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Research Application Summary

Field experiences on promotion of forage technologies to the smallholder dairy farmers in Western Usambara Highlands, Tanzania

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Abstract

Dairy industry is among the important components of the livestock sub-sector in Tanzania and it is of great potential towards contributing to poverty reduction and improving food security. The industry in the country comprises of smallholder semi-intensive dairy farming practise in urban and peri-urban areas and the major extensive cattle production practiced by the pastoralists. Together, the dairy industry contributes about 30% of the GDP from livestock. The total amount of milk per year is approximately 2.2 billion litres and is projected to rise to 3.8 billion by 2022. This is considered low production compared to large size of animal herds and land size and low uptake and poor utilization of productivity-enhancing technologies are among the major causes. Establishment and proper management practices of high yielding fodder species such as Napier *(Pennisetum purpureum*) and Guatemala (*Tripsacum laxum*) grasses are among of the solutions for enhancing smallholder dairy production in areas where land is scarce and nutrition has been the major challenge. However, the uptake of these technologies is also still low for reasons such as small land holdings among smallholder farmers, poor extension services and scarcity of high quality propagation materials. As an effort to address the dry season fodder challenges among the smallholder dairy farmers in the Western Usambara Highlands (WUHs), the Livestock Community Action Research Project (CARP) promoted adoption of high yielding fodder grass varieties and silage making. The promoted fodder grasses include three high yielding Napier varieties namely Ouma, Kakamega2 and Bana in comparison to local Napier and Guatemala grass. Farmers, researchers and extension officers through participatory approaches worked together in assessing the performance of the five (5) fodder grass varieties in demonstrational smallholder farms and co-evaluated them as forage for ruminants. About 180 farmers/households adopted the newly introduced high yielding Napier grass varieties after they had evaluated their quality and potential yields in on-farm demonstration plots. It was learnt that prolonged farmer-extension personnel interactions, as well as presence of farmer's associations increases adoption chances. Also, it was learnt that smallholder farmers will only adopt a new technology/practice if it is superior to what they already have in place, and only if it is affordable in terms of labour and finance. For example, most farmers chose Ouma variety due its high quality attributed to its dark green leaves, less hairiness and high yield followed by Kakamaga2. Although Kakamega2 was quantitatively valued superior but was less preferred due to its high hairiness and its close visual resemblance to local Napier. Also, farmers ascertain that forage chopping using hand tools for silage is tedious and time consuming. It is suggested that agricultural policies should put much emphasis on extension through increasing efforts to increase

number of smallholder farmers being reached by extension personnel. Also, more emphasis should be put on strategies for enhancing rural mechanization; and enhancing access and affordability of production inputs.

Key words: Adoption, Agricultural extension, Dairy farming, Lushoto, Napier grass, Tanga

Résumé

L'industrie laitière est l'une des composantes importantes du sous-secteur de l'élevage en Tanzanie et a un grand potentiel pour contribuer à la réduction de la pauvreté et à l'amélioration de la sécurité alimentaire. L'industrie, au sein du pays, comprend des pratiques de production laitière semi-intensive de petits exploitants dans les zones urbaines et périurbaines et la principale production extensive de bétail pratiquée par les pasteurs. Dans Ensemble, l'industrie laitière contribue environ 30% du PIB de l'élevage. La quantité totale de lait par an est approximativement 2,2 milliards de litres et pourrait augmenter jusqu'à ,8 milliards d'ici 2022. Ceci est considéré comme une faible production par rapport à la grande taille des troupeaux d'animaux et ; la dimension des terres, une faible absorption et une mauvaise utilisation des technologies améliorant la productivité sont parmi les principales causes. L'établissement et les pratiques de gestion appropriées des espèces fourragères à haut rendement telles que les graminées Napier (Pennisetum purpureum) et Guatemala (Tripsacum laxum) sont parmi les solutions pour améliorer la production laitière des petits exploitants dans les zones où les terres sont rares et la nutrition a été le défi majeur. Cependant, l'adoption de ces technologies est également encore faible pour des raisons telles que les petites propriétés foncières détenues parmi les petits exploitants agricoles, les services de vulgarisation médiocres et la rareté des matériels de multiplication de haute qualité. Comme un effort pour relever les défis fourragers de la saison sèche chez les petits producteurs laitiers des hautes terres de l'Ouest d'Usambara (WUH), le Projet de Recherche sur l'Action Communautaire en Matière d'Elevage (CARP) a promu l'adoption de variétés de graminées fourragères à haut rendement et la fabrication d'ensilage. Les graminées fourragères promues comprennent trois variétés Napier à haut rendement, à savoir Ouma, Kakamega2 et Bana comparativement par rapport à Napier local et la graminée Guatemala. Les agriculteurs, les chercheurs et les vulgarisateurs, par le biais d'approches participatives, ont travaillé ensemble pour évaluer la performance des cinq (5) variétés de graminées fourragères dans les petites exploitations de démonstration et les ont co-évaluées comme fourrage pour les ruminants. Environ 180 agriculteurs / ménages ont adopté les variétés de la graminée Napier à haut rendement nouvellement introduites après avoir évalué leur qualité et leurs rendements potentiels dans des parcelles de démonstration au champ. Il a été appris que les interactions prolongées entre les agriculteurs et le personnel de vulgarisation, ainsi que la présence d'associations d'agriculteurs augmentent les chances d'adoption. De plus, il a été appris que les petits exploitants agricoles n'adopteront une nouvelle technologie / pratique que si elle est supérieure à celle (s) qu'ils ont déjà en place, et seulement si elle est abordable en termes de main-d'œuvre et de financement. Par exemple, la plupart des agriculteurs ont choisi la variété Ouma en raison de sa haute qualité attribuée à ses feuilles vert foncé, à sa moindre pilosité et à son rendement élevé, suivi de Kakamaga2. Bien que Kakamega2 ait été quantitativement évalué comme supérieur, mais moins préféré en raison de sa pilosité élevée et de sa proche ressemblance visuelle avec le

Napier local. De plus, les agriculteurs constatent que le hachage du fourrage en utilisant des outils manuels pour l'ensilage est fastidieux et prend du temps. Il est suggéré que les politiques agricoles doivent mettent beaucoup l'accent sur la vulgarisation en intensifiant les efforts pour augmenter le nombre de petits exploitants agricoles atteints par le personnel de vulgarisation. Aussi, il faudrait mettre davantage l'accent sur les stratégies de renforcement de la mécanisation rurale; et de l'amélioration de l'accès et de l'abordabilité des intrants de production.

Mots clés: Adoption, vulgarisation agricole, Élevage laitier, Lushoto, graminée Napier, Tanga

Introduction

Tanzania has a high population of ruminant livestock including 25 million cattle, 16.7 million goats and 8 million sheep (MLFD, 2015). The current human population in Tanzania is estimated at 54.2 million and projected to reach 89.2 million people in 2035 (NBS, 2018). Ruminants play important roles in income generation and food security to majority of the rural poor. For example milk production per year in Tanzania is approximated 2.2 billion litres and projected to rise to 3.8 billion by 2022. Moreover, most of the milk is produced under mixed crop-livestock production systems namely extensive agro-pastoral and subsistence smallholder dairying (MLFD, 2015).

Forage including fodder grasses, fodder legumes and crop residues are the major feed resource for ruminants. Inadequate forage production due to land scarcity and poor agronomic practices are among the major challenges facing the smallholder dairy farming systems in Tanzania. Incidences of dry season fodder scarcities culminating into reduced milk production and animal body condition losses are common in Tanzania (Wassena *et al.,* 2015). In a previous study (Maleko *et al.,* 2018a) conducted in the West Usambara highlands (WUHs) of Tanzania we reported that the average milk production dropped from 5.6 to 3.0 litres per cow per day in wet and dry seasons, respectively.

In East Africa, efforts to curb dry season fodder scarcities have included promotion of high yielding fodder species including Napier and Guatemala grasses as well as leguminous trees/shrubs such as Calliandra, Sesbania, Mulberry and Gliricidia species (Orodho, 2006; Wambugu *et al.,* 2011). However, uptake is still low and the reasons for low uptake include small land holdings among smallholder farmers, poor extension services and scarcity of high quality propagation materials (Maleko *et al,* 2018b).

As an effort to contribute into redressing the dry season fodder challenges among the smallholder dairy farmers in the WUHs, the livestock Community Action Research Project (CARP) promoted adoption of high yielding fodder grass varieties. The promoted fodder grasses include three high yielding Napier varieties (Pp cv ouma, Pp cv Kakamega2 & Pp cv bana) in comparison to local Napier and Guatemala grass. Farmers, researchers and extension officers through participatory techniques worked together in piloting the five fodder grasses in on-farm demonstration plots and co-evaluated them. Thereafter farmers were facilitated to establish small fodder gardens near their homes for multiplying the selected locally well performing grass varieties with intent of promoting large-scale planting into their farm boundaries and contour strips. Establishment of home fodder gardens/plots near homes, in addition to increasing the available propagation materials was thought essential for enhancing forage production knowledge sharing among community members. Herein, the field experience involving smallholder farmers, extension officers and researchers working together on-farm to evaluate and promoting adoption of high yielding fodder grasses is elucidated.

This field experience is expected to be beneficial to a range of stakeholders including extension officers, researchers and policy makers for helping with acceleration of adoption of forage technologies.

Study description

This study was conducted in the WUHs located at 4° 38'S and 4° 53' S and longitudes 38° 14' E and 38° 22' E in Lushoto district, Tanga, Tanzania. The WHUs lies at altitudinal range between 1200 and 1800 m above sea level, the mean annual precipitation and temperature are 1100 m and 17^0 C, respectively (Figure 1). The WUHs are among major milk-shed areas under smallholder dairy farming system in Tanzania. In particular, mixed crop-livestock farming systems involving rearing of few high producing livestock such as dairy cattle and goats under zero grazing is ubiquitous in the WUHs. Crops including maize, beans, potato and vegetables are grown either as mono-crop or intercropped in fragmented and denudated farms while Napier and Guatemala grasses are limited within the farm margins. The aim of this study was to examine both yields and nutritive values of fodder grasses available to dairy cattle in the WUHs and, as well as, study effectiveness of conserving soil and water resources in sloppy highland smallholder farms through employment of the recommended sunken seedbed technique (Tumbukiza method). Three improved Napier varieties (Pp cv ouma, Pp cv Kakamega2 & Pp cv bana) versus local Napier and Guatemala grass are been compared in terms of growth (height) and farmers' preferences.

Planting was done in December 2016 whereby matured and healthy stem cuttings for both Pp cv ouma, Pp cv Kakamega2 were purchased at Tanzania Livestock Institute (TALIRI), Tanga, Tanzania. Healthy stem cuttings of Pp cv bana were obtained from Sokoine University of Agriculture (SUA), Morogoro, Tanzania. Local Napier and Guatemala stem cuttings were obtained the smallholder farms in WUHs. Planting was done in three villages namely Bombo, Hambalawei and Viti in 3 smallholder farms that were willingly provided by the owners. The sunken seed bed technique (Tumbukiza method) literally meaning planting in holes or furrows aiming at retaining soil moisture, control soil erosion and optimize nutrient use by the crop was employed (Nyambati *et al.,* 2011).

Farmers' evaluation of the fodder grasses. On-farm evaluation of the five fodder grass varieties was done by 30 smallholder dairy farmers both women and men at the demonstration sites when the grasses were considered matured for forage use (Plate 1). Researchers and extension officers facilitated the farmers in developing criteria for evaluating both quality and prospective biomass yield of the grasses. The criteria included leaf colour, leafiness, growth vigour (height and stem thickness), potential biomass and leaf and leaf sheath hairiness. A score scale of 0 to 10 was agreed upon with 0 being less/few or non-existent whilst 10 being most important/dominant. For leaf color, yellowish score was close to 0, pale green around 5 and dark green close to 10. For hairiness/tillering 0 coressponded to no hair/tiller while close 10 very hairy/many tillers. Potential biomass and growth vigour included 0 very small to 10 very high. A score card was designed and each farmer moved around the plots and was facilitated to fill the score form. The mean scores for each fodder variety were computed and shared to all participating farmers and a discussion for common consensus was done. In addition, in April 2017 a total of 80 farmers, Lushoto district government officials including the District Executive director (DED) and livestock officials

were invited to visit the fodder demonstration plots for awareness creation.

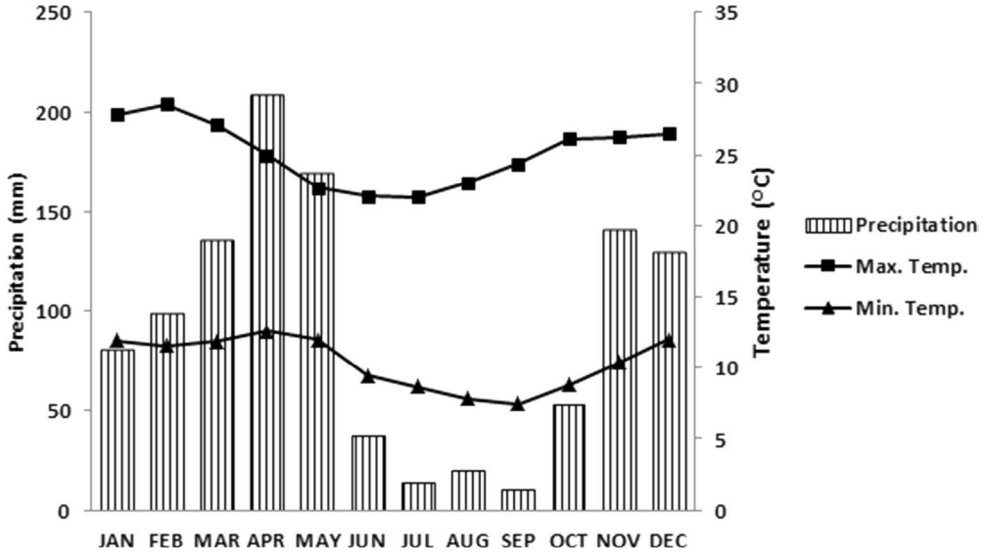

Figure 1. Average monthly precipitation and temperature between 2006 and 2016 in West Usambara Highlands, Tanga, Tanzania (Source: Maleko *et al.,* 2018a).

Plate 1. Farmers participating in awareness creation meeting and evaluation of the five fodder varieties in WUHs, Tanga, Tanzania, April, 2017

Promotion of adoption of high yielding farmers preferred Napier varieties. Extension officers at the respective project villages who were involved at the entire activity of the pasture establishment trials employing the Tumbukiza Method were requested to register a number of interested farmers for enhancing adoption in October 2017 (Onset of rain season). The farmers were requested to prepare a furrow with a length of 1.5 m and width 0.5 m and depth of 40 cm. The topsoil was mixed with 2 buckets of dry cattle manure and then returned to the farrow while subsoil was heaped down the slope. Farmers were provided with sixs healthy stem cuttings (30 - 40 cm long) of Ouma or Kakamega2 and taught on how to plant them into the furrow and take proper care of them.

The adopting farmers were advised to understand that planting material was scarce and expensive (3000 Tsh/kg ≈1.31USD/kg) in Tanzania hence they needed to aim at multiplication. The idea

being that until April 2018 the small multiplication plots would produce between 40 – 60 matured tillers and each tiller will provide between 4 - 5 cuttings which could be replicated or planted into the farm boundaries, contour strips, fodder plots or given to other farmers. In April 2018 during the wet season more stem cuttings of Ouma and KK2 were distributed to interested farmers by the aid of village extension officers. This was an effort to continue the promotion of improved Napier varieties which began in October 2017. Apart from extension officers the leaders of the farmer groups namely Shume Dairy cooperative Group in Viti and Hambalawei villages and those of innovation platforms (IP) in Ubiri and Mbuzii villages were closely involved.

Promotion of silage making under smallholder farm conditions. Apart from comparing the four napier varieties in terms of growth, biomass and herbage quality, it was thought necessary to set on-farm silage making trial under smallholder farmer environment and draw lessons of its potentiality given the fact that silage making was unfamiliar practice to Tanzania smallholder dairy farmers (Maleko *et al.,* 2018a). In particular, the baseline study indicated that there was no single smallholder farmer observed to be making silage in the WUHs, Tanzania (Maleko *et al.,* 2018a).

Findings/Lessons and Implications

In terms of forage growth local Napier was found to be the fastest growing followed by Ouma and Kakamega2 while Bana was relatively slow. Guatemala which is a different species exhibited the slowest growth (Figure 2). The finding that Guatemala was the slowest in terms of growth was consistent with the farmers' evaluation who gave it the lowest score. Also, this was in agreement with the previous field survey which found it relatively unpopular in WUHs' smallholder farms. Farmers' low preference to Guatemala grass was attributed to poor quality related to lower milk production when fed to dairy cattle (Maleko *et al.,* 2018a).

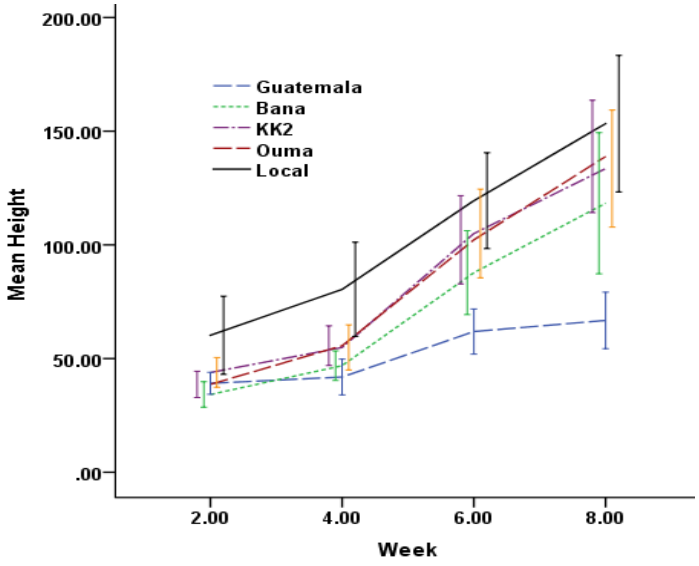

Figure 2. Variation in height among the five fodder grass varieties within eight weeks in 2017 growth season, Lushoto, Tanzania

Cumulative yields for three consecutive cuts for the Napier varieties and two cuts for Guatemala were computed (Figure 3). Ouma and Kakamega2 did best followed by local Napier while bana and Guatemala were the least perfoemers (Table 1). This was also consistent with the farmers' evaluation and it was testified that Ouma had the rapidest regrowth during the dry season compared to the rest of the grasses. Most farmers gave highest score to Ouma and it was attributed to higher potential biomass yield, high leafiness and low hairiness values. Local Napier and Kakamega despite the fact they scored high biomass potential their hairiness was a demerit as it was claimed inconvenient to handle due to accompanied skin irritation especially in hot days. Also, the farmers' higher preference for Ouma than Kakamega2 was related to Kakamega2's higher visual resemblance to local Napier. It was learnt that farmers prefer to try new things if seems superior to what they already have in place.

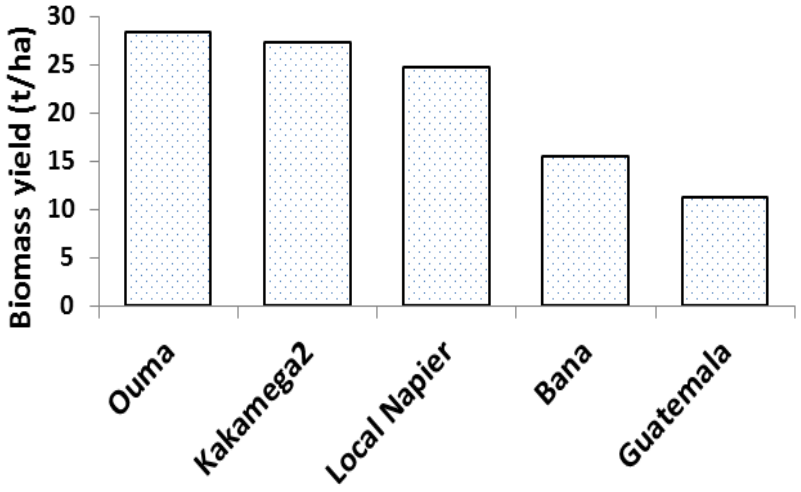

Figure 3. Cumulative biomass yields for five fodder grasses in on-farm evaluation trial in WUHs, Tanzania in 2017.

Table 1. Farmers' evaluation of five fodder grasses in terms of quality and quantity using a 1 – 10 scale (1 least while 10 most) in the WUHs, Tanzania, 2017

Evaluation criterion	Bana	Ouma	Kakamega2	Local Napier	Guatemala
Greenness	6.0	8.5	6.2	4.0	5.2
Leafiness	6.3	7.4	6.2	4.3	6.5
hairiness	3.9	0.9	6.7	8.2	3.3
Tillering	3.8	8.1	6.6	4.4	1.8
Growth vigour	4.0	5.7	7.0	6.5	3.0
Potential biomass yield	3.4	6.4	6.4	6.1	5.0

As of 15th April 2018 the number of farmers/households who have adopted improved forage grasses in the CARP villages was 180 and both men and women had established fodder plates (Plate 1). Figure 4 below shows number of farmers/households per project village. It can be noticed that many farmers adopted at Viti and Hambalawei, largely because of the presence of committed extension officers and dairy cooperative union which made knowledge sharing and planting material distributions easy. At Mbuzii and Ubiri only 24 farmers adopted of limited planting materials, however the number of adopters could have increased due to presence of IPs ins these villages. Few numbers at Bombo and Ngulwi villages was attributed to the fact that the extension officer for these juxtaposed villages was a nursing single mother and there was neither farmer's association nor IP in the area.

Experiences with training farmers on silage making indicated that it is possible to make good silage under smallholder environment in the WUHs. However, forage chopping to fine cuttings using bush knives was tedious and time consuming (Plate 2). Also, the technology was less attractive for adoption by both men and women given the number of chores in smallholder farms (76.19%, 21 respondents). The participating farmers liked the technology but not its labour demand. In response to feedback from farmers efforts for promoting forage choppers through CARP are underway. Also, links between farmer associations to agricultural input supplier such as molasses, mineral premixes and veterinary services are being enhanced by CARP IPs.

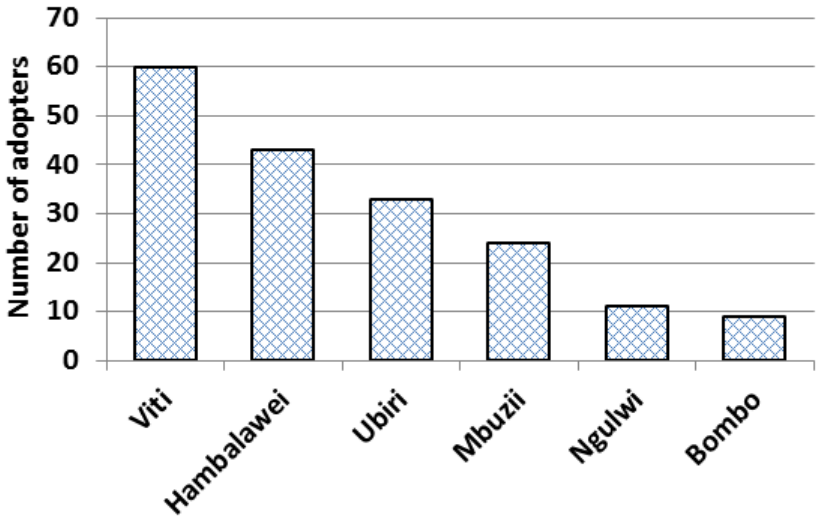

Figure 4. Number of smallholder dairy farmers who have adopted the improved napier varieties in the seven CARP project villages, WUHs, Tanga, Tanzania

Plate 2. Chopping of the harvested Napier herbage for ensiling purpose and opening of the silage at a smallholder farm in WUHs, Lushoto district, Tanzania, August 2018

Conclusion and recommendations

Based on this field experience farmers will adopt only those technologies which are appealing to them. Unless the technological costs including labour and finance are affordable by farmers the level of adoption will be low. It was also experienced that prolonged farmer-researcher-extension officer interaction increased adoption chances. It is suggested that agricultural policies should put emphasis on extension through increasing efforts to increase number of smallholder farmers being reached by extension personnel. Also, emphasis should be put on strategies for enhancing rural mechanization, and access and affordability of production inputs such as labour reducing machines.

Acknowledgement

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