Tracing the Path of Technology Diffusion: The Case of Nturumenti, Narok, Kenya

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Abstract

An array of technologies; growing improved wheat varieties, bulking and collective marketing of wheat grains, sheep breed improvement, ram sharing, feedlot sheep fattening for market, strategic sheep deworming, pasture establishment and conservation practices; were introduced to members of a community based organization (CBO) in Nturumenti, anti-female genital mutilation and anti-poverty organization (AFAPO) in 2014. The CBO members, composed of youthful 19 men and 7 females, were intensively exposed and involved in the new skills both theoretically and practically in the farmers' field school model. Even though the 8 farming technology options were suitable for the study environment, their adoption and diffusion varied. However, one of the introduced ideas, bulking and collective marketing of wheat grains, was not attempted for application by the farmers. Instead, the farmers felt that individual marketing of wheat grains immediately after harvesting was convenient and a quick way of recouping the invested funds particularly for the resource poor farmers in Nturumenti. In 2019, a follow-up study, conducted approximately 5 years after the exposure to determine the adoption and technology diffusion rate, it was observed that close to 80% of the agro-pastoral farming CBO members adopted more of the technologies associated with pasture establishment, production and conservation albeit the fact that they were lowly ranked in terms of awareness, at 13.3% for pasture establishment, synonymous to reseeding, and 16.7% for harvesting and conservation of cereal crop residues referred to as feeding of wheat straw during the ex-*ante* study. Indeed, the adopted ideas were practiced at commercial level and even diffused to non-CBO members. The findings indicate that even though, field demonstration exposed the farmers to a wide "menu" of technology options, the farmers, starting with the early innovators, adopted the technologies that mostly suited their needs and guaranteed to improve their livelihoods; and others farmers 'imitated' them.

Introduction

Technology dissemination, diffusion and adoption is a complex process. A number of factors, some based on the particular technology aspect (Comin and Mestieri 2013) and also intrinsic factors of the adopters (Bandiera and Rasul 2010; Gudrun Dahl 1987), affect the adoption plane. The phase of agricultural technology adoption in developing regions is even more intricate since societal factors also come to play (Bandiera and Rasul 2006). A cross-sectional study of 23 randomly sampled famers from an area where 8 different technologies were promoted by a project funded by International Centre for Agricultural Research in Dry Areas (ICARDA) was conducted in 2019, approximately four years after end of the project. The aim of the study was to determine the level of adoption of three technologies, two of which were promoted by the project (pasture establishment and conservation; rearing of Dorper sheep) and one which was not (rearing of improved dairy cattle) but that was expected to be triggered by the presence of good pasture material emanating from the establishment and promotion of conserved forage.

Objective

The objective of the current study was to determine the adoption and rate of technology diffusion of pasture and livestock husbandry practices among an agropastoral farming community in a Kenyan arid and semi-arid land (ASAL).

Methods and Study Site

A data capture tool was designed for the cross-sectional study which was filled during farm excursions to the randomly selected respondents. Among other parameters, data was recorded on name, age category and gender of the farmer, years involved in farming, agricultural farming technologies applied in the farm, where technology was sourced, type and breed of livestock reared in the farm and whether the farmer had participated in the ICARDA project and or if was a member of the AFAPO – CBO.

Results

The randomly sampled farmers (Table 1) consisted of, 9 (39%) farmers who participated in the project (contact farmers) and 14, (61%) farmers who did not participate (non-contact farmers).

Table 1: CBO membership status of farmers interviewed

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Member	9	39.1	39.1	39.1
	Non-member	14	60.9	60.9	100.0
	Total	23	100.0	100.0	

In terms of gender (Table 2), out of the 23 farmers interviewed, five (22%) were female and males were 18 (78%).

Adoption of pasture, Dorper sheep and dairy cow rearing technologies

Overall, the adoption rate of the two technologies disseminated; pasture production and rearing of Dorper sheep, varied between the technologies and across the two categories; members and non-members with the level of pasture technology adoption being the least 48% and sheep rearing being the highest, 91% (Table 2). However, when segregated into member and non-member status, it was observed that contact farmers had more adoption rate (56%) compared to non-members (43%). However, dependence test showed that the differences were not statistically significant (p=0.552).

Table 2: Adoption rate of pasture, Dorper sheep and dairy cow technologies

Farmer status	Type of technology adopted (%)		
	Pasture	Dorper sheep	Dairy cow
Member (N=9)	55.6	88.9	77.8
Non-Member (N=14)	42.9	92.9	28.6
Mean (N=23)	47.8	91.3	47.8

The pasture production technology was further classified into two; up to 5 acres and above 5 acres (Table 3) planted. Overall, most of the respondents 26% had up to 5 acres of their land parcels on pastures. Those who had more than 5 acres of their land on pastures were 22%. However, the adoption rate varied between the members and non-members and was 33% and 21% respectively for those having up to 5 acres on pasture. Similarly, adoption was higher, 22%, for members and 21% for those having pastures on more than 5acres of land portion.

Table 3: Proportion of land under pasture production in Nturumenti.

Farmer type	Acre of land under pasture (%)		
	none	1 - 5	Above 5
Member (N=9)	44.4	33.3	22.2
Non-member (N=14)	57.1	21.4	21.4
Mean (N=23)	52.2	26.1	21.7

Majority of farmers (52%) did not have land under pasture especially for farmers who were not members of the CBO (57%). Those with land under pasture ranging one to five acres were 26% (Table 4). Although more of contact farmers, (33%) had more land on pasture than the non-contact (21%), the differences was not significant (p=0791). The technology of pasture production was being adopted by farmers with bigger parcels of land.

In Dorper sheep technology, non-contact farmers had slightly more adoption rate (93%) than members (89%). Overall and across the study area, grade dairy cow rearing technology adoption rate was 48% (Table 3). However, big disparity in adoption rate between members (78%) and non-members 29%) was observed, an indication that adoption rate depended on farmer status (χ^2=5.316, p=0.021). In contrast, dairy cow rearing technology adoption rate was low, 48% (Table 4) but which also showed variation between the member and non-member status, 78% and 29% respectively. The dairy cows, averagely 2 cows per farmer, were reared by CBO members on approximately 4 acres of land as opposed to the Dorper sheep, 16 heads, on the same parcel (Table 5)

Tables 4: Rate of technologies adoption for CBO and non-CBO members in Nturumenti

Farmer status	Acre pasture	Dorper sheep	Dairy cows
Project member (N=9)	3.9 (6.49)	15.8 (9.47)	1.7 (1.58)
Non-project member	2.8 (4.42)	13.6 (6.83)	0.6 (1.09)
Mean (23)	3.2 (5.21)	14.5 (7.83)	1.0 (1.38)

Flock sizes of Dorper sheep reared by either contact or non-contact farmers.

Higher percentage of contact farmers (33%) had more than 20 Dorper sheep per household compared to non-members with only 21% who had more than 20 herd per household (Table 5). Most of the non –contact farmers had flocks of up to 19 sheep. However, dependence test showed that this differences was not significant (p=0.537).

Table 5: Proportion of farmers belonging to CBO or not rearing Dorper sheep

Farmer type	Number of Dorper sheep (%)		
	Less than 10	10 – 19	20 - 29
Member (N=9)	33.3	33.3	33.3
Non-member (N=14)	21.4	57.1	21.4
Mean (N=23)	26.1	47.8	26.1

Size of dairy cow herd reared by either contact or non-contact of farmers

Largely, CBO members owned more cows than the non-members. The proportion of non-CBO member farmers (71%) did not own dairy cow as compared to farmers (22%) who participated in the project (Table 6). Majority of famers (56%) who were exposed to the technology owned between one and two dairy cows (Table 6). Dependence test showed that there was high correlation between exposure to technology and owning a dairy a dairy cow (χ^2=5.807, p=0.055).

Table 6: Proportion of farmers belonging to CBO or not rearing Dairy cows

Farmer type	Number of Dairy cow Number (%)		
	none	1 – 2	3- 5
Member (N=9)	22.2	55.6	22.2
Non-member (N=14)	71.4	14.4	14.3
Mean (N=23)	52.2	30.4	17.4

There was high significant positive correlation (p=0.017) between area under pasture and number of dairy cows per household. Households with larger area under pasture had more dairy cows meaning that the availability of plenty of pastures encouraged the rearing of grade cows. However, the correlation between area under pasture and flocks of Dorper sheep was not significant. There was some mild positive correlation between the number of Dorper and the number of dairy cow per household (p=0.246) meaning that farmers who were successful in rearing of sheep, were diversifying by rearing large ruminants, high yielding dairy cows.

Discussion

Overall, the adoption rate of the two technologies disseminated; pasture production and rearing of Dorper sheep, varied between the technologies and across the two categories; members and non-members with the level of pasture technology adoption being the least 48% and sheep rearing being the highest, 91%. But when segregated into member and non-member status, the diffusion rate was high among the contact farmers (56%) as compared to the non-members (43%). Among the agropastoral community in the study, sheep is treated as petty cash and a must have (Wahome 2018; Konig et al. 2016; Katiku et al. 2013) because of its many uses; cultural and economic. Among the Maasai community, sheep are reared for meat but also play a role of providing milk for domestic consumption (Wahome 2018; Benkhe and Muthami 2011). Comparatively, Dorper sheep yields more milk than the Red Maasai sheep explaining their higher rate of adoption (Konig et al. 2016). Farmers were adopting dairy cows in order to increase and diversify the sources of milk for initial home consumption and the surplus for sale (Quinlan et al. 2016; Gudrun dahl 1987). However, in terms of ranking for milk production and other benefits, the small stock is ranked behind cattle (Kosgey et al. 2008) meaning that if conditions were favourable particularly pasture availability, dairy cows would be reared.

The initial adopters of pasture and Dorper sheep were officials of the CBO. They similarly had bigger flocks of sheep and bigger parcels of land. It is these members of the community that influenced the diffusion of the technologies because of their position in the community i.e. they are respected because of their positions of responsibility and leadership. Similar observations are reported by Sinja et al. (2004). The team while working with farmers in Northern part of Zimbabwe, found out that farmers' decisions to adopt a new crop was influenced by their social hierarchy and networks.

Size of pasture land, Dorper sheep and dairy cattle rearing

On average, farmers who participated in the project had each 2 hectares (four acres) of land under pasture. They were also keeping on average 16 Dorper sheep and two dairy cows. The figures for non-members were slightly lower, one hectare (3 acres) of land and 14 head of Dorper sheep and one head of cow (Table3) meaning that they were still in the process of adopting the technology from their neighbouring farmers. It's reported that a farmer will imitate a neighbour's behaviour when the neighbour is successful especially in cases where the farmer has little experience of his own (Conley and Udry 2010). Related to the extent of adoption is the cost of the technology, level of interactions among the farmers and the level of knowledge and specifically the extent of 'learn on the job' type of exposure (Comin and Mestieri 2013). The contact farmers, CBO members, immensely benefited from this kind of learning through the innovation platform conducted during the dissemination of the two technologies, pasture establishment and sheep rearing.

There was no female headed households practicing pasture production. Male headed households had on average at least four acres of pasture with a herd of 15 Dorper sheep and one dairy cow as compared to female headed households who on average had 13 Dorper sheep and rarely one dairy cow. These results agree with the reported norm (Miriti et al. 2019) that in most ASAL communities, and more so for the Maasai community who are also more patriarchal, most resource, land and animals, belong to the male gender.

Conclusion

It is concluded that when dealing with smallholder pasture and livestock technologies farmers, it is helpful for the disseminators to provide sufficient information on the idea and to initially target the more influential members of the community since they are trusted by the rest of the community. Other members of the community will eventually adopt practices that they observe being implemented by people in their locality and are in positions of leadership in the society.

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