G/nut Gibaish (1100 and 950 kg/feddan), respectively. While the lowest yield obtained by sesame local (195 kg/feddan). The increased over decreased of improved versus local showed that sorghum wad-ahmed exceed local by 11%, millet Ashana 36%, sesame Promio 13% and groundnut Gibaish exceed local by 25%. The study recommended strengthening research extension farmers and enhancing farmers' participatory technology development.

Keywords: Assessing; Technology transfer; Participatory technology development; Marginal analysis; Income; Yield

1. Introduction

Improved technologies can achieve its purpose only if is transferred to and adopted by farmers. The traditional agriculture was neglected receiving on research services, limited extension, credit, and infrastructure, basic social services in the form of education primary health care and safe water supply and negligence of traditional agriculture has caused massive migration from rural areas [1]. One of the key policy conclusions of the workshop was Technologies for sustainable Agriculture in order to whole spectrum of farming systems in the study area. 0nfarm research via demonstration farms aimed towards implementation of applied research on working farm together information and

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disseminate technologies to grassroots needed to needed to ensure food security in the study area. Effective improved technologies can result in higher agricultural production and increased incomes of farming families which may unequivocally have appositive impact on rural poverty levels increased crop yields will reduce costly imports of agricultural commodities and cost of production of basic raw materials for agro-industries [2] .

[3] participation techniques are being used to improve health and agricultural practices in many areas of the developing world. Community participation lends itself particularly well to the introduction of new agricultural technologies for a number of reasons. Firstly, any new practice, technology, or variety must complement existing farming practices. Therefore, extensive consultation and discussion with the farmers is critical. Secondly, farmers are natural innovators: experimenting often comes naturally to them. They also have well-developed knowledge and networks that they use within the community to share information.

The conventional approach to agricultural research and extension has often been criticized for its top-down nature. This approach has led to the technology recommendations that are too general ignoring the multiple farming situations

within a farming situation. Participatory approaches offer readymade solutions to this problem. Hence, of late there is growing awareness globally on the use of participatory approaches in agricultural research and development. The main objective of agricultural research is to solve the farm and farming related problems of farmers by developing appropriate technologies. Research management primarily involves perception/identification and articulation of the research problem, project prioritization, selection and resource allocation, planning of research activities, monitoring and review of the project, and utilization of research results. Technological change has been the major driving force for productivity and promoting agriculture development in all countries in the past 'the the choice of technologies and their adoption was to increase production, productivity and farm incomes. Over many decades, policies for agriculture, trade, research and development education, training and advice have been strong influences on the choice of technology the level of agriculture is becoming more integrated in the ago-food chain and the global market ,while environmental, food safety and quality ,and animal welfare regulations are also increasing on the sector .its faced with new challenges to meet growing demands for food ,to be internationally competitive and toproduce agricultural products of high quality .At the same time it must meet sustainability goals in the context of on-going agricultural policy reform.

[4] said that, Technology transfer (TT) is the movement of technical and organizational skills, knowledge, and methods from one individual or organization to another for economic purposes. This process usually involves a group that possesses specialized technical skills and technology that transfers it to a target group of receptors who do not possess those skills and who cannot create that technology themselves. Technology refers to a society's capability to transform natural resources into products for consumption. Technology transfer in a narrow definition includes movement of technical equipment, material, designs, engineering knowledge, techniques, and procedures of production. A broader understanding also refers to the transfer of the capacity, knowledge attached to the technology, personal know-how, and skills of workers. Technology transfer may accelerate economic growth, regional development, and industry innovation, and by offering workplaces, reduce unemployment and poverty in developing countries.

As populations continue to increase and land degradation ever-encroaching, a new form of agriculture must be utilized to maintain production and preserve natural resources to secure longevity of the agricultural industry. This can be achieved via technology and the transference of knowledge regarding sustainable practices to farmers in developing nations. Additionally, new forms of agricultural technology must be adopted in developed nations in concurrence with conservation agriculture systems. Technology is not simply new forms of machinery or tools, but various practices and systems to promote sustainable production. Yet, with lacking land tenure and proper infrastructure, it is difficult to spread this knowledge and technology to developing nations. Furthermore, developed nations are reluctant to adopt more sustainable practices or new forms of technology in fear of reduced yield or increased cost. Sustainable Development Goal 8 Indicator 8.2 clearly states a goal to increase economic productivity via technological upgrading and innovation, focusing on labor-intensive areas-hence the need for more sustainable agricultural technology [6].

1.1. Research objectives

- To test the performance of technology transfer across participatory technology transfer of farmers
- To introduce improved agricultural technologies for increasing farmers crop yields
- To strengthen the productive capacity of small farmers towards natural resource management and sustainable agricultural production.

1.2. Participatory Technology Development (PTD)

According to [5], Participatory Technology Development (PTD) is a strategic action and a purposeful process by which scientists sponsored technology is tested, suitably modified and refined by the farmers in their fields leading to its, viability and acceptability by them in their farming situations. The goal of PTD is encouraging stakeholder participation in research and technology development and transfer is to improve the functional efficiency of formal research (better technologies, more widely adopted, more quickly adopted). Another objective is to empower the stakeholders, especially the marginalized ones, on their own decision making so that their research capacity to make effective demands on research and extension organizations is strengthened.

2. Research methodology

This study was conducted in Shawa village, Zalingei locality of central Darfur state during 2022/2023 cropping seasons. Clustered random sampling applied. Demonstration farm established in an area of 1.5 feddan, and Farmers field school (FFS) of 25 farmers established. Participatory Technology Development (PTD) for men and women farmers was also developed in an area of 1.5 feddan. Improved seeds grown versus local check. Thus improved millet Ashana, millet local, improved Sorghum Tabat, improved Sorghum Wad Ahmed, improved Sorghum Butana, and Sorghum local, improved Sesame Promio, Sesame local , improved ground nut Gibaish and G/nut local, were grown on an area of 1.5 feddan. Each treatment comprising NPK fertilizer micro dose (0. 0.3, 0.6 and 0.9 gram/ hole) randomly practiced. Fertilizer micro dose with a percentage of 17-17-17 was added and mixed with seeds per hole at planting method. Farmers experienced to farming and theoretical FFSs training in all research technical packages of land preparation, sowing date, seed preparation, seed dressing, thinning, weeding, water harvesting, soil conservation, pests and diseases control, seed production technologies, harvest and post harvest technologies field days. Knowledge disseminated and field day attended by researchers, farmers, extension officers as partners from ministry of production and economic resources, international and national agencies, civil opinion leaders and students from Zalingei University. We used partial crop budget to identify cost benefit analysis.

3. Results and discussions

Results of partial crop budget revealed that all crops finically gave positive net returns. The highest yield kg/ha was obtained by Sorghum Wad-Ahmed 3500, Sorghum Butana with 3250, 3000 kg/ha for sorghum local and G/nut Gibaish, while the lowest yield/ha shown by sesame local (776 kg/ha). Therefore, the highest net returns was recorded by sorghum Butana (SDG 329048), sorghum wad-Ahmed (SDG 295477), sorghum local (SDG 269048) and G/nut Gibaish (SDG 108990). While the lowest net returns was computed by G/nut local with SDG 21,381.

This result entails that the use and application NPK fertilizer micro-dose in small amount ranging from 0.3 gram to 0.9 gram tend to improve crop productivity as well as net return. This result also goes with what had been said by Breima 2015 improved technologies enhanced productivity and farms income, Table 1.

Results of dominance analysis and indicated that treatment T3, T4, and T5 (SorhumTabat, G/nut local and G/nut Gibaish) were dominated due to higher costs and lower net resents, this results was agreed with what had been said by Breima, (2020), Table 2.

Results of marginal analysis revealed that sorghum Butana gave the highest MRR 1230 this results indicated that NPK fertilizer increase profit by 1=230. More over this result give evidence that NPK fertilizer is very important in sorghum production, and farmers can get higher profit with limited and fewer budgets, Table3.

Results of Participatory Technology Development (PTD) of improved yields compared to local showed that, the highest yield obtained by improved sorghum Wad-Ahmed and improved G/nut Gibaish (1100 and 950 kg/feddan), respectively, followed by improved millet Ashana (450 kg/feddan), while improve sesame Promio produced 220 kg/feddan. Therefore local sorghum yielded 988 kg/feddan, groundnut local 760 kg/feddan, while the lowest yield obtained by sesame local (195 kg/feddan).

The increased over decreased of improved versus local showed that sorghum wad-ahmed exceed local by 11%,millet Ashana 36%, sesame Promio 13% and groundnut Gibaish exceed local by 25%. This result implies that farmers participation in research technologies developed will be more knowledgeable productive and can adapt technologies under their own condition, Table 4.

Table1 Partial crop budget

Crop	variety	Treatment	Area/m²	Production/kg	Yield kg/ feddan	yield kg/ha	Adjusted yield kg/ha	Price SDG/kg	Straw value SDG/ha	Gross field benefit SDG	Cost variation SDG/ha	Net returns SDG/ha
sorghum	Wad-Ahmad	NPk	4m	1.4	1470	3500	2800	300	119,048	959,048	663,571	295,477
sorghum	Tabat	NPK	4m	1.1	1155	2750	2200	300	119048	779,048	584,286	194,762
sorghum	Butana	NPK	4m	1.3	1365	3250	2600	300	119048	899,048	570,000	329,048
sorghum	Local	control	4m	1.2	1260	3000	2400	300	119048	839,048	560,000	269,048
millet	Ashana	NPK	4m	0.6	630	1500	1200	400	105000	585,000	640,000	(55,000)
millet	Local	control	4m	0.4	420	1000	800	400	105000	425,000	640,000	(215,000)
Sesame	Promio	NPK	4m	0.4	420	1000	800	247	47,619	302,600	579,286	(276686)
sesame	local	control	4m	0.31	326	776	621	247	47,619	201,006	577,024	(376018)
G/nut	Gibaish	NPK	4m	1.2	1260	3000	2400	222	238,095	770,895	661,905	108,990
G/nut	Local	Control	4m	1.0	1050	2500	2000	222	238,095	682,095	660,714	21,381

Source: author 2022

Table 2 Dominance analysis

Treatment	Cost variation SDG	Net benefit SDG/Fddan
T1 Sorghum control	560,000	269,048
T2 sorghum Butana	570,000	329,048
T3 Tabat	584,286	194,762D
T4 G/nut local	660,714	21,381D
T5 G/nut Gibaish	661,905	108,990D
T6 Sorghum wed Ahmed	663,571	295,477

Source: author 2022

Table 3 Marginal analysis

Treatment	Cost variation	Marginal costs	Net returns	Incremental net benefit	MRR%
Sorghum Control	560000	-	269048	-	
Sorghum Butana	570000	10000	329048	123000	1230
Sorg. wad-Ahmed	663571	93571	295477	(33571)	(36)D

Source: author 2022

Table 4 Yields of Participatory Technology development compared against local

Crop	variety	Area/m2	Yield improved kg/feddan	Local yield kg/feddan	% change
Sorghum	Wad-Ahmed	4200	1100	988	11
Millet	Ashana	4200	450	330	36
Sesame	Promio	4200	220	195	13
G/nut	Gibaish	4200	950	760	25

Source: author 2022

4. Conclusion

This study was conducted in Shawa village situated in Zalingei locality of Central Darfur State during 2022/2023 cropping season. The highest yield kg/ha was obtained by Sorghum Wad-Ahmed, while the lowest yield kg/ha shown by sesame local. We concluded that, all treatments were financially gave positive net return except Millet and sesame. It was obvious that, the use of NPK fertilizer will enhance crop yield and net returns of farmers which give evidence that investment in improved technologies can improve farmer's livelihoods. I t was also noted that Participatory Technology Development (PTD) of improved yields exceed local yields and This is will definitely pave the way in adopting and dissemination of technology in the study area.

Recommendations

- Strengthening research extension farmers
- Enhancing farmers Participatory Technology Development (PTD)
- Use of NPK fertilizer will ensure crop yields
- Making credit services more accessible to farmer.
- Enhancing farmers' capacity will improve technology awareness.
- Rising technology awareness should enhance development.
- Provision of machinery inputs will increase crop areas.
- Encouraging participatory research approach will encourage technology adoption.

Compliance with ethical standards

Acknowledgments

Great thanks and appreciation's to co-authors for their share and comments, my gratitude's also extended to World Journal of Advanced Research and Reviews, editors and team work for giving this opportunity

Disclosure of conflict of interest

No conflict of interest is to be disclosed

Statement of informed consent

Informed consent was ensured from all individual participants and stakeholders included in the study.

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