Towards Improving Agricultural Extension Service Delivery in the SADC Region

Proceedings of the Workshop on Information Sharing among Extension Players in the SADC Region



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Background

Sustainability and productivity of agricultural sector worldwide depends on the quality and effectiveness of extension services among other factors. Observations show that in developing countries, there is a gap between agricultural performance and available research information. This has been attributed to poor extension services delivery as well as limited interaction between technology developers (researchers) and extension workers. Poor communication between actors in extension services delivery particularly the Government, NGOs, private sector (agribusiness) and farmers has also been shown to hinder flow of developed technologies to farming communities.

Extension workers are known to be the link between researchers and farmers. To fulfill this role effectively they have to keep abreast with new technological developments. This calls for the extension workers and researchers to work together as partners in the research and innovation processes with strong linkages. A strong link between extension workers and researchers will improve the quality of disseminated information, as well as, adoption of new technologies by farmers, and consequently lead to increased agricultural production and improved livelihoods of the rural poor.

It was through the appreciation of this that Sokoine University of Agriculture (Tanzania) in collaboration with the University of Zimbabwe and Eduardo Mondlane University (Mozambique) organized a regional workshop in Dar es Salaam, Tanzania to:

- Promote information sharing through networking and improve the existing knowledge base on extension service delivery
- Strengthen linkages between technology developers and extension workers in the SADC region
- Deliberate on how strengthened linkages between technology developers and extension can lead to increases in agricultural productivity and incomes of smallholder farmers
- Map out a strategy to address the existing Agricultural research-extension gap in the SADC region.

This document is a compilation of scientific papers presented in the workshop presented by SADC Member State. The workshop addressed six specific areas of interest as listed below.

- Strategies and methodologies of extension services delivery
- Social economic factors in strategies and methodologies of extension services delivery
- Extension service delivery: country specific information
- Bridging the gap between researchers and extension workers/farmers
- Bridging the gap between researchers and extension workers for policy change
- Networking in Extension service delivery

Agricultural Extension in Botswana: Growing a Hybrid over Decades of Selective Experience

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Summary

The study reviewed agricultural extension in Botswana to assess its growth and achievements in ensuring good service delivery since 1935 when formal structures of agricultural extension were beginning to establish. The objectives were to (1) identify the strategies that have been used over time; (2) determine the merits and demerits associated with the strategies; (3) identify the challenges of the extension system; (4) determine the extend of use of the lessons from historical approaches in maintaining good service by the present extension system; and (5) make recommendations for further improvement of extension service delivery. Published and unpublished secondary sources revealed several restructuring programs undergone by agricultural extension, and up to six different extension approaches that have been tried out over the years (1935 – 2005). Restructuring programs dealt with challenges of previous extension approaches each time a new one was introduced. Aspects of challenges to effective extension delivery in Botswana: administrative or management, staff training, Physical, farmer, and general, have persisted through out the 65-year evolution of Botswana's agricultural extension service. Human resource management reforms such as job analysis, supportive supervisory interpersonal relationships, organizational development and work life improvement are discussed and recommended for further improvement of agricultural extension in Botswana.

Key words: Agricultural Extension Delivery Challenges

Introduction

In the developing countries, improvement of agricultural production, profitability, and sustainability depends on the farmers, to adopt change and their innovative use of technologies, organizational approaches, management systems, institutions, and availability of resources. Agricultural extension through advisory services and programs forges to strengthen the people's capacity to innovate by providing access to knowledge and information. According to the USAID report (2002), farmer capacity building can be achieved through (1), advising farmers on opportunities not only in agricultural production as it is the case in developing countries, but in marketing, conservation, and family livelihoods; (2) facilitating development of local skills, organizations, links with other programs, and related institutions; (3) developing and transferring new technologies to farmers; and (4), taking a wholesome approach to addressing public interest issues in rural areas such as resource conservation, health, monitoring of food security and agricultural production, food safety, nutrition, family education, and youth development.

Presently, according to Information Communication Technology (ICT) bulletin (2003), agricultural extension is at a time of crisis with services which are suffering under bureaucratic centralized management structures. The report adds that the agricultural extension services find themselves squeezed by decentralization policies, diminishing public funds and the privatization of public services that urgently need changing. The ICT report points out to processes such as decentralization, privatization, and a diverse range of information service delivery systems that respond to the needs of all beneficiaries shaping agricultural extension worldwide.

In Botswana, a number of factors challenge the success of the extension delivery system. The First National Conference on Agricultural Extension in 1995 identified five major categories of problems that are:

- ***Physical*: r**eferring to rainfall that leads to low and unreliable yields, limited market for products and inadequate transport and communication facilities.

- ***Administrative or Management:*** referring to inadequate residential and office accommodation, uncoordinated grass root level extension system, low moral among extension workers, extension agents attending to administrative and emergencies rather than extension duties, un complimentary programs, subsidies targeted to operations rather than to the product and lack of targeted programs for farmers.
- ***Training:*** as in the shortage of specialized trained personnel and inadequate in-service training.
- ***Farmer:*** the constraints including lack of credit facilities, absentee farmers, poor adoption rate due to negative attitudes, shortage of drought power, shortage of farm labour, inadequate farmer's organizations, and inadequate knowledge and skills on improved farming practices.
- ***General:*** referring to poor coordination among sister departments, inadequate research extension linkages, extension agent/farmer ratio too high, and some extension areas too wide for one agent.
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The paper provides a review of agricultural extension in Botswana with emphasis on previous systems since 1935. The focus is primarily on the lessons throughout the evolution of agricultural extension, systems and approaches: challenges and opportunities offered for the improvement of the present. As pointed out by Hulme (1989), whatever the present situation is regarding extension, an awesome set of problems ought to be tackled if service delivery is to be made more effective. The paper suggests the answers to improving Botswana's agricultural extension as embedded in the historical path through which it evolved, and the present approaches aiming at improving the past.

Methods and data sources

According to Adam (1992) there is "little that can be said about improving extension that has not been said before". He says that many of the "so called new ideas" about extension often turn out to be earlier visions not put in practice. As stated by Creswell (2003), the purpose of literature review is to share with the reader the results of other studies that are similar to the one being reported on. Therefore, to gain an in-depth understanding of the challenges and opportunities for agricultural extension in Botswana overtime, secondary sources were reviewed. Botswana government documents, conference proceedings, reports, other studies, informal interviews and discussions with Ministry of Agriculture officials, extension workers and experts, and farmers provided the data used in the paper. The emerging lessons and themes of issues provided the basis for the recommended strategies for further improvement of agricultural extension in Botswana.

Findings

Agricultural Extension Approaches Used in Botswana and Challenges

The purpose of agricultural extension service in Botswana has always been to assist all farmers regardless of their socio- political status and presently, with more emphasis on group extension approaches than individual. The first extension activities in 1926 emphasized animal agriculture whose specific messages targeted dairy production. The duties of the first extension agent, the dairy inspector covered extension and research. According to Hobb (1985), the agent's responsibility was to find the best management practices for dairy production and persuading farmers to adopt the practices.

In 1935, the Department of Agriculture was established. The department's mandate was to do research on crop and pasture agronomy, and develop pig, poultry, and forestry production while other livestock production was relegated to the Veterinary Department. The extension approach used then was the Foremen Farmers. "Foremen", referred to also as 'Cattle Guards" were appointed by the department of Veterinary Services which had been established much earlier to advise farmers. The extension system under the Foremen Farmers approach was found to have little effect and was eventually changed in 1947. At the same time, the emphasis of extension in 1940's shifted to small scale, traditional sector agricultural production. As a result, two small scale irrigation schemes were set up.

In 1947, the Cooperative Demonstration Plot Scheme (CDPS) therefore, became an established extension approach and marked the birth of a fully fledged agricultural extension service in Botswana (Lever, 1970). The CDPS extension approach required extension agents to conduct demonstrations on the farmers' fields to get new technologies to reach a wider population of farmers. This was for a wider coverage of the dissemination of information. Despite the high yields on the demonstration plots, many farmers failed to continue once they did not have access to subsidies. New ideas did not transfer to the farmers' fields as sustainability and adoption of ideas were a major problem in this system.

The Pupil Farmer Scheme (PFS), an approach based on a concept borrowed from Zimbabwe replaced the CDPS in 1962 (Lever, 1970). In the PFS extension approach, one extension agent worked with and targeted 15 to 25 farmers. To qualify as a pupil farmer and be part of the 15 to 25, a farmer had to own a plough, drought oxen, and have cleared the bush and de-stumped his or her field. As the pupil farmer progressed and production methods improved, he or she was promoted using a scale of "pupil farmer, progressive, improved, and then master farmer", the highest ranking (Baker, 1988). Five years into the implementation of the PFS yielded 4150 registered farmers; thus making 16% of the farmer population in Botswana registered under the PFS. The total according to the categories on the progression scale were, 1700 pupil farmers, 1400 improved farmers, 750 pupil livestock men, 200 progressive farmers, 100 master farmers. Farmers who were not registered with the scheme were not getting any extension advice. The PFS approach was dropped and replaced in 1976 following a consultancy commissioned to evaluate the scheme (Willet, 1981). Some of the constraints unveiled by the evaluation were: lack of coordination, inadequate supervision of staff, lack of equipment, poor transportation, poor housing, selectivity and limited coverage.

The Ford Foundation supported consultancy commissioned by the Botswana government in 1972/73 to review the national rural development programs recommended a shift in focus from subsistence to commercial farming and the replacement of the PFS by a more 'modern' approach that was able to reach more farmers, the Integrated Rural Development Program (IRDP). The approach proposed combined both rural and agricultural extension service delivery and covered many rural development projects such as education, rural infrastructure, water supplies, health, rural industries and agriculture (Mrema, 1995). For agricultural extension, emphasize was to be on group methods and work through farmers associations, and individual farm visits. More funding for research, agricultural credit schemes, and subsidies for agricultural inputs was recommended. Therefore, the PFS was eventually replaced by the Accelerated Rural Development Program (ARDP) in 1973 to 1976 following a report by the consultants, Chambers and Feldmann (1973) and recommendations for an integrated rural development program. However, according to Mrema, (1995), Chambers (1977) reviewed the ARDP in 1976, after three years of implementation. Chambers observed that:

- Overall, the ARDP was a success as a rural extension system and thus, a success at providing services and building rural infrastructure but poor in raising agricultural productivity and production (Odell 1978 in Mrema, 1995).

- Success was evident in the implementation of rural infrastructure and social welfare projects.

- The implementation capacity of the ARDP on agricultural development was the lowest as only 30% of the allocated budget had been used by the end of the three years. Lack of trained workforce was seen to be the cause of poor implementation capacity of the Ministry of agriculture (MoA) during the ARDP.

After the Chambers (1977) report, the Ministry of Agriculture engaged in several human resource development projects including the expansion of Botswana College of Agriculture in 1979-84, then the only College in the country offering higher training in agriculture. This was to offer personnel of the Ministry opportunities for higher training at BSc and MSc.

As per the influence of development ideologies of major international agencies such as FAO, the Botswana government introduced the Farming Systems Approach (FSA) in the 1980's and several programs assisting farmers with inputs such as Arable Land Development Project (ALDEP), Accelerated Rainfed Arable Project (ARAP) and Agricultural Technology Improvement Project (ATIP). This was an attempt to increase farmer productivity and agricultural production. Challenges of the extension approach were reported as: the spending of lots of money on subsidies was worrisome, a major part of agricultural extension service was to ensure the subsidies reached farmers and therefore, a diversion from its mission; and, a big proportion of the extension agents work time went to the distribution of inputs, payment of subsidies, and assessment of farmer applications.

In 1989-90, a major review of the agricultural sector in Botswana was conducted and the findings led to the development and adoption of a new agricultural policy that emphasized household food security as opposed to national food self sufficiency in 1991. The challenges for agricultural extension with the new policy were reported by Mrema as: extension advice to farmers needing a design that gave maximum economic benefit rather than promoting national production plans; farmers requiring economically sound advice on farm techniques that are relevant to their situations rather than attempting to produce food that ignores their economic advantages; subsidies included in the policy packages needed targeting; farmers expected to adopt a commercial rather than a subsistence production approach; and, service provision through the private sector not forth coming and requiring encouragement.

At the same time as the new policy on agriculture was formulated, The Ministry of Agriculture underwent a major reorganization through the Organizational and Methods (O&M) study of the Government Departments. This led to the split of the former Department of Field Services and the establishment of two parallel agricultural extension systems in the Ministry and regions: one system was for livestock production and health, and the other for crop production and forestry.

The Ministry of Agriculture underwent another restructuring through the Organizational and Methods exercise. The restructuring was approved by Cabinet in November, 2005 and the implementation began in 2006. The restructuring took into consideration a number of recommendations from Mrema (1995) and others at the First National Conference on Agricultural Extension (1995). Some of them were the separation and renaming of the Department of Animal Health and Production, the Department of Veterinary Services and another one of Animal Production. The two departments are under the Deputy Permanent Secretary, Technical Services. In addition, the extension services were reorganized into one unified extension service under six Regional Agricultural Coordinators at regions and coordinators reporting to the Deputy Permanent Secretary (Support Services). Other departments which were renamed were the Division of Agricultural and Statistics as the Division of Research and Statistics; the Department of Crop Production and Forestry became the Department of Crop Production. Another new department was that of Agricultural Business Promotions; while, the Department of Agricultural Research was maintained without change. The other recommendation was the establishment of a coordinating unit of agricultural extension under the Deputy Permanent Secretary's Office (Support Services). This meant the integration of agricultural extension functions under Crops and Horticulture, Animal Production, Farmer Education, Animal Health, Agricultural Business Promotion and Conservation of Agricultural Resources would be under the coordination of Extension Service Coordination Department.

The roll out of the implementation plan of the restructuring continues with challenges. According to discussions at forums such as the stakeholders workshops of the Rural Extension Coordinating Committee (RECC) and Farmer Association Meetings, by the extension personnel and experts, other Agricultural Officers at the Ministry of Agriculture and farmers countrywide, as the roll out of the implementation plan of the restructuring continues, challenges also emerge. These are:

- Staff movements of the MoA such as retirement, redeployment, inter departmental and inter ministry transfers disturbed continuity of extension service delivery, as well as delayed programming.

- The Department of Extension Service Coordination not having its own personnel but coordinating the activities of other department personnel and causing confusion in the leadership and role conflict among staff.

- Having no unifying strategic plan for departmental extension functionaries coordinated by the department of Extension Service Coordination therefore causing confusion especially at the extension-farmer interface.

- Inefficient services provision by extension workers in the respective extension areas and district.

Table 1: Agricultural Extension Strategies and Challenges of Year 1947 to 2005

YEAR	EXTENSION APPROACHES	CHALLENGES
1935	Foremen Farmer	Little effect on adoption and farmer development
1947	Cooperative Demonstration Plot Scheme	Problem with sustainability and adoption of ideas.
1962	The Pupil Farmer Scheme	Lack of coordination & inadequate supervision of extension staff. Lack of equipment. Poor transportation & housing for extension agents. Scheme selective with inadequate coverage.
1972	Integrated Rural Development Program	Improvement to the Pupil Farmer Scheme not evident. Became more of a rural extension with many rural development projects than agricultural extension.
1973	Accelerated Rural Development Program	Poor in improving agricultural productivity & production. Poor implementation capacity and lack of trained workforce.
1980	Farming Systems Development Approach	Diversion of extension from its mission' Extension agents spending more of their work time on distribution of inputs, payment of subsidies, & assessment of farmer applications.
2005	Unified Extension System With Regional Agricultural Coordination	No continuity of extension programmes due to slow process for filling up positions in the new department. Delayed extension operations due to MoA staff movements. Lack of a common/unifying strategy for all departments in the MoA that have an extension function.

Table one illustrates the evolution of agricultural extension in Botswana over 65 years and seven strategies that were adopted and used over time, plus the challenges experienced. According to Mrema (1995), all types of extension approaches have been used in Botswana. He gave examples of the Pupil Farmer Scheme, the Farming Systems Research projects by Agricultural Technology Improvement Project (ATIP), as examples of strategies that have been modeled around the Training and Visit (T&V) and Farming Systems Research (FSR) extension approaches, respectively. The T&V and the FSR are within the framework of eight agricultural extension approaches used by extension organizations world wide (Axinn, 1988).

Lessons and Opportunities for Improvement

The experience from the historical approaches to improving agricultural extension delivery, a number of lessons can be drawn that further advise the present extension system. The trend emerging from table one shows changes that occurred in agricultural extension in Botswana; in some cases, faster than the implementation of intervention programmes meant to tackle challenges of previous systems. For instance, it took 12 years and 15 more to accept that the Foremen Farmers and the Cooperative Demonstration Plot Scheme that followed it were not working. While, one year was enough to show that the Integrated Rural Development Programme was not much of an improvement on the Pupil Farmer Scheme that it replaced. This amplified the importance of monitoring and evaluation, and the frequency at pre-determined intervals.

In addition, It appears from the thematic analysis of the challenges as reported by the evaluation of the systems that some functions of management were at fault: lack of coordination and supervision of extension staff, diversion of extension from its mission, lack of adoption by farmers, lack of continuity of extension programmes, and poor implementation capacity are some of the challenges that are indicative of the fact. This confirms the contention by Rivera and Kalim Qamar (2003) about the extension organizations having to revitalize their management systems and programmes. They suggest four key management functions in extension: good leadership, high level employee training, increased budgets and salaries, and combating resistance of change by extension personnel.

Conclusions

The purpose of this paper was to review the history of agricultural extension in Botswana to identify the strategies that have been used to improve service delivery, determine the challenges, the interventions targeting the challenges, and the success of the intervention programmes at meeting the challenges for a more improved agricultural extension in Botswana. The following conclusions were made:

1. Seven extension strategies have been used, one after the other, over 65 years since 1935. It appears that the restructuring and organization of agricultural extension in Botswana has utilized aspects of all eight types of approaches found essential in agricultural extension world wide. This in itself is invaluable experience that needs factoring into all future evaluation or restructuring exercises to improve service delivery.
2. All restructuring programmes of the Ministry of Agriculture (MoA) were an attempt to solve problems of previous extension approaches and strategies thereof. However the timeliness was a challenge as the criteria guiding the choice of interval at which the monitoring and evaluation was done and decisions for replacement of an approach were made were not clear.
3. The five groups of constraints of agricultural extension in Botswana: physical, administrative, staff training, farmer, and general/logistics are recurring problems from 1935 and are well known. This is evidenced by the mention of the same even presently, in agricultural extension fora country wide.

Recommendations

All five constraints of agricultural extension in Botswana excluding can be addressed through a management framework that enables the development of appropriate structures for the organization of agricultural extension, the design of best strategies and a strategic human resource plan. This is to manage change, have continuous development of intervention programmes for improving the system and at the same time recognizing the diverse needs of farmers and those of extension agents. The following human resource management reforms are recommended in order to strengthen those already in place such as the Performance Management System (PMS):

1. Job Analysis: - the Moa should review the current jobs of extension workers to develop more current job profiles especially for extension agents who are at the forefront of the agricultural extension service delivery. Job analysis should also indicate the current skills requirements of extension workers. As noted by Vijayaragavan and Singh (1989), most extension organizations do not have clearly defined job descriptions or job specifications for extension workers. The same applies to the MoA in Botswana. There is no evidence of a job description or job specification review for extension workers since the Job Evaluation Exercise of the Public Service in the late 1980s. However, a Job Analysis study by Tladi (1996) revealed that the job of extension agents had eight job operations or objectives, with three, farmer education, administration of extension services, and implementation of government schemes seen by extension agents as most important.
2. Organizational development and change management: - The average education level of Botswana farmers with increasing unemployment of graduates and more people retiring early from employment into farming has obviously improved and therefore suggests diverse farmers' needs. The farmers' needs impact on extension programming and skill requirements of extension workers.
   For example, some of the challenges resulting from the restructuring of extension in 2005 we reported as slow recruitment for new positions and increased staff movements. This change needed fora during which extension workers of all cadres could discuss, be prepared, and given coping skills training to ensure smooth transfer of employee emotions, attitudes, and values as the organization of extension changed (Dessler, 2003).
3. Supportive Supervisor Interpersonal Relationships: - The MoA should see to the revision of the training policy, have systematic training plans, improved work conditions with more supportive supervisory interpersonal relationships, more transparency in dealing with issues of employee welfare such as promotions and career advancement, and transfers to have renewed trust in the management by the employees.
4. Work Environment and Work Life Improvement: - the work life of extension workers needs improvement; not only the office space and residential accommodation as recommended by NDP-9. According to a study by Tladi (1996), the key impediments in the agricultural extension work environment as reported by extension agents in Botswana were lack of prospects for career advancement, lack of regard for staff welfare, insufficient job information flow, inadequate performance feedback, and inadequate equipment.

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An Evaluation of Factors that Hinder Subsistence Farmers From Diverting to Profitable Farming in Botswana: A Lesson for Extension Officers

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Summary

The government of Botswana has over the years provided support programmes to farmers to subsidize agricultural inputs in order to raise the level of profitability. Despite the wide range of Agriculture support there has been very little improvement in traditional agricultural sector. The objective of the study is to identify the factors that hinder traditional farmers from transforming to profitable farming. The results show that most of the farmers did not adopt some specific types of innovation like row planting, use of fertilizers, use of improved crop varieties, crop rotation and pest control techniques. The reasons for not adopting such innovations included most importantly because extension agents don't know whom they are serving.

Introduction

Botswana is a landlocked country with a total surface area of 582 000 km^2. The country has a population of about 1.5 million, about half of whom live in rural areas and derive their livelihood from agriculture and other rural subsistence activities. Botswana's climate is semi-arid to arid with a mean annual rainfall of ranging from 650 mm in the extreme North east to less than 250 mm in the extreme southwest. Historically, agriculture has been the main form of economic activity for the majority of the Batswana. At the time of independence in 1966, agriculture contributed about 40% to the GDP and about 90 % of total employment opportunities in the economy. By the mid-1990s, the sector's contribution to GDP and employment had fallen to around 3.1% and 16% respectively. In 2005 the agricultural sector's contribution fell to 2.5%. Agriculture in Botswana is practiced primarily for subsistence, rather than for commercial purposes. The productivity in agriculture sector is so low that it cannot meet domestic demand.

The government has spent a lot of money through programs on arable development programs such as Arable Lands Development Program (ALDEP) and Accelerated Rainfed Arable Program (ARAP) which have not been actively utilized by farmers as expected by government. The success of these programs in transforming the sector to meet the agricultural policy objectives has been minimal, and as a result subsistence farming does not bring enough income to traditional farmers (NAMPPAAD 2000).

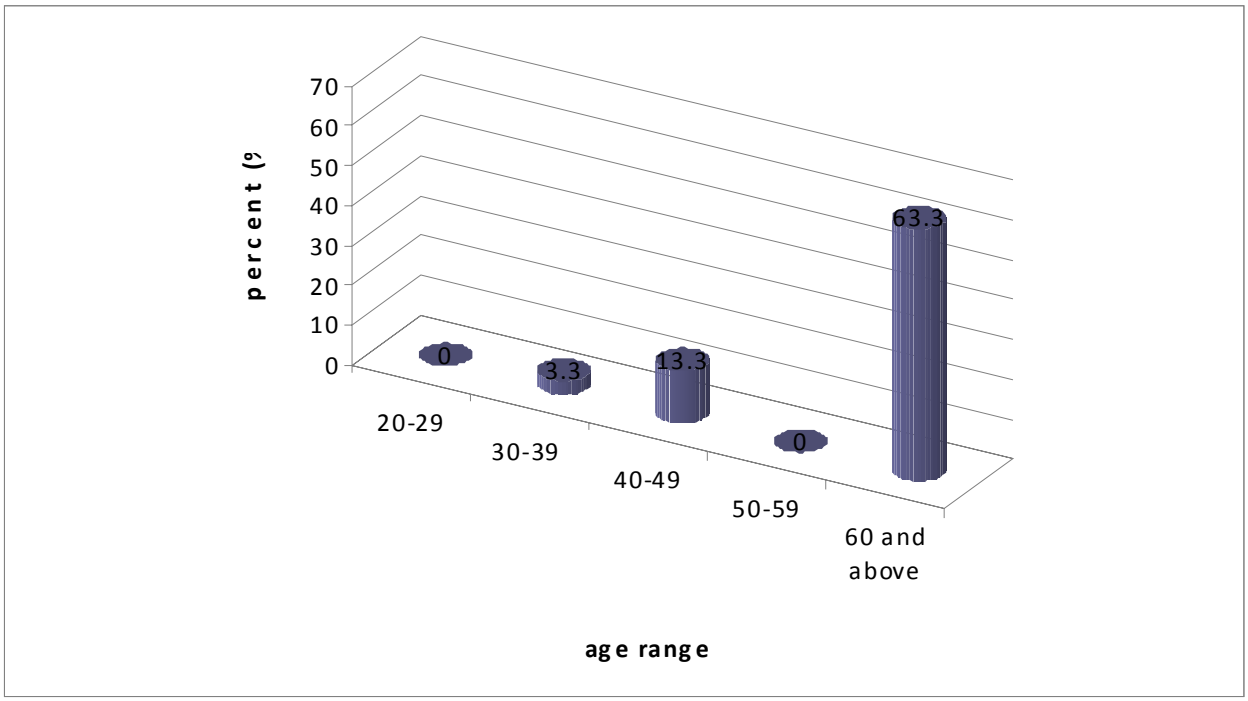
Despite all the government's efforts and well intended policies there is very ample evidence that there has been very little progress in progression and productivity of subsistence farmers. The problem therefore is: why is it that subsistence farmers do not transform to profitable farming. The main objective of this paper is to identify the reasons why subsistence farmers do not transform to profitable farming and also to find out who are this farmers in Botswana who use this government programes without any desire results. How come they don't graduate from subsistence farming into profitable farming.

Methodology

The target population of this study was farmers in Matlhage extension area in the Kgatleng Agricultural district. The systematic sampling was used to select a limited number of farmers in Matlhage extension area. A sample size of thirty farmers was drawn from a population size of four hundred and fifty farmers in such a way that every tenth farmer is selected until the sample size of thirty farmers was obtained. A closed ended questionnaire was used to collect data . Statistical Packages for Social Scientists (SPSS) was used to analyze.

Results and Discussion

Figure 3.1: Age of respondents



The majority of farmers are aged above 60 and above and that is shown in figure 3.1 below. Those below the age of 50 years represent (16.6%) and this shows that the young and able bodied are not much involved in farming as they migrate to urban areas in search of job opportunities. The farming population particularly the household heads is aging. The average age of the farming population was found to be 57-58 years and having been in business for about 30 years, about 20% of the younger generations say they would like to give up farming. Extension officers must know how to get productivity from this aged population. Extension officers must also be able to recognize the need to come up with extension outreach programmes which are specifically made for different age groups in the faming community. The results in figure 3.2 below shows that the majority of the respondents are having primary education, followed by those who have never been to school. Since a fair majority of farmers attended primary school, their education level might influence their adoption rate and behavior. Extension workers should take into consideration the education level of the farmers in order to improve on the adoption rate of innovations.

Table 3.2: Educational level of respondents

		What proportion or size of the farm is cultivable?				
		1-2ha	*3-4ha*	*5ha*	*6ha and above*	*Total*
Educational level	*Never gone to school*	**4**	**17**	**13**	**3**	**37**
	Primary school	**14**	**16**	**23**		**53**
	Junior certificate		**3**	**4**		**7**
	BGCSE/OLEVEL			**3**		**3**
Total						**100**

The majority of the farm land is owned by those farmers who have never gone to school , so the extension officers should be aware that they are dealing with illiterate farmers so they should be given

special treatment such that they can understand the innovations introduced to them better, for all the government programs to succeed , as such farmers should be dealt with, with respect to their education level.

The results above shows that there is high association (Pearson chi squire of 4.982 and a p-value of 0.836) between the number of hectares ploughed and the educational level . Therefore it is very important for the extension officer to work very closely with the never gone to school farmers if they are to increase profitability and productivity. The weak link is that those who have not gone to school make a very sizable proportion of farmers.

Conclusion

In conclusion the findings of the study show that the farmers are old and they have low level of education. The low levels of income and high risks associated with subsistence farming affect the age distribution of farmers. The farming population is aging and it is unlikely that they will be bothered very much to increase production level above subsistence and that is one of the factors that hinder traditional farmers from diverting to commercial farming. The farmers' levels of adoption of innovations are very low which means very low yields. This low level of adoption of technologies hinders them from diverting to commercial farming. It can be concluded that the reasons for not adopting some specific types of innovations by traditional farmers included expensive farm inputs, shortage of hired labour, lack of funds, low rainfall, lack of draft power, limited market outlets, infertile soils and most importantly there is poor extension workers outreach since they want to treat all farmers equally without taking into consideration farmers' personal characteristics such as educational level, age, farm size, gross income and tradition which differ from farmer to farmer..

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Use of Mechanized Technology in Conservation Agriculture: The case of Kotsonkoaneng Farmers in Butha-Buthe District, Lesotho.

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Summary

The state of Lesotho's agricultural economy is currently in shambles and requires a transition to sustainable development. The authors consider the change of mindset of different stakeholders in rural areas as well as adaptation of new technologies such as conservation agriculture (CA) as an important mechanism for the transition to sustainable agriculture. On the basis of case example in Kotsonkoaneng, the study demonstrated how changing of the mindset and the acceptance of improved farming practices can increase yields and protect the environment. Bridging the gap between research and extension with respect to CA demonstrations, field days and farmer trainings were held.

Introduction

Lesotho is considered as one of the least developed countries. A large part of the country's population derives part of its livelihood from agriculture. However, in recent years, agricultural production has declined due to land degradation and soil compaction. These alarming circumstances caused the Ministry of Agriculture and Food Security (MAFS) in collaboration with the Food and Agricultural Organisation (FAO) of the United Nations through the Department of Agricultural Research (DAR) to take immediate remedial action to alleviate this situation by introducing a new technology called Conservation Agriculture (CA). CA is defined as minimal soil disturbance, permanent soil cover, as having labour saving properties which is a potential solution to farm power shortages that is suitable to households under labour stress. It makes use of four principles that should be followed strictly. The four principles are as follows:

1. Minimal disturbance of soil: means the field may be directly seeded or looking at its conditions, it can be ripped to break the plough pan as farmers have been using mould board plough for a long time.
2. Permanent soil cover: use of crop residues or green manure as cover crops. Leaving the crop residues is very important as when the soil is covered, it is protected from direct rain impact, and even from hot sunrays and strong prevailing winds. When the rain drops on the mulch (crop residues), the cover prevents the soil from breaking up hence reducing erosion and encouraging water infiltration.
3. Multi-cropping: refers ideally to crop rotation, for example, after harvesting maize, another crop such as beans can be planted so that it can bring back the nutrients and improve the soil status disturbed by the maize crop.
4. The integration of crop and livestock production: 30% of crop residues is used to feed the animals at home and 70% left on field as soil cover.

The concept of CA is spreading fast and is practiced by commercial farmers as well as small emerging farmers. According to Reijntjes (2002), CA is challenging farmers to produce in a more sustainable, integrated and ecological friendly way by adhering to the concepts of Integrated Pest Management and Integrated Weed Management.

In 2005/2006, CA was introduced in the seven lowlands districts of Lesotho, as one of the soil management practices. This practice however, met a number of problems such as poor understanding and negative attitude of some farmers. Benites *et al* (2002) also discovered that African farmers face many constraints and challenges in conversion from conventional tillage to CA. These include free

grazing of animals, lack of information and unavailability of equipment and herbicides. On farm demonstrations, field days and trainings have helped to share this information with farmers and bridge the gap that existed between research and extension. In CA, results are not always realized in the first years and this probably led to farmers from five districts of Lesotho abandoning it. Despite low yields from CA in the first year, Kotsonkoaneng farmers in Butha-Buthe District remained optimistic that they will ultimately succeed with this practice. The benefits arising from CA in Kotsonkoaneng have caught the attention of individual farmers from neighbouring villages and local authorities. This is evidenced by more farmers who joined CA in the 2009/2010 cropping season. They have noted higher agricultural yields in the face of strong variations in climate. Acknowledging CA as crucial to the sustainable rural livelihoods of Basotho farmers and that these very same farmers are at the centre of preventing land degradation in all its forms, has many implications for increased agricultural production in Lesotho.

Objectives of CA introduction Lesotho (are to)

- Promote the empowering of Basotho farmers through information sharing and improved service delivery.
- Communicate and disseminate research results and share information with farmers to improve productivity.
- Conduct means (demonstrations, field days, trainings) of enabling easy adoption of this new farming practice.

Methodology

Awareness campaigns were used as a method of sensitizing farmers about CA where the four principles were explained in detail. DAR held these campaigns in conjunction with District Crop Officers and Agricultural Extension Officers from the participating Districts. Farmers' fields were used for demonstrations where staff from both the Districts and DAR monitored these fields from land preparation until harvest to ensure maximum yields. DAR also facilitated the securing of inputs from the FAO office in Maseru on behalf of farmers engaged in CA. FAO provided all the financial support for this project while farmers were only responsible to ensuring that all operations undertaken on their fields were done smoothly.

Results

Progress reports from the 2006/2007 to 2008/2009 cropping seasons show a fluctuation in yield, number of farmers and acreage planted. For example, in 2006/2007 cropping season, there were 19 farmers with an acreage of 18.5 hectares which was planted maize, while 10.5 hectares was for beans. The yield for this period was a low average of 114Kg/ha. For 2008/2009 planting season, the number of farmers had decreased to 11 with acreage totaling 13ha which was all allocated to maize production. Despite a decrease of the area planted a higher maize yield average of 446Kg/ha was obtained.

Discussions

As already highlighted through Ca higher yields are obtained in subsequent years. It is worth noting to indicate that a comparative economic analysis between CA and conventional tillage in Lesotho is still on going. The 2008/09 season shows an increase in yield even though the number of farmers had declined. In the same way, this requires further analysis for a number of possible factors could be owed to this. For example, it is possible that farmers who relinquished CA are those that obtained very low yields in the previous season, or that rainfall distribution was the source of this yield difference.

Acknowledgements

The progress made in this project is due to the intervention by the FAO, without whom none of these could have taken place. It is also important to note the contribution of DAR and District Agricultural Offices for their support in this. Last but not least, farmers who relentlessly showed resilience despite all challenges faced should be given credit.

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Harmonization of Methods and Strategies in Extension Delivery System in Malawi

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Summary

Smallholder farmers producing both cash and food crops are important drivers of the agriculture sector in Malawi. Group approach is used to increase farmers' coverage with agricultural extension messages. Variety in the methods used to disseminate information and messages on agricultural technologies provide wide choices amongst extension workers and their clientele. On farm harmonized demonstrations, field days, radio, simple publications and the mobile van are some of the methods that have proved effective in promoting some technologies. Farming clusters and Lead farmers are innovative strategies used in farmer mobilization to adopt innovative technologies for agricultural enterprises of their choices. The objective is to promote adoption of agricultural technologies and farmer innovation in order to increase productivity and production so as to meet household or market requirements. The strategy uses the village as an entry point as well as organizing, planning and implementation base for all interventions. Operating within the decentralization system, agriculture committees ensure that agricultural development agenda is prioritized in overall development agenda. The harmonization framework provides guidance to ensure inclusion of all agricultural extension service providers from public, private and civil society organizations. Farmers are more empowered and organized to mobilize resources to undertake different agricultural enterprises. Peer learning through farming clusters and Lead farmers has resulted in increased adoption of technologies that meet their agricultural production requirement. Mobilizing farmers in farming clusters and mounting of harmonized demonstrations and field days has helped to increase adopting of productivity and production by farmers.

Introduction

Malawi is one of the countries in the sub-Saharan Africa. It borders Zambia to the east, Mozambique to the south and west and Tanzania to the North. Agriculture is an important sector in Malawi considering that its economy is largely agro-based. With a population of about 13 million people, it is estimated that the sector employs about 80% of the total work force and contributes 80% of the foreign exchange earnings. The agriculture sector is subdivided into two sub-sectors; namely the smallholder and the estate or commercial sub-sector. Performance of the smallholder sector greatly influence overall social and economic performance of the country's economy because it contributes over 70% of the Gross Domestic Product (GDP). Malawi has an estimated 2.2 million hectares of arable land and 90% is cultivated as small farms. Smallholder farmers are involved in production of food crops such maize, rice, potatoes, cassava and bananas. They are also actively involved in the production and marketing of the country's major cash crops like tobacco, tea, coffee, cotton, sugarcane and macadamia. It is estimated that women farmers constitute over 60% percent of Malawians farmers.

As an agro-based economy, agriculture is one of the priority sectors whose aim is to increase food security at household and national levels and economic growth. Agricultural extension services play a pivotal role to ensure that the clientele have access to improved and proven technologies and that their concerns and needs are properly addressed by relevant service providers. Use of innovative methods and strategies to increase coverage is therefore a concern for all involved in agriculture extension and advisory services. This paper therefore discusses historical background of agricultural extension services in Malawi, highlights successful stories on methods and strategies that are used to disseminate agricultural technologies and messages. Challenges impeding out-scaling of the strategies and methods are also mentioned.

The Agricultural Extension Service in Malawi

Agricultural Extension Services in Malawi dates back to the colonial times with estates aiming to increase productivity and production. This resulted in the creation of the Department of Agriculture in 1907. Since then, agriculture extension in Malawi has gone through reforms over years in terms of approach and systems.

In the early years, Government sent out instructors to teach farmers recommended crop production practices. Coercion was considered the appropriate way to get farmers practice what they had learnt. Those who failed to implement were punished with a fine or imprisoned. Similar observations were made by Oryokot (2005)[1] that bye laws were used in Uganda during the period 1898 -1956 to ensure that farmers follow agricultural practices in soil and water conservation. Progressive farmers acted as role models and received preferential treatment from the government. Individual approach was predominantly followed in the system. With time the Individual approach was considered discriminatory as resource poor and women farmers were deemed not adequately covered.

The Master Farmer concept was later adopted by the extension service to allow innovative and better off farmers demonstrate recommended practices. These farmers received preferential treatment and support in form of inputs and extension services from the government to enable them provide quality demonstrations to fellow farmers. After independence in 1964, the Master Farmer approach was changed because it resulted in resentment from farmers who were expected to follow the Master Farmer's examples.

In order to set good examples as an exemplary farmer, the then State President Ngwazi Dr Kamuzu Banda gave himself the title of M'chikumbi No.1 meaning farmer No. 1. Any farmers doing better in terms emulating the example set by M'chikumbi No. 1 were given the title of M'chikumbi No.2. However, not many farmers emulated the Mchikumbi No.1 or 2 because it was considered to favour commercial farmers and failed short of addressing poor farmers' needs of achieving food security and it was perceived to be political. This resulted in the change approach to the use of groups which were thought to be inclusive and accommodating.

In the 1970s, **group approach** was considered as the appropriate means of reaching out to smallholder farmers with extension messages. The commissioning of major integrated projects such as the Lower Shire and Shire Highlands Development project in the south, Central region lakeshore projects and the Lilongwe Land Development Programme in the centre and Karonga-Chitipa Development Project in the north necessitated the use of groups in order to increase coverage of farmers with agricultural extension messages. These projects provided farm input loans to farmers to enable them implement promoted technologies. Groups were therefore important to facilitate management of the loans including recovery by the extension workers.

The increased number of groups created a need for proper management for them to be effective. The Ministry then adopted the Block Extension System (BES) in 1981. The BES was a modified Training and Visit System that aimed at reaching out to farmers of all gender categories. The extension workers subdivided the section into 8 blocks to be visited once in every fortnight. The system operated on a rigid straight line mode of operation that made supervision easier. Although the system is believed to have achieved some positive results by going beyond **specialized** groups of farmers, it failed to reach out to some categories of farmers especially the resource poor hence adoption did not significantly improve (Ministry of Agriculture and Irrigation 2000).[2] Similarly, Swanson and Mathur (2003)[3] observed that the effectiveness of the T&V system in one of the regions in India was debatable as it

[1] J.Oryokot (2005) Report of the sensitization workshop on rural radio for policy and decision makers in East and Southern Africa

[2] Ministry of Agriculture and Irrigation (2000): Agricultural Extension Policy in the New Millennium: Towards Pluralistic and Demand-Driven Services in Malawi.

[3] Swanson BE and PN Mathur (2003) : Review of the Agricultural Extension System in India

encouraged hierarchical tendencies that already exist in central government. The system was blamed for denying the front line extension workers opportunity for creativity and innovativeness due to lack of flexibility in the mode of operations.

Political changes in 1990s necessitated a paradigm shift in provision of agricultural extension and advisory services. The wind of democratic change blew over Malawi resulting in the subsequent adoption of democratic principles. Decentralization policies and presence of other agricultural extension service providers necessitated the review of the agricultural extension delivery system. The current agricultural extension policy was launched in 2000 to accommodate the changes on the scene. The policy advocates for **pluralistic, demand driven, decentralized** extension services. The policy ensures that agricultural extension services are more inclusive to allow other service providers such as farmer based organization, the private sector and the civil society organizations to take active roles in the delivery of extension services. This is to give the clientele a wider choice of services from diverse service providers.

The District Agricultural Extension Services System (DAESS) was conceptualized to operationalize the agricultural extension service policy. DAESS has governance structures that provide opportunity for harmonized planning, resource mobilization, coordination and networking of players and stakeholders in agricultural extension services provision. Pictorially presented as in figure 1, the DAESS structures are part of the Local Government structures at the District Assembly.

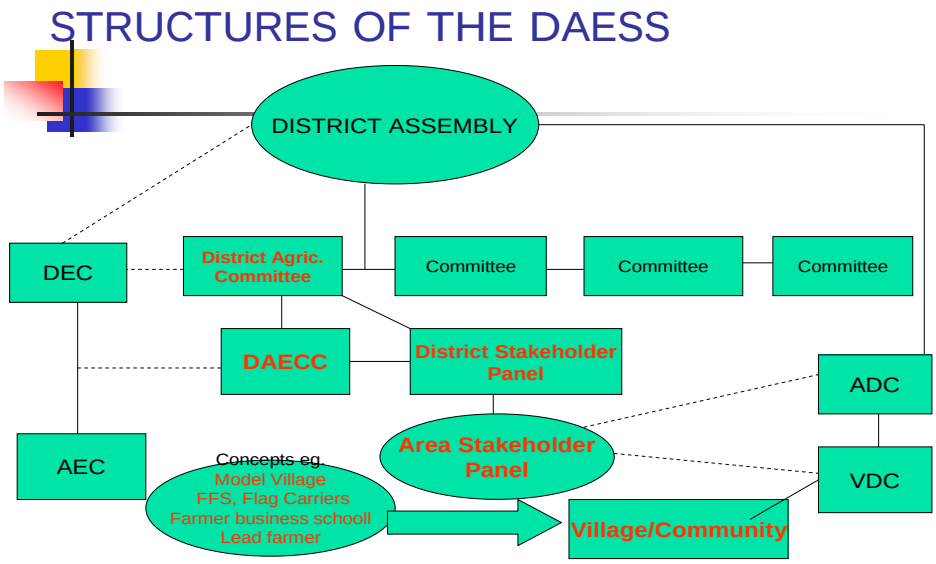

Fig 1: The Structures of District Agriculture Extension Service (GOM 2006)[4]

The entry point for the DAESS system is the village. People in Malawi live in communities known as the village which is headed by the Village Headman or Group Village Headman. The village is considered the most stable institution under Malawi setting. Traditionally Malawians give respect to the local leadership such as the Village Headmen. Any development intervention is therefore taken through the village for awareness creation and to solicit support, acceptance and ownership by the village members. The structures under DAESS therefore aim at creating conducive environment for enhancing harmonisation of programmes beyond the village/community so as to include all service providers. Also serving as a strategies to empower farmers, the system through its structures at village (Village Development Committee), Area (Area Stakeholder Panel) and district (District Stakeholder Panel) provide a mechanism for enabling farmers to envision, identify and organize agricultural needs

[4] Government of Malawi (2006) The District Agricultural Extension Services System, Implementation Guide

for coordinated implementation and response by service providers. DAESS (GOM 2006)[5] has four focus areas namely:

a) Organization of farmers demands
b) Organization of service providers' response to farmers needs
c) Stakeholder coordination
d) Facilitate Funding acquisition for agricultural extension services from a diverse base of resources.

Effective Agricultural Extension Methodologies

Agricultural Extension Services need to use a variety of innovative methods to facilitate access of farmers and their organizations to knowledge and information and interactions amongst stakeholders (Christapolos 2010)[6]. One of the challenges faced by the Department of Agricultural Extension Services in Malawi is shortage of agricultural extension workers to adequately reach out to farmers with messages on technologies. According to GOM 2009, staff farmer ratio was estimated to be 1:2,500 farmers against the recommended ratio of 1:750. The implication is that extension service providers need to use methods and strategies that would reduce the knowledge and information gap and ensure optimum coverage of farmers with extension service. The Department of extension therefore uses a number of methods such as village meetings, demonstrations, field days, farm radio programmes, publications (posters and leaflets), strategic extension campaigns and mobile vans.

i) **Village meetings –**village meetings are widely used in Malawi for different purposes. As an agricultural extension methodology, village meetings are mainly used for sensitization and awareness creation. Village leadership such as chiefs and influential leaders play an important role in mobilization of farmers. As Front line agricultural extension workers enter the community through the village, local leaders are an important point of contact in the village. Any extension worker has to lobby for their support; therefore adequate sensitization is vital for their support during village meeting. Development conscious village Leaders have used village meetings to make important decisions and commitments with their subjects.

ii) **Demonstrations** – this is one of the commonest extension methodologies used by extension workers to disseminate information and message on agricultural technologies to farmers. These demonstrations are mounted at research stations, farmers training centre and on farmers' fields. Previously, on farm demonstrations were mostly used by agricultural extension workers in the public sector and the Non Governmental Organizations (NGOs). The private sector especially the agricultural input suppliers also mount demonstrations strategically along the road sides to market their products. This is done in collaboration with the public agricultural extension officers at all levels.

On farm demonstrations are the 'classroom and chalkboard' for an extension worker. The success story about on farm demonstration is that a new dimension has been added with agricultural extension service providers creating partnership in planning and mounting of demonstrations. Some examples include the seed companies who have worked together with public sector to identify farmers to mount the demonstrations. The Cotton Development Trust has a viable platform that has facilitated joint planning and implementation of cotton demonstrations and also ensured that farmers have access to cotton inputs. In order to provide choices of technology packages, demonstrations are harmonized by ensuring that packages are formulated and demonstrated side by side. Visibility is an important issue in demonstration to inform people what is happening. Sign posts which are well labeled are displayed in the field with participating partners acknowledged. These demonstrations show both methods of implementing a technology

[5] Government of Malawi (2006) The District Agricultural Extension Services System, Implementation Guide
[6] I. Christapolos (2010): Mobilizing the potential of rural and agricultural extension. FAO. Rome, Italy

and the results of the technology. The climax of demonstration are the field days to showcase performance of technologies.

iii) **Field days –** field days are important events in the department of agricultural extension services and the Ministry as a whole. In order to ensure successfully organized and conducted field days, the department of agricultural extension services backstops the lower levels offices (division, district and extension planning level) on programming of field days and encouraging frontline extension staff to conduct field days. Field days provide opportunity for interaction and learning amongst staff and farmers as farmers showcase results of the technology. Through the interaction, subject matter specialists get feedback from farmers on performance of displayed technologies.

The harmonization framework is used to improve coordination and collaboration in the planning and implementation of field days. Coordination in planning and implementing field days has proved to be cost effective. Field days attract a wide range of stakeholders who include input suppliers, donors, policy makers, projects staff, civil society and extension service providers. The field days start from the grassroots to national level. The success story about field days is that advance planning has given opportunity to partners to attend, learn and appreciate the programmes at field level. Field days especially those held at national level have been used as an advocacy tool to lobby for support for agricultural activities and programmes from District Administrators, Politicians and Traditional Leaders.

iv) Farm radio programmes – farm radio programming dates back to the 1960 (GOM 1978) [7] when the first farm radio programme was produced by the Ministry of Agriculture, Extension Aids Branch. Not until 1993, when Malawi has witnessed proliferation of FM radios stations, the Ministry of Agriculture was the sole provider of farm radio programmes. Malawi to date enjoys a network of public, private, religious and community FM radio stations. Being an agro-based country, farm radio programming is becoming an interesting field, such that the private sector and the civil society extension services have farm radio programmes. The success story about farm radio is that in order to harmonize efforts by various stakeholders in farm radio programming, a farm radio symposium has become an annual event. This is non sponsored event where participating institutions share costs. Partnerships are proving effective in farm radio programming.

Successful 6 months radio campaigns on marketing of farm produce, early maturing varieties and soil and water conservation have been conducted through partnership between Farm radio International, Ministry of Agriculture and public, community and private radio stations. The development broadcasting unit housed by the Public radio broadcaster Malawi Broadcasting Cooperation has given voice to the rural farmers by providing forum to voice out their concerns. A lot more service providers in the education, health and agriculture sectors have responded or acted on certain issues after it has been revealed through the radio.

v) Publications – the Ministry has an agricultural communication branch that has survived the test of time since it was established in 1958. The communication branch is mandated to disseminate agricultural information and messages using multimedia approach. Leaflets, posters and a bimonthly magazine called Za a Chikumbi is produced to provide farmers with reading materials on technologies or messages trained by extension workers. These are distributed free to farmers through the network of frontline extension staff. These are produced by subject matter specialists as new messages or in response to a problem.

[7] Government of Malawi (1978) : The Extension Aids Branch 1958-1978

vi) Strategic Extension Campaigns

Strategic extension campaigns are conducted to address agricultural problems identified through a participatory process. Practising lead farmers are involved to explain to fellow farmers the benefits and dangers of certain practices. As Adhikarya (1996)[8] noted that farmer involvement in planning and implementation of the campaigns increase responsiveness as measured by changes in knowledge, attitudes and practices. This is attributed to the relevance of objectives, methods and messages contained in the information, communication and education materials (IEC). By definition an extension strategic campaign is a campaign conducted over a specific period to address an identified problem. The campaigns are held for specific periods. In Malawi, strategic extension campaigns have been used to promote adoption of technologies such as use of manure, soil and water conservation technologies (vetiver) and one one maize planting. One of the successful campaigns held recently was a 6 months radio strategic campaign on soil and water conservation using vetiver. In the campaign, radio stations partnered with communities to identify problems and develop campaign strategy which was successfully implemented over a 6 months period. Now one can see conserved fields with vetiver grass planted.

Mobile vans have added to the effectiveness of campaigns in Malawi. These are vehicles mostly land rovers fitted with public address and video/ film showing equipment. Mobile vans are 'crowd pullers' in rural communities of Malawi. When in an area, the van makes public announcements and puppet shows during the day and video shows during the night. Estimated attendance ranges from 200 – 350 adults per show. This is so because as people come to hear the message they also get some form of entertainment.

The extension methodologies cited above are not exclusive in that a combination of methods is used for complementarity. In order to ensure efficiency and effectiveness in the delivery of extension services, the department uses **innovative strategies** that ensure increased farmer coverage and active participation. Using participatory approaches; the model village, farming clusters and m'ndandanda and Lead farmers are some of the innovative strategies that are leaving a mark.

Model village _ Malawians live in villages headed by the Village Headmen and Chiefs. The decentralization policy gives power to the people to have a vision of their villages and actively participate in development interventions. The current agricultural extension policy likewise encourages extension workers to use the village as the entry point for planning and implementation of all interventions. All the extension methods described in the document are implemented at village level. The harmonization framework ensures coordinated planning and implementation of programmes, technologies, efforts and resource mobilization and utilization. Some key questions that the harmonization framework addresses are **what** are your harmonizing?, with **who** are you?**, where** are you harmonizing and **how** are you harmonizing? Six principles guide the harmonization process:

1. Policy focus and policy environment
2. Identification of gaps and issues
3. Approaches and Strategies
4. Technology packaging
5. Out-scaling technologies
6. Monitoring and Evaluation

A frontline extension worker calls for village meeting after briefing the village heads. This follows a series of meetings to strategize, plan and implement. The product of such meetings is a village action plan. The village action plan serves as a document that provides direction to the elected village committee and the extension worker in the course of implementing the activities.

[8] R. Adhikarya (1996) Strategic Extension Campaigns: Increasing cost effectiveness and farmer participation in applying agricultural technologies. FAO SD dimension, Rome. Italy

In order to ensure that farmers collectively plan and implement agricultural programmes farming clusters and m'ndandanda are encouraged. Farming clusters are described as a group of **empowered farmers** in a catchment area or locality who are committed to work together to undertake agricultural enterprises. M'ndandanda is a stretch of well managed fields of not less than a 1 kilometer in length (DAES 2008)[9]. In both strategies, extension workers look at farming families holistically ie as producers vis-a-vis their assets eg fields, livestock and resource endowment. The holistic approach enables farmers to use the integrated farming approach. Supported by elected committees, farming clusters and M'ndandanda have proved to:

1. Increase extension coverage with extension messages
2. Improve coordination and collaboration amongst stakeholders
3. Increase farmers access to markets for farm inputs and produce
4. Availed agro-dealers a readily available market since farmers are organized
5. Make farmers voice heard to service providers

Harmonized demonstrations are strategically mounted in the farming clusters and the village. These are plots or sites on a farm, field, garden or village used to train farmers on improved or new improved technologies. Harmonized demonstrations look at issues or technology gaps holistically i.e. theme, technology, technology package, service providers and sites of the demonstrations. Considering the diversity of farmers in the villages and sites in terms of resource endowment and needs, more than 3 technology packages are demonstrations. This is in a bid to address farmers' needs and aspirations. The following is an example of a technology package.

Examples of Technology packages

Theme: Drought mitigation

1. Unimproved maize variety, compost/ animal manure, planting pit and fertilizer
2. Early maturing maize variety, compost/animal manure, planting pit and fertilizer
3. Early maturing maize variety, planting ridge, herbicide, compost and fertilizer

These technology packages are demonstrated on the same field side by side. The success story about harmonized is that farmers are given choice on different technology packages that are being demonstrated. Secondly, since the harmonization starts from planning, it gives opportunity for subject matter specialist to harmonize across programmes and disciplines. Sites for mounting harmonized demonstrations include research stations, day training, residential training centers and farmers' fields. Lead farmers host on farm demonstrations. Lead farmers are farmers who have mastered a particular technology and are willing to assist fellow farmers upon being nominated and accepted by fellow farmers in their communities. The harmonization framework has added value to the management of farming clusters in that it has helped stakeholders to see a bigger picture of how to add value to demonstration following the value chain approach. Although harmonization of agricultural extension methodologies and strategies has registered some successes it has faced some challenges.

Challenges

Although there are some success stories registered with some methodologies and strategies used in agricultural extension, some challenges impede implementation and out-scaling of technologies. These include:

1. Inadequate operational resources (human, material and financial) to fully out-scale the success stories.
2. Poor mobility means for extension staff

[9]Department of Agricultural Extension Services (2008) Guidelines for Clusters and Ulimi wa M'ndandanda for various stakeholders –revised (unpublished).

3. Inadequate capacity building opportunities for staff
4. Inadequate coordination, collaboration and networking amongst service providers
5. Weaken research extension farmers linkage

Conclusion

The role of Agricultural Extension Services in agricultural development is crucial. With resource limitations, a combination of methods and strategies in dissemination of messages and technologies helps to make an impact. Working with smallholder farmers who have low literacy levels necessitates diversity in methods and strategies to assist them get agricultural information and messages for improving livelihoods.

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An Overview of Public Extension Services in Mozambique

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Summary

The public extension service in Mozambique was created in 1987 as one of the four national directorates of the Ministry of Agriculture. The 16 years of destabilization war made it difficult to establish and operate extension networks in most part of the country. The peace agreement signed in 1992 permitted a quite number of international donors to support agriculture sector including the public extension services. As result, a five year Extension Master Plan (1999-2004) was prepared and implemented aiming at strengthening research-extension linkages, multiple extension service delivery systems, social inclusion (particularly women, youth and PLWHA) and quality staff at different levels. The current Extension Master Plan (2007-2016) aims at consolidating the previous Extension Master Plan (EMP) and advocates more participatory extension approaches.The EMP focus in two approaches: (i) adoption of Unified Extension Services (SUE) encompassing crop production, livestock and natural resource management, and (ii) development of an integrated National Agricultural Extension System (SISNE) with functional partnerships between public and private extension services including the outsourcing. Furthermore, the EMP emphasis on strengthening linkages among the key agricultural stakeholders such as research, education, agricultural input and equipment, marketing and financial institutions, therefore, focusing on supply-side development, demand-side development and agricultural services provision objectives. Main beneficiaries of public extension services, the smallholder farmers, organised in groups of interest, associations and cooperatives, experience production of surplus, from 1t/ha of grain maize to about 3 t/ha, as result of technical assistance provided by the field extension officers. DNEA recognizing that the number of field extension officers is too low (700) for the demand and aiming at increasing the extension coverage, is promoting participatory approaches such as Farmers Field School (FFS). It was reported an 85% adoption rate for the technologies disseminated through the FFS. Furthermore, recognizing the complexity of farming systems and low availability of new profitable technologies, low effective demand for extension services and weak institutional linkages, extension service is developing three principles (i) deconcentrating extension services to district level, (ii) promoting participatory approaches and (iii) strengthening collaboration among key stakeholders. Some mechanisms to improve collaboration and partnership among farmers, extension, research, agricultural input and tool providers, financial and other stakeholders include: Periodic Technology Review Meetings (REPETE) which analyse pros and cons of technologies generated by research and disseminated by extension services, jointed monitoring and evaluation of extension activities and programmes.Training of extension staff and farmers on technical production skills is required. On the other hand, agribusiness, marketing, monitoring system, cost-benefit, problem identification, priority setting, planning, implementation and M&E skills are also needed (Eicher, 2002, DANIDA, 2002, Finney, 2003, Walker et al. 2004).

General background

1.1. Mozambique profile

Mozambique is a vast country with an area of about 799 380 sq. km and around 2 400 km of coastline along the Indian Ocean. Mozambique shares about 4 330 km of land borders with Tanzania, Zambia, Malawi, Zimbabwe, Swaziland and South Africa. The country is divided into 10 provinces and 128 districts.

The Mozambican population is estimated at 20 million inhabitants (52% are women) and is predominantly rural (70%) (INE,2007). Rural poverty is primarily attributable to limited agricultural development, limited market development and poor productivity levels. Mozambique's Gross National Income (GNI) per capita increased from 144 USD in 1995 to USD 400 in 2007 (IMF, 2009). Agriculture plays an important role in rural employment, contributes to household and national food

security as well as reduction of the mainly rural poverty, and is central to the economy accounting for 22% of GDP and 10% of export. However agriculture contribution to GDP is gradually decreasing from 37% (1997) to 24% (2000) and to 20% in 2002, while the contribution from industry is rapidly increasing in the same period (from 22% to 31%) (IMF, 2003, 2007). Poverty has declined from 69% (1996) to 54% (2003). Agricultural development is fundamental for poverty reduction as rural families generate about 80% of their income from the agricultural sector, while the other 20% has a strong link with the local economy (INE, 2000). Nationwide, HIV prevalence is 15% and life expectance 47 years for men and 51% for women (CNCS, 2010).

1.2. Agricultural Sector

The potential for increasing agricultural production remains enormous. Of an estimated area of 36 million ha of potentially arable land, only 5.7 million hectares (16%) are currently under cultivation. It is estimated that about 3.3 million hectares of land can be irrigated, but at present only about 50 000 hectares of land (0.13%) are under irrigation.

The Ministry of Agriculture formulated the vision for the sector as: "An agricultural sector that is integrated, sustainable, competitive, diversified, and basis for welfare and economic accumulation, articulated through value added chains with broadly shared benefits." The formulation of the vision took into consideration the constraints to agricultural development: (i) markets; (ii) financial services, (iii) technology, and (iv) access to natural resources. These pillars illustrate that the constraints to agriculture are multi-sectoral and go beyond a narrow sectoral definition of agriculture.

The long term goals of the agricultural sector in Mozambique are to improve food security and reduce poverty by supporting the efforts of smallholders, the private sector and governmental and non-governmental agencies to increase agricultural productivity, agro-processing and marketing, while keeping a sustainable path for the exploitation of natural resources (MADER, 2005).

Mozambique is increasing the agricultural production mainly in maize and cassava: 1.3 tons maize to 2 tons and cassava from 6.6 tons to 9.7 ton from 2005 to 2009, respectively. However there still have a deficit in other crops such as rice, potatoes, chicken meat, fish and oil. Despite the increasing on maize and rice production, in general yields are low (Maize 0.9 ton/ha; cassava 5.5 ton/ha; groundnuts 0.5 ton/ha, rice 1.1ton/ha in 2005) (ASP, 2005). The main cash crop are cotton, cashew nut and tobacco. The use of modern inputs and mechanization is almost nonexistent (less than 2% use fertilizers or pesticides, 15% use animal traction and less than 10% use some form of agricultural equipment) (DNSA, 2010).

Thus he challenge for agriculture in Mozambique is how to mobilize the latent agricultural productive capacity and transform agriculture from a largely subsistence production system to a more market oriented production system while improving national and household food security taking into consideration the vulnerability to climate changes.

The country focuses on District as the centre of the development process and according. The National Strategy for the Decentralised Planning and Financing Programme (MPD, 2005), the main planning and financing mechanisms have been gradually adapted to place all the districts as the base.

This paper aims to present an overview of the development of Mozambique public extension in the context of the agriculture strategic vision in the country. The role of the private sector, Non

Governmental Organizations and farmers is also considered, as well as the linkages of the research-extension on the technology transfer process along the value chain.

2. Agricultural Extension

The public extension service was formally established in 1987 as one of the four national directorates of the Ministry of Agriculture. Prior to independence agricultural extension was completely focused on commercial and export cash crop production. After independence in 1975, priority was given to Government owned state and cooperative farms. The failing production led to a paradigm shift towards greater attention for smallholder and large-scale private production. The 16 years of destabilization war made difficult to establish and operate extension networks in most part of the country. The peace agreement signed in 1992 allowed for and significant increase of international donors support to the agriculture sector including the public extension services.

The evolution of agricultural extension can be divided into four major phases: (i) establishment phase (1987-1992): first experience in some pockets based on T&V; (ii) expansion phase (1993-1997): introduction of modified Training and Visit; flexible use of the approach; extensive donor support for public and NGO extension; (iii) master plan phase (1999-2004): adoption of pluralistic extension system (iv) Current master plan (2007-2016): adoption of decentralization to district level and deconcentration processes, multiple service provider system, farmer empowerment and outsourcing extensions services.

The first EMP (2004-2009) was focused in two approaches: (i) adoption of Unified Extension Services (SUE) encompassing crop production, livestock and natural resource management, and (ii) development of an integrated National Agricultural Extension System (SISNE) with functional partnerships between public and private extension services including the outsourcing. In the absence of a public extension system in most parts of the country, private and NGO extension service deliverers filled the gap to some extent since 1992. Furthermore, the EMP emphasis on strengthening linkages among the key agricultural stakeholders such as research, education, agricultural input and equipment, marketing and financial institutions, therefore, focusing on supply-side development, demand-side development and agricultural services provision objectives (DNER, 2004). It was anticipated that the SUE will advance to attain greater cost effectiveness and enhance farmer responsiveness compared with the situation where public sector extension is the sole provider.

The main NGO's contributions to the SISNE (i) increased geographic coverage and number of farmers reached; (ii) promotion participatory learning approaches; (iii) formation of farmer and community groups; (iv) promotion of best practices (food security, farmer organizations, market support and agricultural advocacy); and (v) combating HIV/AIDS. Some negative NGO lessons are the notion that some place more attention on community participation as the ultimate goal rather than a means to agricultural development. Most NGOs have promoted the involvement of "animators" and community members, but these often lack capacity. Other NGOs have provided incentives and hand-outs with short term goals and impeding the emergence of normal market forces for credit and seed distribution systems. (Gemo et al 2004).

The second EMP provides the strategy of the Ministry of Agriculture for agricultural extension from 2007 to 2016 and is based on the Agricultural Support Programme documentation (ASP, 2005) and is implemented through the National Agricultural Extension Programme 2007-2014 (PRONEA). The EMP was also formulated taking into consideration generally recognized need for a paradigm shift on agricultural extension due to decentralization, participatory planning monitoring and evaluation and the wide-spread introduction of multi-stakeholder approaches in agricultural innovation systems and value chain developments

The general objective of the current EMP is "Improved food security, economic growth and poverty reduction, especially for male and female subsistence farmers, including female-headed and disadvantaged households, by increasing agricultural productivity and production through a steady uplift in production efficiency and the provision of new technology and institutional innovations while promoting participation and sense of ownership among producers"

To address the objectives the EMP has tree components each one addressing one objective, namely:

(i) To Improve the capacity to implement extension programmes within a pluralistic and participatory framework; (component 1)

(ii) To Increase the technical and managerial capacity of producers in the planning, monitoring and evaluation process and in service provision (component 2)

(iii) Provide extension services at provincial and district level for the promotion of agricultural productivity and sustainable use of resources (component 3).

Table 1: Components and subcomponents of the Current master plan (DNEA, 2007)

Components		
1.Supply-side Development (for extension and technical services)	**2.Demand-side Development**	**3.Agricultural Services Provision**
Subcomponents		
1.1.Central Agency Reorientation and Support	2.1.Farmer Organization and Empowerment	3.1.Provincial-level Services Provision
1.2,Private Sector/NGO Service Provider Promotion	2.2.Group, Association and Enterprise Development	3.2.District/Local-level Services Provision

2.1. Human Resource Management

The public extension service has been characterized by great variability in terms of availability of extensionists but since 2006 the trend has been in the raising: increased from 2005 (645 extensionists, but 629 in 1999) to 2009 (693 extensionists, 11% female) against 1252 planed on EMP (Figure 1).

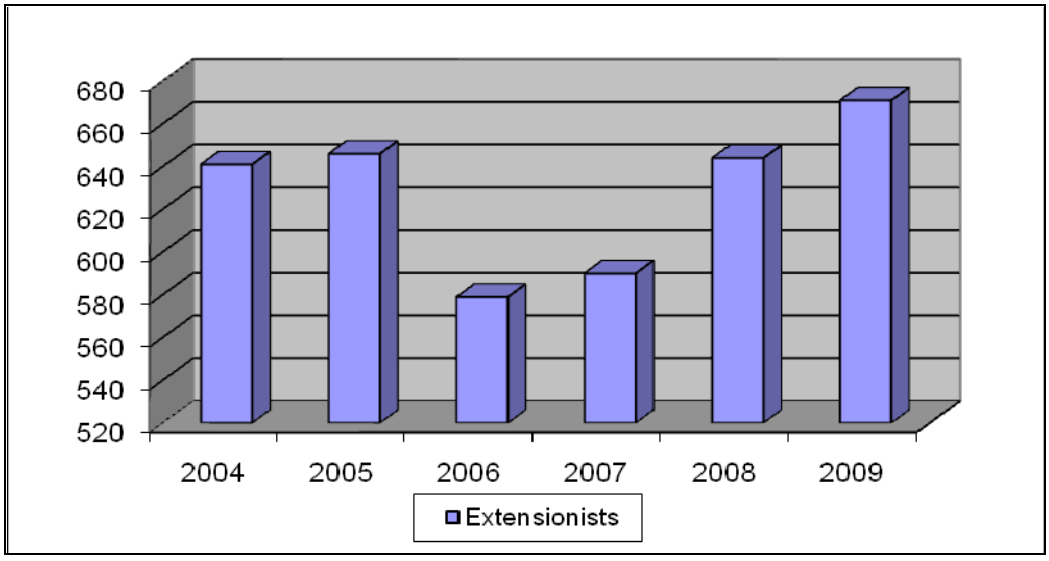

Figure 1: Number of public extension agents from 2005 to 2009 (DNEA 2009)

Due to efforts under a human resource development program training and recruitment of new personnel), more than 95% of the extensionists in 2009 almost are certificate and 4% are BSc. The figure in qualification of the extensionists is a big jump if compared with 2005 when the qualifications varied from a first degree (4%), diploma (59%), and certificate (32%) to others (5%) (Gemo, 2006). In 2005 only 23% of the staff were civil servants and the rest were contracted, but the percentage of civil servants has increase in 2006 and currently all staff are civil servants. It's hoped that this fact will contribute to the stabilization of the pool of extensionists, at least in the public services.

The number of NGOs operating in agricultural extension increased from 42 in 1999 to 89 in 2006, employing 775 extension officers (DNEA, 2006) to 83 NGOs and 25 private firms in 2009 employing 985 extension officers.

Since 2008 MINAG field equipment and refreshment training were provided for all the 590 extensionists all over the country as well as means of transport. Other incentives were the improvement of the contractual status as well the sensitization of the administrative officers to benefit the staff according the rule, such as the compensations for exposure to toxic products. Recently approved by the Public Administration Ministry is the compensation of the staff working in remote areas. However there are continuing need to sensitize the local and provincial authorities to plan and acquire works means while recruiting more staff. In 2009, 53% of the 693 extensionists had motorbike, 33% had bicycle and 14% no "own" mean.

2.3. Coverage

The public extension network covers 127 of 128 rural districts, NGOs are present in 91 rural districts, while 50 districts have private extension, but all 128 districts are covered by one or other provider. From 2006 the public extension extended the coverage to more 21 districts more than the plan, so the network teams were split to cover more districts (Figure 2).

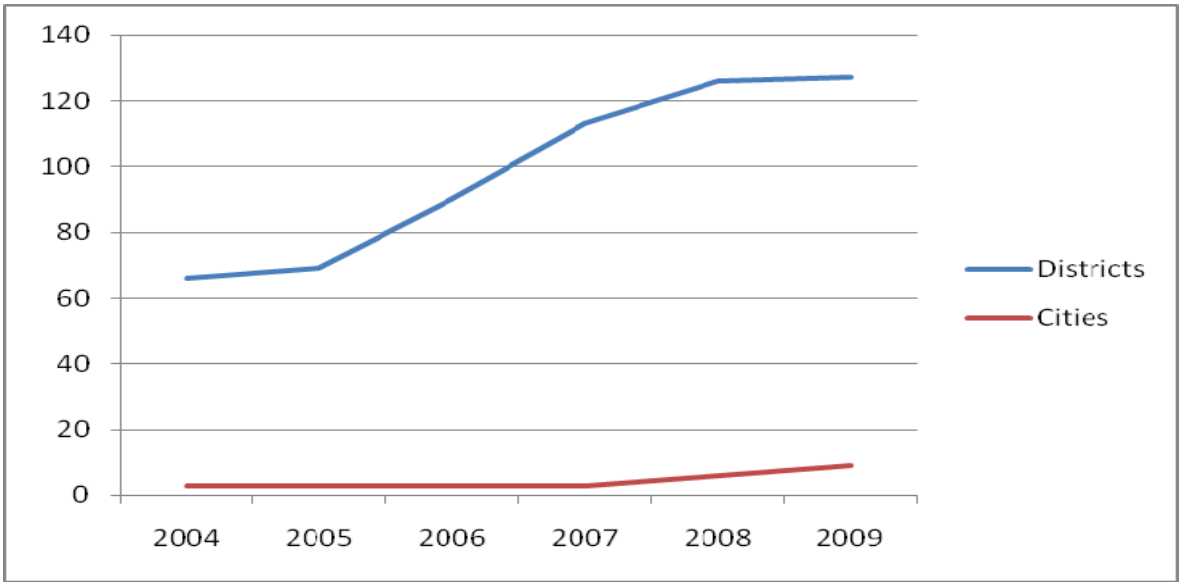

Figure 2: Evolution of the coverage of the public extension in Mozambique (DNEA, 2009)

The total extension coverage in 2006 for the public, NGO and private extension services was reported to be 191 629, 322 700, and 259 346 households assisted respectively (DNEA, 2006). In 2009 it was reported 378 043, 203.683 and 375.351 households, respectively. The public coverage was 76% of the

planed households due mainly to 10% reduction of the extensionists resulting from involvement in others tasks and some death, combined to the slowly recruitment process of new staff. These coverage represents 12% of the total farmers households (TIA, 2008).

3. Development and Technology transfer process

3.1. Agricultural research and extension linkages

Different formal mechanisms exist for coordination between research, and extension providers, farmers and other local stakeholders on the demand for and availability of technology. The stakeholder's involvement in agricultural research and technology transfer process must be observed along the value chain: input provision, land preparation, production, harvest and post harvest, agro processing and commercialization of the agricultural products (crops, livestock and forest). The MINAG, through the DNEA and Provincial Agricultural Extension Services, SPER, has created a good environment to increase the exchange of information and experience among the stakeholders. The degree of collaboration and coordination of activities varies from province to province. Apart from the annual planning and evaluation meetings and group discussion, other mechanisms include the Periodic Technology Review meetings (REPETEs), trainings, studies, trials, supervision and field days.

The REPETEs meet at least once a year at central level, provincial and sometimes District level to analyses best practices in technology supply based on demand. For 2011 almost 2 district per province intend to plan a REPETE (DNEA 2010 National Planning Meeting). The partners are also committed in attending the REPETEs.

Most of the commercial private farms are involved in the cotton, tobacco and cashew production under contract whereby they provide technical assistance and inputs to smallholders and the smallholders repay their loans at harvest time. This type of arrangement facilitates smallholder access to inputs, a secure market and payment in cash and farmers agree to sell their cash crop to the private firms at an agreed price. Seed production associations increasingly play a role in private agricultural extension. Private entrepreneurs in commercial production support smallholders through out growers' schemes.

The extension services at central, provincial and district level have organized a number of meetings with NGOs and private firms to coordinate the activities of MINAG and partner organizations. All stakeholders are invited to the annual national meeting of extension, which is held in a elected province. This year the XVI National Meeting of the Agriculture Extension Services will take place in Zambezia province.

At central level the formal interaction between research and extension was referred as limited to annual research and extension meetings and the Consultative Council meetings of MINAG (DNEA, 2007). Tit seems that the situation has improved, extending to other activities promoted by the Technical Directorate for Documentation and Technology Transfer (DTFTT) of the National Agricultural Research Institute (IIAM) and DNEA. However, much remains to be done to increase the connectivity between public, private and NGO extension in Mozambique.

3.2. Extension systems and methods

The main extension system used in Mozambique is Training & Visit which was modified to suit the specific conditions of the country, now known as MT&V Extension System. And the combinations of the three extension methods, individual, group and mass have been used by extension service providers, however, the group methods are the most common. In 2009, public extension services

provided technical support to 85% of farmers organized in groups and associations as well as in Farmer Field School (FFS) and 15% were individual farmers. Individual farmers are those dispersed but strategically located for horizontal dissemination of technologies not only for the neighbouring farmers but also the public at large who may pass through the site during the demonstration period. Due to reduced number of extension staff, the DNEA/MINAG is training farmers as FFS's facilitators. While the mass media methods are used to disseminate general information to the farmers through the local and national radios to an estimate of 260 hours per year throughout the country. On the other hand, printed and audio-visual materials are prepared and distributed to the extension staff and leader farmers.

Farmer organisations

Many of the associative groups are of a social nature, for instance for managing peak labour demands, credit and savings associations and community development activities; others have an economic nature, for example for input supply and produce marketing. In 2009 DNEA reports working with 7.818 farmer groups with 151.679 members and 4591 associative groups with 136.863 members. Farmer associations assisted by the public extension have been increased from 2.476 in 2005 to 4.591 in 2009. This fact was reported as resulted of the following: (i) the decentralized and rapid registration process approved Rule 2/2006; (ii) credit system under the District Development Fund for food promoting and employment (iii) the implementation of the Action Plan for Food Production which has provided incentives to the farmers and (iv) the training support provided by some NGOs such as Clusa, Kulima and ACDI-VOCA. The FFS, form a special category of farmers' groups, which are highly relevant for agricultural extension. The FFS approach involved 110 facilitators in three provinces (DNEA, 2006) up to 966 facilitators (86% are farmers) assisting 1254 FFS in 2009. Till 2006 157 FFS had been established in three provinces and 12 Districts. FFS can, graduates farmers into strong players in participatory planning, monitoring and evaluation. The expectation is the expansion of FFS methodology gradually over country. .

Outsourcing

Outsourcing is also another way to increase the coverage. Outsourcing covered almost 12% of the total farmers assisted in 2009. Collected data in April 2010 indicated the reduction of the assisted farmers due closing of some outsourcing programs in Zambezia, Nampula and Niassa provinces. To change this tendency it is required more commitment of the local and provincial Authorities to observe the sustainability issues of the outsourcing in order to avoid some collapses, when the program closes.

An outsourcing capacity is also developing at district level, but of a more modest kind. District Agricultural Offices have signed contracts with associations and individual farmer promoters for services such as seed and planting material multiplication and dip tank management and the contract spraying of cashew and groundnuts, as well as chicken vaccination.

3.4. Monitoring and evaluation

Data relating to the selected indicators are collected at all levels to provide information of the performance of the agricultural Extension. Data on the number of farm households assisted and the percentage of these households, which are adopting a new technology has been reported. The District is the base of planning in participatory approach from the villages. The Planning Monitoring and Evaluation Department (Figure 3) at central level is responsible for orienting, preparing and consolidating the annual work plan and budget preparation, for monitoring the implementation of

these plans, and for implementing and coordinating extension evaluation studies and supports the monitoring and evaluation units of the provinces (DNEA, 2007).

Little experience exists with participatory monitoring and evaluation, but some work has developed through the FFS Approach. Villagers value the services provided by the extension officer and the extensionists. DNEA reported an 85% adoption rate for the technologies disseminated through the FFS. According to the current EMP farmers have been trained and empowered to be aware in this process. Thus international and local technical assistance will be recruited to assist DNEA and the provinces.

The number of adoption studies is extremely limited as well as the impact studies. Several national extension impact studies are available on the basis of data analysis of the national household survey, the agricultural household survey and PRONEA's own data collection. A 2004 World Bank commissioned study has backed up the existing databases with a focused additional household survey. The data suggest that extension, both public and non-public have indeed had a positive effect on the adoption of technology, access to inputs such as tools and seeds, as well as markets.

Impact studies on the interventions of NGOs in agricultural extension are occasionally available, but mostly not to the District or Provincial authorities; There is a lack of cost-benefit studies of present and new profitable technologies for smallholders also due to a weak relation with research, both institutionally as well as technologically.

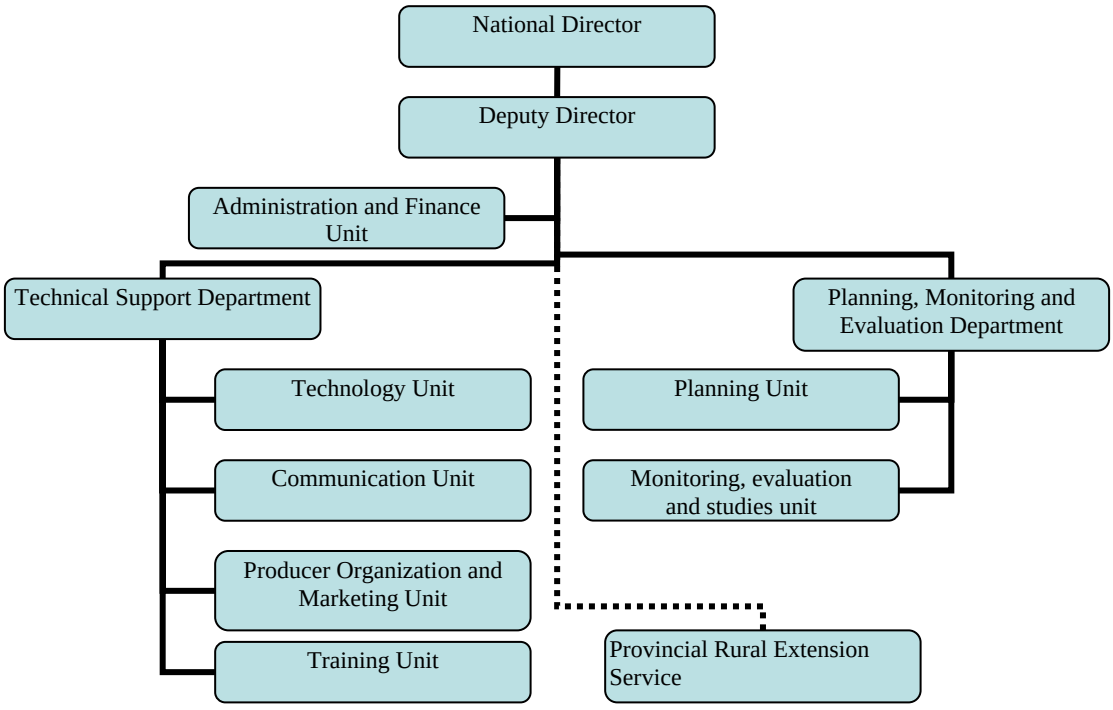

Figure 3: Organizational structure for the central level agricultural extension

3.5. Cross cutting issues

Participatory extension requires social inclusion and quality staff at different levels. As HIV AIDS focal point within the Ministry of Agriculture, DNEA is coordinating the HIV program and is mainstreaming HIV AIDS as well as Gender in the programs and activities. Natural resources mainstreaming is other cross issue adopted by DNEA, such as climate change mitigation tasks.

Although the unification of public extension increased the understanding of cross-cutting issues, there are still insufficient numbers of knowledgeable, trained extension workers and as a consequence extension face limitations to systematise recommendations to the producers.

4. Learned lessons

Main beneficiaries of public extension services, the smallholder farmers, organised in groups of interest, associations and cooperatives, are improving their yields as result of technical assistance provided by the field extension officers;

The high turnover of personnel once they have gained experience to the NGOs or to assume other positions, manly District Directors, can indicate that the training program for the extension personnel is adequate;

Outsourcing requires strong monitoring and evaluation, so building capacity is need. At the other end the targets to be achieved in the contracts need to be more realistic and business oriented and monitoring and partnerships at district level need to be improved;
Despite some coordination challenges there are good collaboration between the public extension service and the private firms in promoting some commodities (tobacco, sugar cane); this is essential as farmer empowerment, especially women and other social groups is crucial in participatory extension.

Challenges

Agricultural extension for smallholders in Mozambique faces some challenges in reaching the poor, as follow:

- Addressing adequately the socio-economic drivers of the stakeholders participation
- Complexity of farming systems and the lack of availability of new profitable technologies as well as post harvest loses estimated at about 30% (Gemo, 2008);
- Establish ties between suppliers of agricultural inputs and users (producers and associations);
- Strengthening the financial services and improving roads;
- Establish clear ties with private companies and NGOs involved in providing extension services, strengthening the rural extension networks through outsourcing;
- Strengthening the recent created District Services for Economic Activities (SDAE) capacity to make adequate integration of extension tasks in one public system at district level (agricultural, livestock production, fisheries and wildlife, industry, trade and tourism).

4. **Perspectives**

- The incentive system, based on performance, for public extension staff needs improvement;
- More attention is required for the profitability of the technology delivered;
- Recruitment and training of extension staff and farmers on technical production skills is required;
- Consolidation of farmers group.

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Agricultural Extension Service Delivery in the Semi-Arid Regions of Mozambique – A Case Study of the Mabote District

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Summary

This paper focus on drought vulnerability reduction activities that are being promoted by the government of Mozambique in the semi-arid district of Mabote (southern Mozambique). Rain water harvesting promoters and improved barn artisans were trained and equipped in Mabote district based on its Multiple Use Resource Centre (CERUM). For 2010, conclusion of 105 improved barns is under way, along with more than 100 on-farm rain water harvesting demonstration plots already established. Even furrows plots yielded much higher than traditional plots for all crops. A similar trend was followed by the plantation holes technology at the CERUM plot. Whereas even furrows were considered labour intensive, plantation holes were considered less labor intensive by the beneficiaries. Increased productivity and bigger maize spikes, fuller and heavier millet spikes and higher number and fuller groundnut pods were considered benefits by farmers. On-farm field days during planting seasons and demonstration sessions were key linkage instruments between researchers, extension officers and farmers along with the training of artisans and promoters, actively involved in the delivery of the field days and demonstration sessions. Land tenure insecurity tended to impact negatively on investment in improved furrows. Similarly, lack of awareness of district authorities on the benefits of the improved technologies was acknowledged an important constraint that was eased through development of demonstration trials. The extension services aimed primarily at solving the farmer's most important needs, worked with the beneficiaries in their socio-economic reality, teaching them to be self-sufficient in farming better on their own efforts and resources. It can be concluded that extension activities to reduce drought vulnerability in Mabote district are in good track.

Key words: Dry lands; Rain fed agriculture; Extension; Post-harvest

Introduction

Mozambique suffers from many natural disasters, being drought one of the most important. It occurs most frequently in Southern Mozambique with high to moderate drought risk, where rain – even when above average – is inadequate and results in critical water shortages and limited agricultural productivity (INGC, 2009). According to INGC (2009), between 1956 and 2008, drought has claimed far more lives (100,200) than other natural disasters (5064).

Although natural potential is not compatible with crop production, Mozambican dry land communities rely on land cultivation using predominantly manual technologies in small plots with rare involvement of modern improved technologies (inputs and machinery). Due to low production and productivity levels, dry land communities survive on alternative livelihood sources based on the collection, processing and/or marketing of bush meat, honey, clay, roots and tubers, medicinal plants, building materials, thatching grass, firewood and the production of charcoal and salt (Norfolk, 2004).

According to Kyomo (1992), ecologically sound, economically viable and socially just technologies are a key factor for sustainable agricultural development, where the needs of the present are met without compromising the ability of future generations. This statement brings us to the need to make research information work for the livelihoods development with emphasis to arid and semi-arid areas.

For that to happen, a close cooperation between research and the end beneficiaries is crucial and implies the development of a linkage mechanism – extension services.

A good extension service should be able to convey the flow of information about new and better technologies that solve particular constraints from research institutions to the farmers, and back to researchers and policy makers (Kyomo, 1992). According to the same author, field days during the panting season involving researchers, extension officers and farmers is one of the advisable linkage mechanisms. Tollefson (1995) added in that apart from field tours, demonstration plots and meetings are also useful means to introduce new techniques, aiming at convincing the farmers that these techniques are profitable.

Bridging the gap between research, extension and farmers is recognized as one of the most serious institutional problem for agricultural development, with an appropriate communication mechanism as a crucial component to improve transferability of technical information (Tollefson, 1995). The late author argued that farmers tend to follow on-farm demonstration trials that show direct benefits to them, meaning that farm scale demonstrations are practical and credible and that for this approach to work, extension officers should be well trained and the farmers should be adequately informed.

Interesting data on the potential contribution of improved sustainable agricultural technologies in crop yields in 57 developing countries of Africa, Asia and Latin America were reported by Tollefson, Tomasiewicz, Linsley, Paterson and Hohm (2002). According to these authors, in 286 projects carried out between 1999 and 2000 across 8 farming system categories, farm yield increases of 79% were verified, thanks to the following improvements:

- More efficient water use in dry land farming
- Improvements in organic matter in soils
- Pest and weed control

The same study reported some constraints for adoption of improved technologies by farmers, such as:

- Heterogeneity in agro-climatic environments (agro-ecology; local and regional biophysical factors and farmer characteristics)
- Biomass availability (amount and availability of crop residues for soil moisture conservation and fertility enhancement)
- Economic incentives
- Access to information by farmers
- Land issues (tenure insecurity impact on investment in technical improvements)
- Quality of extension services
- Political constraints (lack of awareness of policy makers about the benefits of improved technologies)

Tamele and Gomes (2009), citing Kassam et al (1982) presented the following agro climatic potential for maize, groundnuts and millets in rain fed low input dry land systems:
a) Maize: 0,4 to 0,7 ton/ha

b) Groundnuts: 0,2 to 0,3 ton/ha

c) Millets: 0,2 to 0,4 ton/ha

Reporting about the Kenyan experience, Nambiro and Omiti (2007) referred that half of the number of farmers were willing to pay for extension visits, raising the possibility of partial cost recovery in extension services relevant to farmers needs.
As regarding to extension premises, Semana (1999) proposed the following 3: (i) educational, (ii) philosophy and (iii) scope with responsibility. From these, the following will be detailed:

- Educational:
  - Tackling farmer's needs
  - No classroom but rather at farmer's home
  - Based on the farmer's own conditions
- Philosophy:
  - Starting where people are
  - Starting with what people have
  - Help farmers help themselves to farm better using their own efforts and resources under the following principles:

(i) No enforcement on farmers

(ii) No charity approach

(iii) Beneficiary participation

(iv) Activity through local leaders

(v) Solid extensionist skills

(vi) Extensionist focus in the activity

In order to reduce disaster risks in drought prone areas, the Mozambican government established a specialized technical body under the auspices of the National Disasters Management Institute (INGC) - the Directorate for the Development of Arid and Semi-Arid Zones (DÁRIDAS), with the role to undertake drought vulnerability reduction extension activities based on gathering, systemization and popularization of adequate technical solutions, potentially adoptable by resource poor communities living in semi-arid regions. In doing so, INGC is trying as much as possible to reduce the gap between research and extension by looking for effective and sustainable ways to deliver highly valuable knowledge and skills available in research institutions to dry land communities through the establishment of effective extension services.

The objective of this report is to give an overview of the work that is being undertaken by INGC in Mabote district towards reduction of community vulnerability to drought through the establishment of specialized extension service delivery activities targeting rain fed crop productivity increase and post-harvest loss reduction.

Materials and Methods

This paper discusses food security activities applied to improve the current's low-input rain fed crop production systems in Mabote district, in two directions:

a) Crop production increase, through dry lands improved agricultural productivity;

b) Post-harvest loss reduction, through adoption of improved barns

a) Description of the study area

This study was carried out in Mabote district, located southwestern Mozambique, in a dry tropical climate, where average annual temperature is 24^{o}C and rainfall is 600mm. In Figure 1, rainfall data for the 2008/2009 cropping season are presented. No rivers or permanent ponds are available in the region and small scale rain fed crop production is the main source of livelihoods, with half of the plots measuring less than a hectare, half of these owned by women. The soils are sandy, with low water retention capacity, leading to a situation of permanent vulnerability to drought.

b) Description of the activities

Due to the lack of centers of excellence in dry lands development in Mozambique, INGC's strategy was based on the development of District Multiple Use Resource Centers (CERUM), a physical location where many dry land development technologies and skills are concentrated for use in specialized extension activities. By the time the activity was conducted, Mabote's CERUM was ran by a very small team composed by 1 junior agronomist, 1 mid-level agricultural technician, one accountant and 3 support staff. Linkage to agricultural research was done through INGC's capacity building German-funded project (PRO-GRC), which hired specialized senior experts in the field of soil and water management to provide training and back-up support to INGC's and district government field staff. Involvement of research institutions was done in an indirect manner, i.e., through PRO-GRC, with little proactive involvement of research institutions.
Beneficiary identification was done at community level, combining the recommendation of district authorities and that of the community on grounds of their openness to adopt new technologies – contact farmers. In fact, due to that fact, many of the beneficiaries were already part of the district's extension system. Such beneficiaries plus the INGC and district government technicians were subjected to theoretical-practical classes. For rain water harvesting, the beneficiaries were trained to become "promoters", who were equipped with basic tools (pick, measuring tape, shovel and hoe) whereas the beneficiaries trained for building improved barns became "artisans", who were also equipped with basic tools (5-liter bucket, measuring tape, bricklayer's spoon, plumb line thread, mold of blocks and mold for discharge box and crowbar). Each promoter or artisan was requested to be the first to implement the technology in which he was trained at his homestead, to serve as a role model within the community. These community members plus INGC's and local stakeholder's technicians subjected to training are the key elements in the long-term sustainability of the activities.

Implementation of rain water harvesting technologies

Implementation of rain water harvesting technologies in association with principles of conservation agriculture started with training of rain water harvesting promoters (Photo 1) in order to improve the yields and diversify crop production and reinforce food security and nutrition, thus reducing drought vulnerability. The techniques thought to the promoters were: cultivation in even furrows (Photo 2), cultivation in plantation holes (Photo 3), cultivation in furrows spaced with reception areas covered with plastic (Photo 4) and the use of dead vegetable covering - mulching (Photo 5).

After training of the promoters, each one established his own on-farm demonstration plot, with at least 1000m^2 area, where intercropping was mandatory, involving maize, sorghum, groundnuts, cassava and beans. In parallel, INGC also established similar plots in the CERUM, all of them for use in field days (Photo 6).

For each on-station or on-farm demonstration plot, a comparative unit with the traditional technique was established, with planting seasons occurring almost at the same time with the improved plot. The yields from the 2008/09 planting season were estimated between the improved and their unimproved counterparts (Photo 8). Yield measurement took in consideration the intercropping reality of the plots.

Ideally, each promoter was demanded to train 10 neighbouring community members. The promoters concentrated only in the replication of two technologies, namely cultivation in even furrows and cultivation in plantation holes. The remainder techniques were only displayed at the CERUM. Promoters also benefited from regular refresher sessions for revision, consolidation and feed back on their constraints and discussion of technology improvements.

Once or twice a year each promoter gathered his/her neighbours in field days and advantages and disadvantages of the technologies were discussed in a farmer-to-farmer approach (Photo 9). On the other hand, the CERUM also organized one field day for representatives of communities where on-farm demonstration trials were conducted to complete the framework.

Implementation of the post-harvest loss reduction techniques

In order to reduce grain post-harvest losses, in the beginning of 2010, the Gorongosa model of improved barns (Photo 10) was promoted through the training of local artisans (Photo 11), who were immediately business-oriented, meaning that they were instructed, from the very beginning, to render their services against payment of a small fixed fee by interested farmers. In fact, for every improved barn requested, the beneficiary paid 450,00 meticais (equivalent to USD 14,00), for manpower. Additionally, the interested client was taught on brick making and supposed to devote the necessary time (Photo 12). As a promotional strategy at this initial stage, INGC shared the costs by supplying some materials (1 sac cement, 2 iron rods and wire) worth around USD16,00.
The barns were built with unburned clayish sand bricks (Photos 13 and 14), using very little cement and wiring (just at the base and top). Training methodology was similar as that for the training of rain water harvesting. Two sizes were involved in the training, namely a 800 and a 1000 kg capacity improved barn.

Training included topics such as the right drying stage of the grains and the use of chemical treatments for the grains inside the barns. Some advantages of the improved barns as opposed to the traditional barns were highlighted, namely (i) the first grain in, is the first out, (ii) the pests do not attack the grains, (iii) what goes in is the grain and not the ear (spike) and (iv) the excess humidity retained by the grain during drying does not result in spoilage as it is absorbed by the barn walls.

c) Description of crop yield measurement

In order to be able to convince farmers about the advantages of adopting the new technologies, during 2008/09 planting season crop yields were measured. Six on-farm demonstration plots (even furrows) and one CERUM's demonstration plot (plantation holes) were selected. Varieties used in the demonstration plots were Matuba, for maize, Common Natal, for groundnuts and Zavala and Munhaça, for cassava. It was not possible to identify the varieties of other crops (Millets and Nhemba beans). In all the plots, seedling was during December 2008 and January 2009. Total rainfall was 637.5mm, the majority having fell in December (250 ml) and February (155mm).
In the selected plots, a minimum of 2 consecutive lines for each crop were selected and its useful area was measured. From the selected lines the following information was recorded:

- number of plants per useful area
- number of wads (maize), of ears of corn (millets) or pods (groundnuts of Nhemba beans) within the useful area
- Wads weight from the useful area
- Weight of the dry grain (maize, groundnuts and beans) one month after cropping
- Yield per plant and per square meter and its extrapolation for hectare

In some cases, it was possible to measure the yields in control plots (cultivated with the traditional techniques).

Results

Rain water harvesting technologies

Thirty three promoters were trained and equipped with basic tools. During the 2007/08 and 2008/09 planting seasons, rain water harvesting technologies were still being established, after training of promoters. It was during the 2009/10 planting season when a wider adoption movement started to be observed as the farmers started to believe in the benefits of the technologies from the on-farm trials (Photos 15 and 16). Ever since the promoters have declared having established in total at least 100 rain water harvesting plots, but from these at least 52 could be verified physically.

In Table 1 are delivered data on yields and yield differences between improved and traditional techniques. The following comments are made regarding these data:

a) Productivity differences between locations could be due to differences in soil characteristics and rainfall differences;

b) Crop varieties were not standardized between plots;

c) Yield measurement in the on-farm control plots was difficult as the farmers started early to harvest in these areas, resulting in only 6 trials and few crops;

d) The data were based on only one year and there was no replication blocks;

e) Due to the gradual harvesting of the Nhemba beans (leaves and pods) to fulfill the family feeding needs, it was particularly difficult to measure its yield, restricting it to one farmer (plot nr 2).

f) The yield of cassava was impossible to obtain in the only plot where it was planted due to lack of cooperation of the farmer who did not want to harvest at the time of measurement.

Post-harvest loss reduction techniques

The first 8 improved barn promoters were trained and equipped in March 2010 in Mabote (Photo 17), who immediately after, received a small incentive to build their own barns. To time, 15 improved barns had been built, each at an average cost of USD 42,00, from which 38% was subsidized by INGC as a promotional campaign. At the 2010 harvesting season, CERUM's demonstration barn was charged with grains and used in the first field day on the issue.

Due to (i) the low costs involved in the construction, (ii) the good reputation of the technology in a neighbouring CERUM that has been building Gorongosa improved barns for 2 years and (iii) opening of the farmers to CERUM's[10] activities, around 90 improved barns have already been booked for up to the end of 2010. It has been observed that the majority of the barns were requested by relatively prosperous farmers (those who owned many wives or bigger plots, who could much easily pay for the artisan's manpower and could make the bricks).

Discussion

Yield results presented in this paper are to be regarded with caution as they are based on only one year where rainfall was within normal patterns for the district. Other variables (to be thoroughly discussed ahead in this chapter) were not so inadequately approached in order to allow extraction of solid results. The merit of the contents of this paper is that it shows some definite trends such as:

[10] Mabote CERUM has many other demonstration activities, such as drinking rain water harvesting techniques, artisanal and industrial processing of vegetables, fruits, meat, fish, milk, roots and tubers, promotion of non-conventional ("wild") nutritive drought tolerant plant resources, zero artificial watering reforestation techniques, etc, delivered in user-friendly ways.

a) The technologies seem to work in such a way that are attracting the attention of the beneficiaries;
b) The communication strategy adopted within the extension activities seem to link research-extension-farmers in an effective way, as testified by expansion activities undertaken by key farmers without the direct involvement or direct supervision of extension officers.

Rain water harvesting technologies

The following main issues reported by Tamele and Gomes (2009) are discussed regarding the results presented:

In general, even furrows plots yielded much higher than traditional plots. For maize, even furrows yielded from 1 to 1.7 ton/ha, against 0,1 to 0,7 ton/ha in traditional plots. In one plot (number 3), maize increased from 1.5 ton/ha in the traditional plot to 3.3 in the improved plot, probably due to a much higher water retention capacity and higher fertility of the soils as suggested by its physical characteristics.

The plantation holes technology was tested at the CERUM (plot number 7) for maize, where yield increased 10 times from traditional cultivation (0,1 ton/ha) to the improved technique (1,1 ton/ha). This figure is promising, but should be repeated in a wider area and in different planting seasons.

The plantation holes technology had an additional advantage of having been considered less labor intensive by the beneficiaries. Regarding groundnuts, even furrows presented yields ranging from 0,1 to 0,6 ton/ha, whereas in the only plot representing the traditional technique it yielded 0,1 ton/ha. On the other hand, millets followed the same pattern, growing from 0,6 to 1,4 ton/ha.

Apart from the higher yields, superiority of the results was supported by a higher number of wads per maize plant (1 per plant in the traditional plots against 2 per plant in the even furrows in plots 3 and 6) and higher number of pods per plant in the case of groundnuts (from 30 to 79 per plant in plot number 5). In spite of the impossibility to measure the yield of cassava and Nhemba beans, visual observation pointed towards superior performance of the improved technology. Amongst the benefits reported by farmers for the improved technologies were the increased productivity and bigger maize spikes, fuller and heavier millet spikes and higher number and fuller groundnut pods.

The above mentioned results for improved cropping practices compared favourably with those issued by Tollefson et al, (2002) and they could be linked to improvements in more efficient water catchment, retention and use in dry land farming, along with improvements in soil organic matter.

The differences observed in the full expression of the improved technology advantage could well be explained by wide differences in agro-climatic environments and farmer characteristics, as well as lack of crop residues (biomass) to preserve soil moisture and improve soil fertility, as referred by Tollefson et al, (2002).

During the demonstration sessions, some feedback messages were delivered by the farmers, namely:

- Cultivation in even furrows was labor intensive (Photo 18).
- Even if cultivation in plantation holes yielded less crop than cultivation in even furrows, that technology was less labor intensive and therefore more appreciated.

An implication of these messages for researchers and police makers is that if progress is to be made more quickly, some sort of mechanization of the most labor-intensive even furrow activities should be achieved.

In fact, eye observations led to the conclusion that even furrows and plantation holes tended to be location-specific, with even furrows more practiced where soils were very sandy and less fertile (easier to practice; the most efficient in rain water catchment; the more productive; the more vulnerable communities) and plantation holes where soils were heavier and more fertile (land heavier to manipulate; soils with better natural rain water retention capacity; areas naturally more productive; relatively less afflicted communities). These observations, despite making sense still need to be confirmed by appropriate studies.

When compared to improved plot's yields presented above, those issued by Kassam et al (1982), cited by Tamele and Gomes (2009), for the Mabote agro climatic area, it can provisorily be concluded that even furrows allowed attainment of higher maize, millets and groundnut yields than the traditional cropping practices. This conclusion takes us to the next discussion step: How to communicate effectively with the farmers to maximize up-take of this technology.

Some observations made by extension staff regarding promoter's behavioral issues that must be taken in consideration during the implementation of this activity were:

- Promoters believed in the improved technology
- Promoters were proud of practicing the technology and thus were voluntary to share their experiences with fellow farmers at field days
- Despite the technology being labour consuming, promoters were interested in changing gradually (a new portion each year) their whole traditional cropping area into even furrows.

Post-harvest loss reduction techniques

Despite having acted against Semana (1999), who advocated a non-charity principle in delivering extension messages, the fact that INGC gave a 38% subsidy in the total barn cost was an important incentive in the sense that the technology was new and not advertised. Farmers want to see as many successful examples as possible before they can adopt a technology.

Operation of extension services relevant to the needs of farmers

Semi-arid zones in Mozambique historically tended to be neglected and considered marginal. As a result, fewer resources used to be allocated to such zones, when compared to potentially "more productive" areas. One of the issues that used to be neglected was agricultural extension, once these zones were not prioritised. In the case of Mabote, only two unspecialized extension officers were allocated, with no specific Terms of Reference towards dry lands development.

Under these circumstances, the role INGC is playing in Mabote is very crucial in establishing a structured extension service that conveys the flow of information about new, better or appropriate technologies that solve the very particular problems faced by rain fed dry land farmers, from research institutions to the farmers, and back to researchers and policy makers, as reported by Kyomo (1992).

Field days and demonstration sessions during planting seasons were described by Tollefson (1995) as advisable mechanisms to link researchers, extension officers and farmers. In addition to these mechanisms, INGC included the training of artisans and promoters, who in turn were active subjects in the delivery of the field days and demonstration sessions. Most of the demonstrations occurred on-farm, which was in line with statements by Tollefson (1995), who considered that farmers tended to believe in on-farm demonstration trials with direct benefits to them.

As reported by Tollefson et al (2002), in Mabote area land tenure issues tended to impact negatively on investment in improved furrows. In fact, due to cultural reasons, livestock are run freely during

historically off-season cropping periods in the region (after harvesting and before next planting: June to October). This constraint implies that the plots had to be fenced with barbed wire, to avoid crop damage by cattle, but still continued susceptible to goats, which increased the cost to access the technology. With a more massive adoption that can be foreseen for the future, it might be possible that this cultural habit is changed.

Tollefson et al (2002) reported that lack of awareness of policy makers about the benefits of the improved technologies could be an important constraint. As a matter of fact, not only in Mabote, but in other semi-arid districts, one of the main limiting factors used to be a weak involvement of local, provincial and sometimes central level authorities in the activities under expansion in the dry land areas. More recently, the situation is changing radically when local authorities are put before convincing demonstration trials, in such a way that district governments are starting to commit human and financial resources to both rain water harvesting and improved barns. Another way of dealing with this situation followed by INGC was to produce a guideline for the development of arid and semi-arid zones, a practical and easy to use document where these issues are explained in a very simple and practical way. Nambiro and Omiti (2007) referred that when extension services were relevant to Kenyan farmers, half of them were willing to pay for these services. Similarly, in the case of Mabote, it is a fact that the farmers that requested improved barns were prepared to bear around 62% of the total cost of the technology (around USD26,00 from the farmers). This fact might mean that the technology is relevant for them. INGC's approach to its extension services in the dry lands followed most of the premises exposed by Semana (1999). In the educational component of the extension services, the activities aimed primarily at solving the farmer's most important needs (food) and were conducted on-farm. Both activities were not conducted on the farmer's own conditions (the promoters received equipment and the improved barn beneficiaries received a 38% sponsorship), in a transitory way for the establishment of good practice examples in the district, after which all the described incentives can easily be removed without compromising the programme.

Regarding the extension philosophy, the programme acknowledged the need to start working with the beneficiaries where they were, with what they had, teaching them helping themselves to farm better using their own efforts and resources. No enforcement was placed on farmers and there was no charity attitude. The activities were carried out involving beneficiary participation and local leadership participation. Every effort is being undertaken to develop solid extensionist skills. Still to be achieved is extensionist focus in the activities, which depend on the local government's decision to hire enough number of extensionists to be trained within the scope of INGC's activities.

In conclusion, it can be said that the efforts for bridging the gap between research, extension and farmers to reduce drought risk vulnerability in Mabote district are being undertaken within the correct principles and practices. The technologies seem to be right and to address farmer's needs and level of development. Nevertheless, the link with research should be strengthened through a more proactive involvement of research institutions in dry lands development activities.

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Tables

Table 1. Yields from intercropped improved or traditional technology's plots in Mabote, during 2008/09 cropping season

Plot number	Traditional cropping			Improved technology (Even furrows)		
	Intercropping	Number of pods or ears, or cob per plant	Grain weight (ton/ha)	Intercropping	Number of pods or ears, or cob per plant	Grain weight (ton/ha)
1	Groundnuts	_	_	Groundnuts	78	0.6
	Maize	_	_	Maize	_	1.6
2	Groundnuts	_	_	Groundnuts	66	0.5
	Maize	1,0	0.5	Maize	1,5	1.0
	Nhemba beans	_	_	Nhemba beans	_	0.6
3	Maize	1,0	1.5	Maize	2,0	3.3
4	Groundnuts	_	_	Groundnuts	70	0.2
	Maize	_	_	Maize	1	1.4
	Nhemba beans	_	_	Nhemba beans	_	_
5	Groundnuts	30	0.1	Groundnuts	79	0.1
	Maize	_	_	Maize	_	_
	Millets	_	0.8	Millets	_	1.4
6	Maize	1,5	0.7	Maize	1,9	1.7
	Nhemba beans	_	_	Nhemba beans	_	_
7	Maize	0.3	0.1	Maize	1	1.1

Source: Tamele and Gomes (2009)

Where: Plots 1 to 6 are "on-farm" and plot 7 is "on-station".

FIGURES

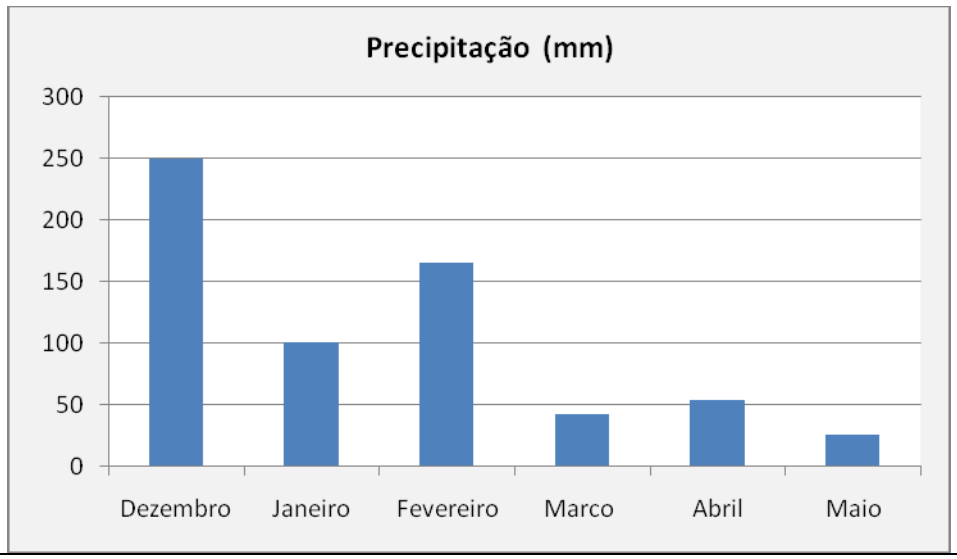

Figure 1: Rainfall recorded between December 2008 and May 2009. (Source: Tamele, C. and Gomes, F., 2009)

Government Intervention Programmes Through Extension to Improve Agricultural Research and Extension services in Communal Areas of Namibia: A Review

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Summary

Agricultural development lies at the heart of income generation, poverty reduction and food security of most developing countries including Namibia. The Namibian agricultural sector has, broadly, a dual system comprising a well developed, capital intensive and export oriented commercial sub-sector and a subsistence-based communal farming sub-sector, low in technology and external inputs and highly labour intensive. Agriculture directly or indirectly, supports about 70 percent of the country's population. However, the capacity of a farming system to adapt to changing weather and climate conditions is chiefly based on its natural resource endowment and associated economic, social, technology and political conditions. The paper discussed the theoretical framework for the interface between research and extension. The aim of this study is to assess agricultural research and extension activities in Namibia that aim at improving rural households' livelihood in the globally changing environment. The presentation will be illustrated by many examples from the realms of crop and livestock production including seed multiplication, soil fertility, conservation tillage, animal draft power, and livestock improvement schemes. The study found sufficient evidence that some research-extension strategies being employed are relatively successful. The main challenge remains to strength national agricultural research system with an appropriate institutional and coordinating structure, focusing on decentralised adaptive research and on farm trials.

Introduction

Agricultural extension services are a vital component of rural development in all the developing countries of Southern Africa including Namibia. These services are accountable for cooperation amongst farmers, researchers, farmer organisations and community developers. The agricultural extension service is a basic tool in government programmes and projects that aim to bring about changes in agricultural production and raise rural living standards. Recent trends had shown that population growth, growth of towns and the number of people involved in non-agricultural activities have led to increasing demand for agricultural products. Therefore, intensive and sustainable used of productive land can help in addressing the problem of enough food for household consumption and income generation. In order to achieve this, farmers must be given an opportunity to access agricultural education, necessary information on appropriate food production technologies and markets information. However, with limited resources, extension officials in Namibia found themselves not delivering to their expectations.

The study is based on a brief discussion of the theoretical framework for the interface between research and extension. The objective of this paper is to assess agricultural research and extension activities in Namibia that aim at improving rural households' livelihood in the globally changing environment since independence in 1990. The study is based exclusively on formal public-sector linkage between agricultural research and extension mechanisms. Relatively little research has been conducted on reviewing agricultural research and extension services linkages theory and assessing, investigating or examining its practice in Namibia. However some related studies have been done such as by Kumba (2003). The paper starts with a brief of theory of agricultural extension including agricultural research-extension linkage. This is followed by overview of agricultural research and extension approaches in Namibia and experience in the Northern communal areas (NCA) of Namibia. The paper ends with conclusions and future considerations.

Theoretical foundation of Agricultural Extension

The definitions of extension vary depending on the application of the concept. Bembridge, (1993) defined agricultural extension as a system of non-formal education for adults in rural areas which is based on relevant content derived from agricultural, social and communication research synthesised into a body of concepts, principles and operational procedures. Extension is therefore, a process of working with extension agents, researchers and farmers in order to bring about appropriate technology that change in agricultural production and raise rural living standards.

One of the well known theory in literature is the diffusion theory. This theory has emphasised the transfer of technology in order to increasing food production and alleviates poverty in developing and underdeveloped countries. The feedback side of the diffusion model is inherently weak, as extension officials and farmers do not make relevant participation in the technology generation process. The diffusion model is more relevant to policy makers, merchants, banks, input suppliers and transportation companies. The model has little relevance when it comes to serving resource poor farmers, natural resource management, sustainable development and ecological agriculture (Ergano, Not Dated).

Over time extension importance in promoting research-based practices has increased. Due to scientific research based practices, extension was given an important role in agricultural and rural development processes in Europe and North America. The importance of agricultural extension services also spread to developing countries including the small-scale farming sector in Southern Africa. Bembridge (1993) contends that technology transfer is an integral sub-sector of the extension process that is involving the transfer and spread of farming information from researchers via subjects matter specialists and extension workers to farmers as well as the transfer of feedback from farmers to researchers. Figure 1 illustrates the relationship between main actors in the research–extension linkage system.

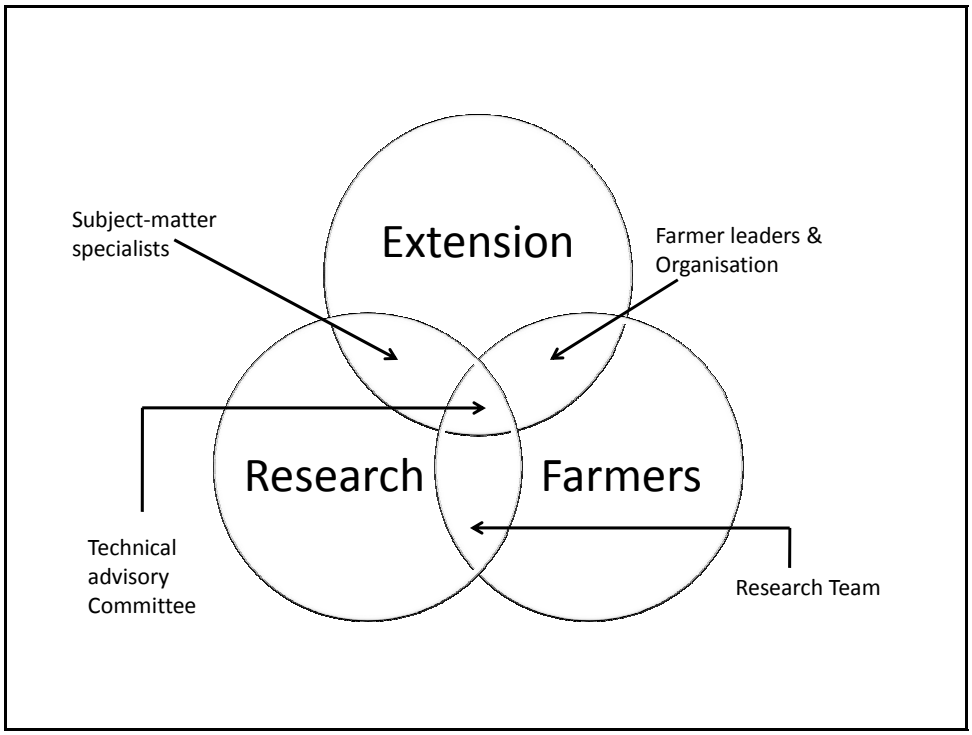

Figure 1 Linkage among main actors in research-extension system

Extension provides the crucial link between research and the farmer (Figure 1). The concept of linkage implies that the communication and working relationship established between two or more organisations pursuing commonly shared objectives in order to have regular contact and improved productivity (Agbamu, 2000). The term extension has frequently, however, been criticised for the linear, unidirectional flow of information between research services and farmers (Farrington, 1994). Nevertheless, Agbamu, (2000) contends that agricultural research and extension services are two systems which are linked by information flow and feedback. For agro-technologies to be relevant to local needs, researchers, extension workers and farmers must play important roles in identifying research problems, adapting the recommendations to local conditions and providing feedback to researchers about the innovations that have been developed.

The participation of extension workers in adaptive research trials allows them to become familiar with the technologies they are expected to promote and also helps to ensure that the sociological dimensions of farming are not neglected (Agbamu, 2000). Farmers participation in diagnosis, testing and dissemination involve: (1) organised with groups of farmers rather than individuals, (2) recognise that researchers and extensionists are unlikely to capture the complexity, diversity and risk facing low-income farmers, (3) that farmers own knowledge is important, and (4) that farmers themselves are best-placed to interpret how relevant new technologies might be (Farrington, 1994) .

Agbamu, 2000 discusses forms of research- extension linkages where research and extension organisations operate at the same or have unequal status in a country, using a bottom up approach or top-down approach in decision-making on linkage activities. The same author also points out that in some cases there is no organised linkage system between agricultural research and extension organisations. Hence there is a need to understand the practice of bottom up and top-down approaches as well as absent of an organised agricultural research-extension linkage system particularly in developing country such as Namibia. The Namibian agricultural research-extension linkage system follows relatively a top-down approach system.

Overview of Agricultural Research and Extension Approaches in Namibia

Agriculture sector

Namibia is a vast country with a predominantly arid climate, and to a great extent in need of improved and more diversified agricultural production systems to sustainably optimise land productivity. Namibia population is estimated to be around 2 million people amounting to an average density of 2.2 people per km^2 (FAO, 2007) with an annual population growth rate of over 3 percent. Approximately 60 percent of the population lives in the Northern communal areas (NCAs) of the country (NPC, 2006, FAO, 2007). NCAs are characterised by subsistence agriculture dominated by dry land crop production and have the highest poverty and HIV and AIDS prevalence in the country (MOHSS, 2007).

Namibia's agriculture can be divided into two distinct sectors: the capital intensive, relatively well developed and export oriented sector, and the subsistence-based, high-labour, low-technology communal sector. The communal farming areas directly support more than 70 percent of the nation’s farming population, though they only occupy 33.5 million hectares (NAP, 1995) of the aggregate agricultural land. Farming in communal areas is characterised by subsistence rain-fed crops and common grazing for livestock, resulting in low levels of productivity, high variability of output from year to year, and household food insecurity, thus resulting in a high degree of poverty. On the other hand, the commercial farming sub-sector occupies approximately 36.2 million hectares (NAP, 1995) of agricultural land, which is mainly used for extensive livestock and game ranching.

Crop production is concentrated in the northern regions of Namibia, which are semi-arid and whose soils have low fertility. The staple grain crops of the NCAs are pearl millet, sorghum and white maize with limited but widespread planting of cowpea, groundnut and bambara nut. Millet is the dominant crop of the NCAs. Farming in the communal agriculture sub-sector offers the greatest potential for growth and diversification. Livestock and grain production represents the foundations for the growth

of agricultural incomes, exports and rural employment, consequently contributing to import substitution and household food security. The Government of Namibia's main challenge is, however, the lack of the necessary human capacity with the required technical knowledge and skills to develop and implement successfully programmes and projects.

Role of agricultural extension in Namibia

In most poor countries extension services is managed by public sector or state (Campell, 1999). Similarly in Namibia the role of non-state agents is limited in scope and bulk of extension service is provided by public sector (Kumba' 2003). The government agricultural extension services mainly provided subsidised agricultural services (e.g. ploughing, farming input sales, the development and maintenance of farm infrastructure), and the administration of government programmes such as drought relief and credit schemes (through Agribank). Extension services aim to help farmers to develop and adopt improved farming technologies and practices, organised themselves in cooperatives as well as have access to information (i.e. markets and policies) and infrastructure.

The Directorate of Extension and Engineering Services (DEES), in the Ministry of Agriculture, Water and Forestry (MAWF) was created to provide agricultural extension services to farmers, agro-based industries and other stakeholders in the form of information communication, advisory and training services. Although the government through DEES has tried to implement the policy of decentralisation in order to bring service close to the farmer it is often difficult because extension offices are the only government offices in many remote areas. It is reported that many farmers are living and farming far away from the nearest Agriculture Development Centre (ADC) (MAWRD Baseline Surveys, 2003). In addition the capacity of both farmers and extension officials to travel extensively in the regions is limited. Henceforth, for the majority of rural farmers to get assistance for agricultural extension services long distance are travelled by both farmers and agriculture extension officials. As a result there is a need to build more ADCs in the regions that will not only help farmers, but will also create more interest in farming amongst those that do not farm, particularly the youth.

Agricultural research and extension strategies

The two directorates in the MAWF responsible for extension and research services are the Directorate of Extension and Engineering Service (DEES) and Directorate Agricultural Research and Training (DART). These directorates are managed by different directors (managers) making the extension-research linkage programmes implementations difficult. The MAWF during the mid 1990s'has realised that in order to carry out information from researchers to the farmers and vice versa it needed a developmental strategy. Consequently, the Farming System Research or Extension (FSRE) approach was officially adopted as a development strategy for farmers in 1997. The FSRE is mainly characterised by various approaches such as it is holistic, participatory, demand driven, multidisciplinary and problem solving. The question here is did the FSRE succeed in Namibia. Kumba (2003) argues that it remain unclear whether resource-poor farmers in communal farming regions have been effectively incorporated into the planning, designing, financing, implementing and evaluating process of state-controlled and agricultural development programme that have come under the supervision of regional FSRE teams. Fleissner, 2000 as cited by Kumba (2003) contends that farmer participation on equal footing with professionals in the activities of FSRE teams is still exceptionally limited and that many Namibian agricultural professionals have virtually abandoned the FSRE approach. In addition, certain agricultural professionals in Namibia even developed antagonistic attitudes towards the FSRE approach and are regarding it as a threat to their line of work (Matanyaire, 2000 as cited by Kumba, 2003). Recently a Farmer and Extension Development (FED) strategy was introduced in North central regions (NCRs) of Ohangwena, Oshikoto, Oshana and Omusati.

The FED seeks agricultural extension technicians (AETs), farmer associations and individuals to work with farmers' groups through field visits, provides short course and informal training, as well as works with farmers to establish on-farm demonstrations of new technologies. The FED groups are introduced to new technologies such as use of Draught Animal Power (DAP) technologies and new crop varieties mainly by conducting on-farm trials and demonstrations. Besides the FED groups, farmers are also

encouraged to form farmers' associations or co-operatives. Nevertheless, it is unclear whether the FED strategy is successful or not.

Furthermore, strong research and extension support is essential for the development of the Namibian seed industry. Plant improvement research is conducted on station by DART and demonstrations are made on farmers' fields in collaboration with DEES. Moreover, the seed co-operatives in NCAs of Namibia are said to have little managerial, technical and infrastructural capacity to adequately cope with national seed requirements, especially in times of disasters (floods and drought) (Awala et al, 2010). As a result farmers' use informal sources of seed. These include farm saved own seed, farmer to farmer exchange and buy uncertified seed at local open markets.

Experiences of agricultural research and extension services in NCRs of Namibia

Livestock and crop production systems are envisaged to satisfy many rural household basic needs in Namibia, although this depends on receiving sufficient rain.

Crop production and role of agricultural extension

Crop production is a dominant farming activity in NCRs. Farmers intercrop cereal crops with leguminous crops and vegetables. The use of new crop varieties is disseminated by government extension officials to farmers. The strategies are based on on-farm demonstrations of new technologies and training of farmers by the agricultural extension staff. The new crop cultivars' interventions aim at improving farmers coping strategies especially during drought seasons. In addition the extension officials also disseminate information with regards to production inputs and sell government subsidised fertilizers and crops seed to resource poor farmers. Together with traditional varieties of pearl millet, sorghum and cowpeas farmers today use improved varieties of crops. However, it is notable that many farmers are still using the seeds of local crops (Table 1). Table 1 shows also that the adoption of Okashana no. 1 (pearl millet variety) is moderately good, whereas those of Kangara (pearl millet variety), Macia (Sorghum), Nakare and Shindimba (both cowpea) remain very low.

Table 1 Role of extension in introducing new crop varieties in the NCRs of Namibia

Variable	Farmers' Response	No. of farmers in (%) Omusati Region	No. of farmers in (%) Oshana Region	No. of farmers in (%) Oshikoto Region	No. of farmers in (%) Ohangwena Region	Average (%) NCRs	Level of technology practice by farmers
Planted seed	Yes /No						
Pearl millet varieties							
1. Local Mahangu seed	No	18	12	14	15	15	High
	Yes	82	88	86	85	85	
2. Okashana nr. 1 seed	No	35	27	51	23	34	Moderate
	Yes	65	73	49	77	66	
3. Kangara seed	No	86	89	95	95	91	very low
	Yes	14	11	5	5	9	
Sorghum varieties							
1. Local sorghum seed	No	9	13	5	12	10	High
	Yes	91	87	95	88	90	
2. Macia seed	No	83	91	94	79	87	very low
	Yes	17	9	6	21	13	
Cowpea varieties							
1. Local cowpea seed	No	6	77	1	8	23	High
	Yes	94	23	99	92	77	
2. Nakare seed	No	93	99	99	83	94	very low
	Yes	7	1	1	17	7	
3. Shindimba seed	No	94	100	99	94	97	very low
	Yes	6	0	1	6	3	

Source: *Adapted from MAWRD, Baseline Surveys. Baseline Survey of the impact of Agricultural extension services in Omusati, Oshikoto, Oshana, Ohangwena regions. Directorates of Extension and Engineering services. Outapi, Tsumeb, Ongwediva, Eenhana, 2003*.

Livestock production and role of agricultural extension

The Directorate of Veterinary Services (DVS) in the MAWF is carrying out annual vaccination campaigns in the NCAs against Foot and Mouth and Contagious Bovine Pleuro-Pneumonia (CBPP) diseases. Vaccination awareness's also are done against Lumpy Skin Disease, Rabies, Anthrax, and Newcastle disease. However, in order to improve vaccination campaigns strategies, more training in animal health issues needs to be conducted and more crush pens have to be constructed in the remote areas of the NCAs. Although extension services in case of animal castration is well understood by farmers the same cannot be said about dehorning as new innovation (see Table 2). Dehorning of cattle is one that farmers still do not practice to any significant degree. Traditionally many farmers tend to think that horns are positively correlated with fatness and/or frame size, and hence more money. Hence, farmers need to be given the right information with regard to disadvantages of horns. Although extension services has been putting more effort into promoting the importance of livestock supplementary feeding only few farmers are reported to give additional feeds to their animals (Table 2).

Table 2 Role of extension in improving livestock activities in the NCRs of Namibia

Variable	Farmers' Response	No. of farmers in (%) Omusati Region	No. of farmers in (%) Oshana Region	No. of farmers in (%) Oshikoto Region	No. of farmers in (%) Ohangwena Region	Average (%) NCRs	Level of technology practice by farmers
Castrates livestock	Yes	81	77	77	61	74	High
	No	4	16	16	39	19	
	Not applicable	15	7	7	0	7	
Dehorns cattle	Yes	4	18	5	7	9	Very Low
	No	66	55	79	93	73	
	Not applicable	30	28	16	0	19	
Gives supplementary feed to cattle	Yes selectively	32	30	16	43	30	Low
	Yes all herd	36	29	16	27	27	
	No	7	27	48	30	28	
	Not applicable	25	14	20	0	15	
Cattle Vaccination yearly	Yes	50	61	56	45	53	Moderate
	No	3	9	22	55	22	
	Not applicable	47	30	22	0	25	

Source: Adapted from MAWRD, Baseline Survey. Baseline Survey of the impact of Agricultural extension services in Omusati, Oshikoto, Oshana, Ohangwena regions. Directorates of Extension and Engineering services. Outapi, Tsumeb, Ongwediva, Eenhana, 2003. *Note: Not applicable results because some farmers did not own livestock (cattle).*

Moreover, more than 60 percent of farmers in the NCRs are reported currently, to use draft animal power and implements for crop cultivation (i.e. ploughing and weeding) as an alternative technology to traditional hand hoes (MAWRD Baseline Surveys, 2003). As a result draft animal power and implements is observed to be more effective and efficient than hand hoes. Experience in the northern Namibia has shown that the use of Draught Animal Power (DAP) can improve crop production by 8 percent (Chigariro et al, 2008). The same authors argue that DAP can be used as a vehicle to minimise the negative effect of HIV/AIDS on agricultural productivity and household food security. There is therefore, urgent need for agricultural extension officials to continue training farmers and to encourage the use of animal draft power technologies especially cultivators. However, DAP implements such as cultivators are hardly available and this has confined farmers to using hand hoes. Many of these DAP implements are imported from other African countries such as Zimbabwe and Senegal as a result they are very expensive when they are available for farmers. So there is a need to sensitise local businesses to start the manufacturing and supply adequately of DAP implements at affordable prices.

Marketing information and use of mass media in agricultural extension

The marketing of agricultural produce, both livestock and crops, has not been a focus of great attention by agricultural extension staff in the NCRs of Namibia. If any, marketing information is only provided to few farmers (MAWRD Baseline Surveys, 2003). The 2003 Baseline Surveys in NCRs of Namibia, in case of livestock marketing has found out that less than 10 percent of the farmers claim to get marketing related information from Meatco[11], AETs and farmer organisations. Consequently, the market off-take of cattle in the whole of NCRs is estimated to be less than 5 percent. The problem of marketing is fairly characterised by the lack of proper market infrastructures and poorly marketing information dissemination.

[11] A parastatal responsible for all formal meat marketing activities in the NCAs.

The major source of disseminating agricultural information in the NCAs of Namibia is the use of radio (MAWRD, Baseline Surveys, 2003). However, information heard on the radio and via direct contact with extension workers fulfils different and complementary roles. Radio is more suitable as a source of news and information of immediate relevance and for creating awareness of farming innovations. AET interventions are aimed at increasing understanding of new technologies, developing technical skills, encouraging testing of an innovation by farmers and supporting adoption by the farmer. Other communications sources that can be used by farmers include cell-phone, television, newsletter and magazine. Finally the role of AETs in introducing conservation tillage practices is observed to be minimal. Conservation farming is mainly addressed by non-public sector in Namibia to few selected farmers.

Conclusions and future directions

The major agricultural research and extension challenges facing rural farmers in Namibia include adoption of new technologies which ranging from new crop varieties, improved livestock breeds, improving soil fertility through conservation farming as well as adapting to new draft animal power techniques and implements. In addition procurement of production inputs and marketing of agricultural output need also to be addressed through information communication. Moreover, the Farming System Research or Extension (FSRE) approach remains the main development strategy for farmers in Namibia. The successfully implementation of the FSRE is made complex by: inadequate understanding of the approach among stakeholders, lack of feedback from farmers to researchers and extension officials not being able to reach out on all farmers in remote areas.

It is concluded that for research to be more relevant to farmers, there is a need to create an agricultural research and extension linkage that allows farmers to choose appropriate technologies from research stations. Henceforth, eliminating the perception that the extension services system is a separate system from research system, consequently, strengthening the linkages. Finally, radio remains the most popular mass media communication used by communal farmers in Namibia. However, it is observed that the majority of rural farmers now own or have access to mobile phone (cell-phone) which maybe explore as a medium of information dissemination.

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The Importance of Veterinary Extension in Disease Outbreaks in Reference to a Rift Valley Fever (RVF) outbreak in Rural Mpumalanga, South Africa.

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Summary

Disease eradication campaigns in rural Africa need dedicated veterinary teams to be a success. A significant amount of money and time should be spent on extension so that the prevention and eradication systems succeed. Veterinary extension refers to the transfer of animal disease information to communities or a group of individuals using different methods. In 2008, a small village called Libangeni in rural Mpumalanga experienced an outbreak of Rift Valley Fever (RVF) where several deaths of kids were recorded. This was a rare disease in the community and a lot of information was needed. The main goal was to stop the disease from spreading and to avoid human cases. Liaison with the local Department of Health was done. An area of a radius of 10kms was targeted. Using the Sender, Message, Channel, Receiver and Effects (SMCRE) model, an extension plan was drafted. A team of 12 officials that included 2 Veterinarians, 4 Animal Health Technicians, 2 Veterinary Nurses and the rest being Dip Tank Assistants was first trained to equip them with the RVF information and steps to deal with the SMCRE model. The sender was the State Veterinary Office. The message included the typical signs of RVF in animals, the zoonotic potential and recognising signs and symptoms in humans and finally the prevention methods. Channels used included the local radio that broadcasted in the local language, pamphlets and posters were distributed to mainly schools, shopping malls, bars and clinics. Information meetings were arranged by the local dip tank committees. Vaccines were then provided by the State. The vaccination campaign resulted in 92% of the cattle herd, 89 % of goats and sheep herds being vaccinated in the specific area targeted. There was also the response from the Department of Health informing people to protect themselves from mosquitoes with all the areas around the water holding facilities being sprayed. Dealing with the aged and less literate in rural areas needs a lot of consideration and planning in advance. Understanding the history and culture of the community helps in the success of veterinary extensions. The success of the vaccination campaign and the response from other stake holders could be attributed to the valuable information shared by the Extension team.

Introduction

Animal disease outbreaks can cause a devastating effect on the economy of countries that are mainly dependent on agriculture. Disease eradication protocols should always be put in place for every disease including non zoonotic and zoonotic diseases. Successful control of diseases will always succeed if there is extensive extension that is done. Veterinary extension helps farmers and the public in general to understand the disease, its effects both economically and socially and also any zoonotic potential.

Veterinary extension is usually defined as a practical and also understandable advice that is given to a group of people or communities about livestock diseases including the treatment, prevention and also ways that influence the productivity of humans and animals (McCrindle, 1995).Veterinary Extension is part of Agricultural Extension where all principles that apply to Agricultural Extension also apply to Veterinary Extension. There are certain prerequisites for one to have an effective Agricultural Extension. Assessment and cooperation of stakeholders in setting up a period of working and also planning the activities is needed. Implementation of the plans and coordination of the activities with a final efficient monitoring and evaluation system leads to a successful extension period (Bembrige,1991).

Agricultural extension has failed because of a number of factors. A few examples like lack of communication between extension offices, lack of training given to the workers and also lack of evaluation in all the extension work that is done leads to complete failure of some extension activities (Benor et al.., 1984).Some of the methods used in Extension include The Farming Systems Research and Extension (FSR-E) method, Farmer-led and Farmer to Farmer Extension Methods and also Visiting and Training Methods (Sekokotla, 2005).The SMCRE is one of the extension processes used.

Rift Valley Fever (RVF) is an arthropod borne viral disease that usually occurs in Africa. It is usually associated with high rainfall patterns and can cause high abortions in sheep, goats and cattle with a high mortality in kids and lambs. It can also cause illness in people. Outbreaks are usually associated with areas that have water holding bodies. Infected mosquito eggs can stay dormant for a long time until favourable conditions are available. Recent outbreaks in South Africa have been seen in 2008 with a major outbreak happening in 2010.RVF can lead to huge economic loss with a lot of abortions and also lamb and kid deaths (de Klerk and Pienaar, 2010).

An outbreak of Rift Valley Fever (RVF) occurred in Libangeni, Dr J.S Moroka Municipality ,Mpumalanga in May 2008. Libangeni is a small village with a population of 5000 people and about 3300 cattle and 2500 goats and sheep. 25 kids were reported dead within a space of 36 hours showing signs of diarrhoea and anorexia. Adult animals were also having diarrhoea but no deaths were recorded. Post Mortems were done and samples sent to a laboratory confirmed RVF.

RVF control will need involvement of Agricultural Extension methods for efficient control to avoid major losses and also prevent a lot of human life losses. Combining the knowledge of disease epidemiology and the basic extension principles leads to an effective Disease control method that should be quite a tool to use.

Materials and Methods

A team of 12 officials were assigned to deal with the outbreak campaign. It included 2 Veterinarians, one a State Veterinarian who deals with Disease Control and Regulatory. The other State Veterinarian deals with the Clinical Cases. Four (4) Animal Health Technicians (AHTs) who work with the Disease and Regulatory State Veterinarian and Two (2) nurses who usually work with the Clinical State Veterinarian. The other Four (4) were Dip Tank and Post Mortem Assistants. The State Veterinarian Office is 35 km away from the site of the outbreak and a Central Operation Centre was set up at the AHT's office in Libangeni that is about 5 km from outbreak site. All necessary training about RVF was given to all the Staff members.

Six (6) vehicles were made available for the campaign and each vehicle was first equipped with the all the Information material before it was released. The Equipment and Material included a loud hailer, posters, pamphlets, markers etc. The SMCRE(Sender, Message, Channel, Receiver, Effect) model was used to work up an extension plan. The Sender was the Regulatory State Veterinarian operating from the State Veterinary Office in Siyabuswa, 35 km from the Outbreak site in Libangeni. He had the help of the Clinical Veterinarian and the Animal Health Technicians. The figure to illustrate the SMCRE model is shown on Figure 1. The Message was distributed in different methods. The main aim of sending the message was for the Community to be aware of an outbreak of Rift Valley Fever in the area and also to know about the prevention methods that we had planned to do to achieve our objective of Disease Prevention as the Main Objective of State Veterinarians. Information included The typical Rift Valley Fever signs in animals that included the sudden death of kids and lambs, diarrhoea in both adults and young animals, heavy abortions in goats, sheep and also cattle, jaundice and high fever. The transmission method was even more emphasised taking into consideration the typical heavy rains that occurred during that year.

The zoonotic potential of RVF was one of the main important message that was passed to the community. More emphasis was put on how one gets infected when he is exposed to the virus especially if they get in contact with the fluids of infected animals. People were also encouraged not to eat and touch animals that get sick and die. With the poverty being a problem in rural communities, convincing the community not to eat what they call "free meat" needs a lot of determination is spreading the method. Typical signs and symptoms in human beings were also a major thing to inform the community so that they were aware. The help of the Community Health Centre Staff that we informed about the presence of the Rift Valley Fever helped us in spreading the message on the signs and symptoms of the disease.

The prevention methods centred on animals and human. It is very difficult to prevent animals from being bitten by mosquitoes especially during the day when they are grazing. The best method of controlling animal infections was via vaccinations. The state provided the vaccine and the message that was being sent out was for the community to bring all their animals for vaccinations. Humans were encouraged to avoid contact with dead animals or animals that die suddenly. Different Channels of spreading the messages were used. Local radio announcements that used the local language were aired, that informed the community of the presence of RVF in the area and prevention methods. Announcements for the dates of animal vaccinations were also done via the Community Radio. Pamphlets printed in English, Tswana (the local language) were distributed to school kids, patients and visitors at Community Animal Health Centres, revellers at beer halls and motorists who passed through a busy road in the village. Posters were also put on walls around the Schools, Beer halls, Clinics, Community Halls and on trees around some common paths. Meetings were arranged with the Dip Tank Committees. These Committees are responsible for arranging week to week cattle dippings. Any disease investigations like Brucellosis and Bovine Tuberculosis testing is done after informing the dip tank committees. Meetings were also done with the Traditional leader of the area to inform him about the plans, the disease itself and the consequences of not preventing the disease from spreading. Loud hailers were also used especially for the sheep and goats vaccinations where door to door vaccinations had to be done.

About 150 short questionnaires were distributed among the farmers where the vaccination campaign concentrated on. These were just to analyse the response of the community from the informative week that we had. The most important receiver was the Community. There were also small groups of receivers like the Community Nurses who were supposed to be at least be informed of what was happening so that they can spread the message to the community.

Results

Vaccination responses and a small questionnaire that was distributed was used to measure the effects. There was a 10km radius that was targeted for vaccinations. A total of 92 % of the total cattle herd in the area was vaccinated. Despite the concern of the communal farmers agreeing with us to use the live vaccine in some of the animals that we were not sure of their pregnancy status, the response was great. Cattle were vaccinated at state provided crush pens where they drove their animals to the pens.

A total of 89 % of goats and sheep were also vaccinated against RVF. It was so difficult for the communal farmers to bring the goats and sheep to designated areas as we do not have any handling facilities for the goats and sheep. As a result, goats and sheep vaccinations were done using a door to door method. Analysis of the questionnaire 2 weeks after the vaccinations campaigns showed that 98% of the respondents heard the message that there was an outbreak of RVF. 68 % of them got the message through the radio, 20 % were informed by school kids, 6 % got the information from the posters, 4 % heard from relatives, 0% from community health workers and 2 % listed other methods. The questionnaire also checked if the respondents sent or agreed for their animals to be vaccinated, 96 % did sent their animals for vaccination, 3 % did not believe in vaccinations and 1 % were not available on the day of vaccination.

Discussion

A response of 92% and 89% vaccination rate is considered a success if one uses the SMCRE method (Sekokotla, 2005). The success rate is usually above 72 %. The extension effect is measured by the results. The main purpose was to inform the community and also to vaccinate the animals. Poor vaccination campaign responses are usually related to the effort of the vaccinating team with regard to the Veterinary Extension that was shown.

Results from the questionnaire show a very important method of information transfer. Local radio stations that broadcast in the local language are very important especially in rural communities where literacy rates are very low. It would have been interesting if the age group and level of literacy were

included in the questionnaire. This was one of the shortcomings in a follow up and future follow ups questionnaire should be designed in a research like model. Distributing messages to school kids also plays a huge role with a total of 20% getting the message from school children. It should also be noted that primary school kids are thought to send the message home better than high school kids.There were no respondents who got the RVF information from the Community Health workers which was surprising as we spent some time informing the Health Staff about the RVF dangers and what they should recommend. It could have happened that we did not meet anybody who was told by the health workers as primary information as other means of communication had already spread the information. Community Health Staff did show a huge interest and there it could not be concluded that they were not interested. It should also be noted that in communal areas, there are tendencies of some communal farmers who believe in traditional medicine and it's very difficult to convince them to treat their animals or even vaccinate. This trend is also seen even during clinical case attendances where some farmers report the cases when they have actually failed to treat and the animal would now be in a bad condition. The 3 % of the respondents who did not believe in vaccinations represent these type of farmers. Previous experience has shown that this is not only typical of communal farmers but even some successful commercial farmers.

In conclusion, time and money should be allocated in veterinary extension is disease control success stories have to be told. Veterinary workers usually leave the extension to media instead of being in the forefront and providing the media with the necessary and considerable information.

Acknowledgements

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TABLES AND FIGURES

Figure 1. SMCRE Method Illustration

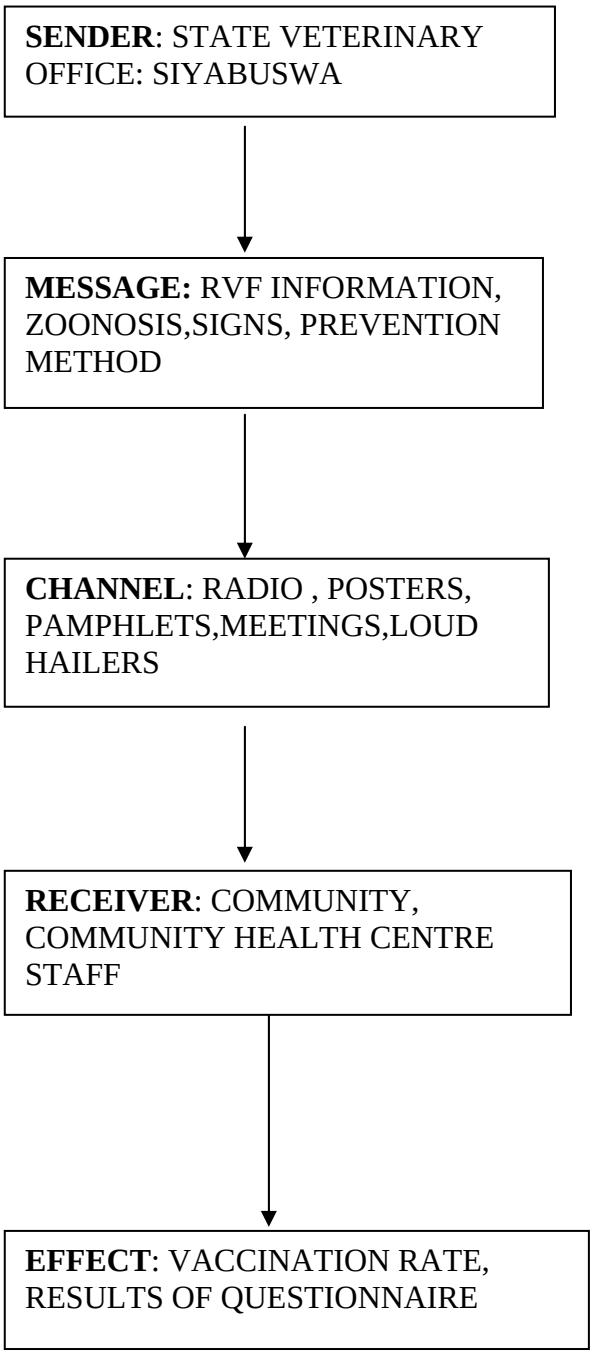
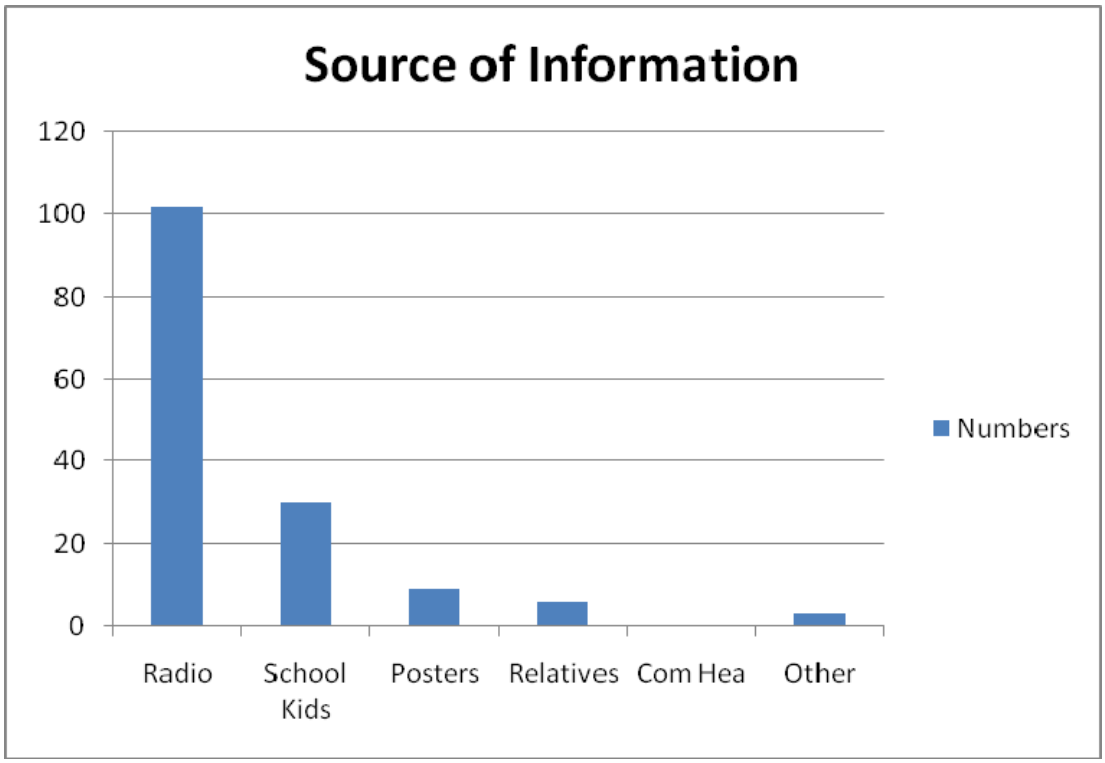


Figure 2: QUESTIONNAIRE - RIFT VALLEY FEVER OUTBREAK CAMPAIGN IMPACT ASSESSMENT

1. Did you hear about the Rift Valley Fever Outbreak
   a) Yes
   b) No
2. If Yes, how did you hear about the Rift Valley Fever Outbreak?
   a) Radio
   b) Posters
   c) School Children
   d) Health Workers
   e) Relatives
   f) Other
3. Did you vaccinate your animals?
   a) Yes
   b) No
   c) Do not believe in Vaccinations
   d) Was Away.

Figure 3: Graphical representation of the number of respondents who received RVF information from different sources



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Dissemination of agricultural technologies in small grain production through extension services to small scale farmers in South Africa

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Summary

Small-scale agricultural production in South Africa varies significantly. Farmers grow a variety of crops and thus have different objectives as they face different environments. This presents a challenge to institutions which offer support through extension services to small-scale farmers. The Agricultural Research Council-Small Grain Institute (ARC-SGI) is dedicated to provide all small-scale farmers and resource-poor farmers that produce wheat, or are interested in introducing the crop, with the relevant information to produce it with success. ARC-SGI has the capacity and technology available and is serving emerging small grain farmers on a national basis. The institute is involved in most areas where wheat is produced or has been produced in the past. The National and Provincial Departments of Agriculture are the custodians in making sure that they interact with relevant stakeholders to ensure that the emerging farmers get the necessary support. Various communication channels are used, directed at the appropriate level of farmers understanding. Farmer training has been conducted in six of the nine South African provinces. Great success has been achieved with this intervention which helped some producers to form working groups, agricultural forums and associations.

Keywords: technologies, small scale, small grains, extension services

Introduction

Most of the world food production is grown by small-scale farmers on small farms. These farmers who are endowed with limited resources have become the mainstay of the food supply for billions of people in the world and this situation is likely to proceed for a number of decades if not centuries (Shaner et al. 1982). Crop production by small-scale farmers; however, are characterized by low productivity typically because of the adoption of low production inputs. The world population is increasing at an alarming rate while food production will struggle to keep up (Traxler and Byerlee, 1993). Thus large numbers of people are starving and living below the poverty line. It is well documented by experts in this field that the only means of dramatically increasing productivity is to improve the farmer's technological capabilities (Frankenberger and Walecka, 1987; Rhoades, 1987). During the green revolution in the 1960's, holistic approach of new technologies was adopted which resulted in a boom production in maize, rice, wheat and soybeans. These technologies included amongst others: breeding for natural plant resistance against pest and diseases, production of hybrid seed, herbicide and pesticide formulations and application, irrigation and highly mechanised farming (Danilo, 2002).

Objectives

This paper reports on successes in the generation and dissemination of appropriate agricultural technologies and the development of guidelines for pest and disease control, in context of the small scale farmer in South Africa, with emphasis on the production of small grains such as wheat, barley, oats and triticale. The generally high incidence of pests and diseases in small scale farmer production systems results in great yield losses. The problem in terms of protecting the crop last not only throughout the growing season, but goes up to storage where store grain pests, rodents and fungal attacks threaten yields. Proper intervention through the identification of various insects, pests and diseases, their life-cycle, critical stages of control, preventative measures in the form of Integrated Pest Management (IPM) is of highest priority to save the farm produce and economic losses faced by the farming community. The focus of this work lies on improving the relevance of extension advice

through farmer's participation and training. The main aim is to impart knowledge and skills on new technologies that would significantly increase productivity of small grains within the small scale farming environment and to produce reading material that will periodically update farmers on latest developments. Farmer's participation and training also ensures that producers get easy access to the services provided from extension services such as those offered by ARC-SGI in order to uplift production and ensure more food to a growing population.

Materials and methods

People involved in small scale farming often reside in remote areas. Moreover, they are often uneducated and cannot avail the mass media like radio and television. Research findings cannot easily reach the far flung areas; therefore an effective Agricultural Extension system is important to disseminate the latest agricultural information and technology to these people for adoption to get the subsequent expected or potential benefits. The Farmer Support Programme was established in 1995 by the Ministry of Agriculture, having realized the challenges faced by emerging farmers and it came into full operation in 1996. The programme is operating throughout the country undertaking activities such as need assessment, farm visits, training courses, and demonstration trials, producing and distributing informative articles, assessing the level of diseases and pests within small scale cropping systems and delivering general technical production advice. Since the ARC-SGI continuously generates new technologies to improve production systems adopted by farmers, this information is shared on an ongoing basis.

A need assessment is conducted through discussion sessions with small scale farmers to identify the problems faced by them after which they are verified by qualified and skilled personnel. Once the needs are identified, alternative solutions are formulated and the best solutions are chosen and recommendations on how to best adopt these approaches are made. The most common need of producers is the demonstration of how wheat or barley is grown and which cultivars are best suitable for a particular growing environment. Feedback from the stakeholders is critical for conducting monitoring and evaluation of extension programmes. This can be assessed through periodic meetings, individual contacts and reporting system. The impact of the extension service is judged from actual crop yields attained, and net on farm incomes. A flow chart in Figure 1 summarises the mentioned process.

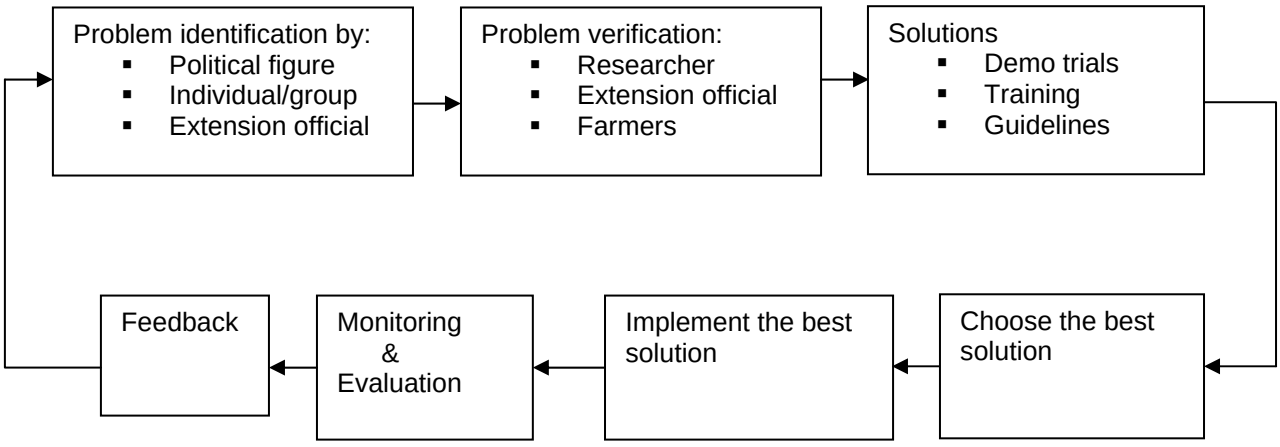

Figure 1: Introducing new technologies

Farmers view extension as a form of assistance to help their know-how, efficiency, productivity, profitability and contribution for the good of their families, communities and the society. Politicians, planners and policy makers view extension as a policy instrument to increase agricultural production, to achieve national food security and help alleviate rural poverty. The ARC-SGI develop technologies that are meaningful to the small scale farmer and provides training on small grain production under these circumstances in the following provinces: Eastern Cape, Free State, Gauteng, Limpopo, Mpumalanga and North West (six of the nine provinces in South Africa). The training lasts for three days for each locality. The following are discussed: Soil sampling, understanding of soil analysis and fertilizer, cultivar choice, soil sampling (practical), soil tillage, identification and control of insect pests of wheat, identification and control of wheat diseases, management of wheat production, calibration of farm machinery, weed control, seed storage, grading and quality, marketing of wheat in South Africa. Three extension officials are involved to cover specific topics. We go as far as 700 kilometres to assist the small scale farmers. On completion of each training, each participant receives a certificate of attendance. Extension methods used are farm visits, demonstration trials, office and telephone calls. Additionally, tertiary students, training in agricultural courses at agricultural colleges and technicons are also trained in the newest and most appropriate technologies. The participating communities are mapped on a map of South Africa in Figure 2.

Figure 2: Participating communities in different provinces

Print media, e.g. magazines, posters, leaflets and newsletters are used for dissemination of technology information. A production guideline with overall information on planting, efforts needed throughout the growth season up until harvesting tailor made for the small farmer has been compiled in Sesotho (a local language). Moreover, slide presentations and accompanying information leaflets assist in the transfer of technical information. Posters documenting the most common diseases that occur on small grains have also been produced.

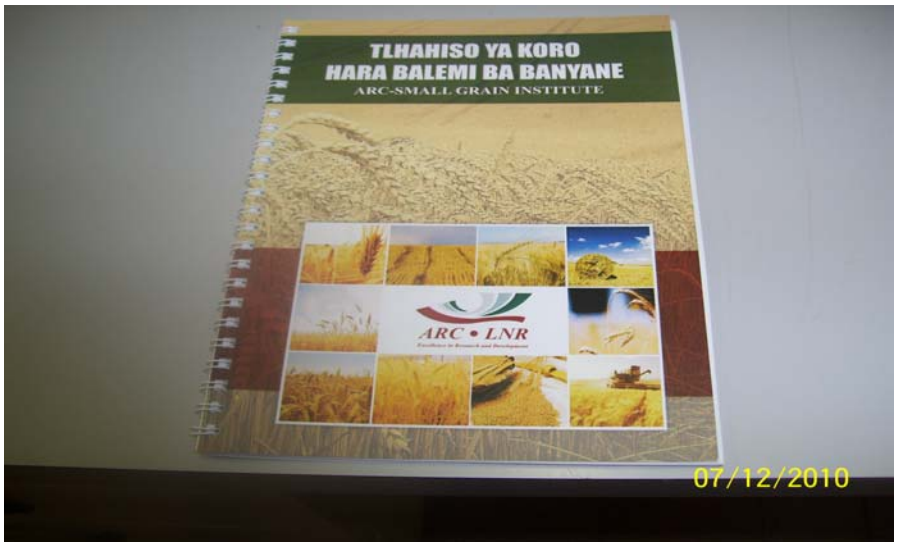

Figure 3: Production guidelines for small scale farmers in Sesotho

Results and discussions

Training courses and farmer's days are often conducted at the ARC-SGI premises in Bethlehem (Free State, South Africa) and at community level within the communities from season to season. Specialists from pharmaceutical companies, seed companies, universities and banking companies are also invited to make contributions in their specialist fields. Table one indicates the total number of participants that attended farmer's days or information days. Producers were represented by both males and females. Extension practitioners who design or disseminate agricultural information should also recognize the apparent patterns in preferences based on age, education status and farm size. Approximately 65% of the group were males, with 25% ranging from the age group 20-35 years and 40% from 35 to 66 years of age. Rural women plays a very critical role in the production of food for the household. They work 12-16 hours per day throughout the year. About 35% were women. It has shown that younger women are less interested in agriculture. Only 10% of women in the age group 20-35 participated. The remaining 25% were older women aged 45-60 years. Younger farmers tend to prefer publications and audio-visual materials more than older farmers.

Table1: Number of participants that attended Farmer's and Information Days held by ARC-SGI from 2006-2009

Attendance		
Season	**Producers**	**Other organisations**
2006/2007	509	---
2007/2008	888	71
2008/2009	514	57
Total	**1911**	**128**

Various methods, including field trips, guest speakers, group discussions, workshops, on-farm demonstrations, audio-visual materials, printed matter and interactive telecommunications have been advocated by extension practitioners for information dissemination in agriculture. Today, more than

ever, a wide range of information sources on new or innovative farming practices is available to farmers. The value of information as a commodity in today's age cannot be overemphasized since it has contributed immensely to the stagnation or progressiveness of many farming operations.

Table 2: Training courses conducted from 2006-2009

Season	Attendance
2006/2007	26
2007/2008	173
2008/2009	268
Total	**467**

Accomplishments since 2007

- 13 training courses were conducted with 467 participants
- Presentations were given at 63 information days where 1911 people attended from 31 communities
- 18 publications were compiled and published in the popular press, specifically for farmers and extension officers.
- Networking with other agriculturally-orientated organisations is also done where 28 meetings and workshops convened
- 215 Farm visits were conducted and 420 farm calls were made
- One of the greatest accomplishments was the publication of the first production guideline for emerging small grain farmers, which was later translated into a local language (Sesotho)
- The number of participants increased from season to season.

Conclusions and recommendations

Technology transfer is an essential mission of the Agricultural Research Council (ARC). As knowledge advances and the needs of the economy change, the ARC will continue to play a role in keeping South Africa in the fore-front of innovation and supporting our economy by aiding in the transfer and commercialization of knowledge. My experience with all the localities trained is that farmers are keen to learn and to know a lot more on farming practices despite problems they face on a daily basis.

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Production of Emerging Farmers: Koketso Goats Improvement Project – A case study in the Kgalagadi Region of the Northern Cape Province, Republic of South Africa

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Summary

The paper puts forward a workable Extension development strategy. It shows on which grounds government interventions strategy should be based and implemented. The paper explores the relationship between the use of participatory processes in the development and use of information and knowledge and their impact on change. The paper is based on a major extension activity carried out in Koketso Goats improvement project. The issue confronting the Department of Agriculture in the Northern Cape that supported the project was determining the most efficient and effective process of government interventions strategies to support rural projects. The focus that emerged was on participatory extension processes.

Introduction

The Koketso Goats Improvement Project of Laxey is a co-operative comprised of 10 female farmers. These communal farmers have thought very deeply as to what they can do to enable them to have a reasonable living standard within the limits of the resources available to them. They have 632 hectares of the land, which they own communally, under the jurisdiction of their tribal leader. They also owned goats as individuals within their families and they have the services of the Extension Officer as a departmental service provider.

This goat co-operative was initiated in 2003 when the women in the community decided to reduce poverty and address unemployment by utilizing their goats as a source of income. The project participants consequently realized that there were a number of aspects relating to goats' management that they would need to consider implementing to ensure the success of the project. After a series of meetings with Extension Officer, it was then decided that the project be subjected a participatory approach based on the innovations advanced by the participants.

The following Principles of Extension as espoused by the Northern Cape Extension Services were followed when that decision was reached:

- That extension should not be forced on the people.
- That extension should not be a form of charity.
- That rural people should participate in every effort intended to improve their way of life.
- That the extension workers should do one thing at a time.
- That the extension staff should utilize local leadership.
- That the extension workers should study the job thoroughly

Livestock Ownership

Livestock ownership is an important socio-economic factor for the lives of rural people (Chavunduka 1973). The project started with 30 goats in 2003. Over the period they have sold 110 goats and are remaining with 130 in their herd.

Livestock Production

The high mortality is a great loss to communal farmers in terms of the total number of goats lost when converted to cash. However, Nkosi (1994) argued that without proper marketing channels people in communal areas will remain reluctant to sell their livestock.

Table 1 Goats production, weaning, mortality for Koketso goat project

Efficiency factors	% 2007	% 2008	% 2009
Kidding	140	129	145
Weaning	85	87	90
Mortality (ewes)	10	15	7
Mortality (kids)	15	11	8

The nature of the project

The Koketso Goats Improvement Project is unique in its nature as the concept originally initiated from within the community.

Aims of the project:

- To improve quality of goats in order to improve the standard of living of the farmers.
- To encourage farmers to use the communal resource together for the benefit for all.
- To efficiently utilize the veld and ensure its restoration for sustainable utilisation.

The management of the co-operative

The land is divided into four camps and is 632 hectares in extent. All male weaners and culls are sold, as they have no place in the project. The rams are introduced to the ewes during the month of May and are withdrawn two months thereafter. This is to ensure that the ewes will kid during the month of December when the first rains arrive in the Kgalagadi.

All the management is done by the management committee comprising of 6 members. The co-operative collects contributions from members amounting to R50.00 per month per member. This money covers the wages for one labour herding the goats, R10 per annum per goat for medication, winter licks, tribal levy and infrastructural maintenance.

Intervention programmes

The following were the various intervention programmes that government used to assist the farmers of this co-operative to improve their production:

- The commercialisation of goats. In this programme the government assists farmers with one hundred (100) goat ewes and three (3) rams as breeding material. They are animals with superior genetic composition. After five (5) years the farmers donate the off-spring back to government so that other farmers can also be assisted. This co-operative benefited from this programme
- The Comprehensive Agricultural Support Programme (CASP). In this programme government assists farmers with on and off-farm infrastructural development, like fencing, boreholes, dipping tanks, stock handling facilities, implements etc. The fencing and the stock water system was constructed at this project through CASP. Not far from this project CASP was also used to construct an auction pan for all communal farmers in the area.

Discussion

Livestock farming is a major occupation of the people of the village of Laxey and contributes substantially to their socio-economic and cultural values. Livestock has been a major source of livelihood for the people over the years, with the income augmented with earnings from various government grants, e.g. old age pensions, remittance etc, and various other means.

Livestock production is an enterprise that requires man's stewardship in accurately coordinating the production and utilization of plants in their existing environment. It is therefore widely documented that age, sex and education of farmers are important attributes that influence their behaviours and to a certain extend the production of their herds (Bembridge 1984). The majority of rural inhabitants are women, children and aged people. (Meyer, 1998) and rely heavily on remittances and pension handouts for a high proportion of household income (Rozas, 1991).

Berger & Berger (1989) regarded education as a factor which acts to equalise opportunities. Numerous authors suggested that education enable farmers to make fruitful use of technology and to open suitability and applicability of new technology (Bembridge, 1984). King and Bembridge (1988) also emphasises the positive effect basic education has on farming progressiveness and that with improving farmers levels of education the adoption rate of proven and recommended farming practices will accelerate. In this project 20% of participants had four years of schooling which suggest that they are illiterate and had 80% two years of schooling and less. This low level of formal education does not arguer well for the agricultural development of the project.

Age has an important influence on the farmers' personality because his needs, behavior and thinking are related to what experienced in the past. Arnon (1981) reported that old age farmers are emotionally committed to maintain traditional farming techniques. In this project 80% of participants are between 50 and 70 years of age while 20% are less that 50years of age and they are still economically active, and their involvement in agriculture is worthwhile.

Recommendations

The key recommendations that are proposed are:

- The use of participatory technology development (PTD) is a concept that should be stimulated more in all aspects of technology development and adaptation
- To obtain durable development, the strategies that are adopted and the rural projects that are supported should be rooted in the local context**.**

Conclusion

Government Interventions should be given to enable farmers to can optimally produce. The role of Extension Services should be to provide encouragement and expertise, and not build dependency of communal farmers on handouts. Care must be taken not to create artificial projects that have been set up for purpose of attaining government funds and are not representative of marginalized groups.

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Gender Based Effectiveness of Agricultural Extension Agents' Contacts with Smallholder Farmers in Extension Services Delivery: A Case of Kilosa District, Tanzania

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Summary

Agricultural extension services in Tanzania have been criticized over the years as ineffective. Literatures show that one of the reasons for their ineffectiveness is overlooking the major role that women who are the main contributors in agricultural production. This study identified the educational tasks/activities that male and female Agricultural Extension Agents (AEAs) performed when contacting smallholder farmers. The study also examined problems that AEA faced based on their gender when delivering extension services to farmers. The study randomly selected 160 smallholder farmers and purposively selected ten AEAs from ten villages in Kilosa District. Primary data was collected using questionnaires, informal discussions, focus group discussions and observations. Collected data was reduced, coded, and entered in the Statistical Package for Social Sciences (SPSS) computer program and analyzed to yield descriptive statistics like cross tabulations, chi-square and contingency coefficient which were used in report writing. The study found that Farmer Field Schools (FFS), home and field visits were methods common methods that AEAs used to contact farmers. With exception of few indices variation, basing on Awareness, Knowledge, Adoption and Practices (AKAP) sequence, the study results generally show that the effectiveness of AEAs in contacting smallholder farmers based on their gender was not much different. The study recommends that village governments should organize farmers in groups for the AEAs to easily contact them. Also, the Agriculture District Office should avail resources to AEAs and set AEAs' performance standards to enhance their job performance. More critical is that the Agriculture District Office in collaboration with the District Council should recruit more AEAs and train them on how to work with both female and male farmers.

Key words: gender; extension services; smallholder farmers; extension methods

Introduction

Background Information

Tanzania's agricultural sector contributes more than 45% of Gross Domestic Product (GDP), employs about 82% of the labour force, and directly sustains 80% of the labour force, and accounts for about 66% of merchandise export (UTR, 2005.) More importantly, it accounts for 45% of the total foreign earnings and the sector provides raw materials to domestic agro-based industries. Many factors contribute toward the development of agriculture, including extension services as an institutional input.

Agricultural technologies and techniques are constantly changing and farmers need to know how to use agricultural innovations for the exploitation of the inherent yield potentials. It is therefore, a mandate and responsibility of agricultural extension services using Agricultural Extension Agents (AEAs) in particular, which form the last transmittal system of knowledge and skills. AEAs occupy a strategic position in the agricultural production cycle as they liaise between farmers and research scientists on the one hand, and between farmers and policy makers on the other.

Regardless of gender, an extension agent has educational as well as communicational roles (Swanson, 1984; Rogers, 1995), which in practice should translate into specific actions or tasks for farmers to perform. Such tasks should cumulatively be able to create situations that engage farmers in carrying

out processes of thinking, feeling and acting, which ultimately enable them to learn. Consequently, application of acquired knowledge and skills in farming should result in increased agricultural production and improved livelihoods of farming communities. This is the major goal of agricultural extension services as explicitly shown in various administrative documents in Tanzania namely, Agricultural Policy of 1997, Agricultural Sector Development Strategy of 2001, Agricultural Sector Development Program of 2006.

Agricultural extension services have been criticized over the years as ineffective (Lupatu, 1995; Nyerere, 1997; Haug, 1999; Isinika *et al*., 2005). Cognizant of the above observations, several studies have established reasons behind the ineffectiveness of extension services in Tanzania (Mattee and Mollel, 1990; Mattee and Mvena, 1988; Kauzeni, 1989; Mwandry, 1992; Due *et al.*, 1996; Suzuki, 2000; Kanyama, 2000; Sonoko, 2001; URT, 2006 and World Bank, 2008). However, few of these studies (Mahunda, 1994; Due *et al.*, 1996, Kanyama, 2000; Pangani, 2006) have considered the gender dimensions of AEAs as one of the possible reason for their ineffectiveness. Furthermore, Lupatu (1995) showed that among other things, extension services have overlooked the major role that women play in agricultural production. In sub-Saharan Africa, where women provide more farm labour than men, agricultural messages have traditionally been disseminated by male AEAs, mostly to male farmers (FAO, 1993, 1997).

In attempts to improve the delivery of extension services to smallholder farmers to increase their incomes and productivity, concurrently improving relevance, sustainability, and cost effectiveness, various strategies and reforms have been employed. For example, in 2001 the Government of Tanzania adopted the Agricultural Sector Development Strategy (ASDS). In order to implement the ASDS, the Government of Tanzania developed an Agricultural Sector Development Programme (ASDP). The ASDP is implemented under decentralization policy, that emphasize shifting from centrally planned to locally planned activities that ensure service provision has greater relevance to the needs of farmers through empowerment measures including improved knowledge, organization, control over the resources, and involvement of the private sector (URT,2006).

In spite of extension services being decentralized to local authorities and the involvement of private agricultural extension service providers. It seems that smallholder farmers have not substantially improved their agricultural and livestock production. The issue of concern in this case is why. There are many reasons which need to be explored. In view of the above, probably the ineffectiveness of AEAs is a result of lack of understanding of the influence of gender in relation to what tasks they actually do at the village level in the course of delivering agricultural messages.

Blanket recommendations are advocated in extension services, male AEAs are posted in communities which would have been suitable for female AEAs and vice versa. As a result extension efforts have failed to attract farmers' demands for extension services. This has resulted in farmers continuing using inappropriate technologies, although many technologies have been developed and tested in the country's research stations.

This study, therefore, investigated the effectiveness of extension agents based on their gender in delivering extension services to smallholders for increased agricultural production. Specifically, the study identified the educational tasks/activities that male and female Agricultural Extension Agents (AEAs) performed when contacting smallholder farmers. Also examined problems that AEA faced based on their gender when delivering extension services to farmers

Theoretical Framework of the Study

The study is based on Awareness, Knowledge, Adoption and Practices (AKAP) sequence, which according to Evenson (1997), is convenient to visualize agricultural extension service as achieving its ultimate goal in terms of economic impact by providing information and educational training through

the following sequence. A: Farmer awareness (and sources of awareness), K= Farmer knowledge and testing of practices (through testing and experimenting), A= Farmer adoption of the technology or practices, P=Changes in farmers' productivity (and behaviour). He further clarified that changes in farmers' behaviour will be reflected in quantities of goods produced. In turn, these can be measured as "economic surplus," which is the added value of goods produced as a result of using a given set of inputs made available by extension activities.

The basis of the AKAP model as postulated by Evenson (1997) was that awareness is not knowledge, but knowledge requires awareness, experience, observation, and ability to critically evaluate data and evidence. Knowledge leads to adoption, but adoption is not productivity. Productivity depends not only on the adoption of technically sound and efficient practices, but also cost efficient practices. Again, productivity depends on the infrastructure of the community and on market institutions. Agricultural extension services affect each component of the sequence. However, the awareness-knowledge part of the sequence is where agricultural extension services strongly substitute farmer schooling. Through frequently organized contacts AEAs "teach" farmers which are more than just informing them. Hence, a need to investigate the effectiveness of the AEAs based on their gender in delivering extension services to smallholder farmers.

Materials and Methods

Description of Study Area

This study was conducted in Kilosa district in Morogoro region, located between 6^0 and 7^0 South of the Equator and between 36^0 and 37^0 East of the Greenwich Meridian. Kilosa district is bordered by Mpwapwa and Kongwa districts to the South and Kiteto to the North and Mvomero district to the East. According to the district Profile Report (2007), the district covers 20 percent (14 567.98 square kilometres) of Morogoro region and 37 percent of its area is under agriculture. The district is divided into seven agro ecological zones of medium altitude plains with some ranges hill of low altitude flat alluvial plains, dissected mountain plateaux, low lands made up of mainly plains with friable clays. Administratively the district is divided into nine divisions namely Gairo, Nongwe, Magole Kimamba, Masanze, Kilosa, Ulaya, Mikumi and Kidete. The district has 37 wards and 161 villages with human population of about 489, 513 of which 244, 201 are females and an average family size of 4.6 (URT, 2002). Major livelihood strategies of the inhabitants include crop production and livestock keeping, with crop production contributing 75% of food and income to people in the district (Kilosa District Profile Report, 2007).

Research Design

A cross –sectional research design and multistage sampling technique were used in this study. According to Babbie (1990) this design is suitable for descriptive purposes as well as the determination of relationship among and between variables so long as the research can identify the population relevant to the study. During the first stage, ten villages were purposefully selected of which, five villages had female AEAs and other five had male AEAs who had been working in villages for not less than three years. From these villages, 16 farmers (eight females and eight males) were randomly selected from the village roster book.

Sampling Procedures

The study population consisted of all smallholder farmers growing crops (cash and food crops) in all the ten surveyed villages which included female and male farmers of various age groups. A list of all farming households in the respective villages in Kilosa district constituted the sampling frame. The sample involved 16 farmers from each village (8 females 8 males) and ten AEAs were purposively selected and interviewed .The total sample size was 160 farmers that were randomly selected. Village government officials, prominent farmers and existing farmer group leaders were purposively selected as key informants in the focus group discussion in each village.

Data Collection Procedures

Data were collected through personal interviews, focused group discussions and questionnaires for AEAs. Data collected included awareness of educational activities carried out by extension agents, knowledge of farmers on agriculture, as well as knowledge of AEAs in extension methods, frequency of contacts and methods used, adopted technologies and practices (of farmers and AEAs). Primary data were collected by interviewing respondents individually in their homes/fields or at the village government offices through personal interviews, using interview schedules. Focus group discussions (FGDs), observations and self-administered, structured questionnaire for AEAs and their supervisors were used to collect primary data from 10 purposefully selected villages out of all 164 villages in the district of which only 42 villages had village AEAs. Five of the villages were under the supervision of female and male AEAs respectively.

The questionnaire contained close-ended and open-ended questions. The close-ended question items were used to tap different opinions and comments from respondents. Also informal discussions were carried out involving the researcher, District Extension Officer and four Subject Matter Specialists. On the other hand, secondary data involved review of literature from printed books, journals, periodicals, theses and unpublished reports from Sokoine National Agricultural Library (SNAL), government offices, websites and individuals.

Data Processing and Analysis

Data from primary sources were organized, coded and entered into a computer and the Statistical Package for Social Sciences version 12 program was used to process and analyze data which yielded descriptive statistics such as frequencies, counts, and percentages. The influence on each of the identified work-related characteristics of respondents was described by using cross tabulations and chi-square test of significance at a significance level of $\propto 0.05$ to determine whether there were any statistical significant variations among variables.

Results

Educational Tasks that AEAs Performed when Contacting Smallholder Farmers

Study results indicate that holding demonstrations, method demonstrations, conducting farmer field schools, farm and home visits, study tours and agricultural meetings were the common educational activities that AEAs did when disseminating agricultural messages to smallholder farmers. All (100%) the AEAs reported to be carrying out farm and home visits, while 80% reported to organizing and conducting farmer field schools. Sixty percent of respondents reported to be conducting demonstrations, 30% reported organizing agricultural meetings. Two out of five male AEAs mentioned agricultural meetings as an activity they commonly carried out when contacting farmers. On the other hand, three out of five female AEAs reported that exchange visits were one of their common educational activities used when disseminating agricultural messages. One out of five male AEAs reported that poster development and Participatory Rural Appraisal (PRA) exercises were the other common educational activities they performed, but none of female AEAs mentioned these. Apart from those differences, three male AEAs out of five and four out five male AEAs mentioned that organizing demonstrations and farmer field schools were common educational activities carried when disseminating agricultural messages to smallholder farmers (figure 1)

Discussions with Kilosa District Extension Officer (DEO), Subject Matter Specialists (SMS) and AEAs, and field observations revealed that in Kilosa district the major emphasis was placed on Farmers Field Schools (FFSs) as a major extension activity for disseminating agricultural messages. This fact was evidenced by the type of in-service training AEAs have attended; some reported that the two weeks seminars were about organizing and running FFSs.

Also, during informal discussions with the DEO, it was mentioned that inadequate funds and supervision due to lack of transport and facilities necessary for using mass media methods like cinema, video shows, development and distribution of agricultural leaflets and brochures was a set back to the activities of AEAs (Table 1).

Table 1. Respondents opinions on the number of contacts that AEA made from July, 2007 to July, 2008 (N=160)

Educational activity	Contact efforts in year	
	Maximum	Mean
Agricultural meeting	6	1.18
Trainings/Seminars	5	0.73
Farm trials	20	1.02
FFS	8	1.09
Exchange visits	3	0.43
Farmer to farmers visits	12	0.55
Brochure/leaflets distributed	-	-
PRA exercise	4	0.100
Video show	2	0.05
Posters	6	0.66
Farm and House visits	10	1.50

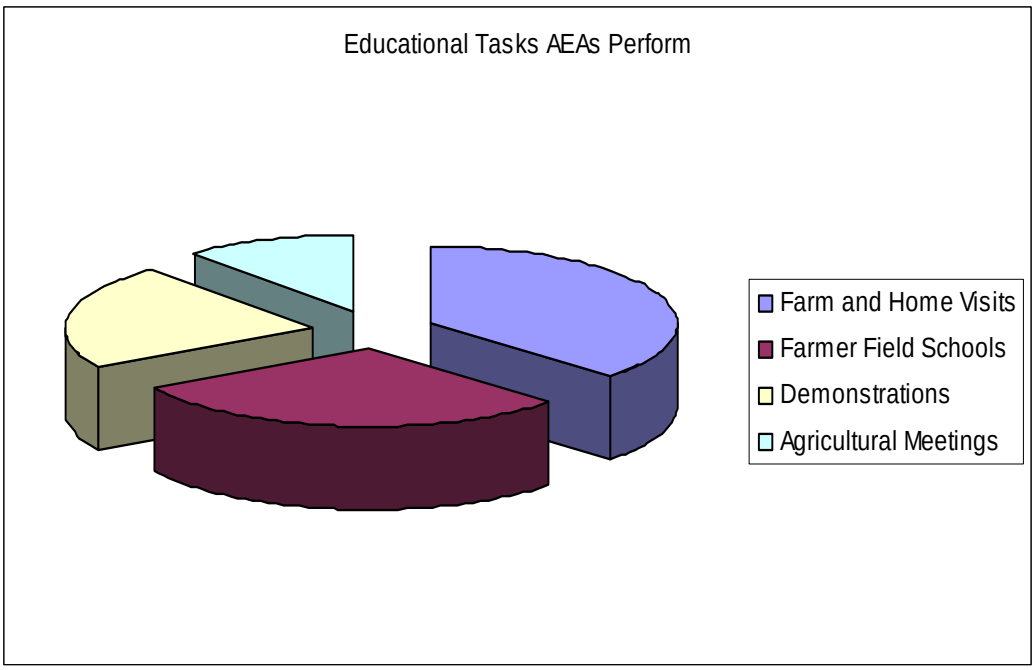

Figure 1. Major Educational Tasks AEAs Perform when Contacting Smallholder Farmers

Problems that AEA Faced on their Gender when Delivering Extension Services to Smallholder Farmers

During focused group discussion with AEAs they mentioned a number of problems they encounter in delivering extension service, apart from inadequate resources such as extension kits, teaching

equipment and facilities, lack of transport, a large number of scattered farmers to contact. Other problems include: Having no working offices, having no specific number of farmers to work with as they are obliged to work in village as a unit of work. They spend most of time in making crop damage evaluation in dissolving dispute between farmers and pastoralist (during cropping season) and they lack important technical knowledge in marketing and entrepreneurship.

Male and female AEAs' Effectiveness Compared by Using Indices Based on AKAP Sequence

Results in Table 2 and 3 show the effectiveness of AEAs based on developed indices which were obtained by combining some individual variable collected based on AKAP sequence. Where those related to awareness of extension activities ,technologies and timetable formed 'Awareness index', the variables which measured knowledge of respondents formed 'Knowledge index,' variable related to adoption of technologies formed 'Adoption index' and adoption of low external input practices like crop rotation formed conservation index while the state of continuing using or not of adopted technologies or practices formed 'Continuance index'. How AEAs use office time formed 'Time use index' and AEAs' efforts to contact farmers (how frequent he/she organized extension activities) formed 'Contact index' and respondents' change in level of production formed 'Productivity index'.

All scores on the index were grouped into two groups: low and high. Sores ranging from 0.0 to 0.49 were labelled low and scores above 0.49 to 1 were labelled high. The finding from the study show that there were significant statistical difference on awareness of extension activity schedule index at $p<0.01$respondents who were advised by male AEAs and knowledge index at $p<0.02$, male respondents had higher scores than female respondents. The finding further show that the situation was different under female AEAs supervision, but instead the variation were on contact efforts index (at $p<0.01$) where 45% female respondents had higher scores compared to only eighteen percent of male respondents.

Table 2. Scores of respondents advised by female AEAs on effectiveness indices (N=80)

	Index	Respondent's scores										
		Female				Male						
		Low		high		Low		High		X^2	df	P value
		n	%	n	%	N	%	n	%			
1	Activities Awareness	32	76.2	10	23.5	32	84.2	6	15.8	0.82	1	0.37**
2	Activities Schedule awareness	41	97.6	1	2.4	34	89.5	4	10.5	2.23	1	0.13**
3	Participation	41	97.6	1	2.4	38	100.0	-	0	0.91	1	0.33**
4	Respondents' Knowledge	24	57.1	18	42.9	21	55.3	17	44.7	0.02	1	0.86**
5	Adoption of High input technologies	19	45.2	23	54.8	13	34.2	25	65.8	1.00	1	0.35**
6	Adoption of Low input technologies	36	85.7	6	14.3	31	81.6	7	18.4	0.25	1	0.67**
7	Continuance	17	40.5	25	59.5	12	31.6	26	68.4	0.64	1	0.40**
8	Contact efforts	23	54.8	19	45.2	31	81.6	7	18.4	6.52	1	0.01*
9	Time use	4	9.5	38	90.5	4	10.5	34	89.5	0.27	1	0.88**
10	Productivity	8	20.5	31	79.5	9	25.0	27	75.0	0.21	1	0.64**

*Significant at $p< 0.05$; ** Not significant at $p>0.05$

Table 3. Scores of respondents advised by Male AEAs on effectiveness indices (N=80)

	Index	Respondent's scores										
		Female				Male						
		Low		high		Low		High		X^2	df	P value
		n	%	n	%	N	%	n	%			
1	Activities Awareness	32	84.2	6	15.8	29	69.0	13	31.0	2.5	1	0.11
3	Activities Schedule awareness	38	100	0	0	36	85.7	6	14.3	5.8	1	0.01
2	Participation	36	94.7	2	5.3	39	92.9	3.	7.1	0.12	1	0.72
4	Respondents' Knowledge	17	44.7	21	55.3	9	21.4	33	78.6	4.9	1	0.02
5	High input Adoption	16	42.1	22	57.9	14	33.3	28	66.7	0.68	1	0.41
6	Low input technology adoption	31	81.6	7	18.4	35	85.3	7	16.7	0.43	1	0.83
7	Continuance	15	39.5	23	60.5	23	54.8	19	45.2	1.87	1	0.17
8	Contact efforts	32	84.2	6	15.8	34	81.0	8	19.0	0.14	1	0.74
9	Time use	8	21.1	30	78.9	6	14.3	36	85.7	0.63	1	0.43
10	Productivity	9	25.7	26	74.3	4	10.3	35	89.7	3.03	1	0.08

*Significant at $p< 0.05$; ** Not significant at $p>0.05$

Discussion

Results indicate that farm and home visits, Farmer Field Schools (FFs) and Demonstrations were the major three educational tasks AEAs performed. Contacts that AEAs made per year were minimal, revealing that many farmers were left out of reach of extension services, and those few who had access to services were superficially served. This is because extension methods that attract attention and stimulate desire for further information such as farmers' field days, agricultural shows, folk media, and video, cinema or film shows and brochures/leaflets distribution were not commonly used by AEAs in the study area. Instead the whole Kilosa district extension service plan was hinged on FFS. On the other hand, FFSs have limitations and challenges (Hakiza *et al*., 2002) and therefore, FFSs should not be the only approach of extension method used by AEAs when contacting smallholder farmers.

The results show that female AEAs contacts efforts were more directed to female farmers than male. On the other hand, male farmers under male AEAs supervision were more aware of AEAs activity schedule and knowledgeable than female farmers. The current finding tends to agree with the findings of FAO (1993) and Mlozi (2005) which found that the dynamics of communication are most effective when AEAs are similar to their clients in all aspects except technical competencies.

With exception of few indices variation, basing on Awareness, Knowledge, Adoption and Practices (AKAP) sequence, the study results generally show that the effectiveness of AEAs in contacting smallholder farmers based on their gender was not much different.

Conclusions and Recommendations

Conclusions

Agricultural meetings, farm and home visits and Farmer Field Schools were commonly used by AEAs to contact farmers. Extension methods that attract attention and stimulate desire for further information such as farmers' field days, agricultural shows, folk media, video, cinema or film shows and brochures/leaflets distribution were not commonly used by AEAs in the study area. This is the result of inadequate funds for extension services, lack of transport facilities, inadequate supervision, large number of farmers to contact, absence of working office and stationeries. Again, both female and male AEAs were faced by similar problems in performing their roles in contacting smallholder farmers. The results generally show that the effectiveness of AEAs based on their gender was not very much different.

Recommendations

Based on the conclusions drawn from the findings, the following recommendations are made:-

(i) Sufficient and appropriate training should be provided to AEAs to equip them with appropriate knowledge of extension methods particularly group methods so that they can employ them appropriately in their efforts to deliver extension services to farmers.

(ii) In order to increase extension contacts and utilization of a variety of extension methods the government in collaboration with other development partners should allocate adequate funds and necessary equipments, tools, transport facilities and teaching/training materials to extension personnel. Also should set up appropriate performance standards for extension staff and increase the remuneration package and promotion and farmers should be informed on the performance standards set and develop a mechanism to involve farmers in the process of appraising AEAs' performance.

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Researchers as extensionists/extensionists as researchers (RaE or EaR) approaches in improving veterinary extension services

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Summary

Traditionally being a system to disseminate the research results to the end users via extension personnel, the end-users' (farmers) output of an extension system is greater when the extended technology is transferred intact/unaltered throughout the chain to the target destination. However, doing this means having people who are fully involved and hence knowledgeable of what is needed to be transferred (in this case referring to people involved directly in the production of the technology in question). This strongly applies to veterinary field due to professional complexity and ethical bounds. For that case, using collective research works as the main data source this paper analyses the potentials of veterinary researchers themselves being involved in the extension of their research results or the involvement of the extension workers from the initial steps of research design through the end. The objective is to bold the benefits of the RaE/EaR approaches in optimizing extension services and its delivery to livestock farmers. It is hypothesized that in addition to enhancing the delivery of the intended veterinary information package to farmers the approaches also integrate research and extension more effectively and efficiently hence reducing the existing research - extension gap. Hopefully the discussion from this analysis will promote researchers in other agricultural fields to adopt the RaE/EaR approaches.

Key words: Optimising extension, research, livestock

Acronyms

EaR	Extensionists as Researchers
MLDF	Ministry of Livestock Development and Fisheries
NALERP	National Agricultural and Livestock Extension Rehabilitation Project
RaE	Researchers as Extensionists

Introduction

The objective of any Agricultural extension programme is to improve farmers' outputs by adopting new or improved farming technologies. Traditionally farming technologies reach the farmers via extension personnel, who have the responsibility to make sure that the desired technology, get used by the farmers. In other words an extension personnel is regarded as a bridge for researcher and a farmer. Historically the flow of information from research to farmers has never been smooth and this has created an information vacuum in an agricultural triangle (farmer, extensionist and researcher)(Belay, 2005). Research results that are to be given to farmers remain redundant somewhere in the system.

The lacking smoothness of information flow is explained by several factors among them include weak links between research, extension and farmers, poorly organized extension systems; lacking coordination among research institutions and extension workers; conflicting policy interests among researchers and extension workers; financial constraints that limit facilitation of extension logistics and plans(Doamekpor, 2005;Mattee, 1994). The other important factors include the poor incentive to extension workers that normally work under hard environments, poor subject matter knowledge among extension workers (Doamekpor, 2005; MLDF, 2010) and poor resource utilization (NALERP, 2004).Critically the end effect to farmers is either the desired technology not reaching the farmers or reaching the farmers in an altered quality which ends up into poor adoption. The best opportunities to serve and educate the farmers must be considered.

This paper focuses on the importance of subject matter knowledge in extension with emphasis to veterinary practice. The key objective is to foresee the potential of using a person who is qualified for subject matter in extension. In this case a qualified person refers to a person who has a full knowledge on the technology that is being transferred to a farmer. That is a researcher or extensionist who is involved in a research, believing that as they are both involved in research they know the exact

research results and information needed by farmers. For that case a researcher can be as good extensionist- "Researchers as extensionists (RaE)" as it is the extensionists as researchers (EaR) in delivering desired technology to target farmers. In addition to enhancing the delivery of the intended research information package to farmers the RaE/EaR approaches also integrate research and extension more effectively and efficiently hence reducing the existing research - extension gap. The assumption is that both researchers and extensionists are the integral part of research (i.e. knowledge generation) and extension (dissemination of the technological package) and hence liable to provide the best quality research information to the farmers. In addition veterinary practice has professional bounds that are guided by ethics of conduct, and in such circumstances only a veterinarian will have a role to extend some form of veterinary technology to farmers

Material and Methods

This paper takes a design of case study approaches to deduce the learning messages.

Case 1: **Developing Tick control extension plan (Sekokotla, 2005)**

This extension case is adapted from Sekokotla, 2005 and is presented here as an example to highlight an importance RaE/EaR approaches in extension delivery.

Assumption: Cattle farmers do not have sufficient knowledge and skills to control ticks in cattle, hence effective extension service is required.

Methodology approach**:**

-Participatory approach.
-Identify extension needs by doing a full research regarding farmers' knowledge, extensionist knowledge, and inputs available for control of tick borne diseases
-Records research results before extension.
-Develop extension priorities based on research findings,
-Implement extension.
-Repeat evaluation of researched parameters after extension;
-Compare impact before Vs after extension.

Key findings**:** Extension needs of the farmers were identified by mutual participation of researcher, farmers and extension worker; Researcher designed extension plan based on actual(unaltered) research findings; Before extensionists were trained they had no sufficient knowledge on the SUBJECT, and hence could not be able to provide required extension. Overall there was an increase of knowledge and high adoption rate of the research parameters regarding tick control among farmers and extension workers.

Remarks: Extension plans related to animal health should involve expertise personnel and the best way is for a researcher to help design and implementation of the needed research results for it to materialize, or otherwise extension workers be part of the research team. The detailed extension plan is described by Sekokotla, 2005.

Discussion

The impacts of RaE/EaR approaches in extension can not be overlooked. The extension system basically involves the researcher, extension personnel and the farmer as the main players in a so called agricultural triangle (Stevens, 2005). In this system there is a flow of technological package along the chain often from the researchers to the farmers via extensionists, and vice versa when the farmers play part as innovators. For a system to be stronger, the three partners should be linked together by a strong bond by mutual participation in the production of technology and its dissemination. Combinations of extension approaches are therefore necessary to make sure every member is fully engaged in the process. In addition livestock farmers are heterogeneous in size, educational backgrounds, indigenous knowledge, interests and the general socio-cultural constructions (Sekokotla, 2005). For that case farmers have their customized priorities and hence the only major driving force for adoption of any technology will be "doing the right thing" (Vanclay, 2004). Doing the right things

partially means having right person to do extension such that farmers are convinced that what is being done is right for them. According to the objective of this paper, no one will be the right person other than the researcher him/herself or extension worker involved in the research.

According to Sekokotla, 2005, the several extension messages can be deduced. The first message is that through participatory approach a researcher takes a wide account of socio-cultural dimensions of the farmers' community and is able to develop a community needy research that will suit the target community. Extension workers have in most cases limited knowledge of what it is required. Involvement of extension workers in designing and conduct of the research becomes part of upgrading their knowledge and hence important for their career updating. This is an essential component of capacity building of extension workers (Sekokotla, 2005; Agbamu, 2000).The second point is that adoption rate is facilitated by the way information reaches the farmer. The poorer the information package the poor will be the adoption rate. The correct information package will be delivered to target farmers via a qualified extensionist, who by knowledge and understanding a subject matter can explain the difficult issues related to the developed technology for farmers to understand (Bolorunduro *et al*., 2005). Researchers being extensionists allows the transfer of unadulterated research results to farmers. Being the one who developed the research results, a researcher has an important role in the implementation of those results to target clientele.

Conclusion and Recommendation

The farmers are likely to benefit more when they receive technological package from a qualified personnel, a person who knows what to carry and give to farmers. The potential of researchers being extending their research results is one of the ways in which research and extension can be integrated. Uneducated extensionists are likely to deliver poor messages to farmers which may have a negative impact on adoption rate. Therefore for effective flow of information from research to farm there must be a participatory nature of communication and training on the subject matter. It is high time to harmonize policy options in most countries so that both researchers and extension workers work together in every research though for farmers. It should be mandatory to include an extensionist in daily research activities.

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Socio-economic factors influencing adoption of improved fallow among small-holder farmers in western Tanzania

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Summary

Declining soil fertility is recognized as one of the major biophysical constraints affecting agricultural production in sub-Saharan Africa. "Improved fallows" technology, a leguminous trees-based soil replenishment technology was introduced in smallholder farming system in Tanzania to address this problem. The objective of this study was to identify the factors that influence the adoption of the technology among smallholder farmers in western Tanzania. A total number of 55 farmers were selected for interview from Tumbi, Malolo, Isikizya, Kigwa and Magiri villages in Uyui district, Tabora region. The villages chosen were the pilot sites where agro forestry research and dissemination activities were taking place. The collected data were processed and analyzed into frequencies, percentages and chi-square for comparison using the Statistical Package for Social Science (SPSS) computer programme, to obtain quantitatively and qualitative information. The results revealed that lack of farmer awareness of the technology, inability of farmers to wait for two years before obtaining direct benefits from the technology were the major constraints to planting improved fallows. The study identifies farmer training through workshops and seminars, enforcement of village by-laws on animal grazing, and facilitation of farmers' access to credit as the major approaches to enhance the adoption of the technology.

Keywords: Agroforestry, Improved fallows, leguminous trees, western Tanzania.

Introduction

The continued threat to the world's natural resources is exacerbated by the need to reduce poverty and unsustainable farming practices. A significant proportion of the rural population is food insecure and malnourished. Studies such as the 2020 vision (IFPRI, 1996) and the World Food Summit (FAO, 1996) show that food security is one of the main global concerns as we move along. Although food insecurity occurs almost throughout the developing world, it is most acute in sub-Saharan Africa, where the attainment of food security is intrinsically linked with reversing agricultural stagnation, safeguarding the natural resource base and reducing population growth rates (Cleaver and Schreiber, 1994). Soil fertility is recognized as one of the major biophysical constraints affecting Africa agriculture (Nye and Greenland, 1960; FAO, 1971; Pieri, 1989; Yates and Kiss, 1992). The need to improve soil fertility management in the continent has become a very important issue in the development policy agenda (Scoones and Toulimin, 1999) because of the strong linkage between soil fertility and food insecurity on one hand and the implications on the economic well being of the population on the other (Ajayi et al., 2003). Agroforestry has the potential to improve soil fertility through the maintenance or increase of soil organic matter and biological nitrogen (N_2) fixation from nitrogen fixing tree species (Young, 1997). Biologically, agroforestry species have the potential to reverse soil fertility decline thereby increasing crop yields (Thangata and Alavalapati, 2003). Various studies have shown the potential of agroforestry as an approach to sustainable agriculture production and soil management, especially in the tropics (Maghembe and Prins, 1994; Nair et al., 1999). There are some technologies that can replenish soil fertility and provide other needs such as fuel wood, hence become integral part of the household subsistence needs.

Researchers in southern Africa have introduced improved fallow as a sustainable option to replenish soil fertility within the shortest possible time (Kwesiga et al.; 1999). Improved fallow involves planting of fast growing plant species that produce easily decomposable biomass. The major species that have been found to be suitable for improved fallows in western Tanzania are *Sesbania sesban* (L) Merr, and *Gliricidia sepium* (Jacq.) Walp. As a result, agroforestry, now is regarded as a sustainable

agricultural system, and is being promoted in most parts of Tanzania. However, adoption of agroforestry technologies has generally been low (ICRAF, 1997). Investigation of why some technologies are more readily adopted than others requires key information about the socio-economic and biophysical interactions that affect farmers in making decisions (Franzel et al., 2001) noted that higher adoption rates of improved fallows in Zambia were associated with proper and effective diagnosis of farmer's problems their participation in programmes and encouragement to innovate. (Mercer and Miller, 1998) found that one of the reasons why agroforestry projects failed was lack of attention to socio-economic issues in the development of the systems as well as in the extension of technologies.

A study in Nigeria (Osemeobe, 1990) found that farmers do not plant trees due to lack of farmer involvement and the unattractiveness of income incentives from tree growing compared with food crops. Based on a sample survey of 55 small-scale farmers in five villages in Tabora region of Tanzania, the aim of this paper is to understand the process and socio-economic factors affecting the adoption of the improved fallow technology within the context of resource poor farmers in Tanzania. The study also aims at highlighting implications of the study for scaling up/out the technology in other geographical locations.

Overview of Western Tanzania (Tabora) and survey methods

Tabora region is located in mid-western part of Tanzania on the central plateau between latitude 4^{o}-7^{o} South and longitude 31^{o}-34^{o} East. It covers an area of 76,151km^2, representing 9% of the land area of mainland Tanzania. A total of 34,698 km^2 are forest reserve and 17,122km^2 are game reserve. Tabora region has a total population of 1,717,908 (NBS, 2002). It has a long dry season of about 5-6 months, with temperatures ranging from a mean minimum of 16.6^{o}C in June to mean maximum of 37.7^{o}C in October. Soils are 80-90% sand (Ferric acrisol), with low organic carbon ranging between 0.4 and 08%. Agro-ecologically, Tabora region falls under uni-modal upland plateau where agro-pastoralism dominates the farming system. The natural vegetation in the region consists of miombo woodlands with mainly *Acacia* and *Cambretum Spps*. Land tenure is public and individuals' farmers have user rights to be allocated and to cultivate the land (Warner, 1993).

Most of the population in the region (93%) depends on agricultural production and 80% of the regional economy is derived from agriculture, of which 30% is contributed by tobacco cultivation (Ramadhani, et al.; 2002). Farm holding size averages about 20ha, most of which is uncultivated (Otsyina et al; 1996). Tobacco is the farmer's main cash crop; other crops grown for both food and cash include maize as, the main food crop, groundnuts (*Arachis hypogaea* L.), rice (*Oryza sativa* L.) and sorghum (*Sorghum bicolor* L.). About 5% of the farmers own livestock ranging from 1 to 100 (Otysina et al, 1997).

Sampling technique

A total number of 55 farmers (30 adopters and 25 non-adopters) were selected to be interviewed. A purposive sampling design was used to select farmers in the study area, and then a random sampling design was used to obtain households as sampling units. A Focus group discussion (FGD) was used to get additional information. In this study those who planted *Sesbania sesban* and *Gliricidia sepium* were regarded as adopters. Farmers who were aware about agroforestry but did not plant fallows were considered as non-adopters. A formal questionnaire survey was administered in 2003 with closed and open-ended questions to collect socio-economic data about various socio-economic characteristics and policy factors. The Statistical Package for Social Sciences (SPSS) software was used to analyze data. Frequency distributions and percentages were used to summarize the information.

Results and Discussions

Demographic structure in the study area

Results show that majority of respondents (70%) were married male of the sampled population, 20% were single, 3% widowed and the rest 7% were divorced (Table 1). The high percentages of married headed families observed in the study suggest that participation of farmers in improved fallow in the study area depends on the perception of the technology by the male members of the community because most of the women are not empowered regarding the use of the land. This is in agreement with (Phiri et al., 2003), in his study found that proportionately more men planted improved fallow than women primarily because married women need consent of their husbands before planting trees but not otherwise.

Table 1 Number of respondents

Household head	Frequency	Percentage
Married male	28	70
Single	12	20
Widowed	7	3.3
Divorced	8	6.7
Total	55	100

The dominant age group among the respondents was between 20-40 years (57%) while the age group above 45 was 43%. All age groups in this survey were active and had the potential of participating in agroforestry. This is contrary to other studies that young people participate more in agroforestry due to their ability to acquire and absorb information about new technology faster than old people (Sonii, 1992). Results of this present study show that almost all the age groups had equal participation with exception those who were above 45 years of age. Our result also support the findings on the adoption of social forestry in India by (Alavalapati et al., 1995) and adoption of live hedge in Burkina Faso by (Ayuk, 1997) that all groups of farmers are more likely to adopt agroforestry.

Table 2 shows that almost all the farmers interviewed had acquired formal primary education, while 7% had no formal primary education. Based on these results education was not a major constraint hindering participation in agroforestry activities in the study area. The majority of the respondents had education that could enable them to read and write and eventually follow technical recommendations.

Table 2: Education level of the interviewed farmers

Years attended schools	Frequency	Percentage
0	7	7
4	11	20
6	7	7
7	24	63
11	6	3
Total	55	100

Occupation

The results showed that 93% of farmers are entirely dependent on farming while 7% are formally employed. It further revealed that majority of farmers are involved in off-farm income generating activities including production of horticultural crops (33%), small enterprises 27% and local brew making 10% and other miscellaneous activities 10%. (Table 3)

Table 3.Occupation of the respondent

Respondent	Frequency	Percentage
Farming	41	93
Formal employment	14	7
Total		
Off-farm activities	55	100
	16	33
Horticultural crops	14	27
Small business	9	10
Local brew	15	30
Others		

Given that improved fallow technology primarily alleviates the problems associated with the use of high cost fertilizer, the findings that farmers who adopt improved fallow technologies are wealthier than non-adopters are not integrated. When asked about the issue of extension services, all farmers interviewed argued that, public agricultural extension officer had not visited them for more than a year. Extension contact comprises information such as the farmer's visit to the extension worker for advice, visits by the extension worker to farms to provide advice, attendance at extension meetings, or a course in the extension planning area. Lack of extension contact and technical knowledge (planting nursery, planting the seedlings) are the major constraints to planting improved fallows. The weak extension system in the study area is identified as one of the key constraints to the adoption of improved fallow in Tanzania.

Table 4: Farmers problems

Problem	Percentage
Lack of awareness and poor knowledge	26%
Not willing to plant trees	17%
Inability to wait 2 years	15%
Lack of seeds/seedlings	7%
Takes long time	6%
Livestock destruction	6%

Constraints facing farmers in participation

Farmers face with a number of challenges that hinder them from establishing and using improved fallows. As presented in Table 4, lack of awareness and poor knowledge on improved fallow is most critical compared to other problems. This is followed by lack of interest to plant trees, the long time it takes to realize benefits from trees, as farmers have to wait for two years before getting benefits from improved fallow, lack of seeds/seedlings. These findings are in agreement with study conducted by (Ajayi et al, 2003) who mentioned the major constraints to planting an improved fallow were lack of awareness lack of seeds/seedlings; and unwillingness to wait for two years before realizing of the benefits of the technology.

In addition farmers mentioned that livestock grazing is becoming a serious problem because of the land tenure system in which land is communally owned and free livestock grazing. Focus Group Discussions (FDG) results which ranged from a group of 5 farmers to 10 farmers at Kigwa and Isikizya village showed that there were no effective by laws. In a related study carried out in Zambia, (Ajayi et al., 2003) found that low effectiveness of the by laws against browsing varies depending on the type of cultural community involved and the level of agro-pastoral farming. Lack of effectiveness of the by laws was due to some factors. These include lack of understanding of the exact provisions of

the by-laws by various components of the community; lack of clear defines roles and responsibilities to enforce the by-laws and livestock rearing.

Farmers' opinion on how to improve adoption

Farmers suggested several approaches to enhance the use and adoption of improved fallows by small-scale farmers in Tanzania. It was recognized that the benefits of planting improved fallow are not clearly known to farmers, since most of them were not involved in training and workshops programs conducted in the area. Hence the respondents proposed that training (through workshops and seminars) for participating and non-participating farmers should be conducted in order to create awareness. Farmers also raised issues concerning by-laws to control free grazing and browsing by livestock. Village by laws should be enforced to control grazing. Farmers recommended that the by-laws should be documented which will be a tool to safeguard all stakeholders including livestock and other non-agroforestry farmers. The reviews of credit conditions to enable farmer's access credit were also suggested. Access to credit could improve farmers' ability to hire laborers to work in improved fallow field especially during the establishment phase before the benefits from the technology accrue to farmers. The formation of farmer groups and policy emphasis to create awareness were also suggested as the way forward to enhance the use of improved fallows (Table 5).

Table 5: Farmers' opinion to improve the use of improved fallow

Opinion	Percentage
Training	39
Seminars and meeting	20
Enforce bylaws	12
Gifts/loans	7
Form farmer group	7
Make follow-ups	5
Political emphasis	3

Conclusion

This study examined factors influencing the adoption of improved fallow at Tumbi, Malolo, Isikizya, Kigwa and Magiri in Uyui district. The results show that martial status, formal education and regular off-farm income had no influence on decisions to plant improved fallow. According to this study, lack of awareness on improved fallows, unwillingness and lack of inability to wait 2 years are the major limiting factors of improved fallow adoption. Lack of access of extension services seems to be a very important factor in agroforestry adoption. Our study supports the findings for (Omoregbee, 1998; Adesina et al., 2001) and (Boahene et al., 1999) that farmers with higher extension contact are more likely to adopt agroforestry technology. The study through discussion with farmers revealed that, the provision of free seeds/seedlings and other equipment might not guarantee tree planting and management needs labor which was formally not planned for tree planting. The commitment of labor to new innovations is a serious problem to households with access to information and agro forestry technical assistance and could influence tree-planting activities.

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Research – Extension – Farmer Linkage: Improving Livestock Feeds in Mixed Production Systems of Central Tanzania

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Summary

The demand and supply for livestock feeds is a challenge to the research institutions and the extension system in Tanzania. As a result participatory approaches to improve the level of adoption and sustainability of projects engaging on livestock feed resources are underway. The Research Institute Mpwapwa has been conducting on farm experiments in collaboration with departments of agricultural extension from respective districts in order to improve the feed resource base for ruminant and non ruminant livestock. This paper explores both the practical approaches for on farm research and development on pastures and forages and the participation of farmers in the implementation of agreed activities. . This paper presents a recent baseline surveys on identifying existing and potential fodder trees and shrubs and willingness of farmer to integrate fodder trees and shrubs in their farming systems. The study was conducted in Singida rural and Kongwa districts in Tanzania. Focused group discussions and key informants interviews were conducted using a semi-structured interview with a well developed checklist. It was observed that farmers were aware of available natural forages and fodder tree. It was also revealed that a number of technologies have been disseminated to the farmers in central Tanzania, but adoption and sustainability were slow due to inadequate participation and ownership from the outset of the projects. However Participatory on farm research provides more opportunities to learn by doing and sense of ownership, although this type of research is more costly than on station research. Moreover strong Research – Extension – Farmer linkage are required so as to facilitate integrated approaches that will improve production and efficient utilization of livestock feed resources.

Introduction

The natural vegetation consists of a dense deciduous thicket with *Commiphora* and *Acacia* are the dominant genera found in central part of Tanzania. Livestock kept depend on the natural pastures characterized by very rapid growth during the short rainy season, resulting in early maturity and rapid deterioration in nutritive value as the dry season sets in. During the dry season, animals are fed on mature forage plants and crop residues, which are generally very low in crude protein, have relatively low digestible energy and low concentration of minerals, particularly phosphorus and calcium (Leng, 1990; Mtamakaya, 2002) and are high in fibre and lignin (Van Soest, 1994) which result into low animal productivity.

In Tanzania, and particularly in rural areas, supplementation using tree and shrub fodder could be an alternative option to conventional protein supplements for ruminant animals subsisting on low quality roughage (Shayo 1991; Goromela *et al*.1993). Forage tree leaves particularly that from Leucaena, Gliricidia, Sesbania and Calliandra on their own or in conjunction with commercial feeds have been used as supplements to a wide range of forage and agricultural by products.In order to embark improvement of livestock feeds in mixed production systems of central Tanzania, a team of scientists from National Livestock Research institute Mpwapwa and Pasture Research Centre - Kongwa, conducted a baseline survey in twelve villages from Singida rural and Kongwa districts to gain an understanding of the existing and potential fodder trees and shrubs, farming system , herd composition and management practices in the traditional sector (Anon, 1986), identify constraints in livestock feed improvement and willingness of the farmer to improve ruminant feeds (Anon, 1986). This paper attempts to describe Research – extension – farmer linkages as drawn from baseline survey in a strategy for improving livestock feeds in mixed production system.

Materials and Methods

Study sites and data collection

An overview of available livestock feed resource in two districts namely Singida rural and Kongwa in central Tanzania was made. Central Tanzania covers an area of 140,000 km², lies at an elevation of 750 to 1750m above sea level. The area has a dry type of climate with a long dry season between April and November, and a short wet season from November to April with an average annual rainfall of 600 mm. and erratic distribution. Most of dweller are agro-pastoralists, integrating crop production and livestock keeping at different degrees depending on socio-economic and cultural situations. According to the 1984 human population census, there are over two million (2,000,000) people of various ethnic, groups namely: Gogo, Nguu, Hehe, Nyaturu, Nyiramba, Kaguru and Rangi.

The study was conducted between Feb – May 2009 in six (6) villages from Kongwa district namely Sagara A and B, Mlali, Mlanga, Chamkoroma and Tubugwe and six village from Singida district namely Msungua, Merya, Sughana, Sepuka and Ikhanoda.(Table 1) The study area was purposefully selected, with the help of District Agricultural/Livestock Development Officers from respectively districts, based on number of dairy cattle and goats and accessibility for most time of the year, followed by selection of contact farmers for implementing fodder trees and shrubs as ruminant feeds in study sites. A semi structured interview was conducted with Farmer focused group of 15 – 25 and key informants. A well designed checklist was used to guide the discussion with FGD and key informants. The checklists were designed to cover aspect of the cropping pattern, known fodder trees and shrubs and conservation, Livestock species and management practices. The major emphasis was on feed resources and feeding strategies during dry season.

Results and discussion

Main Features of the Farming System

From survey it was revealed that the farmers in the study area are agro-pastoralists, engaging in livestock keeping as well crop farming. About 99% of livestock kept are indigenous breed and only 1 % keeps crossbred. Two major types of farming systems were observed, the fallow system and agro pastoralist systems. According to Mwanga *et al* (2005), Fallow systems are farming characterized by annual crops like maize , legumes sorghum and millets with livestock while agro pastoralist system are farming with intimate cropping and livestock keeping of which 50% of needs come from livestock.

Grazing Lands and Feeding Strategy

It was revealed that the grazing lands of the study area in both districts surveyed had no clear boundaries between grazing and cultivating land . However it was observed that during dry season after crop harvest all land turn into grazing lands and on in other hand, the field which was cultivated are considered to be possible place where animal get supplementary feeds. The common grazing lands are in open community an land that seems not to be suitable for cropping and dominated by thicket or land which has been abandoned as a consequence of the shift cultivation. Although there have been a call for village government to clearly demarcates grazing and cropping land, observation show that it might take time due to existing land tenure system and current farmers attitudes.

Available feed resource

Availability and quality of the feed resource fluctuates between the wet and dry seasons of which during wet season forages are plenty in many parts, although available grazing area have greatly been reduced due to farming activities. In the dry season pastures are poor in quantity and quality. The common natural forage plant found in semi arid of central Tanzania are composition of : *Urochloa*

trichopus, *Dactyloctenium* sp., *Aristida* sp., *Eragrostis* sp. and *Chloris virgata*, *Cynodon* sp., *Cenchrus* sp., *Hyparrhenia* sp., *Panicum* , *Astripomoea* sp., *Crotalaria* sp., *Commelina* sp., *Cleome* sp. and *Ipomea* sp. etc. while common thicket species were *Cassia* sp., *Croton* sp. and *Acacia* sp. (Dyne *et al*., 1984). Feeding on fodder trees and shrubs was another source of livestock feeds especial dry season some of fodder tree and shrubs found are Acacia spp, *Adansonia digitata, Brachystegia sp, Commiphora sp, Boscia indica, Delonix elata, Dichrostachys cinerea, Ecborium sp, Ficus sp, Grewia bicolor, L. leucocephala, Markhamia zanzibarica, Watheria sp and Ziziphus mucronata.*

The study observed that feeding strategies adopted in overcoming feed shortage was done by few farmers keeping dairy cattle and goat through collecting and utilizing crop residues. Animals are usually trekked daily for long distance for searching pasture and water during dry season. Although farmers have been sensitized on land use plans, proper grazing plans, fodder harvesting, conservation and utilization little have been adopted. This might be due to inactive implementation of Land Act No 4 and village land Act No 5 of 1999 which prescribe modalities for demarcating allocating developing and giving titles of the land for individuals, groups and association. Other might be due to lack of participation of traditional livestock and crops farmers.

Access to Extension service

About 99% of farmers reported to have an access of extension services from government extension officer and NGOs though not all villages had extension officers. From the previous research and developmental activities the following project impacts were observed among farmers ownership of dairy cows, improved dairy goats, improved cattle and goats shed and few introduced fodder trees around the homesteads. During the discussion it was revealed that extension service is inadequate in some villages due to the following reasons: absence of extension officers allocated close to the villages, transfer of extension officers to another place, one extension is responsible to more than one village and have no reliable means of transport.

Clearly; farmers from margin of village in central part of Tanzania have the least access to formal agricultural extension services. Tanzania has long history in evolution of provision extension service and has adopted several extension approaches in delivering Agriculture technology. Tanzania government is main player in providing extension service. There are few and scattered extension officers which can not meet the current demand among various stakeholders. Moreover the government have not employment enough extensionists and have not replaced those who passed away and retired since 1992 till 2006 through Local government Authority (LGAs). By considering these private sectors, NGOs such as HPI, World vision, Farm African, Concern Tanzania have been facilitating some extension services to the farmer in different forms.

These few conditions identified reflect the severity of agricultural extension service delivery among agro pastoralist with mixed farming. With these understanding farmers with NGOs support have identified some farmers and have sent for short course training to perform some extension services in their respective villages (PARA VET or CAWS) who act as a link agent between farmers and extension.

Research – Extension – Farmer – infrastructure Linkage

Agricultural extension by it own is a service that lies on linkage and network. The linkage and network must be between Researcher – Extension – Farmer-Infrastructure (Figure 2). Research is one of essential element for development and dissemination of agriculture extension , Extension agent is another important element which act as a middlemen between farmers, end user of the technology and research , while Farmer are beneficially of the developed technologies can be an agent of disseminating technology. Infrastructure is crosscutting element includes, Policy, legislation, legal, market opportunity etc. The linkage between these four main actors believed to give a mutual opportunity for all actors to exchange information, ideas and set goals for development. However this

approach does not reduce household poverty (Biggs, 1995) rather it give researcher to understand the complex relationship between environment, economic, culture, politics and other various rural aspect in setting research agenda.

Researcher and Extension officer need to work together with farmers and bringing their knowledge and skills together and scientific information could be generated. The Research – Extension – Farmer –infrastructure linkage provides a key element in planning Research and extension activities which are participatory and demand driven through on farm trials. Therefore there is a need to recognize farm skills and knowledge as an important element in Agriculture technology development and dissemination but it needs careful assessment for its strength and weakness.

Research opportunities

Lack of livestock feed resources in central zone particularly in the dry season comes as one of the major constraints to livestock productivity. Although technology on establishment, conservation and utilization of available and improved livestock feed has been advocated, Few farmers in surveyed area conserve local fodder trees and shrubs for animal feeding and other use like shades. This view is supported by see some of trees, in areas where social development and research institutions have introduced zero-grazing technology and environmental conservation where farmers ware encouraged to establish some browse species for livestock feeding and for other multiple uses.

On farm research and technology dissemination in Kongwa and Singida rural districts

On farm research and other participatory approach in mixed farming require involvement of farmers, extension officer's empowerment and capital. These are referees to Farming system approach. According to Ftzhugh *et al*.(1992) participatory agricultural research must address the following :

- characterize the farming systems by identifying inputs, potential constraints and interaction of components
- Develop interventions to resolve constraints and exploit potential
- Design alternative systems
- Evaluate interventions and alternative systems and
- Elaborate on alternative that have proved to be technically, practical, economically feasible and socially acceptable.

In central zone livelihood improvement of agro pastorist depend on livestock which is estimated to have about 2.3 million head of cattle, 1.7 million goats, 0.6 million sheep. National Livestock Research Institute initiated on farm research project to improve livestock feed in study area, the study included identification of existing of local feed resources, feeding strategy during dry season when feed resource are scarce, farming system exist and find possible means of integrating fodder trees and shrubs in mixed farming of central zone. Following baseline survey in Kongwa and Singida rural districts six village was from surveyed area was selected for implementation of the project. Farmers were select from the selected village based on willingness to offer his/her peace of land, number and kind of animal kept, and willingness to participate on project. Since farmers know each one than researcher and extensionist, farmer was involved in selection of the contact farmers based on readiness to pass technology to others. On farm trial for integration of *Grilicia sepium* and *Leucaena palida* was set to 6- 8 farmers from each village, Chamkoroma,Tububwe and Sagara village and Merya , Sughana and Msughua in Kongwa and Singida rural districts respectively. Through participatory approach more farmers were interested to implement the project, it was obvious that not all farmers were able to carryout the project because of land scarcity and available project fund.

Challenge to on farm research

Based on experience gained, on farm research can be one way of improving Research – Extension – Farmer – Infrastructure linkage through joint planning and implementation of the research activities. At the some time it improve effectiveness of technology development and transfer (Kirway *et al* 2001). Linkage and networking with other stakeholders in production can bring effective and sustainable agricultural extension service delivery in region. This link must be between Market opportunity, demand driven commodity, extension service provider and legal and political support. Research effort has been made , notably level of adoption and sustainable of technology are few one of the reason is that on farm research are expensive compare to on stations, some of technologies are long term benefits of which farmers are un ready to adopt and farmers are un willing to adopt and participate in project that have no significant impact on their daily income and yields. Farmers who are experiencing regular food insecurity can not engaged in project that will take years to reveal its benefits.

Conclusion

This study concludes that, for Agricultural extension service to be improved, integrated approach is required and should be adopted and the impact could be measured on improved agricultural production and livelihoods. Scientific research should incorporate new methodologies that is participatory and client in an existing extension delivery system. One of the methods is enhanced linkage and networking of Research – Extension agent – Farmer – infrastructure. In diverse socio-cultural re thinking of present legal, framework, market opportunities, extension provider and harnessing indigenous knowledge from individual country must be done before adopting any approach. Technology developed and to be developed are diverse and need to be addressed in complex society therefore integrate approach is needed while harnessing strong linkage between Research- Extension-Farmer – infrastructure.

Acknowledgement

Gratefully authors acknowledge to individuals, institutions and DALDOs of Kongwa and Singida rural districts for the support during the study. We are thankful to the Zonal Agricultural Research and Development Fund (ZARDEF) central zone for Funding the fodder tree and shrubs project. Finally appreciation goes to the farmers who tirelessly spent their precious time to participate on study and for organizer and sponsor of the workshop for the invitation.

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List of Tables

Table 1.Districts, Village and Farmers visited during survey

District	**Villages**	**Farmers**
Kongwa	Sagara A and B	
	Mlali	6
	Mlanga	4
	Chamkoroma	12
	Tubugwe	20
Singida rural	Msungua	30
	Merya	25
	Sughana	9
	Sepuka	5
	Ikhanoda	7
	OTC Ilongero	1
Total		**119**

Table 2. Complementarities of farmers to the scientific knowledge

What farmers know better	**What farmers may not know**	**What researcher may not know**	**Researcher's contribution and role in providing new information**
Available resources including forage and other animal feeds	Potential use of improved, exotic or unfamiliar feeds	Contribution of familiar and unfamiliar feeds to livestock productivity under all production systems	- asses productivity with local feeds under specific production conditions or faming systems - asses improved feeds (selection during forage breeding programmes, treated feeds etc) - identify role / use of new feeds within existing feeding systems - compare new with existing feeds to assess potential benefits
Approximate performance of indigenous livestock on locally available feeds	How to improve performance	How to improve performance under field condition	- diagnose nutrient imbalance in diet - identify feed combinations which improve the nutrient balance of the diet
Performance of traditional methods of technology transfer	How to improve efficient	Its performance under dynamic farmers condition	- to asses its performance under specified farming system - compare new method with existing one

Source: modified from Komwijhangilo (2005)

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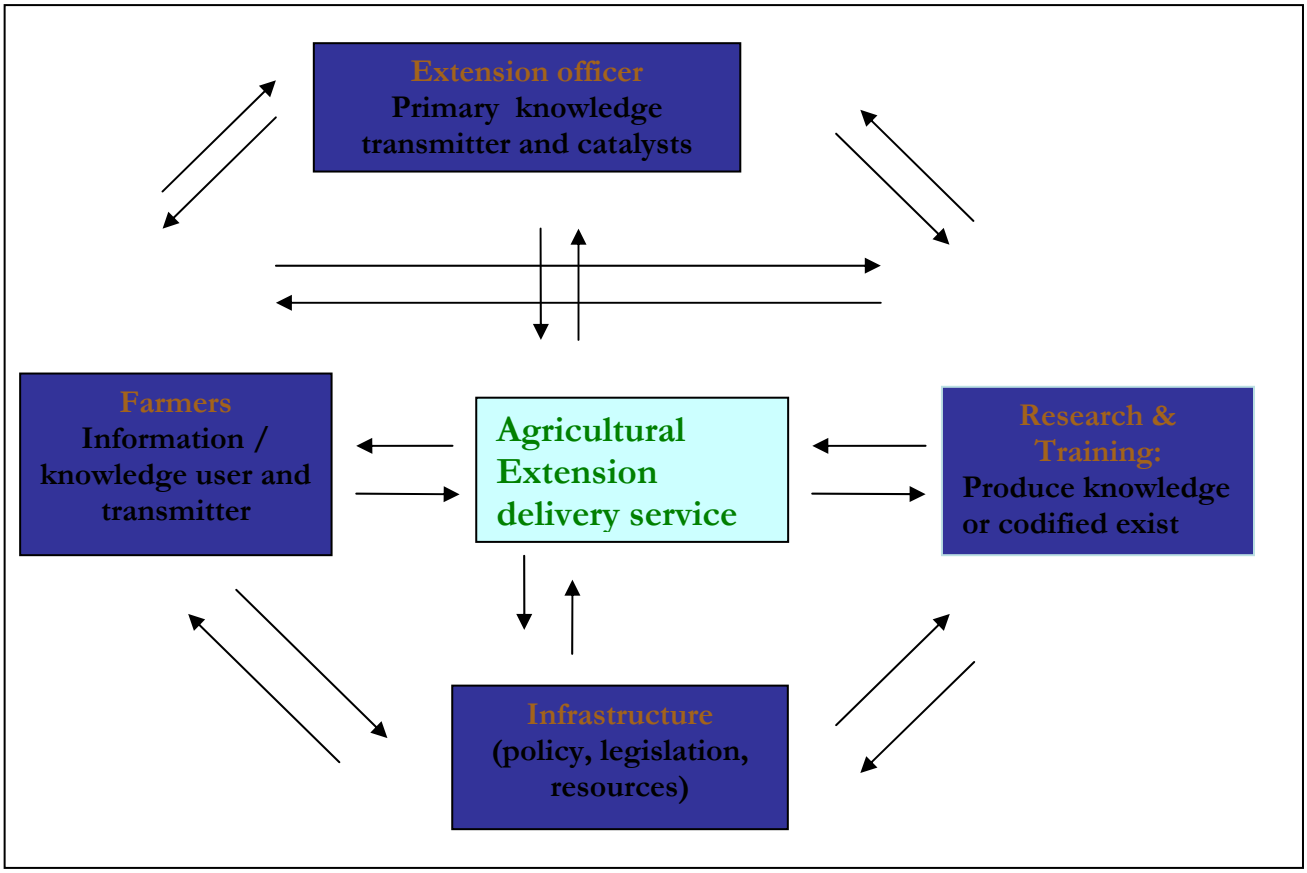
Figure1. Linkage between Researchers – Extension officers- Farmers – Infrastructures



From a class to the Farmer Association: Supporting Technology dissemination with financial sustainability in rural Tabora in Western Tanzania

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Summary

The hypothesis is tested that farmers' participatory involvement in selection and testing technologies under sustainable financial support and knowledge empowerment are essential for technology development and adoption. Effective farmer empowerment and confidence in farmers are strategies that would allow farmers to work independently without close supervision in technology selection, testing and adoption. The household is the unit of economic planning and technology development whose interests should not be confounded in farmer group setting. This paper addresses the method of using households as economic units, technology package approach and credit access as prerequisites for effective extension. Farmers create new ideas for economic development as a result of empowerments such as credit organization and farmer association to attain higher goals in development.

Key words: empowerment, farmer association, integration processes, participatory approach

Introduction

Agriculture development is the mainstay of Tanzanian economy and its development depends on the coherent efficiency of agricultural research and development as an engine for technology development and agricultural extension as the technology developing service system (World Bank,2007).Effective agricultural production is only feasible under the support of the service delivering extension system (Dirk and Paul 1991).But, linkage gaps bridging the input-output relationship between research and extension has clipped the performance of the two systems(Bigsten et al 2003).Poor feedback mechanism between research and extension result in developing research projects with low applied components(Dirk and Paul, 1991).The efficiency of extension can be measured through the economic performance of the communities it is serving (Evenson 1986,Birkhauser et al 1991).The training and visit has been a common method for executing extension during the implementation of NAEP II and TARP II projects in Tanzania through the World Bank funds. However, despite the millions of US dollars that were invested little socio-economic change was effected in rural areas (World Bank 2007).These World Bank funded projects were not well designed because of low farmer participation and lack of sustainability components (World Bank 2007).The farmer field school training has been adopted as an alternative method of extension because it increases farmers' decision making in technology development and adoption (Galpin et al 2000). Low soil fertility improvement programs have been affected by the existing gaps between agricultural research and agricultural extension in rural areas. Technologies targeting soil fertility improvement may not be as attractive as those related to seed variety testing because of the indirect benefits that have to be obtained through a planted crop over a space of time. Yet low soil fertility is a major mitigating factor to crop and livestock production and indeed in Tanzania According to (Stoorvogel and Smaling,1990) many of African countries including Tanzania have a negative net balance of the major nutrients especially Nitrogen and Phosphorus.Tabora region in western Tanzania is characterized by inherently low fertile soils formed on parent materials containing low active clay minerals (Acres, 1983).

Poor soil fertility is associated with low land productivity therefore development of appropriate agricultural technologies through research have been in progress to improve soil fertility (Nyadzi,2006).Despite, the good field performance of research developed technologies some of them

lack practical relevance to farmers(World Bank,2007).Increasing the role of farmers through participatory methods is vital and a need approach towards solving the problem of low soil fertility in agricultural development in Tanzania. Farmers' participation in technology development is a process which is specific to communities, human and natural resources. Technology development is a tool for economic development in which the household is a unit of economic activities in the country. The approach of involving farmers' participation in analysis, planning and identification of potential solutions under given socio-economic conditions in their rural setting is considered to be sustainable (Chambers 1988; Chambers et al.1989; 1997).Participatory approaches are said to accelerate the dynamic forces of technology adoption(Kerr and Chirwa 2004) The village is considered as a unit of economic development. In this paper we address the importance of planning at house hold level and linking the household to farmer groups using different forms of farmer empowerment. The confidence attitude towards farmers to work independently has been integrated in this system of extension approach to develop and adopt technologies for soil fertility improvement in Tabora region, Tanzania.

Materials and Methods

Target Farmer groups

Ulyankulu 5; Bukene 9; Tabora 5(Kazima, Songambele, Itonjanda), Nsimbo 3(total number of farmers 250

Participatory Learning and Planning (PLAP) approach

Farmers analyzed both human and capital resources accessed in their socio-economic environment. The capital resources used in this analysis included Livestock (goats and chicken).These animal species were considered easily accessed investments to agriculture and were gender neutral. Capital assessment was considered to be important as a step towards building a fertilizer system for integrated soil fertility management. Important components of integrated soil fertility management picked by farmers include crop rotation, integration of herbaceous legumes in cropping systems.

Integrated team approach

In bridging the gaps between agricultural research and extension (Roling, 1990) proposed an integrated system of key actors working with farmers in a dynamic flow of information**.** The team comprising soil scientist, extension staff, community development, cooperative organization experts and community credit organization met with farmers to discuss important aspects of poverty alleviation in rural Tabora region. Using the farmer participatory approach and the household as a unit of planning and economic development farmers analyzed their potential to improve their livelihood through agriculture. The team of experts each according to his objectives developed with farmers plans for improving livelihood. Farmers were trained in the class to analyze causes and effects of low soil fertility in household economic development. They assessed available human, natural and labour resources to solve the existing problems. The household was given freedom to pick an intervention based on their social economic conditions. These farmers through the input of the cooperative experts organized themselves into an association with the objective to develop a financial capacity for supporting the financial needs in the cause of agricultural technology development. The financial expert and the community development officer helped farmers to register the credit association. A component of sustainability was included in which every member was to contribute 3,000T Shs per month as the fund for supporting agriculture growth though access agricultural inputs. These farmers were connected to village extension officers in their respective villages and left work independently without a project officer's visit. An evaluation of farmers' performance was made at the end of the season.

Results

Using farmer participatory approach farmers were able to analyze the effects of low soil fertility in their livelihoods. The planning of human, natural and financial needs at the household level was vital for using available resources and making decision for the technology to be adopted for soil fertility improvement. A package of technologies was used and every individual household was free to pick what was conducive under the existing socio-economic conditions. Organization of farmers to access credit has further boosted their morale to test agricultural technologies because they can access agricultural inputs easily. The elevation of farmers into the farmer organization has increased their targets because of the financial security through the farmer association which is developed steadily by monthly individual contributions.

Discussions

The participatory approach used by farmers followed the process as documented in research work by Galpin et al 2000.Farmers' empowerment through training started in the class, where the package of technologies for improving soil fertility was taught. Using the household as the units of economic development targets were set for agricultural production and resources for attaining the set targets were quantified. Farmers assessed their resource base and came with solutions on how to improve soil fertility in their environments Similar finding of farmers participation in soil fertility improvement and technology development are documented (Mowo et al.2006).But, the aspect of sustainability in the process of technology development and adoption has not been adequately addressed in the cited work. The integration of technologies for soil fertility improvement is considered to be efficient among farmers although the aspects of technology adoption sustainability was not documented(Meertens 2003) The sustainability of extension activities through access of credit and economic empowerment has been mentioned in PADEP development activities in Tanzania.However,in this study we targeted the household as a unit of economic development with PADEP targeting the village as the unit of economic development. A multiple set of ongoing activities among the Chemchemi group farmers in such as composting, crop rotation and pigeon pea improved fallows is a bright future for soil fertility improvement in the study area. Extension of agricultural technologies is feasible with farmers' participation within a sustainable system of financial support (Tables 1through 3).This supports the view that effective extension should include activities that will empower farmers not only in skills and technology development but also in financial capacity building.

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The authors wish to thank CARITAS Tanzania and the Roman Catholic Diocese in Tabora for funding the different activities documented in this paper. We wish to thank the Zonal Director for Agricultural Research in the Western zone for the permission given to the principal author to work with CARITAS in Tabora region. We wish to thank our farmers from all Chemchemi groups in CARITAS Tabora for their dedication towards rural improvement and especially soil fertility management.

Table: 1 Pigeon pea varieties tested by farmers in field demonstrations to improve soil fertility and household food security

Pigeon pea variety	Demonstration site	Farmer group leader
00020	Bukene/Simbo	Mzee Ngodoki
00933	Choma cha Nkola	Janeth Kapinga
00576-1	Tabora	Mwalimu Tatu Sambali
00932	Urambo	Stella Habi
00936	Ulyankulu	Fredrick Daniel
0004	Simbo	Maria Nicolaus
0004	Ndalla	Catarina Paulo

Table: 2 Agronomic characteristics of Pigeon pea varieties tested by farmers

Name/trait	ICEAP/00020	ICEAP/00933	ICEAP/00936	ICEAP/00576-1	ICEAP/00932
Type	LD	LD	LD	LD	LD
Stem colour	Green	Green	Green	Green	Green
Flower colour	Ivory	Ivory	Ivory	Ivory	Ivory
Seed colour	White/cream	White/cream	White/cream	White/cream	White/cream
Growth Habit	Indeterminate	Indeterminate	Indeterminate	Indeterminate and Indeterminate	

LD: Long duration

Table 3: Integrated farmer organization, technology testing and adoption

Planning process	**Key players**	**Outputs**
Household needs and constraints assessment	Farmers,Researchers,Community Development officers	Targets of production set, Resource needs quantified, Resource allocation at household level
Technology selection	Farmers	Adoption of pigeon pea soil fertility fallow, adoption of sunflower rotation with bambara nuts, compost manure making
Farmer groups and farmer field schools	Farmers, Community development officer, Researchers and Village extension staff	Demonstration of technologies in individual fields
Credit facility planning	Farmers, community development officer, cooperative expert and financial expert	Farmer credit facility SACCOS
Farmer Association	Community Development officer, Cooperative officer, Researchers	Integration soil fertility improvement in rural development plan
Integration of research, Credit access, Social organization, Farmer participation	Farmers,Researchers,Community development staff, Cooperative staff	Sustainability of the project, improved livelihood

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Essence of Strong Links between Research and Extension: The case of Mpwapwa Cattle Introduced in Chunya District, Tanzania

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Summary

Between 2005 and 2009, a total of 29 Mpwapwa bulls were purchased from the National Livestock Research Institute (NLRI) Mpwapwa and sent to some villages in Chunya District, Mbeya region. This noble approach was initiated by Chunya District Council (HAWICHU). A study was thus undertaken with an overall objective of assessing performance and socio-economic benefits of introducing Mpwapwa cattle in different farming systems of the district. A multi-method approach was used whereby key informant interviews, individual interviews with structured questionnaire and animal body measurements were undertaken. Results showed that out of nine bulls sent to various villages in 2005 only two bulls found alive in mid April 2010. Nevertheless, Mpwapwa x TSZ crossbreds were favoured by a few farmers who owned them due to their heavier birth weights and faster growth rates compared to local Tanzania short horn zebu (TSZ) where a four months crossbred-calf could weigh as much as 40kg and average weight of cattle aged 9 – 12 months was 101.17kg. Apart from free grazing, however, supplementation of Mpwapwa bulls, crossbreds and other cattle were barely used. It is thus recommended that extension services especially on veterinary care should be strengthened in the study areas. Researchers should also strengthen efforts on ECF vaccinations and or use of resistant cattle breeds especially in areas where dipping and other tick control measures are not well placed as is the case in many villages of Chunya district.

Key words: Mpwapwa bulls, dual-purpose, meat, linkage

Introduction

Mpwapwa breed cattle, which is a dual-purpose synthetic breed, was developed such that it is able to withstand the harsh climatic conditions as well as environmental conditions of smallholder farmers whilst maintaining higher growth rates and milk yields compared to the indigenous cattle (Bwire *et al*., 2005). Fifty years since its development, many institutions and individuals have accessed these improved cattle, and there are impressive records available. For example, performance of the animals in some villages in Central Tanzania has indicated that Mpwapwa and Tanzania shorthorn zebu (TSZ) crosses (Mpwawa x TSZ) produced up to six litres per day which was about six times compared to the traditional TSZ (Bwire *et al*., 2005; Komwihangilo *et al*., 2009). Similarly, calf birth-weights of crossbred (MPWxTSZ) was reported to vary from 15 to 20kg compared to birth-weights of 10 to 15kg of the traditional TSZ whereas the average price of milk per litre per day was Tsh. 300 (Komwihangilo *et al*., 2009). The farmers who keep pure or crossbred Mpwapwa cattle reported to fetch higher prices when they sold the animals than the prices accrued for TSZ. The price of live TSZ cattle varied from Tsh. 75,000 to 150,000 per head under good marketing season though that of MPWxTSZ varied from Tsh. 250,000 to 300,000 (Komwihangilo *et al*., 2009). Meanwhile, on station records also indicate that between 2002 and 2008, a total of 1480 Mpwapwa cattle were sent to the several parts of the country whereby a total of 29 Mpwapwa bulls were purchased from the National Livestock Research Institute (NLRI) Mpwapwa between 2005 and 2009 and sent to some villages in Chunya District (Figure 1). This move was initiated by the Chunya District Council (Halmashauri ya Wilaya ya Chunya, HAWICHU). For more than five years since the introduction of the Mpwapwa bulls in Chunya district, however, NLRI had not had any formal follow-up on the success or failure of this noble approach so as to provide technical backstopping on improvement of local cattle herds. This study was therefore proposed as part of NLRI move in evaluating various livestock technologies and assessing farmers' attitudes on keeping Mpwapwa cattle and the general uptake of the improved cattle husbandry practices. This paper dwells on the findings from the evaluation exercise in Chunya and compares findings of a similar activity earlier conducted in Mpwapwa district. The linkages of

research and extension institutions / staff associated with the introduction and management of traditional and crossbred cattle in the respective areas are also discussed.

Methodology

During evaluation of Mpwapwa cattle in Chunya district a multimethod approach was used that included courtesy calls to local leaders, household interviews and physical body measurements of the animals.

1. Courtesy calls and discussion with key informants

Courtesy calls were made at Mbeya Regional Agricultural Advisory Office and Chunya District Council (Halmashauri ya Wilaya ya Chunya, HAWICHU) where the team met several officials including Acting DED, Acting DAS, and Acting DALDO who is the District Livestock Officer. The purpose was to introduce the activity that was to be undertaken so as to let the local administration know what was to take place. On the other hand, these brief visits were intended to gather preliminary information on livestock development in the area and Mpwapwa cattle or their offspring in particular. At the same juncture, the team draws the itinerary for the field activities with the assistance of Acting DALDO and the Subject Matter Specialist (Livestock) at HAWICHU. Similarly, the team met other people in the participating villages including the Kipembawe Divisional Secretary, extension workers and farmers. These latter stakeholders were responsible in the day to day care of the animals that the team was interested on.

2. Household surveys

A cross-sectional survey was made in Chunya district, Mbeya region from 14 to 20 April 2010. A total number of 16 farmers were interviewed using a structured questionnaire. The farmers were interviewed to provide information on general animal husbandry including on how Mpwapwa crosses are managed. The surveyed villages were Makongolosi and Matundas in Makongolosi Ward, Nkung'ungu village in Lupa ward, Mkwajuni village in Mkwajuni ward, Chang'ombe village in Mbuyuni ward Kanga village in Kanga ward and Kibaoni village in Chokaa ward (Table 1).

3. Animal body measurements

Physical body measurements that included body weight, height at wither, rump height and body length were taken for the Mpwapwa x TSZ crosses using the measuring tape. Age of the animals was estimated through observations and by asking the individual farmers. A total of 27 Mpwapwa x TSZ cattle in different categories and age were involved.

Results and Discussion

Criteria used in the distribution of Mpwapwa bulls

The extension officers at Chunya District Council distributed the Mpwapwa bulls to farmers free of charge but the distribution was based on the fact that:

- The recipient had undergone training on livestock production prior to receiving a bull
- The bull would be used among the farmers' groups
- The recipient farmer had a good the number of animals that he / she owned

Status of bulls sent to the villages

Results show that out of **nine** bulls sent to the various villages in 2005 only **two** bulls were found alive in mid April 2010. That means about 78% of all the cattle that were sent to the villages had died, mostly due to East Coast Fever (ECF). Nevertheless, there were a number of Mpwapwa cattle crosses

that were reported and some were observed (Table 2) although these numbers may be lower than the actual figures.

The body weights, heights, heights at wither, rump height and weights of Mpwapwa x TSZ crosses found in the surveyed villages are presented in Table 2. On average a four months crossbred-calf could weigh as much as 40 kg and average weight of cattle aged 9 – 12 months was 101.17 kg but specifically a one year male could weigh up to 115 kg (Table 2) compared to 44 kg and 76 kg for a local TSZ at respective ages (Msanga and Bee, 2006). These data confirmed farmers' arguments that Mpwapwa x TSZ crosses were heavier at birth and grew faster than the traditional TSZ cattle.

Feeding and general management

Free grazing is the normal for feeding Mpwapwa bulls, crossbreds and the other types of cattle kept in the study villages. However, little supplementation of Mpwapwa bulls, calves and cows was reported by some farmers. Maize bran, oil cakes and crop residues were the major supplements that were used, but they were provided not only occasionally but also in varying amounts. This indicates a need to further education and skills on improved cattle husbandry to participating and other farmers in the study areas.

Watering

The major sources of water for livestock in the area were rivers (seasonal and permanent), ponds and boreholes. There was no major costs incurred during watering of the animals from rivers and ponds apart form the initial costs that were incurred in the construction of boreholes.

Breeding

Natural mating was the common method used whereby the bull was rotating from one farmer to another within the group of livestock keepers. It was however, noted that the breeding bulls were not optimally used for breeding purposes. Most of the people who used the bull (or who were said to belong to a group) happened to be closest relatives of the farmer who owned the bull. Thus there was a need for district and village authorities as well as group members to enhance group formation and conducts so that many farmers could benefit with improved Mpwapwa bulls.

Animal health

Status of veterinary services and animal health care

Most of the farmers indicated that they had no routine control of ecto- and endo-parasites. However, they normally provide treatments to the sick animals through occasional advice provided by extension workers or do it on their own. In this latter case, there was a likelihood of wrong prescriptions. It was for example, pointed out by the extension worker in Makongolosi ward that 13 – 15 cattle die every month in a village due to tick-borne diseases especially ECF. When translate on economic terms, this means that there is a loss of 1,500 to 3,000 US $ every month (or TSh. 2,000,000 to 3,750,000). These losses could be minimized or avoided if local authorities, extension workers and local farmers have a common goal to address the prevailing problems. Meanwhile, farmers' experiences / knowledge and attitude indicate that a local zebu strain popularly known as 'Tarime cattle' could relatively withstand the tick challenges prevailing in the study villages other than Mpwapwa crosses. This fact however, is subject to more scientific studies before making firm conclusions on this matter.

Production constraints faced by farmers in keeping improved Mpwapwa breed cattle

There were several constraints identified that affect the livestock industry in the study area especially the keeping of Mpwapwa bulls and their crosses.

These include:

1. Diseases such as ECF, other tick borne diseases and Lumpy Skin Disease
2. Absence of veterinary infrastructure in many villages such as lack of dip tanks
3. Shortage of feeds and water especially during the dry season that is also worsened by the fact that grasslands are burnt down by people who are then searching for gold mining sites
4. Inadequate cooperation among farmers especially in the development of dips and / or in sharing of resources such as Mpwapwa bulls.
5. The traditional management of cattle where farmers are used to moving from one place to another (Transhumance) lead to lack of the spirit for infrastructural developments (e.g. construction of dips).
6. Shortage of hired labourers to attend the animals. This is because some of the cattle keepers are old citizens and the young ones are either involved in mining or other socio-economic activities.
7. Inadequate knowledge on improved methods on livestock production. The majority of farmers in Chunya district who keep large herds of cattle are the Sukuma who rely on local knowledge in livestock keeping. Meanwhile, livestock extension services that could equip them with improved livestock production techniques are inadequately provided due to shortage of extension staff.

However, most of these constraints can be contained if farmers, the district council and other stakeholders could put deliberate efforts on the prevention and controlling following the suggested methods.

Strategies / Mechanisms in place to cope with the production constraints:

Strategies by the extension service

In order to improve productivity of livestock in Chunya district various strategies have been adopted by the District Extension Service. One of these strategies was to initiate and encourage the formation of farmer groups and reaching the groups through Farmer Field Schools. The survey team was pleased to be informed that the introduction of Mpwapwa bulls, for example, aimed at reaching a number of farmers through the existing groups. It is the opinion of the survey team, however, that the department of extension service and other stakeholders in Chunya district should strengthen these farmer groups since a few members of the groups were reported to have benefited from the introduced animals.

Strategies by farmers

Farmers, on the other hands, have a number of strategies in order to cope with challenges in livestock production. These include:

- Use of both modern and indigenous knowledge to control diseases.
- Use of crop residues and transhumance feeding system to cope with shortage feeds during dry season.
- Family members are used as labourers to overcome the problem of labour shortage.
- Use of hand sprayer pumps as an alternative to dip tank to overcome the problem of ecto-parasite.

Discussion

Social and economical contributions of Mpwapwa cattle to the livestock keepers' livelihood in Chunya District

Discussion with farmers and other stakeholders indicated that farmers who owned Mpwapwa bulls and /cattle sired from them were proud of the animals because of their large body sizes and fast growth rates as compared to the traditional Tanzania Shorthorn Zebu (TSZ). This has also been observed in

other parts of the country where Mpwapwa cattle have been introduced (Bwire *et al*., 2005; Komwihangilo *et al*., 2009). However, there were no financial gains that the farmers had accrued from sales of cattle sired from Mpwapwa bulls that had been introduced in the target areas. There were few reasons to this effect:

1. The owners have tendencies of keeping large numbers of stock and at the time of the interview they had not accumulated good numbers of crossbreds that they could dispose of;
2. Some farmers didn't like Mpwapwa crosses because they considered these animals to be more susceptible to tick borne diseases such as ECF as compared to local TSZ subtype particularly Tarime cattle.
3. Most of the bulls had died before they sired adequate numbers that could probably be sold to neighbours

General views on keeping Mpwapwa crosses

Apart from the fact that the bulls were distributed to group of farmers free of charge, there was a feeling that there was no critical analysis of the situation on the ground prior to the distribution. This led to inadequate sense of ownership of the bulls. The general observations indicated, however, that biophysical factors in Chunya district permit performance of Mpwapwa bulls and their crosses. Farmers who owned the Mpwapwa crosses also admitted that the crosses have higher growth rate compared to local breeds. This was confirmed by the body measurements taken during the field studies and earlier findings from other areas in the country (Bwire *et al*., 2005)

Lessons learnt from other areas where introduction of bulls has been more successiful (e.g. Chipogoro)

In 1999/2000 The National Livestock research Institute (NLRI) Mpwapwa initiated a project on improving performance of TSZ in Chipogoro village, Mpwapwa district and Mtumba village, Dodoma district, Dodoma region through introduction of Mpwapwa bulls. Other technologies associated with improved animal husbandry such as feeding and housing were initiated alongside the introduced bulls. The general objective of the project was to improve beef and milk production, thereby improve income and food security among agro-pastoral households. The villages were selected following participatory rural Appraisal session held in several villages to identify priority areas of intervention and farmers willingness on improved livestock management. Training on proper husbandry practices that include proper feeding and disease management were given to participating farmers. Each of the participating farmers was advised to set aside 25 cows every year that could be mated to one Mpwapwa bull. It was anticipated that at least 100 crossbred bulls would be obtained annually and their performance followed up by NLRI.

Performance of cattle in Chipogoro and Mtumba villages

Performance evaluation done in Chipogoro and Mtumba villages (Mpwapwa and Dodoma district) in 2006 indicated that Mpwapwa x TSZ had better breeding traits than the traditional TSZ and despite being reared under some stressful environments with hardly no supplementary energy and protein feeds (Table 3), the crosses (Mpwawa x TSZ) produced up to four litres per day which was about four times compared to the traditional TSZ.

Generally, the introduction of Mpwapwa cattle in the villages showed an increase in lactation yield, a considerable increase in lactation length and shortening of calving interval including a reduced age at first calving. These findings are comparable with previous observation on TSZ and Mpwapwa crosses TSZ in Berege village in Central Tanzania (Rushalaza and Kasonta, 1993).

Table 4 presents the similarities and differences on how Mpwapwa bulls were introduced either in Chipogoro (Mpwapwa district) or in the participating villages in Chunya district. The Table indicates

that while there was a stronger link among researchers, extension workers and farmers in Chipogoro, this linkage was weaker in Chunya.

Conclusion

Biophysical conditions in Chunya district indicate potential for good performance of Mpwapwa bulls and their crosses. At the same time, a few farmers keeping the animals have noted that the animals have higher birth weights and growth rates compared to the local TSZ. However, the study revealed a number of issues that are facing farmers in relation to keeping of Mpwapwa and other breeds of cattle in the study villages that include incidences of deaths and threats of ECF and other diseases. Similarly, it was further noted that farmers' education on proper livestock husbandry and more economical approaches in livestock keeping are inadequate. These are, however, imperative for improving livestock productivity in general and cattle in particular. Individual and group / collective extension approaches on livestock husbandry are still needed. On the other hand, infrastructural development for animal health care (e.g. construction and use of cattle dips, enforcing disease control measures such as mandatory dipping/vaccinations were lacking; and demarcation and development of grazing lands were also not in place. These are equally essential for healthy and more productive herds.

Recommendations

Based on the evaluation following the introduction of Mpwapwa bulls, the following recommendations are given either for a short or long term basis in order to sustain development of Mpwapwa crosses and other cattle breeds / classes:

Short term:

1. It is highly recommended that District authorities should strengthen the coordination and provision of veterinary services rendered to livestock farmers especially those keeping Mpwapwa cattle and or their crosses

2. Participating farmers and other villagers in the area need to be capacitated so as to be able to undertake economically paying livestock production that is also more sustainable than is the case today.

3. Deliberate and closer follow-ups must be made so as to ensure that the female Mpwapwa x TSZ crosses that are present in the villages are mated with pure Mpwapwa bulls that are not close relatives to them so as to avoid inbreeding. This could be done by introducing more Mpwapwa bulls

4. The district, village authorities and individual livestock farmers should collaborate to construct and operate dips and other infrastructure that will allow for control and treatment of tick-borne and other diseases that are rampant in the area.

5. The District should look work towards identification and setting aside specific areas for grazing. That exercise will lead to range / grazing land improvement, reducing of land conflict among farmers and livestock keepers and sustain environmental conservation.

6. The National Livestock Research Institute and stakeholders in livestock production should make sure that Mpwapwa breed cattle or their cross-bred progeny are vaccinated against ECF before they are sent to areas where dipping and other tick control measures are a great challenge.

7. Resources should be made available for extension workers and researchers so as to allow for frequent and periodic follow ups and monitoring.

Long term

1. Research on the identification of the genes for ECF resistance and other tick-borne disease and subsequent introduction of the same to Mpwapwa breed cattle will be a turning point for improving survival of the animals in rural areas where these diseases are a major set back for cattle productivity. This effort should be initiated and strengthened.

2. Rigorous genetics research should be initiated in order to map the genes for ECF resistance that are either present in local zebu strains (e.g. Tarime cattle) or absent in Mpwapwa breed. Similarly, gene mapping of genes for other tick-borne and other parasite resistance are vital.

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Table 1: Villages and number of farmers met during the field visits

Division	**Ward**	**Villages**	**Number of farmers**
Kiwanja	Makongolosi	Makongolosi	1
		Matundas	6
	Chokaa	Kibaoni	4
Kipembawe	Lupa	Nkung'ungu	2
Songwe	Mbuyuni	Chang'ombe	2
	Kanga	Kanga	3
Kwimba	Mkwajuni	Mkwajuni	2
		Saza	1
Total			**21**

Table 2: Average body weights, heights at wither, rump heights and body lengths of Mpwapwa x TSZ crosses in Chunya district

Age category (months)	Body weight (kg)	Height at wither (cm)	Height at ramp (cm)	Heart girth (cm)	Body length (cm)
1 – 4	29.33	65.33	70.00	70.00	63.67
5 – 8	50.00	73.00	77.00	83.00	69.00
9 -12	101.17	91.83	98.67	99.17	56.67
13 – 15	115.00	92.00	97.00	108.00	84.00
16 – 18	134.57	88.57	94.43	113.14	93.57
19 – 24	168.60	94.20	101.00	123.60	104.60
25 – 30	164.00	92.00	101.00	126.00	111.00
31 – 40	219.00	98.67	107.67	137.00	110.67

Table 3. Production and reproduction characteristics of Mpwapwa breed, TSZ* and crossbred cattle at Mtumba and Chipogoro village December 2006

Production trait	Mpwapwa breed cattle	TSZ cattle	Crossbred cattle
Birth weight (kg)	20 – 26	10 – 15	15 – 20
Weaning weight (kg)	50 – 60	20 – 35	35 - 42
Age at first mating (males) (years)	2	3 – 4	2 - 3
Age at first mating (females) (years)	2	3 – 4	2 – 3
Calving intervals (months)	12 – 18	19 – 32	15 – 18
Milk yield (litres / day)	4 – 6	1 – 2	3 – 4
Average lactation length (days)	283	239	250

*TSZ = Tanzania shorthorn zebu
Source: Komwihangilo et al (2009)

Table 4. Similarities and differences on how Mpwapwa bulls were introduced in some villages

How were bulls introduced / Step	Mpwapwa (i.e. Chipogoro)	Chunya
Selection of participating villages	PRAs were conducted in four villages and then one village selected for introduction	Selection of villages did not base on this but on the fact that at least each Division should be reached
Criteria of introducing bulls in villages	Cattle introduced based on several factors including willingness of farmers to keep the bulls, presence of livestock extension worker in the village, presence of functioning cattle dip. Farmers advised to set aside at least 25 cows per year whose progeny could be followed up	Cattle introduced based mainly on willingness of farmers to keep the bulls.
Collaboration pattern at introduction	Strong Research – Extension – Farmer linkage	No involvement of researchers except purchase of cattle from NLRI. Probably weak Extension – Farmer linkage
Farmer training	Strong Research – Extension – Farmer linkage. Topics on improved animal	

How were bulls introduced / Step	Mpwapwa (i.e. Chipogoro)	Chunya
	husbandry taught in classes conducted on farm	
Monitoring by researchers	Farmers were advised to keep records on performance of bulls and the crosses. Frequent monitoring were done by researchers and district extension workers. The field extension workers were more involved.	-

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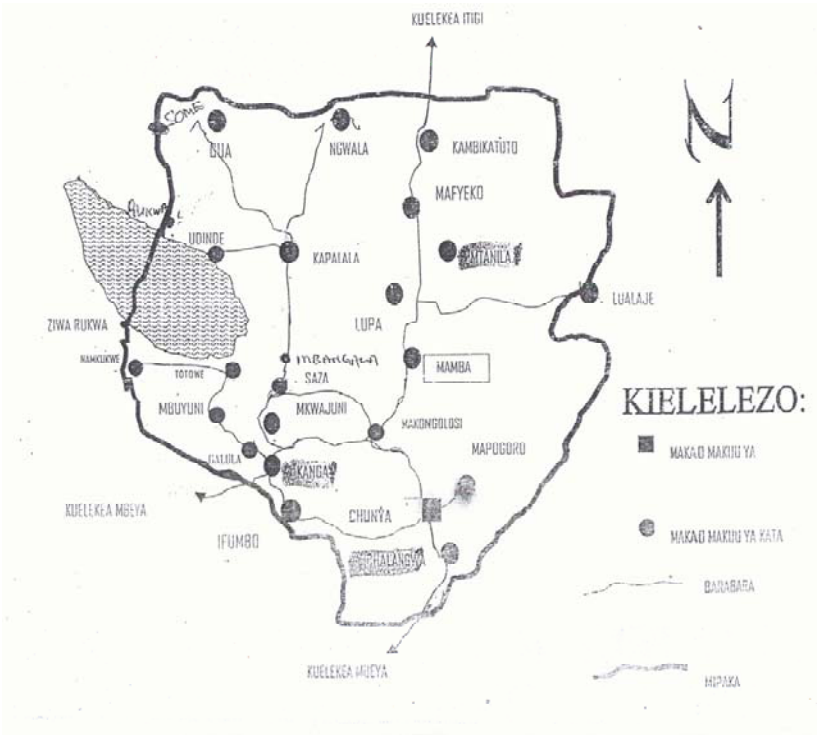

Figure 1. Sketch Map of Chunya District

Agricultural Extension Services Delivery in Tanzania

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Abbreviations

AGITF	Agricultural Input Trust Fund
ARI	Agricultural Research Institute
ASDP	Agricultural Sector Development Programme
ASDS	Agricultural Sector Development strategy
ASLMs	Agricultural Sector Lead Ministries
ASP	Agricultural Service Providers
CBOs	Community Based Organizations
CORDEMA	Client Oriented Research and Development Management Approach
DADP	District Agricultural Development Plan
DALDO	District Agricultural and Livestock Development Officer
DASIP	District Agricultural Sector Investment Ptoject
DED	District Executive Officer
FFS	Farmer Field School
FTC	Farmer Training Centre
GoT	Government of Tanzania
IFAD	International Fund for Agricultural Development
JICA	Japan International Cooperation Agency
LGA	Local Government Authority
LGCDG	Local Government Capital Development Grant
LGRP	Local Government Reform Programme
MAFC	Ministry of Agriculture Food Security and Cooperatives
MATI	Ministry of Agriculture Training Institute
MLDF	Ministry of Livestock Development and Fisheries
MoWI	Ministry of Water and Irrigation
MDG	Millennium Development Goal
M&E	Monitoring and Evaluation
MFEC	Mogabiri Farmer Extension Centre
MTEF	Medium Team Expenditure Framework

MITM	Ministry of Industry, Trade and Marketing
MVIWATA	Mtandao wa Vikundi vya Wakulima Tanzania
NGO	Non-government Government
NSGRP	National Strategy for Growth and Reduction of Poverty
PADEP	Participatory Agricultural Development and Empowerment Project
PPP	Public Private Partnership
PMO-RALG	Prime Minister's Office – Regional Administration and Local Government
SWAp	Sector Wide Approach
TAHA	Tanzania Horticultural Association
TDV 2025	Tanzania Development Vision 2025
VAEO	Village Agricultural Extension Officer
VADP	Village Development Plan
VEO	Village Executive Officer
WARC	Ward Agricultural Resource Centre
WFF	Ward Farmers Fora
WADP	Ward Agricultural Development Plan
WAEO	Ward Agricultural extension Officer
WRS	Warehouse Receipt System
ZARDEF	Zonal Agricultural Research and Development Fund
ZARDI	Zonal Agricultural Research and Development Institute
ZIELO	Zonal Information and Extension Liaison Officer
ZIELU	Zonal Information and Extension Liaison Unit

1.0 Introduction

Agriculture is the main stay of the Tanzanian economy. It contributes 26 percent of GDP, 30 percent of export earnings and provides the bulk of raw materials for local industries. The agriculture sector provides employment to about 75 percent of the total labour force out of which 56 percent are women. Food and cash crops account for about 70 percent of rural income. Since the mid 1990s, the Government of Tanzania has been implementing policies, and legal and institutional reforms which have mainly focused on poverty reduction strategies within the framework of Tanzania Development Vision 2025 and NSGRP. The vision 2025 envisages raising the standard of living of Tanzanians to those of typical medium-income country through ensuring food security, improving incomes and increasing export earnings.

The Agricultural Sector Development Programme (ASDP) is the Government of Tanzania's instrument for agricultural growth and poverty reduction as outlined in the Agricultural Sector Development Strategy (ASDS) and the National Strategy for Growth and Reduction of Poverty (NSGRP). The ASDP Framework and Process Document was developed by the Agricultural Sector Lead ministries (ASLMs)- Ministry of Agriculture Food Security and Cooperatives (MAFC), Ministry of Livestock Development and Fisheries (MLDF), Ministry of Industry, Trade and Marketing

(MITM), Ministry of Water and Irrigation MoWI) and the Prime Minister's Office – Regional Administration and Local Government (PMO-RALG) in early 2003 and was adopted in 2006, following the adoption of multi-donor and Government agreement to fund the agricultural development activities in the country under a Basket Fund Agreement. ASDP provides the Government with a sector-wide framework commonly referred to as the Sector Wide Approach (SWAp) for overseeing the institutional reforms and investment priorities in the agricultural sector.

The Programme's main objectives are, first to increase farm profitability and incomes through better access to and use of agricultural knowledge, technologies and market infrastructure. Secondly, to promote agricultural private sector investment based on an improved regulatory and policy environment. The ASDP implementation framework goes well with the vision of the recently launched Green Agriculture strategy in Tanzania "KILIMO KWANZA" literally meaning "Agriculture First", which aims at mobilizing private-public sector partnerships for enhanced agricultural productivity and broadened development impact.

According to ASDP, provision of agricultural services is at two levels namely, the local and national levels. At the Local Government Authority (LGA) level the implementation of activities are based on District Agricultural Development Plans (DADPs) and great emphasis is placed in contracting of agricultural services and greater control over resource allocation decisions by farmers. At national and zonal levels, greater emphasis is to improve the relevance and responsiveness of agricultural research and extension. The sub-component focuses on improving the management of the Zonal Agricultural Research and Development Institutes (ZARDIs) through the implementation of Client Oriented Research and Development Management Approach (CORDEMA), and through reconstitution and expansion of the Zonal Agricultural Research and Development Fund (ZARDEF). The ultimate aim of these approaches is to build greater farmer influence and accountability into the choice of research programmes, as well as improved management and monitoring of research.

2.0 Agricultural Extension Services Delivery in Tanzania

Extension services are crucial in enabling producers to realise the increased production and productivity in accessing information for marketing and the other support services essential for agricultural development towards poverty reduction and overall development. Extension aims at empowering farmers to identify and analyse their agricultural problems, and gives the right decisions on matters pertaining to profitable and sustainable agriculture, according to the Local Government Act of 1997, the delivery of public extension is now vested with the local governments. The idea is to have extension service administered at the lowest level of the government for better accountability where active participation of beneficiaries and other actors can be more effective. The private sector is expected to increase its role in the provision of agricultural services to farmers, while the public sector will gradually limit its role to policy formulation, financing and regulating the provision of public goods and services.

2.1 Linkage with Research

Linkages with research is of key importance as it create channels through which research agenda is jointly developed, packaged and disseminated to the end users. The Government has strengthened the Agricultural Research Institutes (ARIs), Zonal Information and Extension Liason Units (ZIELUs), Farmer Training Centres (FTCs) along with Ministry of Agriculture Training Institutes (MATIs) in terms of rehabilitation of the buildings, retooling and staffing. It also liaises with higher learning institutions to unlock knowledge and skills making the services more responsive to the demands of farmers and other clients. The Research and academic institutions are sub contracted to conduct the needed research aimed at specific components of interest to government. Likewise, the Academic institutions are contracted in case of a need for special training to effectively foster smooth dissemination of agricultural technologies.

The ZIELUs are established and based within the research centres in the seven agro-ecological zones in order to strengthen the Research – Extension – Farmer linkages. These are core units linking downward with LGAs, farmer groups and Networks and upward with ASLMs. The core functions of ZIELU include assembling, assimilation and dissemination of relevant agricultural knowledge and information; and they focus particularly on success stories to enhance the image of agriculture (up-scaling). At regional level, there are ASDP coordinators who are responsible with close supervision of the agricultural services.

2.2 Linkage with other partners including Private Sector

In line with the current economic reforms the Government is taking steps to make it more attractive for the private sector to participate in the agricultural sector as inputs suppliers, service providers and producers. Participation of private sector, civil societies and rural communities is very crucial in the implementation of the rural development strategies. They facilitate farmers' access to credit and improved production inputs (including seeds, fertilizers), pooling of farmers' produce and storage/preservation/ processing to add value and developing market links with backward linkages. They also link with other service providers (agro dealers, micro-finance institutions, and researchers) to access specialised services required by farmers.

2.2.1 Mogabiri Farmer Extension Centre (MFEC)

The Mogabiri Farmer Training Centre is an example of a grass root private sector under the Anglican Church which is recognized by LGA and the Officer In charge of the centre is being employed by the LGA. This centre has selected 40 villages from two divisions, and from each village they have selected three farmer motivators whom they send to a residential training lasting for two weeks. The training is on different crops/livestock management practices. After the course, the farmers graduate as 'Farmer Motivators', they are provided with a bicycle, gumboots and other necessary working tools. For each service they offer (dehorning, demonstrating contours, etc) to their fellow farmers, they are being paid TShs. 1,000/=. Normally, they have Bi Monthly Monitoring and Evaluation (BEM) where they discuss together with DALDO, WAEO, and VAEOs and may come up with recommendations such as a need for re- training course.

2.2.2 Farmer Organizations

Various forms of farmer organizations exist in Tanzania including farmer groups/fora, SACCOS, Associations and networks and linked to the *Mtandao wa Vikundi vya Wakulima Tanzania* (MVIWATA). The Ministry of Agriculture together with the LGAs promote savings and credit organizations (SACCOS) as a way of mobilizing financial resources for farmers to borrow and invest in agriculture.

Tanzania Horticultural Association (TAHA) is a unique case of viable farmer organization; it has a corporate membership of 18, mainly large scale farmers in the horticultural sub-sector, although there are plans to include small scale farmers in the membership. Small scale farmers are linked to large scale farmers through out grower schemes which allow farmers to access inputs, technology and markets. TAHA is currently advocating against: limited and high cost credit, certain fiscal measures such as lengthy VAT refund procedures, cumbersome pesticide registration procedures; and high freight charges on horticultural exports (40-60 percent of CIF-EU prices). According to TAHA productivity can be improved through intensive training of the workforce, intensified technical support by research and extension services and favourable financial services.

However, more emphasis is needed on empowering farmers and their organizations with knowledge and enhanced decision-making skills to enable them articulate and exert demand on research and extension services.

3.0 Agricultural Extension Methods and Approaches

The agricultural extension approach in Tanzania is demand-driven, involving farmers' groups and fora in the planning and implementation process, integrating among different extension providers, and allowing room for pluralistic extension approaches. In this respect an important component of the extension effort is directed at empowering farmers organizationally and financially, so that they demand for appropriate services. Extension approaches that have been used in extension services are Training and Visit, Contract Farming, Farmer-to-Farmer Extension, Farmer Field Schools, Farming System Approach, and Participatory Extension. Ideally, the best extension deliver system has to be flexible and tailor-made to suit the needs of different categories of farmers.

3.1 Experiences of various methods and approaches used in Tanzania:

3.3.1 Farmer Field School Approach

Farmer Field School (FFS) approach relies on participatory training methods in a form of adult learning that facilitate farmer groups to acquire and apply good agricultural practices for entire crop growth (seed to seed) mainly through field practical (learning by doing). A typical FFS involves a group of 20-25 farmers, currently the methodology is used all over the country and there are about 6,711 FFS.

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The FFS approach is currently being incorporated within District Agricultural Development Plans (DADPs). It is found to be more successful in technology information dissemination to farmers in that it has proved to increase crop productivity. For example, in Mkindo village (Mvomero District) where the approach has been adopted rice production has increased to **5 - 6 tons per hectare from 2.5 tons per hectare.** Furthermore through group interactions, farmers sharpen their decision making abilities and develop leadership capabilities, communication and management skills.

3.1.2 Farmer to Farmer Approach

In Tanzania, there are deliberate efforts of training farmers who can train others under the training of trainers (ToT) approach so as to ensure local based experts (paraprofessionals) are available in the community. Farmers who are capable to train others are selected and participate in appropriate training courses, qualifying them to assist group members in basic farming techniques. Currently this model is practiced to some regions where 930 farmers were trained to train other farmers and a total of 69,750 farmers are acquiring knowledge through this approach. For example the Kilimanjaro Agricultural Training Centre (KATC) Model has introduced the Farmer–to–Farmer Approach in the irrigation schemes where mostly they grow paddy. They are trained on good management practices and each of them selects five other farmers who he/she will be training them on the contents being trained by using her/his field from seed selection to harvesting. The approach has been successful as the farmers have increased production from 2 tons/ha to 6 tons/ha (paddy). Currently, the approach (the KATC Model) is being used by other institutions such as MATI Ukiriguru, Ilonga and Igurusi.

3.1.2 Contract Farming Approach

Contract Farming is not well known as extension approach but as a commercial arrangement between an agricultural company and farmers driven by economic interests. Contractual arrangements have been initiated for some crops (tea, tobacco, sugar cane), mostly by private agricultural business companies, to secure access to smallholders' produce. Under these arrangements, companies provide smallholders with inputs, credit and extension services while the smallholders agree to supply a specified quality and quantity of produce and to make repayments on any loan advanced to them. Methods of production and other market obligations may also be stipulated within the arrangements. However, it is advisable to use participatory extension components in order to improve communication and relations between management and farmers. For success of the contract, the

company managers must ensure that farmers understand both their own obligations and those of the company.

In order to have profitable contract farming, currently, the government is formulating the act that will guide contract farming which will therefore facilitate in resolving some of the issues that have been happening in contract farming which can be avoided by:

(i) Clarifying the contracts between farmers and the company from the outset and keeping on improving the contracts;
(ii) The company to have a good service delivery, both coordination of production process and provision of extension services;
(iii) The company and farmers to share the production and marketing risks; and
(iv) The government to provide a reliable legal framework and protecting the farmers against exploitative agreements/contracts.

3.2 Agricultural Extension Support Services

3.2.1 Input Subsidy

The Government of Tanzania started to provide fertilizer subsidy (100%) in 2003/04 by giving maize farmers DAP, Urea and Mijingu Phosphate fertilisers. From 2008/09 the government has extended the subsidy to fertilizer and improved seed (maize and paddy) using vouchers, where farmers are required to pay 50% of the price of fertilizer and the remaining 50% is paid by the government. Last season 2008/09 a total of 700,000 farmers benefited from this system, in 2009/10 a total of 1,500,000 farmers benefited and in 2010/2011 more than 2,000,000 farmers will benefit. The aim of the voucher system is to facilitate farmers to get inputs at a subsidized price and thus realized increased productivity and hence economic returns. The government also provides input loans through the Agricultural Input Trust Fund (AGITF) for purchasing farm implements like power tillers, tractors and animal drawn implements. Up to May 2010, a total of 155 tractors and 50 power tillers were provided to the farmers under this trust fund.

3.2.2 Warehouse Receipt System (WRS)

Warehouse Receipt System allows the farmers to sell their produce at a better price and access credit from financial institutions. Normally, the farmers' produce is used as collateral and stored in a legally selected warehouse under an agreement between the farmer, financial institution, and Agricultural Marketing Cooperative Society which operates the Warehouse Receipt system (WRS). Under this system, the MAFC facilitated a total of 291 cooperatives societies within four regions (Mtwara, Lindi, Ruvuma and Coast) to access credit from the National Microfinance Bank (NMB) and Cooperative Rural Development Bank (CRDB).

3.2.3 Ward Agricultural Resource Centres (WARCs)

The Government through DADPs has planned to construct Ward Agricultural Resource Centres (WARCs) in each ward that will be stocked with various agricultural information resources that can be accessed and utilised effectively by farmers, extension staff and the public in general. The WARCs are managed by farmers' networks at ward level and will be a meeting centre for farmer groups and networks to share experiences and expertise between researchers, extension workers and farmers. The WARCs are facilitated by district in terms of construction/rehabilitation, provision of extension materials and information. Currently there 166 WARCs being constructed and some have started working e.g. in Lushoto and Urambo Districts.

4.0 Conditions for Success of these Approaches

i. The results and experiences on success stories are disseminated to various agro-ecological zones and LGAs through Farmer Field School, Demonstration plots, on farm trials, Field Days, Farmer Exchange Visit and Agricultural Exhibition.
ii. Researchers in collaboration with extension involve farmers more intensively in the process of technology development, and recognize and reward innovative farmers who may develop new practice that could lead to improved productivity for example innovative/successful farmers are awarded during Agricultural Exhibition and the success stories are scaled up to other places.
iii. Review of curricula for MATIs and other related training institutions is done regularly to incorporate new extension approaches and methods such as value addition approach.
iv. Emphasis on beneficiary demand-driven concept and use of bottom-up participatory approaches with elements of cost-sharing has somehow led to farmer/livestock keepers empowerment, promoted self development and enhanced relevance and ownership of micro-projects (e.g. dairy cattle, dairy goats and dips) and assets created (e.g. tractors, oxen and implements)
v. Empowerment of farmers is specially seen in the formulation and implementation of Ward Agricultural Developments Plans (WADPs) and Village Agricultural Developments Plans (VADPs).
vi. Use of farmer innovative ways of doing things (e.g. farmer facilitators, introduction of ward agricultural shows, formation of Village Facilitation Team (VFT)) not only led to farmers' enlightenment on a number of issues like marketing, but have also enhanced beneficiary interaction and internalization of issues revolving around agricultural services delivery and their livelihoods in general.
vii. Programme's accelerated progress is seen in areas where other development projects/interventions like PADEP, DASIP had adopted a similar approach.
viii. Integration of advisory/extension service with markets and other support services (input subsidy) has accelerated the pace of adoption of agricultural technologies and improved practices due to linkage of extension with the Agricultural Marketing Cooperative Society which operates the Warehouse Receipt system (WRS).

5.0 Challenges

In the course of implementing ASDP, there a number of challenges are encountered as far as extension is concerned:

- Strengthening and facilitating Agricultural extension services and technology development, improving manning levels and working facilities, at least each village and ward to have an extension worker
- Strengthening mechanisms for engaging the private sector in the delivery of extension service;
- Enhancing transformation of subsistence agriculture to commercial;
- Improving agricultural infrastructures, particularly irrigation infrastructures and processing facilities
- Focusing on diversifying market demands and export opportunities, promotion of processing, grading and standardization (value addition).
- Linking farmers more effectively to input and output markets and building linkages between farmers and other agencies (private sector)
- Improving agricultural productivity and competitiveness
- Capacity development for extension staff and empowering farmers and their organizations with knowledge and enhanced decision-making skills to enable them articulate and exert demand on research and extension services farmers,
- Promoting the use of innovative ways (such as ICT) to disseminate technologies
- Responding to the changes in the socio-economic (globalization, climate change, market demand, prevalence of HIV/ADS), gender issues and political environments which exists.

6.0 Way forward

- Strengthen and facilitate the Agricultural extension services, particularly, by developing the private sector as part of implementation of **KILIMO KWANZA**
- The focus of extension services should shift to diversifying market demands and export opportunities.
- Farmers to participate effectively in the entire value addition chain to ensure competitiveness
- Consolidate and build on the current successes and achievements of extension attained with emphasis on efficiency and effectiveness
- Farmer empowerment and linkages with other national and international farmer organisations.
- Extend the KATC and Mogabiri extension models (using farmer trainers) to other parts of the country;
- Ownership of extension service by farmers and make extension workers more accountable
- Create a forum where partners (both public and private) and producers come together to develop common policies and standards in order to improve the management of public private partnership.

The rate of technology transfer through farmer- to- farmer agricultural extension approach in irrigated rice scheme in Zanzibar

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Summary

The Technical Cooperation in Supporting Service Delivery Systems of Irrigated Agriculture (TC-SDIA, commonly known as TANRICE) has been working in collaboration with the Ministry of Agriculture, Livestock and Environment (MALE) in Zanzibar since September 2009. The purpose of TANRICE is to increase productivity of rice cultivation in priority irrigation schemes through strengthening service delivery systems of irrigated agriculture in Tanzania." TANRICE has adopted the farmer-to-farmer extension approach and information obtained from irrigation schemes. At Mtwango irrigation scheme situated at West District of Zanzibar, TANRICE conducted standard training that consisted of baseline survey, residential training and infield trainings between December 2009 and July 2010. TANRICE trained 16 key farmers (with gender consideration) on best rice farming technologies from an irrigated rice scheme. Each of the key farmers formed a group of 16 farmers in the scheme through which the technology was further transferred to the whole scheme. The efficiency of the approach has been measured in terms of rate of adoption of innovation, attendance and participation during the training sessions, as well as yield. The results have shown that generally farmer-to – farmer agricultural extension approach has achieved positive results. Farmers at Mtwango have increased their seasonal yield as a result of applying the best rice practices in the field. There was an average of 90% in the attendance and participation of the training sessions. From this study, it has been also noted that the adaptability of the farmer-to-farmer agricultural extension approach method depends to the location and culture of the farmers in Tanzania and research should be conducted before adopting the approach.

Key words: extension, Mtwango, rice, irrigation, scheme, training, training

ACRONYMS

ASDP Agricultural Sector Development Program
ASDP Agricultural Sector Support Program
CAESP Commission for Agriculture, Extension Services Project (Zanzibar)
CARE Commission of Agriculture Research and Extension (Zanzibar)
CAESP Commission for agriculture extension services project
I D Irrigation Department
JICA Japan International Cooperation Agency
KATC Kilimanjaro Agricultural Training Centre
KATI Kizimbani Agricultural Training Institute
MAFC Ministry of Agriculture, Food and Cooperatives (United Republic of Tanzania)
MALE The Ministry of Agriculture, Livestock and Natural Resources (Zanzibar)
MKUZA Zanzibar Strategy for Growth and Reduction of Poverty
NGO Non-governmental Organization
PADEP Participatory Agricultural Development and Empowerment Project
SHEHA Zanzibar village leader appointed by the District Council
SUA Sokoine University of Agriculture

I. Introduction

I. a. Agricultural extension services in Zanzibar

Agriculture is the mainstay of Zanzibar's economy, accounting, on average for 70 per cent of employment and up to 50 per cent of the country's real Gross Domestic Product. The sector is very much constrained by lack of credits, use of out dated technology and insufficient extension services (MALE 2009). From 1991 to 1993 the Ministry of Agriculture under the commission of agriculture, research and extension (CARE) launched a Commission for Agriculture, Extension Services Project (CAESP) funded by FAO and UNDP to unify the extension services provided by different organs within the Ministry. Within this framework which was planned to last only for ten years, the Section of Extension Services (SES) under the Commission of Agriculture, Research and Extension (CARE) coordinated all extension activities from all departments. Currently the Ministry of agriculture (MALE) with technical consultancy from SUA experts and under the ASSP/ASSPDL financial support develops a research policy and extension vision that will guide extension services delivery in Zanzibar.

In Zanzibar alone rice forms 50% of the staple foods consumed per capita in calorie base followed by cassava (25%), maize (5%), fish (10%) and others (10%). The consumption of rice per capita is 120 kg per year, forming the annual rice demand in Zanzibar to be 120,000 tones. Local production achieves only 13,200 tones of rice per year with self-sufficiency rate of less than 11%. The yield is less than 1 tone per hectare; as a result, annual importation exceeds 70,000 tones. The Zanzibar Irrigation Master Plan has identified 8,000 ha as suitable for irrigation development in both Unguja and Pemba islands. The master plan states that rice occupies about 15,000 ha from the total cropland area of 122,600 ha including tree crops (The National Land Use Planning Unit Report of 1995 estimates). Out of 15,000 ha, irrigated area covers only 450 ha, and the rest of 14,550 ha fields are non-irrigated ones (rain-fed lowland; 7,550 ha and upland; 7,000 ha). The average yield of irrigated rice is nearly 4t/ha, while that of non-irrigated one is less than 1t/ha (ZIMP 2005). The general rice production trend has shown that it is too low being attributed to a variety of constraints including weed infestation, improper soil and water management, disease and insect pests, lack of use of fertilizers, inadequate research and extension, and lack of accepted improved varieties (Khatib 2009).

I. b. The TANRICE farmer- to- farmer extension model

The Technical Cooperation in Supporting Service Delivery Systems of Irrigated Agriculture (TC-SDIA, commonly known as TANRICE) commenced on 12 June 2007 for a period of 5 years between Ministry of Agriculture Food Security and Cooperatives (MAFC) and Japan International Cooperation Agency (JICA). From September 2009 TANRICE in collaboration with the Ministry of Agriculture, Livestock and Environment (MALE) in Zanzibar extended the project to the Isles. The project works within the framework of Agricultural Sector Development Program (ASDP) in Tanzania Mainland. The purpose of TANRICE is to increase productivity of rice cultivation in priority irrigation schemes through strengthening service delivery systems of irrigated agriculture in Tanzania." TANRICE believes that: "Productivity of rice cultivation in priority irrigation schemes is increased through strengthening service delivery systems of irrigated agriculture." Based on the experiences of the Kilimanjaro Agricultural Training Centre (KATC) in providing training for adopting the farmer-to-farmer extension approach and information obtained from irrigation schemes, TANRICE has developed the standard training course for improving rice productivity and subject matter training courses for sustaining the improved rice productivity (Tanrice 2009).

For a relatively poor performing irrigation schemes, TANRICE conducts the standard training course which consists of (1) baseline survey (2) residential training, (3) 3 times of infield training at nursery preparation, transplanting and harvesting stages, and (4) monitoring and planning after harvesting. For relatively better performing irrigation schemes (e.g. more than 50% of plots transplanted with rice seedlings in straight rows, more than 4 t/ha of paddy yield for local varieties or 5 t/ha of paddy yield

for improved varieties, etc.), TANRICE suggests that subject matter training courses (e.g. family budget management, irrigation scheme management, community seed production and distribution) be conducted at the training institutes or at irrigation schemes. Training visits are also encouraged especially for the irrigation scheme management course (Tanrice 2009).

I. c. Mtwango rice irrigation scheme

Mtwango rice irrigation scheme is located at Shehia (village) of Fuoni kibondeni, West District of Zanzibar. The total area of the scheme is 100ha and out of these 82ha is allocated for rice production and the remaining 18ha are used for other crops like maize, cassava and vegetables The soil type ranges from sandy loam in the north (upstream) to heavy clay in the south (downstream). The allocated plot size is 0.1ha. Land development was conducted by the revolutionary government of Zanzibar under UNDP, FAO and WFP through leveling partitioning and allocation of plots to farmers during 1979-1990. Mtwango rice irrigation farmers' association was established since 1992 with 417 farmers (50% females). The Irrigation Department has assigned one technical officer and extension workers in charge of all activities in the scheme. The main source of water is through river Mwera whose surface water is supplemented by rainwater to fulfill the rice irrigation requirements. Two boreholes are currently under construction to supplement the river water, the factor that will enable two seasons per year rice cultivation. Majority of Mtwango village residents are peasants relying on rice production as their major food crop. (Othman et al 2009).

II. Implementation of Farmer-to-Farmer Extension Approach at Mtwango Irrigation Scheme

II. a. Problem Identification through baseline survey

TANRICE conducted initial training trainers of KATI tutors and CARE staff in order to equip them with experiences of their collaborating KATC staff to carry out the program. The training trainers exercise produced a task force of two tutors from KATI one staff from irrigation department and one staff from CARE. The task force conducted a baseline survey in the scheme area from 19th to 22nd January 2010. The purpose of the baseline survey was to collect basic information/data that will be used for evaluation. The baseline survey was also targeted to understand the real situation of the irrigation scheme and to create community awareness on TANRICE activities for the first time in Zanzibar. The survey therefore realized and ranked problems associated with rice farming through field and household visits, formal discussion and meeting of 50 farmers, scheme leaders, Shehia (village) leaders and government officials. The sampling of the farmers for baseline survey was based upon equal participation of male and female farmers, age group and farmers' experiences in rice cultivation as well as Mtwango village historical background.

The outcome of the baseline survey was identification and ranking of specific problems associated with rice farming at Mtwango as stated by both male and female farmers of Mtwango. The field and household survey information collected by the task force and selected farmers acted as justification for the stated problems. At the end of baseline survey farmers were instructed to select 16 farmers according to TANRICE criteria to participate in the two weeks residential training from 8th February 2010. The main criteria for selection of key farmers were they should cover all areas of the scheme, gender equality, age distribution and experiences in rice cultivation. Two scheme leaders and two irrigation department staff assigned to the scheme accompanied the farmers to KATC for the two weeks training on rice farming techniques.

II. b. Residential training and plan of work

The residential training took place at KATC under the expertise of both the task force and KATC tutors. The objectives of the training among others were to equip participants with appropriate knowledge and skills of irrigated rice cultivation and appropriate irrigation scheme management techniques/skills. Others were to equip participants with rice extension approaches/methods;

appropriate marketing techniques so that they can sell their produce with profit and to provide awareness to farmers on the health hazards in irrigated schemes. The course content was organized in such a way that farmers had 25% theory lectures in class, 70% hands-on practices and 5% study and observation tours. The residential training enabled the participants to understand the basic rice farming practices such as water management, extension services and leadership. The problems identified during the baseline survey were discussed and finally participants developed a plan of work that they will use to solve the existing problems at Mtwango.

The most important activities of the plan of work was to form 16 groups each with 16 members and one demonstration plot that will be used as a farmer field school where the farmers can share information among themselves. Each of the group consisted of one key farmer, five intermediate farmers and two other farmers. The plan of work requested the key farmer to deliver all the technology to his/her group at the field by using several tools such as a teaching manual guideline provided by the trainers at KATC.

II. c. The first and second in field training

The residential training was followed by the first in field training during the critical land and nursery preparation period of the Masika (main) season of 2010. The task force conducted a three days workshop to follow up the implementation of the plan of work as pursued by key farmers themselves. The in field training was also a form of follow up procedure and further instruction to implement the better rice practices during land and nursery preparation. During the first in field training workshop the rate of implementation of the plan of work was measured and edited before Mtwango farmers. Reasons for not implementing some of the activities were put forward for rectification. Key farmers under the task force supervision demonstrated seed selection, nursery and land preparation, seed sowing to the intermediate and other farmers. 16 demonstration plots and four experimental plots were prepared by farmers themselves. In this infield training 100 participants were expected to attend and gain knowledge received by only 16 key farmers through farmer to farmer approach.

The second infield training which was conducted one month after the first was successfully conducted to Mtwango rice irrigation scheme farmers during the period of transplanting. During this three days workshop key farmers demonstrated recommended practices of transplanting, leveling, fertilizer application, use of simple tools for weeding and bund making techniques to ensure transplanting of health seedlings, equal distribution of water and reduce loss of water through penetration. The second in field training also included theory session where gender, family budget management and leadership were taught to all farmers. In this case for the second time the farmer to farmer extension approach was followed up.

II. d. The third in field training and monitoring/evaluation phase

The third infield training has recently taken place from 19th to 22nd July 2010 and has included a farmers' day to display the achievements. During the third in field training the key farmers demonstrated to other farmers under the task force supervision the yield estimation, harvesting and threshing techniques. The training also consisted of theory sessions whereby the task force administered the dissemination of marketing skills, gender issues and other post harvest technologies. The third in field training enabled farmers to organize a farmers' day at which farmers within and outside Mtwango irrigation scheme were invited to observe and learn the success brought about through the training. TANRICE will conduct a monitoring and evaluation session at the scheme to when harvesting completes in order to assess the general impact of the training delivered during the season late in August 2010.

III. Results of the Training and Discussion

The efficiency of the approach has been measured in terms of rate of adoption of innovation, attendance and participation of farmers during the training sessions and yield improvement. The results have shown that generally farmer-to –farmer agricultural extension approach for Mtwango rice farmers has been successful. In addition, early evidence has indicated the increase of yield harvest in most plots.

III. a. Results from the baseline survey

Participants of the baseline survey were expected to be 50 farmers from Mtwango rice irrigation scheme with representatives from scheme organization, village leaders and two technical staff from ID. There was an excellent attendance as shown in the table II below:-

Table I. Attendance by male and female farmers (Base line report TANRICE)

Date	Male	Female	Total	Percentage
20/01/2010	32	17	49	98
21/01/2010	32	18	50	100
22/01/2010	32	18	50	100
Average	32	17.66	49.66	99.33

During the baseline survey session at Mtwango irrigation scheme the following problems were identified and ranked as follows: -

Table II. Identification and ranking of problems in rice farming
(Source: Baseline report TANRICE)

IDENTIFIED PROBLEM	RANKING			
	Men	Women	Total	Rank
Inadequate water for irrigation	86	54	140	1
Insufficient initial farming capital	60	31	91	2
Inconsideration of seasonal calendar	43	20	63	4
Lack of marketing knowledge	22	11	33	6
Lack of paddy drying floor	43	20	63	4
Inconsideration of recommended rice farming practices	52	29	81	3

From the identification and ranking of the problems it has been noted that majority of Mtwango farmers emphasized the inadequacy of water as the major problem they face in their scheme. Insufficient initial farming capital was ranked as the second major problem followed by inconsideration of farming practices, seasonal calendar, lack of paddy drying floor and lack of marketing skills respectively. However although both male and female participants were given similar votes in all cases the ranking of male farmers to the problems is doubled as that of female farmers. This indicates that the responses to questions from the male farmers were either exaggerated or they simple did not know the source of the problems they mentioned. In addition all problems with the exception of lack of drying place are related to inadequate agronomical knowledge perspectives rather than infrastructural point of view. This is because the field visit in the scheme concluded that farmers did not have good bunds to reduce loss of water, canals were not cleaned or repaired and plots were not leveled and most farmers believed that a submerged plot during all growing stage of rice would bring more harvest. In addition the water distributors lacked the managerial techniques to distribute irrigation water effectively and adequately to all farmers. It was also found out that farmers before training were using 20cm by 20cm spacing, transplanting overage seedlings and poor hand weeding. From these results it has been shown that if the farmers would receive better rice practices training

they will be able to solve their problems. Therefore training was the prerequisite to obtain better harvest at Mtwango.

III. b. Results from the residential and field trainings

The participation of the farmers during the class and practical sessions were 100% with equal participation of male and females. It was found that most of the theory and practical skills addressed during the course were useful, appropriate and applicable to their irrigation scheme. The following tables show the participation of the farmers during the first and second infield trainings.

Table III. Attendance by male and female farmers (1st Infield training)

Date	Male	Female	Total	Percentage
17/03/2010	20	32	52	52
18/03/2010	24	26	50	50
19/03/2010	37	41	78	78
Average	27	33	30	60

There was an average of 60% participation in the first in field training mainly because of the reasons beyond the farmers' capability. The reasons were that there was funeral of two people in the village and also a downpour especially during the first and second day of the training. In the second field training the attendance however rose again to 90% indicating that farmers were very much interested in the on farm training although there was no allowance provided (only lunch was provided).

Table IV. Attendance by male and female farmers (2nd in field training)

Date	Male	Female	Total	Percentage
14/04/2010	42	48	90	90
15/04/2010	42	48	90	90
16/04/2010	41	46	87	87
Average	41.67	47.33	44.49	89

The results have shown that after the second in field training 90% of the rice farmers transplanted rice seedlings with the new 30cm by 10cm spacing. Farmers were able to identify the advantage of the later spacing because it produced more plant stands than 20cm by 20cm and hand push weeding tool introduced by TANRICE to them can be used easily. Bunds and leveling of plots improved among the key farmers and other intermediate farmers thus enhancing efficient use of water. Rice farmers at Mtwango adhered to seasonal calendar although this factor depends very much on availability of water which is a scarce commodity. All 16 key farmers used fertilizers at the recommended time and space while nursery and seed preparation using recommended methods was applied by all key and intermediate farmers. Experiments on a new rice variety of NERICA, was implemented by the farmers in the field. However hand tools such as push weeding tool and thresher were not widely spread among intermediate and other farmers. This was due to a limited number of these tools as well as during the introduction of these tools some farmers had already transplanted.

The third in field training was attended by over 100 farmers accounting for over 100% expectations. Yield estimation indicated that 90% of the farmers who planted rice during the training season of 2010 will harvest an average yield of 12 polos (600kg) of paddy from the original 8polos. This is an increment of 200kg within a season. In addition most farmers did not complain any more that the water shortage problem was the main issue but rather they believed that better distribution methods needed to be addressed. The participation of farmers outside the Mtwango scheme ensured the spread of knowledge outside the scheme.

IV. Recommendation and Conclusion

Rice production is closely linked with the social harmony and political stability of many developing countries. It is therefore recommended that governments take the appropriate actions to improve the rice farmers' productivity and income, while ensuring the national food security and sustainability. The TC SDIA TANRICE project has supported service delivery system in the rice irrigated scheme since 2007 in all Tanzanian irrigation zones. TANRICE has supported to at least 50% of the total costs required for training trainers and standard trainings at Mtwango irrigation scheme. Governments of Zanzibar should ensure that the trainings are extended to other schemes.

The result in this project has also indicated that the success of farmer-to-farmer approach is very much related to the social structure of the schemes. Mtwango irrigation scheme was developed by the government and farmers have been supported ever since with training and some inputs. Farmers adhere quickly to government call mainly because the rice plots are still owned by the government and farmers have fear of losing them if they defy government efforts. In addition rice farmers' main source of food is rice which they grow. They seldom have enough rice to sell; hence they put more emphasis on their farms. From this study, it has been also noted that the adaptability of the farmer-to-farmer agricultural extension approach method depends to the location and culture of the farmers in Tanzania and research should be conducted before adopting the approach. Normally the projects perform well in a scheme whereby farmers exclusively depend on rice for their living unlikely in schemes close to urban life where rice farming is only a supplement farmers will put less emphasis on following recommended practices.

Generally the TANRICE approach of farmer to farmer is expensive in terms of human and financial resources but the results are always tangible and easily measurable. It is therefore recommended that the trainings to be adopted to other schemes in Zanzibar. In order for a farmer –to-farmer extension approach to succeed a close supervision is needed in the form of in field trainings. Through in field trainings farmer become committed to follow the plan of work. The whole training lasts only for one season in a scheme, the fact that the sustainability of the knowledge to continue is put in doubt. Therefore the subject matter trainings of TANRICE are needed to ensure sustainability and further follow up.

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V. APPENDIX I. Plates

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<tr><td>Mtwango rice farmers and staff at KATC (19/02/2010)</td><td>Learning how to use a hand push weeding tool</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Practical session -Uprooting</td><td>Participants during baseline survey</td></tr>
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</table>

Participants during 1st Infield Training Mtwango	Leveling during 1st infield training Mtwango
	
Rice field before training Mtwango	The Primary canal Mtwango

The Impact of Government – Private Partnership in Technology Delivery in Mpika District of Zambia

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Summary

Agricultural technology development is of no value, if it does not bring about changes and impact in communities. Common bean (*Phaseolus vulgaries*) is one crop that is changing lives in Sub-Saharan Africa, through adoption of highly yielding and preferred varieties. Technologies in most cases face a number of problems to reach end-users. Through partnership of a Non-Governmental Organisation (Self Help Africa - formerly Harvest Help) and the Zambian Bean Programme, in delivering improved technology, has helped change livelihoods for the better of a number of small scale farmers in Katongo Kapala area of Mpika district in Northern Zambia. The objectives of the study were i) to introduce bean seed production as a viable and profitable venture for the small scale farmers and ii) to make available and affordable good quality seed to the local farming communities. Farmers who belonged to clubs were trained in seed production, given initial seed to produce and supported during the first year. Field days were conducted during the growing season. The member clubs came together to form an association namely Shangila Seed Growers Association. The results of this partnership have seen number of farmers joining the venture increase from 46 in 2006 to 200 in 2010. The partnering NGO recognised the success of the group and built the association a community seed bank with the association contributing some local material and unskilled labour. Shangila Seed Grower Association, formed in October, 2006 has now grown to be a recognised bean seed enterprise. Production has increased from the initial basic seed of 700 kg (2006) to 40 Mt of various improved varieties of bean seeds in 2010, estimated at $44,715. Observable positive changes in the lives of the members are evident. These include sending children to schools, iron roofed houses, purchase of solar panels sets, bicycles, drought animals, ploughs and household items. The seeds have benefitted over 50,000 farming households (300,000 persons) across the country over the four year of existence. This is due to benefits seen in incomes and increased food security by the bean seed growers. In most cases National Agriculture Research Systems have technologies but do not have enough resources to deliver and follow-up on these technologies. Non- Governmental Organisations may have resources but without the technology to deliver. Through partnerships, there is synergy in delivering the technology. In this case partners complement each other and result in efficient use of resources as a result of joint planning and execution. In conclusion it is found that where technologies transfer is between public and private partnership, it is usually delivered fast and efficiently for adoption and impact is seen within a short period.

Key words: Partnership, technology, seed production, livelihoods, common bean

Introduction

In Sub-Saharan Africa, agriculture is the base for most livelihoods, about 70% of people depend on It. Agriculture is the main occupation of 72% of workforce in Zambia and contributes to about 13% of GDP (CSO, June 2008), as a result government is investing some resources in agriculture that include development and dissemination of technologies. However, this has not translated into high production, because most of these technologies are not reaching the farmers. The reason in most cases is that government resources are not adequate for effective dissemination. With a number of technologies developed by research, not easily disseminated, the need for partnership was found to be viable to help disseminate these technologies. The Bean programme and Self Help Africa (SHA) came in partnership in 2006 to disseminate improved bean varieties in Katongo Kapala area of Mpika district, in Northern Zambia.

Objectives

The objectives of the programme were;

i) To introduce bean seed production as a viable and profitable venture for the small scale farmers and

ii) To make available and affordable good quality seed to the local farming communities.

The Intervention

In 2006 a local NGO known as North Luangwa Conservation and Community Development Project (NLCCDP) and Harvest Help (UK) Zambia (now Self Help Africa (SHA)) partnered and found that seed production was a viable venture to engage their project members into. They identified five member clubs to be trained in seed production principles. The five clubs were Musanya, Shangila, Buleya, Kabale Development and Kabale Irrigation. The clubs were trained in bean seed production by a Bean Breeder from Zambia Agriculture Research Institute (ZARI) and a Seed Inspector/Analyst from Seed Control Certification Institute (SCCI) for 3 days. Ten members from each affiliated club were proposed to be trained but four could not make it bringing the number of trainees to forty-six. After the training an Executive Committee was formed to oversee the affairs of the apex group.

Basic seed of improved common bean varieties of Lukupa and Lyambai was produced by the bean programme under Zambia Agricultural Research Institute (ZARI). Harvest Help (UK) secured the seed from ZARI and distributed it through the partner local NGO, NLCCDP, to the trainees in the 2006/07 season. Each farmer was requested to grow 1 *lima* (0.25ha) as this was their first year in seed production. The local NGO partnered with Micro Bankers' Trust (MBT) to manage the financial aspects of the group. Farmers were given sprayers and chemicals in form of loans.

The farmers were able to plant according to recommendations and the crop was inspected by the SCCI and certified as Quality Declared Seed (QDS). Three field days were conducted during the season. At the end of the season the farmers together produced 3.2 tons of bean seed. The seed was tested, treated, packed and sold. The price range was from ZK5, 000 – ZK7, 000 per kg (US$1=ZK5, 000). Joining farmers were loaned seed in the following season and were expected to pay back at a rate of 28% (4% per month for 7 months). The recovery rate was good (93.5 %). Only three did not pay as they did not plant their crop.

In 2007/08 season, two more clubs (Bwananyina and Chimwemwe) joined the group to bring the number to seven. The number of farmers that participated that season increased to 74. During the season field days were conducted. The crop was rated good to excellent by seed inspectors. The combined harvest by the group was 10,045 kg for Lukupa and 1,420 kg Lyambai bringing the total for beans to 11,465 kg. The seed was sold at a price range of ZK5, 000 - ZK6, 000 /kg. The seed was sold to a number of organisations that included small scale farmers, Foundation for Wildlife and Habitat Conservation Zambia (FWHC), Harvest Help (UK), Mpika Business Association, and farmers within the Association (farmers decided to buy cash instead of getting seed on loan). The Association also bought seed which they gave as loan to new entry groups of Mukungwa and Kapemba. The seed was sold without any problems The association raised ZK 56,710,000 (equivalent to US$ 12, 000). The group was recommended by the local NGO, NLCCP to open a bank account in April 2007. In August 2007 the group was registered as an association by the office of the registrar of societies with 74 members by the name of Shangila Seed Grower Association (SSGA)

In 2008/09 season the number of seed growers increased to 107, growing Lukupa, Lyambai and Chambeshi (beans) and MGV 4 (groundnuts). The seed of Lyambai was found to be little and the association decided to increase it by having an off-season crop. This was done at Bwananyina, Kabale Development and Chimwemwe. During the main season the seed growers had field days where they shared their experiences with members and non –members. This encouraged a number of non-members to join the association. The association produced 24.1 Mt of beans, 7 tons of groundnuts and 900 kg of cowpeas. The association was found to be viable and was allowed to be independent of the partnering NGOs.

In 2009/10 season the independent association was a success story and this brought more non-members to join. The association membership increased to 200. The experienced seed growers increased their farm sizes and with new members joining there was an increase in production to 40.1 Mt.

In recognising the commitment of the group, Harvest Help (UK) Zambia initiated an idea of a seed storage facility for the group and the work started in February 2007. The Association worked on the project by providing bricks, sand, stones, food (during working time), clearing of the area and labour (at lower rates than hired labour). Harvest Help (UK)/NLCCDP provided the technical or skilled labour and materials for the project.
The interesting part of this work was that community members who were not part of the Association were able to participate in the project.

Roles played by partners

This partnership saw the bringing in of strengths by each partner to bring efficiency in dissemination. The public partners played a major role in trainings, inspections, backstopping and had a technology ready to disseminate. The NGO on the other hand brought in resources (financial and material), market linkages, community mobilisation skills, as well as entrepreneurship skills.
The resulting increase in number of farmers and production (Table 1) indicated that the venture was successful as more farmers came to join the association. The farmers were very impressed with the improved varieties as they had better yields, resistant to diseases and pest as well as good taste.

What used to prevail

These small scale farmers of Katongo Kapala were not different from others elsewhere in the country. They were using local uncertified seed, had small farm sizes (< 0.25ha), they grew for home consumption, poor agronomic practises, which resulted in poor harvests of about 200 kg/ha. This community used to source their inputs from town which is 30-40 km away and had to walk on foot. There were limited market links. The NGO had no expertise in seed production and would be distributing seed as aid to the farmers who had very little knowledge in seed production, resulting in perpetual seed aids to the communities. This was not sustainable as it introduced some element of dependency on the NGO. The public sector that had the expertise and technology had no resources to do the dissemination. This scenario resulted in low production every year. There was very little hope of improvement.

What has changed

The community now has access to four high yielding improved bean varieties (Lukupa, Lyambai, Chambeshi and Lwangeni) (Annual Reports 2007, 2008 and 2009). There is an increase in farm sizes (> 0.5 ha) and productivity (from 200 kg/ha to an average of 1000 kg/ha). The farmers are now producing for sale and using improved agronomic practises. The community now has access to extension services (inspections, trainings, and backstopping) which they are able to pay for if necessary. The association is now linked to seed markets and have a seed sorting and storage facility. Now supply seed companies such as Farmers Link are contracting the association for more production of seeds which is processed, packaged and sold across the country – more farmers benefiting from the technologies.

The Outcomes and Impact

Shangila Seed Grower Association, formed in October, 2006 has now grown to be a recognised bean seed enterprise. Production has increased from the initial basic seed of 0.7Mt (2006) to 40.0 Mt of various improved varieties of bean seeds in 2010, estimated at $44,715. Observable positive changes in the lives of the members are evident. These include sending children to schools, iron roofed houses, purchase of solar panels sets, bicycles, drought animals, ploughs and household items. The seeds have benefitted over 50,000 farming households (300,000 persons) across the country over the four year of existence.

The association has generated a lot of interest from a number of other community service providers as a result of their success and organisational skills. The group has become a learning model for a number of projects within the country and model for Self Help Africa in different countries where they operate.

Conclusion

It is a known fact that National Agriculture Research Systems (NARS) have technologies but do not have enough resources to deliver and follow-up on these technologies. Non- Governmental Organisations may have resources but without the technology to deliver. Through partnerships, there is synergy in delivering the technology. These positive results would not be possible if the two partners went into the community as separate entities. This proved that public and private partnership (P and PP) can have impact within a short period if they worked together as partners in development not as competitors. In this case partners complement each other and result in efficient use of resources as a result of joint planning and execution. In conclusion it is found that where technologies transfer is between public and private partnership, it is usually delivered fast and efficiently for adoption and impact will be evident within a short time.

Appendix 1

Table 1: Increase of number of farmers and seed production in Katongo Kapala, Mpika, Zambia

Year	No of Farmers	Production (Mt)	% Increase in farmers	% Increase in production
2007	46	3.2	-	-
2008	74	11.5	60.9	259.4
2009	107	24.7	44.6	114.7
2010	200	40.1	86.9	62.0

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Effectiveness of extension methods and strategies in Resettlement Areas of Zimbabwe following the fast track land reform programme: A critical analysis

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Summary

Agricultural extension performs an important function worldwide in enhancing agricultural productivity. The complexity and variety of production systems, and the ever changing geopolitical morphology requires that extension models that are flexible enough to suit all these changes are developed. The effectiveness of the extension interventions should also hinges, primarily, on the objectives of the intervention *vis-à-vis* the needs, expectations and targeting of the beneficiaries. In the Zimbabwe scenario, priotization of the development of interventions, methodologies, efficient decision-support tools in the extension sector, should be given critical support if the agricultural sector is to be revived. Zimbabwe has gone through a series a land reform phases, of which the last phase at the turn of the new millennium, which was disorganized and riddled with political conundrum, has proved to be detrimental to agricultural productivity and has resulted in food deficits and increased poverty in many communal areas. While fast tract land redistribution is undoubtedly a noble idea to address the social and economical imbalances, political survival took precedence over the need to address poverty in communal setups in Zimbabwe. Moreover, it appears that the fast tract land redistribution also coincided with the dearth of extension services especially in the government departments leaving a few players, mainly the non-governmental organization to continue with the extension services. This paper therefore attempts to give a critical analysis of the current extension approaches in Zimbabwe's agricultural sector and their suitability in turning around agricultural productivity, taking cognizance of the ongoing land reform programme.

1. Introduction

The Millennium Project recommendations on rural development and food security focus on improving the production and livelihoods of smallholder farmers (UN Millennium Project, 2005a). Reducing poverty and social inequalities, the sustainable use of natural resources, and participatory development are some of the objectives to which extension policies can make a significant contribution. Agricultural extension is one of the main institutional components of agriculture as it promotes the transfer and exchange of information that can be converted into functional knowledge (FAO, 2002) The extension system also provides a framework through which farmers are organized into functional groups in order to gain access to production resources such as credit, inputs, marketing services and information on government development programmes (Lodhi *et al*. 2006)

In Zimbabwe, in the last decade, the extension services in the country have not been able to achieve their goals effectively, because of a number of bottlenecks. While, the country engaged in a fast track land reform with the aim of correcting economic and social imbalances, the objectives of the reform where at tangent with the needs and expectations of the beneficiaries. Moreover, the whole process was undertaken without prior assessment of the adequacy of the available technical assistance. Weak research-extension linkages, lack of adequate resources for on-farm demonstrations, poor mobility, inadequate research and training in extension methodology and lack of an effective system of continuing education for extension personnel at various levels were some of the constraints that the extension services faced in trying to provide technical assistance to the resettled farmers. The economic down turn at the beginning of the new millennium, culminating in dwindling budgetary allocations for the national state extension system also called into serious question the sustainability of what has been a technically based system of extension that reaches the resettled farmers.

Numerous extension service providers, including public-funded institutions, non-governmental organizations (NGOs), commodity processors, farmers' associations, and private agrochemical input suppliers currently operate in Zimbabwe but with limited success. The reason for this include among others, the incoherent land reform programme which has seen the mixing of farmers with different

resource needs, pluralism and lack of coordination among extension service providers at the grassroots level causing lower outputs and confusion at farmers' expense and more probably inappropriate extension methods (FAO, 2002). The objectives of this paper is therefore to give a critical analysis of the current extension approaches in Zimbabwe's agricultural sector and their suitability in turning around agricultural productivity, taking cognizance of the ongoing land reform programme.

2 Agricultural extension approaches and their effectiveness

2.1 The group development area approach

The GDA approach is an old method that was developed in the pre-independence era and was based on area and project development through community participation in which, in some cases, the local people provided labour while government or donors provided the necessary inputs. At its inception this concept was able to enhance penetration of all areas including previously inaccessible to introduce agricultural extension technology. The current resettlement scheme could have provided a suitable model within which this concept could be implemented. However, more often than not, the settlements are not planned and the process has been chaotic. People of different economic backgrounds with different needs are being randomly resettled together. The major constraint here is that it is usually difficult to direct services to the needy; or to focus on a particular individual or group without precluding support and services for the deserving farmers. In most cases, those with financial muscle have great influence on the distribution of the technical and input resources at the expense of poor farmers in same resettlements.

2.2 Master farmer training schemes

Although this approach was widely adopted in the development of competent farmers (Chipika, 1985; Pazvakavambwa, 1994), it is far from being effective in the resettlements. This extension approach was based on the "trickle-down" theory of extension, in which a few progressive farmers receive extension and information, which they are expected to pass on to other farmers through farmer-to-farmer dissemination and demonstration. While the objective of master farmer training was to spread modern, scientific farming techniques in communal areas, it appears that generally there has been lack of interest in these schemes in the resettlements. In addition, there has been a significant reduction of technical persons to introduce the master famer training schemes in resettlements. Moreover, the government, through Agritex is no longer playing the important role it had been playing before the fast tract land reform mainly due to lack of capital, transportation and the brain drain of technical person.

2.3 The radio and TV agriculture programmes

This approach involves gathering farmers together in groups to listen to radio programmes that address either specific geographic areas or the whole nation, depending on the heterogeneity of the farming regions (Mudiwa, 1997). The farmer groups then discuss the extension issues raised in the programmes, and help each other to overcome any difficulties of understanding before applying any of the programmes' messages or technologies that are relevant or useful. After the inception of fast track land resettlement in 2000, the Ministry of Agriculture in collaboration with the Ministry of information also introduced agricultural programmes on both the TV and radio (e.g Murimi wanhasi, Today's farmer) with the aim of helping the new farmers deal with constraints they are facing at their new farms. The farmers were also allowed to phone in airing the problems they faced at their new farms. However, in most instances, the programme was not adequately addressing the concerns raised by the farmer due to the unavailability of experts on the different subjects being raised by the farmers. Moreover, some of the issues under discussion were sometimes irrelevant to many of the farmers who have limited resources. At times some of the discussions are to do with commercial agriculture, but people who are supposed to benefit from these discussions have limited resources and have different objectives for their new pieces of land.

2.4 The training and visit system

The training and visit (T&V) system is an extension management system that was developed for the World Bank by Daniel Benor (Benor and Harrison, 1977) with the objective of increasing the effectiveness of agricultural extension services through comprehensively structured training, delivery and administrative systems. While this proved to be an excellent extension management system in irrigation projects, which follow strict timetables, but had only limited success in dryland farming and the resettlements. This extension approach requires sound administrative system, infrastructure and availability of well trained staff. The T&V is characteristically highly mechanized may be suitable for the resettled farmers. However, it needs homogeneous groups of farmers who are organized with same objectives. In many of the resettlements, the farmers are heterogeneous and have different needs and different resources making it a difficult approach to implement. It also needs a lot of capital and while the World Bank was instrumental in its development, no financial support is currently available to resuscitate this approach in the resettlements. Unfortunately, T & V programmes were dropped due to their ineffectiveness, rigidity, top down orientation, non-responsiveness to farmers' needs, expensive, ineffective in feedback communication with farmers and un-able to meet the challenges of changing circumstances (Röling & De Jong, 1998; Davidson *et al.,* 2001; Williamson, 2002; World Bank, 2003).

2.5 Farming systems research and extension

The FSRE methodology is centered on problem identification and solving. It is systems-oriented, interdisciplinary, farmer-oriented and iterative (FAO, 2002). It emphasizes the role of constraint diagnosis and on-farm trials as a way of facilitating linkages among the farmers, researchers and extension workers. Many institutions, including the Universities in Zimbabwe, NGOs and the Farming Systems Research Unit within the Department of Research and Specialist Services (DR&SS), have been at the forefront in promoting this extension approach with the help of field extension. While the FSRE have had some successes, there has been an observed fundamental disconnect between the issues that FSRE intends to address, and the resources and problems faced by the resettled farmers mainly due to heterogeneity of the farmers. Currently, research activities in resettlements are close to nothing and this has hampered agricultural productivity in the resettlements. In addition, current FSRE efforts also tends to emphasize the traditional cropping systems, with little attention to livestock components or systems. Notably, in some resettlement areas, the land which was only suitable for livestock production was being converted into cropping areas with little yields because of lack of extension services and research activities.

2.6 Commodity-based approach

The commodity-based approach in agricultural extension is generally organized through parastatal organizations or private firms and is very important for cash crops or export crops. Of late it has been used the Government of Zimbabwe through the Reserve Bank to increase production of grain crops such as maize and wheat. In horticulture, the approach has been widely used to establish out-grower schemes and provide research, extension and input credit services to interested farmers. However, despite the remarkable achievements, the commodity-based extension approach has been abandoned with the new resettlement schemes. The new farmers are often not well equipped. In addition, with the political influence characterizing the resettlements, it had become extremely risk to implement the commodity based approach as the farmers getting technical and capital support may be not be bound by the contracts and with the uncertainty of the resettlement programme, the farmers are likely to be resettled elsewhere without prior notice. Generally, the major disadvantages of the commodity based approach is that it gives monopoly power to the parastatals and/or crop processing or marketing companies, thus enabling them to make excess profits at the expense of struggling, and at times poverty-stricken, farmers. In addition, poor management or changes to terms of trade and pricing can result in poor returns to farmers (FAO, 2002). Furthermore, it retains characteristics of the

conventional top-down extension approach, which does not give freedom to farmers and stifles their initiatives.

2.7 Other approaches

Other agricultural extension approaches have emerged as a result of the ineffectiveness of the conventional approaches. These includes among others; the participatory extension approaches, participatory learning approaches, participatory rural appraisals, rapid rural appraisals, participatory technology development, farmer field schools, innovative farmer workshops, and look-and-learn tours. Participatory approaches can be integrated in research and extension to enable full adoption and implementation of technologies being introduced to the farmer. Participatory approaches also ensure that all farmers' objectives, concerns, perceptions and social and economic backgrounds are included in the extension model. However, it seems little is being done in the resettlements to introduce participatory extension approaches

3 The way forward

The majority of extension approaches that has been used were based on a top down approach in which the farmer only seemed to be involved at the behest of the agent, a fact that consequently strangled any sense of involvement and ownership on the part of the farmer (FAO, 2002). Ideas were imposed on the farmer who was often perceived as a passive recipient, incapable of identifying his priority needs and developing the appropriate solutions too. There is therefore need to shift from the traditional master-student relationship between farmers and extension agents to one that thrived more on the involvement and participation of farmers than the agents. To meet this challenge, agricultural extensionists need to prioritize their interventions, fine-tune their methodological approaches, and select efficient decision-support tools to efficiently target the needs of farmers within specific environmental and socio-economic settings (Patanothai, 1997; Bernet *et al.* 2001). This can be achieved through strong government interventions, Participatory extension approaches and farmer participation in research among other interventions.

3.1 Government intervention

The early land resettlement programme was very successful in Zimbabwe largely due to effective provision of extension services. With the fast track land resettlement in 2000, agricultural production dramatically declined due to numerous factors chief among them, the harsh economic conditions and recurrent droughts. The situation was further worsened by the exodus of skilled extension personnel for greener pastures at the height of the economic meltdown, which left farmers without the technical. Consequently, this resulted in weak research-extension linkages, lack of adequate resources for on-farm, demonstrations, poor mobility, inadequate research and training in extension methodology and lack of an effective system of continuing education for extension personnel at various levels. The Government should take a quick and serious step to maximize the number of agricultural extension professionals in the Agriculture Department (extension wing) and also designed a proper policy for it. The government should also ensure continuity in the training of extension personnel, provide infrastructure and transportation for extension workers in the resettlements and also provide incentives to the extension workers.

3.2 Farmer Participation in Agricultural Research

Farmer participatory research (FPR) is a deliberate attempt to integrate farmers' indigenous traditional knowledge (ITK) with the more widely recognized expertise of the agricultural research community. This approach attempts to actively involve farmers in setting the research agenda, implementing trials and analyzing findings and results. In the resettlements such an approach can enable farmers to fully utilize their traditional knowledge in combination with other conventional methods in increasing productivity. The government of Zimbabwe introduced a number of schemes such as the input support programme and the agricultural mechanization programme. Resultantly, the resettled farmers shifted

their thinking towards use of farm machinery as the only way to cultivation of their pieces of land leaving the traditional animal draught power. Farmer participatory research can therefore increase awareness of the farmers on the basic agricultural production methods that can increase agricultural productivity. The FPR can also accommodate the needs of the farmers, their objectives, perceptions, resources and their socio-economic backgrounds in deriving extension models and interventions that suits them.

3.3 Farmer Participation in Agricultural Extension

There is need to support farmer networking to reinforce individual learning, centered within a process which is facilitated by highly trained outsiders (agricultural professionals - both researchers and extension workers), thus comprising an agricultural knowledge and information system (AKIS). Farmer participation in extension will require putting farmers first by placing real ownership and accountability of public extension organizations into the hands of the clients - the farmers, and their communities and organizations. This might be accomplished by developing mechanisms for improving public support (i.e., cost-sharing, local taxes, etc.) that would provide resources to farmers and their organizations, and allow them to choose the types of extension services that are most relevant to their needs. This may also enhance farmer-to-farmer knowledge transfer model with a view of making the farmers totally involved in the production process and still uphold the technical advice even after the initiators of the development projects are long gone.

3.4 Coordination among different extension agencies

A variety of extension agencies among them NGOs, universities, Farmers unions, are operating in Zimbabwe. However, lack of coordination among the extension agencies is resulting in pluralism that is confusing the farmers who ironically should be the beneficiaries of the services. There is therefore need for co-ordination amongst the different extension services. It is also necessary to have an organized monitoring and evaluation system to correctly assess the impact that the current extension has on agriculture. This will pave the way for the adoption of an appropriate mode of extension that addresses the challenges that conventional extension systems present by ensuring that the farmer plays a more active role in terms of decision making on how local agriculture development is supposed to take place.

4 Conclusion

For the current fast track land resettlement programme to be successful, extension service provision should be significantly improved. The extension methods should be model along the socio-economic backgrounds of the resettled farmers. Government should play a leading role in ensuring that infrastructure, transportation and other extension tools are put in place to ensure efficient and effective dissemination of information through extension. Any attempt to improve agricultural productivity in the resettlement areas through research should allow full participation of the farmers so that they fully appreciate and can effectively implement the results from the research. All the extension agencies operating in the country should develop some synergism and collaboration so that there will be no pluralism in the operations of these agencies.

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An Overview of Extension approaches and Methods in Zimbabwe

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Summary

In Zimbabwe agricultural extension for smallholder farmers has been practiced for the past 80 years. Extension approaches have evolved from using the top down approach, where the researcher would prescribe to farmers on a course of action, through forced extension, where farmers are forced to adopt certain practices, to the participatory approach where active farmer participation is promoted. It is the object of this paper to make an overview of extension approaches and methods that have been employed to disseminate information on agriculture technologies in Zimbabwe to date. This review includes a desktop study of the extension approaches promoted in the past and present and interviews with key informants in AGRITEX, NGOs that have been involved in promoting different extension approaches and methods and other stakeholders that have been involved in extension such as farmers' unions. The review established that the top down approach, though it has its own disadvantages, has been effective in the promotion of the plough. It has also been established that the participatory extension approaches have been successful in the promotion of cotton production although it did not spread as desired because it was mainly donor driven and lacked institutionalization within government. The paper also argues that total participatory extension without participatory research and in the absence of effective communication does not work. It also argues that forced extension approach is not sustainable. The paper concludes that for farmers to take up agriculture technology, extension strategies should follow a menu approach based on the type of the farmer, the technology and crop being promoted, and the farming sector rather than a prescription approach.

Key words: extension approach, participatory, top down, technology adoption

ACRONYMS

AGRITEX: Department of Agricultural, Technical and Extension Services
CAMPFIRE: Communal Areas Management Programme for Indigenous Resources
CA: Conservation Agriculture
DR&SS: Department of Research and Specialist Services
FDT: Farmers' Development Trust
FFS: Farmer Field School
FSR: Farming Systems Research
IPM: Integrated Pest Management
GTZ: German Agency for Technical Cooperation
ITDG: Intermediate Technology Development Group
NGO: Non-Governmental Organization

Introduction

Agricultural extension is defined as a service or system which assists farming people improve farming methods and techniques for increased production efficiency and subsequently livelihoods through an informal educational programme (Adapted from Higgs, 1975). The main aims of extension are to help farmers identify and analyse their production problems and hence create awareness on the possibility and opportunity for improvement. Extension is not a simple relationship whereby technologies that have performed well under research conditions are introduced and farmers spontaneously take them up. Extension approaches within a community are affected by economic, social and ecological factors.

Extension approaches that have been promoted in Zimbabwe has evolved from the linear 'top-down' technology transfer through forced extension used in the colonial era to the 'bottom-up' participatory methodologies. In recent years, there has been a return to the top down approach, with the participatory approach being promoted on a smaller scale. When agricultural extension was started in

the late 1920's the top down approach was used mainly through the use of demonstration and the master farmer concept (Pazvakavambwa, 1994). In the 1960's and 1970's there was an element of forced extension whereby native farmers were forced to have contour ridges and storm drains on their fields and it was made compulsory to dip their cattle. In the early 1980's the top down approach was still being used especially the radio listening group method (Mudiwa 1997 cited in Hanyani- Mlambo, 2002). However this did not go far because of the liberation war and other constraints associated with communal ownership of assets). In the mid 1980's up to the 1990's there grew a strong bias towards the participatory approaches through farmer field schools and community based participation.

Around 1983, the farming System Research as initiated in Masvingo and Murehwa with the aim of expanding it in four years (AGRITEX, DR&SS, 1983) However it was criticized for its weaknesses in drawing extension considerations from practice and in incorporating its findings into the extension system (Hanyani- Mlambo, 2002). In the past decade and to date, the government extension agents who are the main extension providers in the country have been using the top down approach especially with the master farmer concept. Currently the top down approach is being used in the promotion of Conservation Agriculture (CA) by both the government and NGO whereby a set of principles is set for farmers to adopt.

Background to extension in Zimbabwe

Agricultural extension was first started by Alvord in 1927 when he was tasked to do the native agriculture extension by the then government. Back then the top down extension approach was exclusively employed, in trying to promote the plough and other modern agricultural practices through use of demonstrations. By 1934 the first Master Farmer graduate was honoured (Matarirano L, 1989).

In the country there are numerous agents who provide extension to farmers. These include government, training institutions, Non Governmental Organizations (NGOs) private sector (agro-input suppliers), and farmers' unions. Government, NGOs and training institutions mainly provide extension to smallholder farmers whereas agro-input companies mainly provide extension to medium and large scale farmers. Traditionally this setup was working but because of the changes in agriculture in Zimbabwe there is need for a more dynamic approach. What is really needed in Zimbabwe is extension service providers who can analyse each agricultural system and together with farmers identify and provide solutions. Prior to 2000 landholdings have been commercial farms which and small scale farmers (communal old resettlement and small scale commercial farms). Extension methods promoted then like the farmer field school were mostly participatory approaches and were aimed at small scale farmers. Promotion of the participatory method was largely donor driven and where mostly promoted when the World Bank and other European countries were advocating for removal of the trickle down approach.

Top down approach /Transfer of Technology (ToT)

This extension approach was based on the" trickle-down" theory of extension, in which a few progressive farmers receive extension and information, which they are expected to pass on to other farmers through farmer-to-farmer dissemination and demonstration. Through this approach, it is expected that farmers accept whatever technology is handed down to them which would have shown good results under trial conditions. Although this approach has worked in the past for exceptionally good technologies like use of hybrids, it has shown shortcomings in other technology promotion such as pesticides adoption and good agronomic management practices. Adoption of recommended practices is still generally low, well below 40 percent across the country (Mudimu, 1998). This approach has been successful in the introduction of hybrids in the early 1980s where through demonstrations and trials, farmers saw the benefits of using hybrids as compared to landraces. Another example the success of this approach was the success of Farmers' Development Trust (FDT)'s promotion of improved management in tobacco production in small scale farmers. This saw an increase in tobacco yields, where farmers in the programme achieved yields of about 2t/ha compared to an average of about 900kg/ha for those outside the scheme(Hanyani- Mlambo, 2002). A failure of this approach has been the ""Kohwa Pakuru" programme which was aimed at encouraging farmers to use herbicides and pesticides in their fields.

Forced Extension

Although this has never been highly pursued, the forced extension approach was used in the 1960 to late 70's. This approach was mainly used for the protection of natural resources through conservation techniques like construction of contours. It was made government policy to ensure that people constructed contours on their fields and those found pulling sleighs were prosecuted. The aim of this was to reduce soil erosion. However, farmers did not understand this well and became rebellious towards the technology although it was good. It is always difficult to balance between policy and democracy. Although it is necessary to encourage farmers to take up technologies that are important, there is need to ensure that the intended beneficiaries are aware of why they are doing it. This has been successful in the construction of contours and storm drains for water and soil conservation and also in the prevention of indiscriminate cutting down of trees in Zimbabwe. However, because this was forced on people by colonial masters and because of the "forcing" nature of the extension approach, people viewed the advise as a form of punishment and this prevented them from seeing the benefits of contour ridges. As a result there was a strong resentment to pegging of contours and storm drains after independence in 1980. Another success story of such extension approach was the dipping of animals by farmers. In the colonial era farmers were forced to dip their livestock.

Participatory approach

Participatory approach was promoted in Zimbabwe in the 1990's. When it was introduced there was interest from all quarters; the government, donors and NGOs. It promised to be an answer to low technology adoption among smallholder farmers in the country. Although a very impressive extension approach, it made too many assumptions about the average farmer, especially the smallholder farmer. Participatory extension expects the farmers to identify their own problems, prioritizing them and find their own solutions (Min of Agric, Zimbabwe, 2010). But this approach is only successful if farmers are well connected to the outside world and really understand their problems and can find their solutions. In Zimbabwe, it is very common to find a farmer who has never traveled outside his community. One of the success stories of the participatory approach in Zimbabwe has been the "Kuturaya" project in Chivi district, Masvingo province. This project was driven by the Intermediate Technology Development Group (ITDG) and German Development Cooperation (GTZ). It was mainly used for promotion of the adoption of soil and water conservation techniques. This project was a huge success in the district and government extension agents were also trained along the participatory approach lines. However this failed out scale to other areas outside the province. The Farmer Field School (FFS) method which is a participatory extension approach has been successful in the promotion of Integrated Pest Management (IPM) in cotton. However use of this method has not spread to other technologies. Another example on the successes of the participatory approach is the CAMPIRE (Communal Areas Management Programme for Indigenous Resources) which is a community based wildlife management programme. However, the participatory approach, despite two decades of promotion, has spread as extensively as expected. This is can be attributed to:

- It was largely donor driven and lacked institutionalization within government who are the major extension players in the country.
- For many years, farmers have relied on the extension worker for information and it needs a big shift in mindset so that the farmers can now tell the extension worker what they want. This will also be affected by the personalities of parties concerned.
- Lack of exposure on the part of farmers makes it difficult for them to suggest solutions to their problems

For participatory approach to be effective in any technology transfer there is need for participatory research into appropriate technologies. In the 1980's when participatory research was introduced there was a complimentary approach to research which was called Farming System Research. In the diagnosis phase, Farming Systems Research involves consultation with farmers on their problems. On-farm trials are often farmer-managed, and farmers assist in the evaluation of research results. This system has been used in the Mother Baby Trials which have been very successful in giving farmers choices on maize varieties that are suited to their areas.

Most of the extension to resource-poor farmers is by government agents and donors. The question that is important in the extension approaches used to promote appropriate technologies for these resource poor farmers is whether they are well positioned to dictate what they want to the extension agents. Many factors which should be considered include the socio-economic backgrounds of the farmers.

Conclusions and Recommendations

The overview of extension approaches that have been used in Zimbabwe shows that no single approach on its own is effective enough for technology adoption. This is more so because of differences in ecological and socio-economic backgrounds of farmers. There is need for diversion from a prescriptive approach where farmers are prescribed technologies which are perceived to suit their problems to a menu approach where a variety of extension approaches are tabled and one or a number of approaches suited for the community are used. However for this to be successful there is need for highly competent extension agents who understands the socio-economic, ecological and management skills of farmers he/she will be dealing with.

One of the reasons why participatory approach has not been taken up as expected is that it has tried to replace the transfer of technology approach. What is needed is not an outright replacement but finding a way for the two to compliment each other. Although the transfer of technology approach has its shortcomings, it still remains a benchmark extension approach with which other approaches can be modified to suit different situations.

For participatory approach to be effective there is need for participatory research.
Farmers can identify their own problems but it might not be possible for them to come up with effective solutions because of complexity of techniques in agriculture. In such instances total participatory research might also be difficult, hence the need to balance top down approach and participatory approach.

Traditionally in Zimbabwe public extension services have been targeted at smallholder farmers with large scale commercial farmers being serviced either by private companies or they had access to good communication like radio, television and even internet. The land reform program has resulted in different land ownership structures and agriculture as whole has necessitated the need for revisiting extension approaches. Most of the beneficiaries of the land reform programme rely on public extension services hence the need to reorient extension approaches to cater for these new players some of whom have had limited exposure to agriculture.

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