



Innovation system approach to technology transfer and outreach in Adamawa state, Nigeria

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Abstract

In this survey study, innovation system approach to technology and outreach was carried out in Adamawa state. Specifically, livestock technology transfer, technologies introduced to respondents and technologies most preferred by respondents in the innovation system were determined. Structured questionnaire was used to collect data from 300 respondents (cattle marketers) in three major cattle markets of the State (Mubi, Ganye and Song) and a focus group discussion (FGD) with 45 actors was conducted in the same location where the markets were sited. Respondents were selected using purposive and multistage random sampling techniques. Descriptive statistics (tables, frequencies, percentages and ranks) were used as tools of analysis. Results revealed that majority of the technology in the system were transferred via extension contact (99.3%) which was closely followed by research institutes with 98.6%. Furthermore, modern transportation technology using large trucks divided into compartments and layers, exchange of information using ICTs, veterinary inspection and collaboration with other actors were the technologies introduced to respondents in the recent past. Others include, livestock sanitary practices, new market outlets and marketing standards. The result further reveals that modern transportation, veterinary inspection, use of ICTs and networking/collaboration with other actors were the most patronized and preferred technologies with 72.0%, 70.2%, 69.9% and 67.7% respectively, these were ranked 1st to 4th. It was recommended that major actors (extension agents, research institutes and cattle marketers association) should strengthen their linkage and collaborate more so as to transfer technology even faster than it is currently obtained.

Keywords: innovation, collaboration, technology transfer and innovation systems

Introduction

Innovation performance depends on the way in which different stakeholders of the innovation system interact with one another, this is done through pathways and there are a number of pathways through which stakeholders (actors) can interact to transfer technologies, the most common include: cooperative research arrangements, education and training, exhibits, government assisted programmes, direct sales/purchases and joint ventures.

Technology transfer is the process of acquiring, sharing and providing knowledge, skills, technologies, personnel and facilities among individuals, research institutes and other organizations to enable the accessibility of technological developments to a wider range of users who can further develop and exploit the technology into new products, processes, materials or services (Mitasiunas, 2013) [6]. Low productivity of small scale farmers in developing countries is often attributed to lack of innovation and low- or non-adoption of improved agricultural technologies. Low productivity may be attributed to the unavailability of technologies and lack of innovation culture among the small-scale farmers. Thus, the question posed is whether this is due to the low extension agent to farmer ratio (1:1500 in most developing countries) which makes it difficult to deliver technologies to the farmers or the small farmer is just too risk averse to want to try out new technologies? Another fact may be that the linear top-down method of technology development and transfer in which

farmers are regarded as spectators in the development process (Hall *et al.*, 2002; World Bank, 2006) [4, 8]. This linear-top-down extension delivery is restrictive in nature which hinders its ability to stimulate the much needed breakthrough to promote innovation and adoption among farmers by disregarding other non-traditional knowledge sources (Daane, 2010) [2].

However, the supply and demand of improved technologies involves a multi-faceted interaction among different actors both in the public and private sector with each playing significant roles to stimulate and trigger innovation, development and adoption (Egyir *et al.*, 2010; Clark, 2002; Hall *et al.*, 2002) [3, 1, 4]. When technologies are developed in isolation with regards to the final users (farmers) this may serve as a disincentive for adoption when the technology is finally introduced to them. Another possible reason may be the low or general lack of innovation spirit among small farmers due to asymmetry information relating to market and improved technology, lack of technical-know-how and the infrastructural platform relevant to increasing yields (World Bank, 2006) [8].

Methodology

This survey study was conducted in Adamawa State Nigeria. It lies between latitudes 7° – 11° N of the equator and longitudes 11° – 14° E of the Greenwich meridian (Adebayo, 2004). The State covers a land area of about 39,741 km² with a population of 3,100,000 persons out of which 1,800,000 (58.06%) are

males while 1,300,000 (41.94%) are females (NPC, 2006). This figure projected at 3.4% annual growth rate brings the total population to 4,154,000 persons in 2016. A purposive and multistage random sampling technique was used in distributing structured questionnaires to cattle marketers. In the first stage, Adamawa State was purposively selected out of the three cattle producing states of northeastern Nigeria due to boko haram insurgency, secondly, three Local Government Areas (LGAs) were purposively selected (based on market size). These three LGAs make up the largest cattle markets in the state (Mubi and Ganye share borders with the Cameroon Republic, thus, they are actively involved in trans-border trades). (Adebayo *et al.*, 2012). One major cattle market was selected from each of the LGAs. The LGAs selected were: Mubi-North LGA, Song LGA and Ganye LGAs. Finally, there was a random selection of 300 respondents from the cattle markets which was in proportion to population size of the market sampling frame. Non inferential statistics such as tables, means, frequencies and ranks were used to analyze the data obtained.

Results and Discussion

Livestock Technology Transfer (TT) and outreach

Table 1 depicts the TT pathways in the innovation system in Adamawa State. It indicates the direction of diffusing new/improved agricultural discoveries/practices resulting from research institutes to other actors or vice-versa. It denotes a range of cooperation between technology developers and seekers and the form/level of TT in an innovation system depends on its functional relevance to agricultural, human and environmental development of the system.

Findings from the study revealed that various channels were used to pass across technology (innovation) to the respondents in the system. The pathways identified from the study includes: research institutes comprising of universities, polytechnics and college of agriculture COA (monotechnic) in the study area (Research institutes were used interchangeably with educational institutes because there were no distinct research institutes as is obtained in other places), extension contact, veterinary personnel, government assisted programs, marketers' association and demonstration.

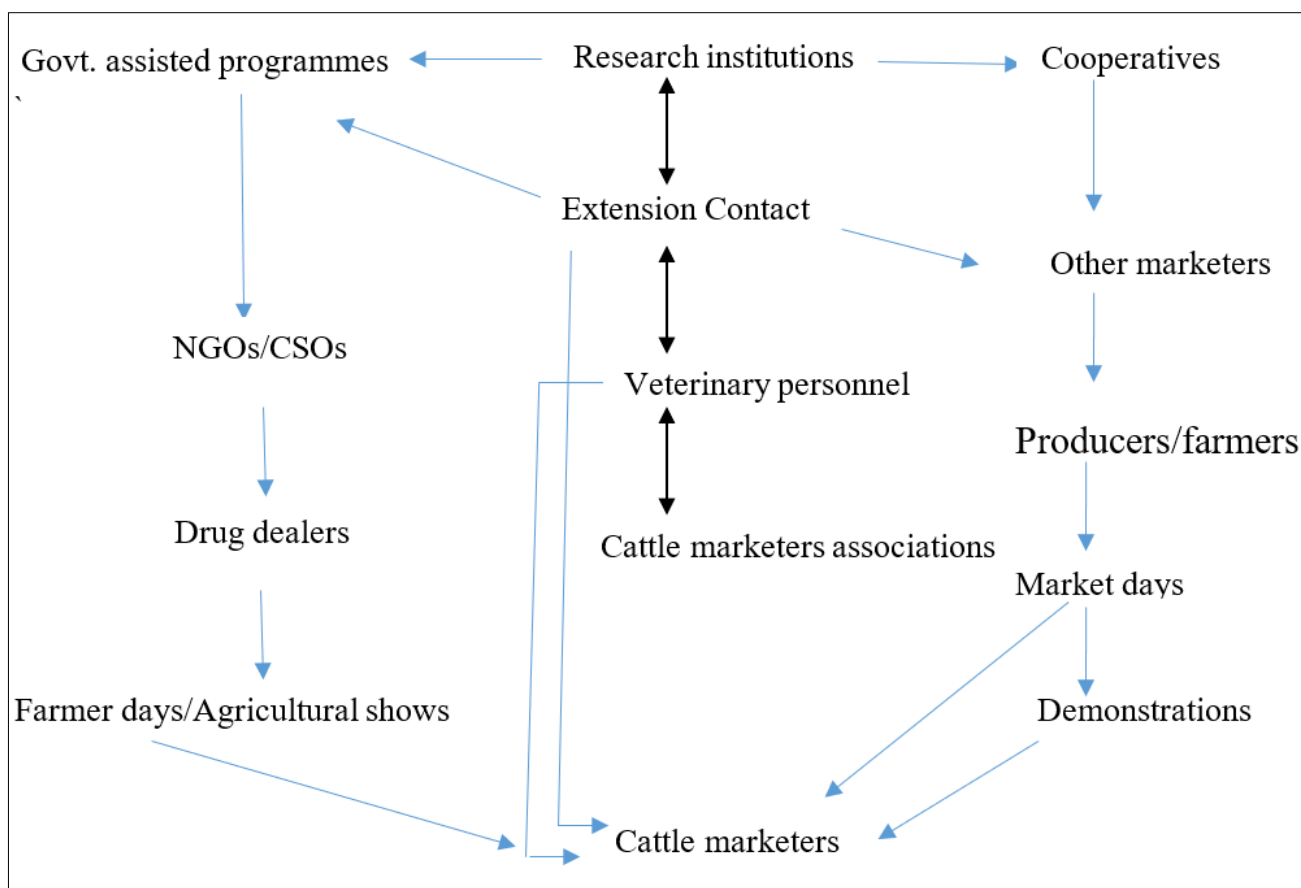
The table further shows the different technology transfer pathways in the system, it reveals that majority (99.3%) of the

technology in the system was transferred via extension contact which implies that extension agents are the most important factors that help to transfer, exchange and communicate technology around the system. This was followed by research institutes with 98.6% implying that, apart from generating the technology, they also move the technology to major actors in the system. 98.2% of the technology was transferred by cattle marketers' association, 97.9% through both governments assisted programs and other cooperative unions. The table further reveals that 91.8% of the technology is transferred by veterinary personnel, 74.5% by mass media and between marketers.

It can be observed from the table that 68.1% and 63.1% of the technology in the system were transferred through demonstrations (usually carried out by extension agents), market days and drug dealers respectively. The low percentage observed from agricultural shows might imply that, it is seldom used for transferring technology in the system. Other pathways used in exchanging technologies are through producers/fatteners, meetings/festivals and feed millers respectively. All these had percentages below 40% which might suggest that these pathways were less effective and thus less frequently used in transferring technologies.

Technology transfer channels in the innovation system

Technologies in the innovation system were found to be transferred through three (3) major routes. First the technologies were generated from the research institutions, it moves through extension services/contact to veterinary personnel, cattle marketers' associations and finally to the cattle marketers themselves as final consumers of the technology. It can also move from research institutes through cooperatives to producers/fatteners, market days and to cattle marketers while the third route is from the research institutions through government assisted programs to NGOs/CSOs, drug dealers, agricultural shows, feed millers and finally to the cattle marketers as shown in Figure 1. This could mean that most of the technologies being transferred were through research institutions, extension contact, veterinary personnel and cattle marketer's associations which might be due to the dual (feedback) communication process between them as indicated by the arrows in figure 1 below.



Key: Bold black arrows = major channels, Thin blue arrows = minor channels, *Source:* Field survey, 2016

Fig 1: Technology Transfer Channels of the Innovation System

Technologies introduced to cattle marketers in the innovation system

Table 2 shows the technologies introduced to cattle marketers in the last 5-10 years. The result reveals that various technologies were introduced to marketers through different pathways, indicating that they (marketers) are aware of such technologies. It further shows that modern transportation technology using large trucks divided into compartments and layers, exchange of information using ICTs, veterinary inspection/collaboration with other actors had 72.0%, 70.2%, 69.9% and 67.7% respectively, these were ranked 1st to 4th implying that these were the technologies introduced to marketers in the recent past which brought significant improvement in the innovation system.

Modern transportation has reduced stress and increased the number of livestock to be moved at a time, use of ICTs has enhanced exchange of information, linkages and networking among actors in the innovation system and veterinary inspection has improved the awareness of some actors (butchers, marketers, members of association) on the need to sell or slaughter healthy animals for consumption thus bringing about collaboration between all actors in the innovation system. This finding is buttressed with that of Nwogwu and Soremi (2015) [7] who observed that a large percentage (60%) of their respondents were introduced to and aware of ICTs in livestock innovation chain in Ibadan. Furthermore, the table reveals that livestock sanitary practices had (66.3%), vaccination (42.9%), new market outlets (Trans boarder trades)

(37.2%) and marketing standards (weights, heights, sizes) (17.7%) respectively. This implies that marketers were introduced to and are aware of such technologies but the low percentages of some of the innovation (new market outlet and standards) may suggest that there is low acceptance, patronage and subsequent low adoption of these technologies. This is in agreement with the findings of Jegede, *et al.* (2007) [5] who reported that technology transfers were over 50% for vaccination, deworming and spraying technologies while low percentages of below 30% were recorded for dipping and fumigation technologies in Enugu State, they concluded that, the low percentages were as a result of poor/low awareness level of farmers.

Technologies most preferred and used by the respondents

The result in Table 3 revealed the most patronized/preferred technology by marketers, the table reveals that modern transportation, veterinary inspection, use of ICTs and networking/collaboration with other actors were the most patronized technologies, these were ranked 1st to 4th as observed on the table implying that marketers have accepted, adopted and are currently using the introduced technologies. This suggests that the technologies have improved marketing performance and the innovation system. Modern transportation using compartments/layers for carrying livestock have reduced the stress and mortality rate of moving cattle on foot from place to place, the use of ICTs has improved the exchange of market information and reduced marketing costs implying that

transactions can take place over long distances without the customer having to be present while networking/collaboration have improved the awareness level of marketers.

Other technologies patronized by the marketers include sanitary practices (57.1%), new market outlet (37.6%) and vaccination (35.1%). these were ranked 5th to 7th respectively as shown on the table. Based on the low-ranking positions (6th and 7th) new market outlet and vaccination, it might suggest that, though these technologies are preferred by respondents, they are still less frequently patronized which may be attributed to the cost involved in vaccination and moving to new market locations, this may eventually have a negative impact on the innovation system. It was found out during the FGD session that only butchers sometimes make use of cold storage system if their goods are not exhausted for the day while some marketers only use standards if they perceive or anticipate a better value for their product. It can thus be concluded that standards and the use of cold storage systems (cold vans) are not practiced in the innovation system.

Table 1: Technology Transfer Pathways in the Innovation System

Pathways	Frequency	Percentage
Research institutes (ADSU, MAUTECH, COA, COE, COHTECH).	278	98.6
Extension contact	280	99.3
Cattle marketers association	277	98.2
Veterinary personnel	259	91.8
Cooperative associations	276	97.9
Mass media	210	74.5
Other marketers	210	74.5
Producers/fatteners	100	35.5
Market days	192	68.1
Demonstrations	192	68.1
Drug dealers	178	63.1
Farmer days/Agricultural shows	101	35.8
Gove. Assisted programmes	276	97.9
Meetings/festivals	94	33.3
Feed millers	90	31.9
NGOs/CSOs	88	31.2

Source: Field Survey, 2016, * Percentages based on multiple responses.

Table 2: Technologies Introduced to Cattle Marketers in the innovation system (in the last 5-10 years)

Innovation (New technology)	Frequency	Percentage	Rank
Transportation	203	72.0	1 st
Use of ICTs (exchange of market information)	198	70.2	2 nd
Veterinary inspection	197	69.9	3 rd
Networking/collaboration with actors	191	67.7	4 th
Sanitary practices	187	66.3	5 th
Vaccination	121	42.9	6 th
New market outlets	105	37.2	7 th
Standards (weights, heights, sizes)	50	17.7	8 th
Cold storage	29	10.3	9 th
Others	5	1.8	10 th

Source: Field Survey, 2016, *: Percentages based on multiple responses.

Table 3: Technologies most preferred and used by respondents

Technologies	Frequency	Percentage	Rank
Transportation	219	77.7	1 st
Veterinary inspection	181	64.2	2 nd
Use of ICTs (exchange of market information)	175	62.1	3 rd
Networking/collaboration with actors	169	59.9	4 th
Sanitary practices	161	57.1	5 th
New market outlet	106	37.6	6 th
Vaccination	99	35.1	7 th

Source: Field Survey, 2016, * Percentages based on multiple responses.

Conclusion

Based on the analysis of the study, it is therefore concluded that extension agents, research institutes and cattle marketers' association are the most important actors that help to transfer, exchange and communicate technology around the system with modern transportation technology using large trucks which is divided into compartments and layers is the best way for carrying livestock because it reduces the stress and mortality rate of moving cattle on foot from place to place. It is thus recommended that these major actors (extension agents, research institutes and cattle marketers association) should strengthen their linkage and collaborate more so as to transfer technology even faster than it is currently obtained.

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