Book of abstracts:

Postgraduate students supported by Africa RISING Project in Ethiopian Highlands

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The Africa Research in Sustainable Intensification for the Next Generation (Africa RISING) program comprises three research-for-development projects supported by the United States Agency for International Development as part of the U.S. government's Feed the Future initiative.

Through action research and development partnerships, Africa RISING will create opportunities for smallholder farm households to move out of hunger and poverty through sustainably intensified farming systems that improve food, nutrition, and income security, particularly for women and children, and conserve or enhance the natural resource base.

The three projects are led by the International Institute of Tropical Agriculture (in West Africa and East and Southern Africa) and the International Livestock Research Institute (in the Ethiopian Highlands). The International Food Policy Research Institute leads an associated project on monitoring, evaluation and impact assessment.

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Cover photo: Feeding the mixtures of foliage of leguminous fodder trees, oat-vetch and local feed resources using feed trough introduced by Africa RISING (Photo credit: ILRI/Kindu Mekonnen)

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INTRODUCTION

Africa RISING is a multidisciplinary and integrated research project that focusses on the Sustainable Intensification (SI) of mixed farming systems. It has been designed to identify and promote outcomes in climate smart development, gender integration, improved nutrition, inclusive agricultural sector growth, private sector growth and research and capacity building; USAID Feed the Future (FtF) focus areas. The project is funded by USAID's Bureau of Food Security (BFS) through the FtF initiative.

Africa RISING implements systems intensification through the engagement of CGIAR and national partners using an action research approach guided by Innovation Platforms (IPs) at different levels alongside an integrated capacity development programme. The project partners include eight CGIAR centers, two federal and four regional research institutions, four local Universities, seven zonal and 28 woreda level extension offices, NGOs, private entrepreneurs (including breweries and factories), USAID innovation laboratories and farming communities. The innovation platforms are used for cross learning, planning and evaluation purposes.

The project is somewhat peculiar in that it had the opportunity to move along the whole Research for Development (R4D) continuum from problem identification through action-oriented adaptive research and scaling partnerships. Actors holding stakes in all steps of this continuum were including in prioritization and planning throughout the project, a factor that we consider to be a major contributor to its success. It explored and prioritized major issues using more than ten tools, formulated seven thematic research areas based on priority issues, which were addressed through 17 primary action-oriented research interventions, and facilitated scaling of validated innovations through co-invested development partnerships. The thematic areas include livestock and feed and forage management, improved crop varieties x management practices, horticulture – fruits and vegetables, natural resource management, and synergies, trade-offs and systems integration. In addition, the project took a crosscutting approach to nutrition, markets and value chains, gender equity, human and institutional capacity development.

Africa RISING encourages elective engagement of participating farmers for the SI technologies to ensure a demand-driven focus. The Africa RISING action research interventions fall under two broad categories, namely component or system research. These are however closely linked as the systems focus often conveys important contextual information that helps in designing component technologies to circumvent unintended consequences and address multiple user objectives.

The project attached 37 postgraduate students (12 PhD and 25 MSc) for their thesis and dissertation research. Similarly, more than 25,000 partners have been enrolled in training and knowledge-sharing forums. Africa RISING has also been building partners' capacity with practical support by providing consumables and other operational support as well as, in some cases, financial support for partners organizing events that facilitate learning and knowledge-sharing on sustainable intensification.

Africa RISING in its second phase (2016-2021) has been targeting 0.7 million households with SI technologies. In the last two years (2017 and 2018) alone, the project has managed to reach and benefit more than 136,363 households with its validated technologies. This equates to a land area of 64,136 ha. The geographical and administrative coverage of the project has also increased from four to 28 woredas and four to seven zones. In the remaining three years of the project, we will seek to generate wider evidence for the benefits of the novel R4D techniques adopted, synthesize the lessons learned and deliver the tools required to support the wider employment of these approaches.

Determination of Cultivar-Dependent Variation in Food-Feed Traits in Lentil (*Lens culinary*)

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Completion Date	:	January 2016
Abstract	:	The study was conducted with the objectives of analyzing and evaluating of lentil varieties for haulm nutritional values, determining the relationship between fodder traits and agronomic traits, and developing Near Infrared Reflectance Spectroscopy (NIRS) equation for predicting nutritional value of lentil haulm. The samples were collected from Debre zeit, Akaki, Chefe Donsa and Minjar field experimental sites of Debre Zeit Agricultural Research Center and the laboratory work was conducted at Animal Nutrition laboratory of the International Livestock Research Institute (ILRI), Addis Ababa. The study was conducted from January 2014 to April 2015. NIRS equation development was done using 633 haulm samples from preliminary and national variety trials. Only 315 samples of national variety trial were used for analysis of nutritional value on twenty-seven testing and five control varieties using Random Complete Block Design (RCBD). Statistical analysis of the data was carried out using General Linear Model (GLM) procedure of Statistical Analysis System (SAS) software. The model developed by NIRS for the prediction of lentil haulm of crude protein (CP), metabolizable energy (ME), true in vitro organic matter digestibility (TIVOMD), ash and fiber fractions were accurate and successful method. In potential environment varieties (PE) haulm CP (11.53%), at Debre zeit, while crude protein yield (CPY)(0.42t/ha), ME (8.55MJ/kg DM) and TIVOMD (57.89%) at Chefe Donsa had the highest (P<0.05) values. In low moisture stress varieties (LMS) higher (P<0.05) haulm CP(9.90%) was obtained at Minjar, but higher values of CPY(0.38t/ha), ME(8.01MJ/kg DM) and TIVOMD (54.74%) were obtained from Debre zeit.In LMS Dz2012Ln0014 had the highest (P<0.05) CP (11.94%), TIVOMD (57.91%) and the lowest fiber fractions than controls, also higher in ME (8MJ/kgDM) contents than Alem Tena and local check. But, Dz2012Ln0013 had the highest(P<0.05) crude protein yield CPY). In PE Dz2012Ln0018 and Dz2012Ln0024 were the highest (P<0.05) in CP (10.05 and 10.19%), CPY (0.46 and 0.48 t/ha) and ME (8.6 and 8.58MJ/kg DM) contents than controls respectively. But, Dz2012Ln0019 had the highest (P<0.05) TIVOMD (59.45%) value. In the present study haulm yield and grain yield were positively correlated. CPY was positively correlated with all studied agronomic traits with the exceptions of grain yield and harvest index. ME and TIVOMD were positively correlated with yield and yield components. In LMS higher (P<0.05) grain yield was obtained from DZ2012Ln0004 (1.22t/ha), DZ2012Ln0001 (1.07t/ha) and DZ2012Ln0005 (1.02t/ha) than controls. DZ2012Ln0005 (4.83 and 2.55t/ha), DZ2012Ln0013(4.67 and 2.46t/ha), DZ2012Ln0012 (4.43 and 2.42 t/ha) had significantly higher (P<0.05) values of haulm yield and haulm digestible dry matter yield than controls respectively. In PE Derash (2.81t/ha) had the highest (P<0.05) grain yield followed by Alemaya (2.09t/ha) andDz2012Ln0016(2.01t/ha). Significantly high (P<0.05) haulm yield and digestible dry matter yield were obtained from

Dz2012Ln0017(6.52 and 3.70t/ha) and Dz2012Ln0026(5.99 and 3.36 t/ha) respectively. Varieties with high haulm nutritional value were not found to be high in their potential utility index that may be, because of their lower values of harvest index due to infestation of mild parasites and incidence of diseases. *Key words: Calibration, Validation, Lentil Haulm, Food-Feed crops, NIRS, Nutritional values*.

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Indigenous Livestock Husbandry and Ethno Veterinary Practices in Endamohoni District of Tigray Region, Ethiopia

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Abstract : Indigenous knowledge is local knowledge that exists and buildup through experiences of the local community in the day-to-day practice and it is economically inexpensive. Farmers use their indigenous knowledge from time immemorial till today, thus it gives a good solution for their problems. However, this knowledge is not well studied, analyzed and documented to be used as a basis for farming system development. Therefore, this study was conducted with the objectives of identifying and documenting farmers' indigenous knowledge in livestock husbandry, and ethno veterinary practices in Endamohoni distric of southern Tigray. The woreda was purposively selected based on its contrasting agro-ecologies (lowland, midland, and highland) and potential of being the source of traditionally knowledgeable peoples who for generations have been associated with livestock rearing. Six kebeles (two kebeles from each of the three agroecologies) were selected as study sites. A total of 175 households (55 from lowland, 60 each from midland and highland), assumed to have a better indigenous knowledge in livestock production were selected for the study. A structured questionnaire was administered to the selected households to collect data on use of indigenous knowledge on livestock husbandry and ethno veterinary practices. After completing the questionnaires for each division, group discussions have been held and an informal meeting with the key informants for triangulation. Result indicated that 88.3, 76.7 and 92.7 % of the respondents in highland, midland and lowland agroecologies respectively were males. The level of education shows that of all the respondents, 55% in highland, 50% in midland and 72.73% in lowland were illiterate. Sheep and cattle in highlands and midlands and goat and cattle in lowland dominated the livestock populations. Shortage of feed in the study areas was ranked as the first constraints of animal production. Farmers use purchasing of crop residue in the highland and midland, destocking in the midland and movement (urna) in the lowland as mitigation mechanisms. Phenotypic selections of different animal species are employed and also keeping history of pedigree is important instrument in the breeding and selection of animals. Breeding of close related livestock is discouraged in the study sites. Seventeen animal diseases and38 aliments were recorded in the study areas and 65 medicinal plants were accordingly documented to treat those diseases. About 83% of the highland, 75 % of the midland and 92.7% of the lowland farmers acquire ethno veterinary knowledge from their old parents. Of the total medicinal plants, (81 %) were wild. In the preparation of the traditional medicine leaves constitute about 51% and 47 % of the medicine was administered orally. The most common preparation method is by crushing and squeezing (45 %). Farmers are aware of toxicity and provide antioxidants. Farmers used herbals (plants) in dairy utensils cleaning, fumigation, milk

processing and preservation. These knowledge and practices of livestock husbandry, animal health and product handling and processing should serve as the basis to develop further interventions to improve livestock productivity in the area. As most of the medicinal plants are grown in wild, it is very important to promote conservation in ex-situ and in-situ. And further biological studies should be conducted on the reported medicinal plant species of the study area so as to utilize them in drug development.

Key words: Indigenous knowledge, Ethno veterinary, Agroecology, Livestock husbandry, Medicinal plants Dairy product

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Analysis of Wheat Value Chain: The Case of Sinana District, Bale Zone, Oromia Region, Ethiopia

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Abstract	:	This study focused on the analysis of wheat value chain in Sinana district of Bale zone with specific objectives of analyzing the market structure-conduct-performance of wheat markets; identifying the determinants of wheat supply to the market and market outlet choice of wheat producers, and wheat value addition at different stages of the marketing chain. Primary data were collected from 120 farmers and 37 wheat traders using structured questionnaires. Descriptive statistics and Econometrics models were used to analyze the collected data. Results show that the main wheat value chain actors in the study area are input suppliers, farmers/producers, assemblers, wholesalers, processors, retailers, commission agents and cooperatives. Market concentration ratio at district level was 88.7% which indicated oligopolistic market structure. The result of 2SLS indicated that size of landholding, livestock ownership, family size and quantity of wheat produced influences amount of wheat supplied to market significantly. The multinomial logit model result indicated that the likelihood to choose wholesalers market outlet was significantly influenced by frequency of extension contact, distance from marketplace, own price of the commodity and membership to cooperative compared to accessing assemblers wheat market outlet. The likelihood of accessing cooperative wheat market outlet was significantly influenced by price given to the commodity and distance from marketplace compared to accessing assembler market outlet. The likelihood of accessing processors market outlet was significantly influenced by price of commodity, ownership of transportation facilities and distance of processors from production place. Result of probit model indicated that access to market information, quantity of wheat produced, distance from marketplace access to market information, access to extension and credit services significantly affected farmer's decision to be engaged in value addition. Therefore, policies aiming at increasing farmer's awareness of producing value-added wheat produce to enhance value creations are recommended to strengthen chain development. *Key words: Value chain, structure-conduct-performance, value addition, 2SLS, multinomial logit, market outlet*.
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Effects of Feeding Different Varieties of Faba Bean (*Vicia faba* L.) Straws with Concentrate on Feed Intake, Digestibility, Body Weight Gain and Carcass Characteristics of Arsi-Bale Sheep

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Abstract : A study was conducted using 40 yearling Arsi-Bale sheep with initial body weight of 19.85+0.29 kg (mean + SD). The objectives were to evaluate the varietal differences among faba bean straws and to evaluate effects of feeding different varieties of faba bean straws with concentrate (2 parts wheat bran: 1 part noug seed cake) fed at the rate 70% straws and 30% concentrate mixture on feed intake, digestibility, body weight gain and carcass characteristics of the animals. The varieties included Mosisa (T1), Walki (T2), Degaga (T3), Shallo (T4) and local (T5) which were grown at Sinana Agricultural Research Center. The experiment consisted of 7 days of digestibility trial and 90 days of feeding trial followed by evaluation of carcass parameters at the end of the feeding period. Randomized complete block design was used for the experiment. The experimental animals were grouped into eight blocks of five animals each based on their initial body weight and each animal within each block was randomly assigned to one of the five treatment diets. Yield were significantly different ($P<0.001$) among varieties evaluated. Crude protein (CP) contents of faba bean straws were 4.9, 5.1, 5.2, 4.3 and 6.2% for Mosisa, Walki, Degaga, Shallo and local respectively and that of wheat bran (WB) and "noug" seed cake (NSC) were 13 and 26.8% respectively. The DM intake of sheep in T2 (754.3 g/day) was higher ($P<0.001$) than T1, T4 and T5 but did not differ ($P>0.001$) from T3 (717.9 g/day) and sheep in T3 had higher ($P<0.001$) DM intake than sheep in T1 and T4. CP intake for T5 was significantly greater ($P<0.001$) than T3, T1 and T4 whereas no significant difference ($P>0.001$) from T2. The apparent digestibility of DM of T1, T2 and T3 were greater ($P<0.05$) than T4 but did not differ ($P>0.05$) from T5. The OM digestibility was significantly higher ($P<0.05$) for sheep in T2 than T4. The CP digestibility of sheep in T5 was higher ($P<0.001$) than that of T3 and T4 but similar ($P>0.001$) with sheep in T1 and T2 whereas CP digestibility of T1 and T2 were also higher ($P<0.001$) than T4. Sheep in T2 had greater ($P<0.01$) average daily gain (64.6 g/day) than sheep in T3 (43.2 g/day), T4 (37.5 g/day) and T5 (48.3 g/day) but no difference ($P>0.01$) from T1 (52.2 g/day). Feed conversion efficiency was higher ($P<0.05$) for sheep in T2 as compared to T3, T4 and T5 whereas similar with values obtained for T1. Slaughter body weight and empty body weight were higher ($P<0.05$) for sheep in T1 and T2 as compared to sheep in T4 but similar ($P>0.05$) among others. Apart from this, the other carcass components were not affected ($P>0.05$) by variety of the faba bean straws. It can be concluded that there is significant difference between faba bean straws from different varieties in feed intake, digestibility, body weight gain and feed conversion efficiency and that faba bean straws when supplemented with concentrate had higher potential as animal feed. Based on these results, Walki and Mosisa varieties could be recommended as pulse crop rotation with cereals in the study area.

Key words: Arsi Bale sheep, Body weight gain, Digestibility, Faba bean Straw, Intake

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Effect of Faba bean (*Vicia faba* L.)-forage Intercropping: Benefits and Trade-offs to Improve Feed Resources in Lemo Woreda, Southern Ethiopia

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Abstract : Faba bean (Vicia faba L.), also called 'broad bean, horse bean' is an annual crop, which mainly grows in the highlands of Ethiopia for human consumption. The objective of this study was to evaluate the effects of intercropping faba bean varieties with oat fodder on forage biomass, straw, grain yields, and straw quality. For the household survey 108 households (HHs) were selected from two kebeles (53 from Upper Gana and 55 from Jawe kebeles). The average HH family size, land and livestock holdings were 5.53 heads, 1.39 ha and 6.73 heads, respectively. Cultivation of forage crops was not widely practiced in the Woreda, but farmers have an experience of not weeding faba bean plots to get more weed biomass. The field trial involved a 3×5 factorial experiment with three replications, whereby three faba bean growing management practices were tested with five faba bean varieties. Samples were taken from each treatment plots. The highest ($P<0.01$) tiller count, number of pods per plant (PPP), seeds per pod (SPP) and grain yield was under improved management, whereas the lowest ($P<0.01$) was under intercropping management practice. The highest ($P=0.0053$) faba bean straw dry matter yield (DMY) (t ha-1) was for Tumsa under improved (9.82) and the lowest ($P=0.0053$) straw dry matter yield (DMY) (t ha-1) was for CS-20DK (1.70) under intercropping management practice. The total feed dry matter (DM), crude protein (CP) and metabolizable energy yields were greater ($P<0.05$) under intercropping than the remaining management practices. Walki (12.36%) under intercropping had the highest CP content and the lowest CP contents were observed for Tumsa (6.73%) and Dosha (6.65%) under traditional management. The mean CP content was highest ($P<0.05$) under intercropping and lowest ($P<0.05$) in traditional management practice. The NDF content was lower under intercropping than the remaining management practices. The ADF content (%) varied from 51.72(Walki) to 64.3 (Gebelchu), 45.38 (CS-20DK) to 68.27 (Gebelchu) and from 46.47 (Walki) to 62.39 (Tumsa) under traditional, improved and intercropping management. The highest ($P=0.0306$) acid detergent lignin content was observed for Dosha in improved management and the lowest ($P=0.0306$) was for Walki and CS-20DK under intercropping management. In vitro true organic matter digestibility value (%) ranged from 43.32 (Tumsa) to 51.11 (CS-20DK) in traditional management, from 45.72 (Tumsa) to 51.02 (Walki) under improved management and from 46.47 (Tumsa) to 55.71 (CS-20DK) under intercropping management practice. In vitro true dry matter digestibility (IVTDMD) value was higher ($P<0.05$) under intercropping than other management practices. The metabolizable energy value (MJ/kg DM) was highest ($P=0.0398$) for CS-20DK (7.97) under intercropping and lowest for Tumsa (6.19) in traditional management practice. Also intercropping management gave highest net benefit (49319 ETB ha1) as compared to the remaining management practice.

It can be concluded that intercropping based on different faba bean varieties with oats could be feasible to provide reasonable nutritive value of forages in the crop-livestock systems of Ethiopia.

Key words: Variety, faba bean, management practice, chemical composition, digestibility.

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Spatial modelling of soil and water conservation activities for a catchment in the Ethiopian Highlands

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Completion Date	:	March 2016
Abstract	:	This thesis focused on the use of soil and water conservation (SWC) planning tools to address two ecosystem services (ES's), erosion control (EC) and dry season baseflow enhancement (BF). The study site was a headwater catchment encompassing Gudo Beret town located in the central sub-humid highlands of Ethiopia. The aims of the thesis were to 1) model the current soil loss risk for the catchment, 2) to simulate a spatial allocation of recommended SWC activities throughout the catchment while giving different weights to the ES objectives, and 3) to estimate potential changes in soil loss and in the water balance as a result of those simulated activity scenarios. In the study, a number of tools and procedures were used: field observations to map erosion hotspots, participatory dialogues with focus groups, remote sensing to generate a land use/land cover (LULC) map, a water balance calculation, and GIS-based spatial modelling tools. The current soil loss risk was predicted for the Gudo Beret catchment using the Revised Universal Soil Loss Equation (RUSLE). Erosion at Gudo Beret was found to far exceed safe limits, with soil loss from rainfed cropland estimated at 47 t ha-1 yr-1 (□=82). Estimates of soil loss compared favorably with measurements and estimates from other sub-humid highland catchments in Ethiopia, but are believed to have significantly under-predicted total losses due to the prevalence of gullies in the study area. The Resource Investment Optimization System (RIOS) tool was used to locate the most "responsive" sites to SWC. Three scenarios were tested in which EC and BF were weighted according to the ratios 1:1, 2:1, and 1:0. RIOS performed a spatial allocation of the activities and produced a hypothetical post SWC LULC map to represent changes in biophysical parameters where activities were allocated. Soil loss was then estimated for the entire catchment for the hypothetical scenarios and a simplified water balance was performed for the rainfed cropland LULC class to assess the potential impact on baseflow, using the soil water storage/drainage term of the water balance as a proxy. The analysis that followed found that soil loss and soil water storage/drainage were not significantly different between the scenarios. The lack of significance between outcomes of the scenarios was attributed to low data quality for some inputs and the relatively small catchment size – both of which suppressed spatial variability which is needed to produce contrasting relative rankings for the ES objectives in RIOS. Recommendations for improving RIOS were given. Despite the results, the model's unique approach draws attention to both the need to target multiple ES objectives in future conservation goals as well as to account for the offsite benefits of SWC.
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Variability in Food-Feed Traits in Chickpea (*Cicer arietinum*) Varieties

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Degree Received	:	MSc (Animal Production)
Completion Date	:	March 2016
Abstract	:	The study was conducted with the objectives of analyzing and developing Near Infrared Reflectance Spectroscopy (NIRS) equation for predicting nutritional value and mineral constituents of chickpea haulm, and to determine the relationship between fodder quality and agronomic traits of chickpea. The samples were collected from Akaki, Alem Tena, Chefe Donsa, Debre-zeit and Minjar field experimental sites of Debre zeit Agricultural Research Center and the laboratory work was conducted at Animal Nutrition laboratory of the International Livestock Research Institute (ILRI), Addis Ababa. A total of 105 tested and 8 control genotypes with 1348 samples of chickpea haulms from preliminary and national variety trials were used for NIRS prediction. Calibration models were developed between chemical and NIRS spectral data. Randomized Complete Block Design with 4 replications was used in the experiment. The plot size was 4m x 1.2m (4rows/plot), 30cm between rows and about 10cm between plants spacing was used. All management activities were done. Statistical analysis of the data was carried out using the General Linear Model (GLM) procedure of SAS (Statistical Analysis System) used for analyzing the data with samples of 597 chickpea haulms from national variety trials. The model developed by NIRS for the prediction of chickpea haulm Crude Protein (CP), ME (Metabolizable Energy), TIVOMD (True In Vitro Organic Matter Digestibility) values and fiber fractions were accurate and successful method. The coefficients of determination for Calibration (r2c), validation (r2v) and Ratio Performance Deviation (RPD) of chemical constituents were within the range of 0.97-0.99, 0.96-0.99 and 3.61-26, respectively. The r2c, r2v and RPD for minerals were between the range of 0.71-0.99, 0.68-0.92 and 1.58-3.55, respectively. Higher CP value was recorded in kabuli and desi type chickpea at Debre zeit, Alem Tena and Minjar locations. Dz2012ck0084 and dz2012ck0018 had higher ($P<0.05$) CP, ME, TIVOMD and lower in fiber fractions for moisture stress area. On the other hand, dz2012ck0036 had higher grain yield. The CP content of the haulm was significantly ($p<0.001$) higher and negatively correlated with days to 90% maturity (DTM), grain yield (GYLD), biomass (BM) and haulm yield (HYLD). Moreover, the ME and TIVOMD were negatively correlated to all agronomic traits, except hundred seed weight (HSW). The highest correlation coefficient with strong associations ($p<0.001$) were observed for BM with HYLD ($r=0.90$), BM with GYLD ($r=0.82$), GYLD with HYLD ($r= 0.51$) and DTF with DTM ($r= 0.63$). Grain yield was positively and significant ($p<0.001$) correlated with DTM and BM and also significantly ($p<0.001$) and negatively correlated with HSW. Genotypes which combined moderately high grain and haulm yield, better haulm quality traits and ultimately medium potential utility index were Dz2012ck000024, Ejere, Chefe and Dz2012ck0017 from kabuli for moisture stress area, Dz2012ck0007, Dz2012ck0001, Dz2012ck0012, Arerti and Dz2012ck0004 from kabuli for

potential environment, Dz2012ck0036, Dz2012ck0031 and Dz2012ck0029 and Natoli from desi type chickpea. Generally, the present showed the possibility for simultaneous improvement of high grain and haulm yield with desirable haulm quality traits to address the high demand existing for dual purpose food-feed traits of chickpea genotypes in mixed-livestock system of Ethiopia.

Keywords: Calibration equations, chemical composition, chickpea haulms, genotypes, mineral, multi- location, NIRS, nutritional quality.

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Effect of Graded Levels of Tagasaste (*Chamaecytisus palmensis*) Leaves Supplementation on Performance of Yearling Menz Sheep in Ethiopian Highlands

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Degree Received	:	MSc (Animal Nutrition)
Completion Date	:	May 2016
Abstract	:	The effects of supplementation with graded levels of tagasaste (Chamaecytisus palmensis) leaves on feed intake, digestibility, and body weight gain (BWG) and carcass characteristics were studied using thirty yearling and intact male Menz sheep. The sheep were blocked into six blocks of five sheep based on their initial body weight and animals from each block were randomly assigned to five treatment groups with six replications per treatment in randomized complete block design (RBCD). Barley straw was fed ad libitum as a sole diet in treatment 1 (T1) and as a basal diet supplemented with 100, 200, 300 and 400g dried tagasaste leaf in the other treatments i.e. T2, T3, T4 and T5, respectively. A 90day growth experiment and 7- day digestibility trial were conducted. Dry matter (DM), organic matter (OM), and crude protein (CP) intakes increased ($P<0.05$) with increasing levels of tagasaste leaf in the diets. Sheep fed T1, T2, T3, T4, and T5 diets gained ($P<0.05$) -5.5, 19.2, 40.7, 61.8 and 71.8 g/head/ day, respectively. The apparent digestibility of DM, OM, CP, neutral detergent fiber and acid detergent fiber significantly increased ($P<0.05$) with increasing levels of tagasaste leaf supplementation. The hot carcass weight showed a significant increase from T1 (6.9 kg) to T5 (11 kg) with increasing level of supplementation. Dressing percentage on slaughter weight basis and empty body weight basis did not differ ($P>0.05$) among treatments, but dressing percentage on empty body weight basis have higher than on slaughter weight basis this imply that the influence of digesta. Supplementing a basal diet of barley straw with tagasaste leaves improved DM intake, BWG, digestibility of nutrients and carcass. It is concluded that 400g/d/head of tagasaste leaf can serve as a protein supplement to low quality feed during dry season for efficient performance of sheep. *Key words: Chamaecytisus palmensis, Supplementation, Body weight, feed intake, Carcass, Menz Sheep*
Permanent Link	:	https://hdl.handle.net/10568/78131

Growth Performance and Nutritive Quality of Tree Lucerne (*Chamaecytisus Palmensis*) Fodder under Different Management Conditions in the High Lands of Ethiopia

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Degree Received : MSc (Animal Production)
Completion Date : June 2016

Abstract : Tagasaste (Chamaecytisus palmensis), also known as tree Lucerne, is an evergreen, hardy leguminous shrub that is adapted to high lands of Ethiopia. The objective of this study was to evaluate growth performance of tree lucerne in terms of survival, root collar diameter (RCD), plant height and biomass yield as influenced by different management. To conduct the present study three highlands districts (woredas) located in southern region (Lemo), in Oromia region (Sinana) and Tigrai region (Endamehoni) were selected. Within each woreda, two kebeles were purposely selected to be used as action sites, and from each kebele a minimum of 25 farmers were selected to participate in tree Lucerne adaptation trials. Each farmer received about 150 seedlings to plant and grow. Data were collected on feed resources, household characteristics and survival and performance of the seedlings. The tree lucerne fodder plots established and performed well were used to collect data on the effect of cutting height, and cutting frequency on the biomass yield of fodder. The fodder plants were subjected to two cutting heights (1m and 1.5m), and three cutting frequencies (2, 3, 4 times per year). The average household family size and livestock holdings were 8.08 heads and 10.35 heads, respectively. According to the result about 66% of the land was used for crop cultivation and the remaining 34% was apportioned into improved forage and other back yard trees in the study area. About 85.4% respondents perceived that the landholding size is decreasing, while about 13% of the farmers said that it remained stable over the years. Grazing (both private and communal) contributed the largest share of the feed resources, followed by crop residues. About 44% of the farmers mentioned that their main reason for engaging in tree lucerne cultivation is to produce livestock feed supplement. The maximum survival rate was observed for plants which grew around backyard on small plot followed by that grown on the contour lines, whereas the lowest survival rate was achieved from plants grown around waterlogged areas. Transplanting too small seedlings showed lower ($p<0.05$) survival rate as compared to the remaining agronomic and management practices. Planting space of 100cm between rows and 100cm between plants resulted in significantly ($p<0.05$) higher dry matter yield than 50x50cm spacing. Tree lucerne showed accelerated growth in terms of height and RCD after six months. Annual biomass production was substantially greater for six months cutting interval than for the more frequent harvests in a range of 4.17 to 8.22 t ha-1. Whereas, the two cutting height not showed significant ($p<0.05$) differences on biomass yield. Leaf proportion of the biomass yield consistently decreased from 63.55 to 54.52% and the stem increased from 2.38 to 16.54% as the cutting interval prolonged from three to six months, respectively. The crude protein contents for the month of June (28%) was significantly ($p<0.05$) higher than that of

October (24.6%), whereas, the other months had intermediate value. There were no significant ($p<0.05$) differences in IVOMD and ME contents among the different cutting months. The current study revealed that with proper management practices, tree Lucerne can be a suitable protein supplement for ruminant livestock in the study areas.

Key words: cutting height, cutting interval, botanical fractions, digestively, crude protein

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Estimating Water balance of Tegona watershed in south eastern Ethiopia using SWAT Model

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Completion Date	:	June 2016
Abstract	:	Water resource development is certainly the basic and crucial infrastructure for a nation's sustainable development. To utilize water resources in a sustainable manner, it is necessary to understand the quantity and quality in space and time. This study was initiated with the objective of evaluating the performance and applicability of the Soil and Water Assessment Tool (SWAT) in analyzing the influence of hydrologic parameters on the stream flow variability and estimation of monthly water yield at the outlet of Tegona river watershed in Bale mountainous area. The total 468 km2 area of the watershed was subdivided into 12 sub-basins and 60 hydrologic response units (HRUs). Sensitivity analysis, model calibration and validation were made to evaluate the model performance for simulation of stream flow on monthly time step. The calibrated SWAT model performed well for simulation of monthly stream flow. Statistical model performance measures, coefficient of determination (r^2) of 0.71, the Nash-Sutcliffe simulation efficiency (ENS) of 0.77 and Percent difference (D) of 8.33, for monthly calibration and 0.86, 0.83 and -12.25 respectively for validation, indicated good to very good performance of the model simulation. Mean monthly and annual water yield simulated with the calibrated model were found to be 23.7 mm and 284.2 mm, respectively. The model slightly overestimated the flow on most of rainy months. The baseflow separation result indicated that subsurface flow was source of water in the study watershed. Overall, the model demonstrated good performance in capturing the patterns and trend of the observed flow series, which confirmed the appropriateness of the model for future scenario simulation. Therefore, it is recommended that SWAT model can be a potential tool for simulation of stream flow and water balance components of ungauged watershed in the highlands of Ethiopia with similar hydro-meteorological characteristics to Tegona watershed.
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Improving the Quality and Quantity of Forages Produced from Intercropping of Faba Bean with Forage Oats in Lemo Woreda, Hadiya Zone, Southern Ethiopia

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Completion Date	:	August 2016
Abstract	:	Faba bean (Vicia faba L.), also called broad bean or horse bean is an annual crop, which mainly grows in the highlands of Ethiopia for human consumption. The objective of this study was to improve the quantity and quality of forages produced from intercropping of faba bean (Vicia faba L.) with forage oats (Avena sativa L.) on forage biomass, straw, grain yields, and straw quality. Farmers have an experience of not weeding faba bean plots to get more weed biomass. The field trial involved each farmer has 2(10×30) m2 large plots and each plot divided in to (3*10) m2 for two faba bean varieties and three treatment practices. The land was selected carefully for uniformity of slope and fertility. Soil was prepared carefully before sowing. Samples were taken from each treatment plots beginning before soil samples from the upper 15 cm to lower 30cm, the final after harvest soil sample from each treatment plot. The highest (P<0.01) tiller count, number of pods per plant (PPP), seeds per pod (SPP) and grain yield was under improved management, whereas the lowest (P<0.01) was obtained from intercropping management practice. The total feed dry matter (DM), crude protein (CP) and metabolizable energy yields were greater (P<0.05) under intercropping than the remaining management practices. Gebelcho under intercropping had the highest CP content (9.53%) and the lowest CP contents were observed for Dosha under traditional management (6.84%). The mean CP content was highest (P<0.05) under intercropping and lowest (P<0.05) in traditional management practice. The NDF content was lower under intercropping than the remaining management practices. In vitro true organic matter digestibility value (%) ranged from 55.9 (Gebelcho) traditional to 65.9 (Dosha) intercropping management practice. In vitro true dry matter digestibility (IVTDMD) value was higher (P<0.05) under intercropping than other management practices. Generally intercropping management gave higher net benefit and particularly intercropping the variety Dosha (41869ETB ha-1) gave highest net benefit as compared to the remaining variety and management practices. It can be concluded that intercropping faba bean with oats could be feasible to provide reasonable nutritive value of forages without or less affecting the faba bean grain yield in the crop-livestock production systems of Ethiopia. *Key words: biomass, chemical composition, digestibility, faba bean, management practice, variety, yield*
Permanent Link	:	https://hdl.handle.net/10568/78136

Adoption and Welfare Impact of Improved Food Legume Technologies in Bale Highlands of Ethiopia: Intra and Inter-Household Empirical Analysis

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Degree Received : MSc (Agricultural Economics)
Completion Date : August 2016

Abstract : This study was designed to investigate the adoption of improved food legume technologies and welfare impacts of improved food legume varieties specifically on income, consumption expenditure and calorie intake in Bale highlands of Ethiopia. The study focused particularly on the identification of factors determining adoption of improved food legume technologies, evaluation of welfare impacts of adoption status and intensity of improved food legume varieties, identifying intra-household impact dynamics due to adoption of improved legume varieties and spotting out the major challenges and opportunities faced by smallholders in their adoption of improved food legume technologies.. This study used cross sectional data that acquired from a total of 600 households, which were randomly and proportionately sampled from 12 major legume producer kebeles in 3 districts of Bale highlands by using three-stage sampling technique. Probit and Clog-log binary model were estimated to identify the underlying factors that determine adoption of improved food legume varieties; and fertilizer and pesticide, respectively and separately. PSM model was estimated to evaluate the welfare impacts of adoption of improved food legume varieties. In addition, continuous treatment effects model (GPS) was also employed to estimate the welfare impact of intensity of adoption by discarding non-adopters from the analysis. The results from probit and clog-log indicate that age, livestock holding, farm size, membership in farmers cooperatives, contact with agricultural research center, household head participation in off-farm activity, distance from agricultural extension office and main market; and location (district dummy) were factors that significantly determine farmers decision to adopt improved food legume technologies. The study also indicates that adoption of improved food legume technologies can motivate farmers to shift from the monocropping system to diversified one, improve income since they fetch higher prices than common cereals and they are the major source of protein for the household who cannot acquire it from animal products. However, adoption of improved food legume technologies is highly constrained by labor-intensive nature of the production, lack of improved food legume technologies especially waterlogging tolerant varieties and market irregularities. The outputs from PSM indicate that adoption of improved food legume varieties has positive and significant impact on the income and the adopter receive 25% higher income than non-adopter. The intra household analysis indicated that households with productive labor force receive better treatment effect while households with economically dependents female members receive considerably lower treatment effects from adoption of improved food legume varieties, suggesting the prevalent intra-household differences. The result of GPS also confirms the positive effect of intensity of adoption on income,

consumption expenditure and calorie intake. The results generally suggest the need to design interventions enhancing adoption of food legume technologies focusing on improving adoption rates and minimizing intra household difference in income.

Key words: Adoption, Impact, Food Legume Technologies, Probit, Clog-log, PSM, GPS, Bale Highland, Ethiopia

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Agrobiodiversity conservation practices and gender consideration in Sinana district, southeastern Ethiopia

Title of Thesis/ Dissertation	:	Agrobiodiversity conservation practices and gender consideration in Sinana district, southeastern Ethiopia
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Degree Received	:	MSc (Ecosystem and Biodiversity Conservation)
Completion Date	:	September 2016
Abstract	:	Agricultural biodiversity have significant role in food security, environmental protection, income generation and cultural values and many conservation activities are performed by women but no recognition is given to them as important contributors. Many conservation activities are performed by women but due to unbalanced decision making roles in resource allocation, monocropping has increased from time to time resulting into decrease in nutritious crops, income diversification and increase in environmental problems (like soil and air pollution due to the use of high insect and pest side). The study was carried out in Sinana district, south east of Ethiopia between November 2015 to June 2016 to investigate agrobiodiversity practices and the role of gender in its conservation. A sample of 364 respondents was selected using simple random sampling technique from four kebeles (villages). Using a semi structured questionnaire, data were collected from 182 female respondents, of which, 91 were married women and 91 female household heads; and 182 were male household heads. In addition, twelve focus group discussions (FGDs) were conducted with farmers' (three groups per kebele) Data were analyzed using SPSS version 20 software to generate descriptive statistics. Chi-square was used to analyze the participation level in agricultural activities by women and men. Pearson correlation was used to test the relationship between gender, age, land size, land ownership and diversity. In addition, Simpson's index (D) = (1-$\sum$ Pi2) also used to identify the diversity of plants and animals that are used by women and men. The results show that rural women, cultivate and domesticate more diversified crops/plants and livestock respectively than men on their land holding. Women participated in all farming activities including decision making, land preparation, seed selection, crop management (weeding, storing, pest control), harvesting and selling commodities and animal domestication. But their participation level has significant Variation on each activity performed in agricultural (P=0.01), and also crop diversity by using Simpson's index (agricultural diversity on men's land = 0.864) and that for women's land =0.84), which plays a great role in conserving agricultural diversity. So, there is need to create opportunities for rural women to improve their level of participation and decision making in farming activities for conserving agricultural diversities through well organized and integrated awareness creation, experience sharing, promoting women's work, identifying constraints and exposing women to different simple technologies.
		Keywords: Biodiversity, Gender, Participation
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Assessment of surface water resource and irrigation practices in Gudo Beret Kebele, Amhara region, Ethiopia

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Degree Received : MSc (Geography and Environmental Studies)
Completion Date : May 2019

Abstract : "Ethiopia is mainly an agrarian nation and the rainfed system has always played a central role in supporting its society. Agriculture is the core driver for Ethiopia's growth and long-term food security. Cultivable land area of the country is estimated to be between 30 - 70 million hectares. Currently, some estimates show that only 15 million hectares of land is under cultivation. From the existing cultivated area only about 4 to 5 percent is irrigated. The development of irrigation and agricultural water management thus holds significant potential to improve productivity and reduce vulnerability to climactic volatility in the country. Though Ethiopia has abundant water resources, its agricultural system does not yet fully benefit from the technologies of water management and irrigation. In mixed crop–livestock systems, irrigation can increase crop yield and livestock feed supply through increased crop productivity and residues of food–feed crops. Irrigation also serves as a buffer against drought. GISs and simulation models have contributed to the identification and evaluation of potential solutions to water resource problems during the past decade. Understanding the water resource potential of an area can help devise mechanism for efficient use and maximize benefits while minimizing potential conflicts. GIS and hydrological models can be used to understand the spatial dynamics and dynamics and distribution as well as determinants of water resources within landscape. The main objective of this research is to assess the water resources potential and examine major constraints of the present water resource management and irrigation practices in the Gudo Beret area of the North Shewa Zone of Amhara Regional State. Specific objectives include: Analysis of surface water resources, land use/cover types and irrigable area; identify the constraints of irrigation and water management practices; examine the current policy and by-laws related to irrigation water management and examine the gender and nutrition aspect of small-scale irrigation practice. Relevant spatial data were gathered from high resolution satellite image (PALADIS), soil depth base map, topographic maps and ground survey and GPSs. Non-spatial data were acquired through interview, questionnaire, written sources. Simple random sampling has been employed to select sample irrigation scheme and sample respondents. Analysis of results shows that five rivers and nine springs are available in the study area. The study also identifies six major types of land use/cover (i.e. bare land, built up, farmland, forest, grass land and water bodies). Forty percent of the farm and grass land and 29% of total area were irrigable land. The most important irrigation related constraints observed include seasonal water shortage, unavailability and less utility of technologies, limited market and absence of irrigation canal to save water loss. Local communities have good institutional by-law to govern water use and irrigation scheduling as well as conflict

resolving methods. Also in the study area participation of women in irrigation farming has increased by 29.7% within ten years. This could both improve food security and income and also buffers crop failure due to drought. There is also a possibility of improvement in human and livestock nutrition as irrigation facilitates diversification.

Key words: Water resources, management, irrigation, agricultural technologies, GIS, Gudo Beret

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The Effect of improved fodder production on livestock productivity in Endamehoni District, Southern Tigray, Ethiopia

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Degree Received	:	MSc (Land Resource Management and Environmental Protection)
Completion Date	:	December 2016

Abstract : Feed shortage and low quality of available feeds are constraints for livestock production in the highlands of Ethiopia. Improved fodder production combined with appropriate postharvest handling practices have been practiced to alleviate the problems. The objective of this study was to evaluate the perception of farmers on improved fodder and quantify the effects of improved fodder in livestock performance, forage yield and quality of intercropped oat-vetch and benefits obtained from the fodder production. The study involved both field observation and questionnaire with 40 purposively selected livestock owners who practiced improved fodder production. The effect of cultivated oat-vetch supplementation on daily body weight gain and milk yield was quantified using 8 oxen, 7 cows and 3 sheep. Forage biomass yield on dry matter (DM) basis was calculated after drying a sample of 300g green forage in an oven at 60^0C for 48 hours. SAS was used to carry out descriptive statistics on questionnaire data and field observation variables. Feed shortage has been a major constraint for animal production during dry periods and farmers use different coping mechanisms ranging from purchasing of feeds from the market and destocking unproductive animals. The majority of the interviewed households practice irrigation and produce cultivated fodders such as oat-vetch, alfalfa, phalaris and elephant grass. The oat-vetch mixture DM yield in Embahasti (8.71 t/ha) was significantly higher than that in Tsibet (6.48 t/ha), ($P<0.05$). The mean DM, Ash, OM, CP, NDF, ADF and ADL content of oat-vetch mixture were 94.4, 8.9, 91.1, 11.9, 65.9, 45.9 and 6.1, respectively. The TIVOMD (%) and ME (MJ/kg DM) of oat-vetch mixture were also 60.2 and 8.85, respectively. All respondent farmers replied that supplementation of cultivated fodders to their animals have resulted in positive impact on milk yield, body weight gain, health and coat color of their animals. On-farm observation of the performance of animals indicated that supplemented cows, oxen and sheep were able to gain 293, 265 and 88.9 g of weight per day respectively. The average daily gain of crossbreed cattle and local cattle breed were 161 and 307g, respectively. Moreover, the oat-vetch supplementation resulted in daily additional milk yield of 2.33 liters per cow for crossbreed cattle, and 1.0 liters per cow for local cattle. Development of fodder plants, such as herbaceous forage legumes and fodder trees species in their farmland can mitigate the constraints of feed scarcity and improves livestock productivity. The study recommends the development of fodder plants, such as herbaceous forage legumes and fodder trees species in their farmland which can mitigate the constraints of feed scarcity and their expensive price.

Key words: breeds, oat-vetch mixture, productivity, crossbreed, body weight, milk yield

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Analyzing Performances of Selected Sustainable Land Management Practices in Gina Beret Watershed, North Shoa

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Completion Date	:	December 2016
Abstract	:	The study was conducted at Basona Werana Woreda North Shewa zone. Land degradation, which includes degradation of vegetation cover, soil degradation and nutrient depletion, is a major ecological problem generally in Ethiopia and particularly in the study area. As a response of the ever-expanding land degradation, rehabilitation of degraded lands through intervention of Sustainable land management has been practiced in the study area. Despite these efforts, there are no studies in the area, which would provide information on the effectiveness of different intervened sustainable land management practices for further up scaling in the study area. The main aim of the study is to identify, characterize and examine the performance of selected sustainable land management practices in the study area. Selected sustainable land management practices include Tree Lucerne with stone bund, Phalaris with Stone bund, only stone bund, which was introduced in the past three years and area without Sustainable Land Management practice as a control was compared with each other in selected farmlands. All 30 houses hold farmers of the watershed, 5 five key informants and 12 farmlands were selected purposively for the survey and data obtained from agriculture experts of the Kebele. Data collection method include transect work, questionnaire survey, key informant interviews and field observation. Transects were used to collect soil samples and questionnaires to gather the necessary information from the sampled households and key informants. A total of 24 soil samples were taken from selected areas. Six soil samples were taken from each practice site. The samples were compared for selected nutrient. The results of soil chemical property analysis revealed that, the status of soil organic matter, total nitrogen and available phosphorous of the soil with each selected sustainable land management practice showed significant difference. Sustainable land management practices improved farmland soil fertility through maintaining organic matter and plant nutrients and improving soil structure increasing water infiltration and reducing run off. The reason for soil fertility differences may not only be the introduction of set of sustainable land management practices but also to the difference in land management history of the farmlands. The decline in fertility of the soil without the practices may be the removal of plant nutrient by erosion and depletion of soil. The farmers prioritize sustainable land management practices phalaris with stone bund first Tree Lucerne with stone bund second and finally the stone bund are very effective in improving farm land soil fertility. Finally, based on the findings of the study, it has been recommended that farmers have to be encouraged and need to be aware from planning phase to implementation in improving the quality of measures. They have to protect bunds from grazing, practice cut and carry for stall feeding and carry out the maintenance of the structures by

themselves. They have to introduce combinations of land management practices with good land management for effective crop land improvement in order to achieve sustainability and food security.

Keywords: Soil degradation, Sustainable land management, farmers' perception, soil quality, Stone bund, Tree Lucerne, Phalaris.

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Mapping and Quantification of Crop-Livestock Interventions in Africa RISING Sites of Ethiopian Highlands

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Degree Received	:	MSc (Agricultural Economics)
Completion Date	:	May 2017

Abstract : Agriculture is the backbone of the Ethiopian economy and therefore this particular sector determines the growth of all the other sectors and, consequently, the whole national economy. The agricultural sector contributes 42% to the country's GDP, on average, crop production makes up 60% of the sector's outputs whereas livestock accounts for 27% and other areas contribute 13% of the total agricultural value added (CSA, 2015). The sector is dominated by small-scale farmers who practice rain-fed mixed farming by employing traditional technology, adopting a low input and low output production system. RD&E in smallholder agriculture often focuses on specific elements of the farming system, sometimes leading to the introduction of improved agricultural technologies. There has been a plenty of efforts to achieve sustainable intensification in agricultural production, but many efforts fail to map the dissemination of the crop-livestock interventions, to quantify the inputs saved and the extra amount of outputs obtained by the use of improved technologies and to identify the factors affecting the dissemination of the crop-livestock intervention. As a result, this study was conducted with the objectives of mapping the dissemination of the crop-livestock interventions, quantification of the inputs saved and extra outputs obtained and identification of the factors affecting the dissemination. The study was conducted in the eight kebeles of four districts; Lemo from Hadiya Zone, South region; Sinana from Bale Zone, Oromia region; Basona Worena from North Shewa Zone, Amhara region and Endamehoni from South Tigray Zone, Tigray region. In order to generate relevant data, 160 farm households who were participating in the Africa RISING project were selected using multistage sampling technique. This study also showed that potato (ware and seed) varieties introduced by the project propagated within and outside of the intervention locations. Farmers liked potato for its adaptability and high productivity in all four locations. The duality of the function (food and income) of the potato for the smallholders households make it the most disseminating crop across all sites. Potato yield on average was 16 tons per hectare whereas the existing national average was 10 tons per hectare. An average yield of wheat was 21.5 quintals per hectare, average barley yield was 13 quintals and average faba bean yield was 14 quintals per hectare. Interms of profitability potato could fetch on average 62713 birr per hectare when the market price is high, but due to the perishability of the potato and market fluctuation, the net return is not consistent. Faba bean returns about 25866 birr per hectare and wheat returns 10187 birr per hectare whereas barley returns on average 3361 birr per hectare. The most important factors affecting the dissemination of the crop-livestock interventions in the study areas are: education level of the farmers in schooling years, technology characteristics of the interventions,

farmers' perception about the yield, and time after the intervention, extension contact and communication channels. Hence, the future crop livestock interventions seeking to achieve sustainable intensification should carefully consider and choose improved agricultural technologies suitable for the particular agro-ecologies and should give due attention for the factors that affect the dissemination of the crop-livestock technologies.

Key words: Crop, livestock, interventions, sustainable, intensification, dissemination, mapping, quantification.

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Biomass Yield and Nutritive Value of Sweet Lupine in Mid Altitudes of Lemo District, Hadiya Zone, Southern Ethiopia

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Degree Received	:	MSc (Animal Nutrition)
Completion Date	:	November 2017
Abstract	:	The study was conducted to determine the biomass yield and nutritive value of sweet lupine varieties in mid altitudes of Lemo district, Hadiya zone, southern Ethiopia. The study involved a factorial experiment arranged in a randomized complete block design with three replications. The treatments for the study were two sweet lupine varieties (Vitabore (V1) and Sanabore (V2), six levels of Planting spacing (30cmx7cm (S1), 40cmx7cm (S2), 30cmx15cm (S3), 40cmx15cm (S4) 30cmx20cm (S5) and 40cmx20cm (S6) and two locations (Upper gana and Jewe kebeles). Agronomic attributes, yield, chemical composition, and in vitro digestibility values were studied. The data were subjected to analysis of variance and correlation analysis. Sweet lupine varieties in Upper gana kebele gave the highest green forage yield (39.58 t/ha) and forage dry matter (4.84 t/ha) at 30 cm x 7cm planting spacing. Grain yield (GYD) was significantly (P<0.001) affected by location, being 2.98 t/ha at Upper gana, and 2.15 t/ha at Jewe. Vitabor in Jewe kebele gave higher forage DM content (15.63%) while sanabor had higher forage ADF content (38.86 %) in Upper gana kebele. Sweet lupine forage in Jewe kebele gave the highest organic matter (87.01%) and acid detergent fiber (37.50 %) content at stage of 100 % flowering respectively. The effect of location (L), stage of flowering (SF) and planting spacing(S) on sweet lupine forage crude protein (CP) content was highly significant (P < 0.01). Metabolizable energy content of sweet lupine forage was significantly (P < 0.01) affected by both location and stage of flowering. Sweet lupine forage in Upper gana kebele gave the highest CP content (23.11%) while sweet lupine varieties at 50% flowering had the highest forage CP content (23.03%). The highest forage CP content was recorded in sweet lupine which was planted at 40 cm × 20 cm (23.67 %). The highest metabolizable energy content was obtained in Jewe kebele (9.31MJ/kg) and at stage of 100% flowering (9.44MJ/kg). In vitro organic matter digestibility (IVOMD) of sweet lupine forage was highly affected (P < 0.01) by both location (L) and planting spacing (S). Sweet lupine forage gave the maximum in vitro OM digestibility (68.15%) in Upper gana kebele while planting at a spacing of 40x20 cm gave the highest in vitro OM digestibility (69.10%). Sweet lupine grain crude protein (CP) content and in vitro organic matter digestibility (IVOMD) was highly (P<0.01) affected by location. The highest CP (29.11%) content and IVOMD (80.49%) sweet lupine grain recorded in Upper gana kebele. *Keywords: Sweet lupine Variety, planting Spacing, agronomic attributes, Yield, Chemical composition*
Permanent Link	:	https://hdl.handle.net/10568/103250

The implications of Climate Smart Agriculture on soil fertility and productivity: the case of Tula-Jana landscape, SNNPR Ethiopia

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Completion Date	:	June 2018
Abstract	:	Adopting agricultural technologies such as CSA which aims to improve productivity and promote environmental sustainability remains the top agenda for international organizations. Yet, the impacts of these technologies on achieving the goal of food security and environmental sustainability has not been deeply explored. This study was conducted with the objective of assessing the implications of adopting climate smart technologies on soil fertility and productivity. The study employed a comparative analysis between CSA adopters and BAU with 0 year of intervention. Soil survey, HH survey, field observation and key informant interview was used to collect data. The soil survey was conducted to determine the impact of years of intervention on the soil fertility as well as the fertility status of soil under CSA intervention when compared to other land uses. The result of the study revealed that CSA made improvements both on soil fertility and productivity. The SOM content of soil under CSA showed improvement both with intervention and time. Plant nutrients including Nitrogen and phosphorus also showed improvement. The crop and livestock productivity of CSA adopters was found to be higher than BAU. The vegetation dynamics of the area also transformed significantly. The fertility of soil under CSA intervention, however, was lower when compared to other land use systems like agroforestry and grassland. This indicates that CSA needs to be adopted at a landscape level integrating other land use systems for the overall ecological health of the area. *Key words: Adaptive capacity, Climate Smart Agriculture, mitigation, resilience, soil fertility*
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Improving the Efficiency of Agricultural Development: *Can farmer typologies be used to predict the adoption of agricultural innovations for the poorest farmers, and therefore, increase the impact of rural development programs on the rural poor?*

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Abstract : This investigation, through a literature review, outlines how agricultural development is an effective tool for achieving the goals of human development theory, the participatory approach to development and the sustainable development approach. In this investigation, sustainable intensification is identified as an essential part of agricultural development. Through an examination of the literature, it is made clear that there is a low adoption rate for agricultural innovations, this inhibits sustainable intensification. Moreover, it is demonstrated that the distribution of agricultural innovations favours wealthier farmers, who are less deterred by the perceived risk associated with the adoption process. Antecedent research has tried to improve adoption rates by targeting particular groups of farmers, known as farmer typologies. Traditional typologies focus on the structural characteristics of farms, such as farm size, crop diversity and livestock diversity. Despite the use of these typologies, adoption rates remain low. An emerging method for creating typologies incorporates the personal motivations and attitudes of farmers, however, these have not been empirically tested in relation to the real-life adoption of innovations.

This investigation used data from the Africa Research In Sustainable Intensification for the Next Generation (RISING) project based in the Ethiopian Highlands to investigate three types of typology. The ultimate aim of this investigation was to see whether a particular set of typologies can be used to identify high adopting farmers in the lowest wealth quartiles. The first set of typologies is based solely on the structural characteristics of the farms surveyed. The second set of typologies is solely based on motivational characteristics. The third set of typologies is based on both structural and motivational characteristics. Two variables are used to measure adoption: Adoption rate, which indicates the percentage of innovations which farmers continued to use after phase one of the Africa RISING program; Adoption strength, which measures how strongly farmers have adopted each innovation. The results of this investigation indicate that there is sufficient evidence to support the use of all three sets of typologies to predict high adoption rates and high adoption strength in farmers. However, there is insufficient evidence to support the use of structural clusters for predicting high adoption rates, or adoption strength, for farmers in the lowest wealth quartiles. There is also insufficient evidence to support the use of motivational typologies to predict high adoption rates for farmers in the lowest wealth quartiles. In contrast, the results indicate that motivational typologies could effectively predict high adoption strength for farmers in each individual wealth quartile. There was sufficient evidence to suggest that combined typologies could be used to

predict high adoption rates and high adoption strength for farmers in the lowest wealth quartiles.

This research shows the promise of using motivational characteristics to group farmers. This investigation should encourage further research which investigates how motivational typologies can be operationalized in order to catalyze sustainable intensification and make agricultural innovations more accessible to the rural poor.

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Distribution and Management of Fusarium Wilt (*Fusarium oxysporum* f.sp. *lentis*) of Lentil (*Lens culinaris* Medikus) in Central Highlands of Ethiopia

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Completion Date	:	November 2018

Abstract : Fusarium wilt of lentil (F. oxysporum f.sp. lentis) causes huge lentil yield losses in central highlands of Ethiopia. In this study, extensive wilt survey of eight major lentil-growing districts, viz. Adaa, Aleltu, Lume, Gimbichu, Minjar-Shenkora, Siyadebrena Wayu, Moretina-jiru and Ensaro in central highlands of Ethiopia was conducted during the 2017cropping season. The study of the objectives were to: 1) assess the distribution of lentil Fusarium wilt in the central highlands of Ethiopia; 2) determine the extent of seed infection due to lentil Fusarium wilt pathogen on seed lots collected from different sources in the central highlands of Ethiopia; and 3) evaluate the effect of lentil varieties and seedbed types as components of integrated management option. Data of the survey revealed 100% mean wilt prevalence and 32.8% mean wilt incidence were observed. The highest (75%) and the lowest (2%) wilt incidence were recorded in Moretina-jiru and Lume, respectively. Morphological and cultural assessment of 192 isolates of wilt causal agents showed hihgest frequencies of Fusarium oxysporum f.sp. lentis (100%) followed by Rhizoctonia spp. (23.4%) and Sclerotium rolfsii (3.0%). A factorial experiment involving lentil variety and seedbed type, each at four levels, was carried out in a split-plot design with three replications. The four lentil varieties were ILL-590 (susceptible check), Alemaya, Derash and Denbi, and four seedbed types were flat bed, open raised bed, tieraised bed and farmer's practice. Among the seedbed types, raised seedbed exhibited relatively lower disease incidence than others. Interaction of the varieties and seedbed types was significant in wilt reduction. The highest wilt incidence (ca. 82.0%) was recorded on ILL-590, susceptible lentil line, planted on flat bed; whereas, the lowest (ca. 8.8%) Fusarium wilt incidence was noted on cv. Derash planted on raised bed. A combination of cv. Derash and raised bed gave significantly ($P < 0.05$) higher grain yield (3827.0 kg/ha) than all other treatment combinations at Chefe Donsa. Unlike Chefe Donsa, raised bed contributed significantly ($P < 0.05$) higher grain yield of not only cv. Derash but also cv. Alemaya than all other treatment combinations at Debre Zeit. Significantly ($P < 0.05$) lower grain yields (in the order of 68.0 kg ha-1) were obtained from integration of the susceptible genotype (ILL-590) with flat bed than all other treatment integration irrespective of the trial locations. The highest (1018.0% unit/days) in AUDPC values were obtained by flat seedbed type and ILL-590, while the lowest (342.4% unit/days) in AUDPC values were obtained by raised seedbed type and Derash variety at Debre Zeit. Wilt incidence and AUDPC values were significant and negatively correlated with yield parameters. Lentil seed infection due to Fusarium oxysporum f.sp. lentis ranged from 0 to 22.2%. It was concluded that using resistant variety with raised seedbed significantly reduced Fusarium wilt incidence and gave

reasonably high yields. The future research work should focus on screening several lentil genotypes for source of resistance.

Keywords: Lentil, Survey, Management, Wilt, Fusarium oxysporom f.sp.lentis

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Adoption of Improved Potato Varieties and Its Impact on Household Nutrition: Evidence from Emba Alaje woreda, Northern Ethiopia

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Completion Date	:	June 2019
Abstract	:	High population pressure and continuous decrease of the land holding size results in increase of food insecurity. To meet the increasing food demand of the growing population there is a need to intensify production practices. In this regard, improved potato varieties production plays a great role in improving the household's food security, food consumption, and food diversity, and there-by contributing to nutrition security. This study analyzes the probability and use intensity of improved potato varieties adoption and, the effect of adoption on households' nutrition security. The data was collected in 2018 at Emba Alaje woreda from a survey of 370 households (185 improved potato variety growers and 185 non-growers). Sampling weights were used to account the proportion of the sample compared to the whole population. Tobit model was used to analyze the factors affecting the probability and use intensity of improved potato varieties adoption. Both propensity score matching (PSM) and endogenous switching regression model (ESRM) were used to analyze the impacts of improved potato varieties on households' nutrition using Food security scale, Food consumption score and Household dietary diversity score proxy variables. To control the possible selection problem invers mill's ratio was included in the second stage equations. Size of own land, distance of the nearest plot, access to extension services, the existence of neighbor adopter, perception on the improved potato varieties' maturity period and tuber yield potential were found as the main factors of adoption probability and use intensity of improved potato varieties. The PSM result indicated that, adoption of improved potato varieties increases the average food security scale, food consumption score and the dietary diversity score by 1.79, 6.6 and 0.8 points, respectively. Similarly, the ESRM result confirmed that, improved potato varieties adoption increases the average food security scale, food consumption and dietary diversity score by 2, 6.1 and 1.4 points, respectively. Thus, to improve the nutritional status of the farming households, government should give due emphasis for potato production and the extension service need to be strengthen. *Keywords: Improved potato variety, Adoption, Nutrition security, Endogenous switching regression model, Propensity score matching, Tobit model, Northern Ethiopia*.
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Species Richness and Diversity of Indigenous Fruit Trees and Shrubs in Tigray, Northern Ethiopia

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Degree Received	:	MSc, Ongoing
Completion Date	:	
Abstract	:	
Permanent Link	:	

Role of indigenous wild tree fruits trees in ensuring food security and their comparative nutritional values in comparison with commercial fruit trees

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Abstract	:	
Permanent Link	:	

Local ecological knowledge of trees on farms, constraints and opportunities for further integration in Tigray Region, northern Ethiopia: A case study of smallholder farmers in Abreha Wa Atsbeha and Adi gudom

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Abstract	:	Farmers have been managing agriculture systems for centuries, and trees often play a significant role within these systems. Understanding the local ecological knowledge (LEK) and perceptions of smallholder farmers about integration of trees on farms is essential to the identification of the drivers and understanding the barriers to integrating trees on farm however most times these is not taken into account during planning and research. In this study a model approach was adopted with two contrasting sites one with high adoption levels and the other with low levels of adoption. The main factors that distinguished the two sites are that in Abreha wa atsebha (Site A) practices such as free grazing are no longer being practiced and zero grazing has been adopted. However, on the other hand in Adi gudom (Site B) free grazing is a practice that the community is struggling with and farmers are not very receptive to the idea of tree planting due to the said problem. Most of the trees that farmers would prefer to plant on farm are available in the community nursery in abreha wa atsbeha which is not exactly the same for Adi gudom .Furthermore the trees they have planted are exotic and farmers have little knowledge on how to manage them and the benefits they provide. Bridging these gaps in knowledge presents an opportunity for enhancing adoption. The main drivers to tree planting common to both sites identified by farmers included income generation, ownership, government policy and direct benefits from trees. On the other hand, barriers included farm size, negative interaction, water scarcity, obstruction during ploughing and incapability to fence tree seedlings. In site A agroforestry interventions have been responsible for improvements in food security and in site B with low tree cover there is an opportunity for transfer of knowledge for targeted interventions.
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Local knowledge and land use history in Debre Birhan

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Completion Date	:	May 2014
Abstract	:	
Permanent Link	:	https://hdl.handle.net/10568/41680

Influence of varietal selection and treatments on nutritive value of selected pulse crop residue

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Completion Date	:	May 2017
Abstract	:	The current study was aimed to analyze the utilization of crop residue in the mixed farming systems of Ethiopia, to explore the possibility of improving straw yield and nutritive value of chickpea, faba bean and lentil without compromising grain yield and to identify the effect of dung and wood ash treatments on the nutritive value of chickpea, faba bean and lentil straw. Data on crop residue production and utilization was collected in two highland regions of Ethiopia from 160 households. To assay the varietal variation and food-feed relation in faba bean, 4 improved and released variety and one local variety were planted at the Sinana Agricultural Research Center, Ethiopia during 2014-2015 cropping season. To evaluate the variability in grain yield and straw traits in chickpea and lentil, 24 improved varieties and one local variety of each crop were replicated four times in a randomized complete block trial in two locations of Debre Zeit Research Center during the 2013-2014 cropping season. Straw from plots of the local varieties of the trials was used to determine the effect of 4% urea treatment, dung ash treatment (0g ash/L, 100 g ash/L, 200 g ash/L 300 g ash/L) and wood ash treatment (0 g ash/L, 150 g ash/L, 200 g ash/L) on the nutritional value. All straw samples were analyzed for proximate analysis, in vitro organic matter digestibility and metabolizable energy using a combination of Near Infrared Reflectance Spectroscopy and conventional feed analyses methods. Results showed that farmers prefer using crop residue from pulses over crop residue from cereals for livestock feeding purposes. Proportions of cereal and pulse residue used for soil mulch was positively affected by education level of the farmer, distance between homestead and cultivated land, extension service, awareness about soil mulch, slope of cultivated land, participation in farmer-to-farmer extension and crop residue generated in the preceding season. The proportion of crop residue from pulses that was used as feed was positively affected by education level of the farmer, livestock extension service, number of small ruminants and crop residue stack from the previous season. The effect of the variety, location and variety-location interaction on grain yield, straw yield and straw nutritive value was significant in chickpea and lentil. The correlation between grain yield and straw traits of chickpea was weak in all locations. Grain yield of lentil correlated weakly to crude protein and ME in Chefe Donsa while it correlated moderately to crude protein in Debre Zeit. Grain and straw yields were positively, strongly and significantly correlated in faba bean. Grain yield of faba bean correlated weakly to the nutritive value parameters of straw. Varietal variations in grain yield, straw yield and straw quality traits within its fractions were significant. The botanical structure of faba bean straw can be used as a reliable method for screening faba bean genotypes for straw quality. Urea treatment showed potential to improve the nutritive value of chickpea, faba bean and lentil straw. Dung ash treatment up to 300 g ash/L and wood ash treatment up to 200 g

ash/L did not improve the nutritive value of chickpea, faba bean and lentil straw. Integrating straw yield and nutritive value into improvement programs of chickpea, faba bean and lentil could improve the nutrients supply for livestock and increase the amount of cereal straws allocated to soil mulching.

Keywords: Genetic variation; pulse straw; ash extract; urea treatment

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Prospects for Sustainable Intensification of Smallholder Farming Systems in Ethiopian Highlands

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Completion Date	:	August 2017
Abstract	:	This dissertation examines the prospects of sustainable agricultural intensification by rural farming households in Ethiopia. Although widely accepted as the new paradigm for agricultural development in sub-Saharan Africa, several research and empirical questions still surround the concept of sustainable intensification, particularly its operationalization. Efforts to promote, measure and monitor progress towards sustainable intensification are hampered by the lack of quantifiable indicators at the farm level, as well as the uncertainty over the relationship between intensification and sustainability. This dissertation contributes to this knowledge gap by examining the relationship between agricultural intensification and sustainability, with a view to determine if sustainable paths of agricultural intensification are possible within the smallholder farming systems of Ethiopian highlands. To help better execute the research inquiry, and achieve the main goal of this study, the themes of this dissertation are addressed through three separate but interrelated essays, on top of the introductory and conclusion chapters. The first essay, presented in chapter two, examines the drivers and processes shaping agricultural intensification by smallholder farmers. This chapter contributes to the literature by providing evidence of how agricultural intensification depends on a wide range of factors, whose complex interactions give rise to different intensification pathways. The implication is that, even in a region that is undergoing the process of agricultural intensification, households are likely to respond differently to intensification incentives and production constraints, and thus pursue different paths of agricultural intensification. The second essay, chapter three, develops a methodological framework for defining elements of sustainability based on observed, context-specific priorities and technologies. Farm level indicators of agricultural sustainability are developed using insights drawn from literature and adapted to the Ethiopian context through consultations with agricultural experts and key stakeholders in the agricultural sector. A Data Envelopment Analysis (DEA) framework is applied to synthesize the selected indicators into a relative farm sustainability index, thus reducing subjectivity in the sustainability index. A generalized linear regression model applied on the computed sustainability scores shows that farm size, market access, access to off farm income, agricultural loans, access to agricultural extension and demonstration plots are key drivers of agricultural sustainability at the farm level. Despite being applied to the Ethiopian context; the methodology has broader policy implications and can be applied in many contexts. The third essay, chapter four, examines the relationship between agricultural intensification and relative farm sustainability, and identifies four clusters of farmers depending on their relative levels of intensification and sustainability.

The main thrust of this essay is to examine whether farmers who are highly productive are also sustainable, and whether systems that are relatively more sustainable are mostly on the highly productive farms. The results show that of the farms that are relatively most intensive, in terms of the gross value of crop output per hectare, only 27 percent are relatively more sustainable. Of the farms that are relatively most sustainable, about 60 percent are more intensive. Overall, only 10 percent of the farms were both highly intensive and relatively more sustainable. In order to understand the typology of farmers that are likely to embark on sustainable paths of agricultural intensification, multivariate methods of Principal Components Analysis (PCA) and Cluster Analysis (CA) were used to cluster farmers according to their common characteristics. Multinomial Logit (MNL) regression models were used to model the probability of cluster membership as well as the likelihood of farmers embarking on different intensification trajectories. is used to analyze the odds of embarking on a sustainable intensification path. The results suggest that increasing farmers' access to technical information through demonstration plots and government extension services, addressing farm liquidity constraints, improving market access, as well fostering crop-livestock interactions, significantly increases the likelihood of sustainable intensification.

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Diversification Patterns of Mixed Crop-Livestock Production in Smallholder Farming Systems and Its Implication for Household Food Security: The Case of Gudo Beret Watershed, North Shewa, Central Highlands of Ethiopia

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Completion Date	:	April 2018

Abstract : Mixed crop-livestock production is one of the prime livelihood strategies for rural households of Ethiopia. So far, limited studies exist on crop-livestock diversification patterns and household food security nexus in the highlands of Ethiopia. The objectives of this study were, therefore: a diagnosis of dynamics of mixed crop-livestock production, defining crop-livestock diversification patterns, examining factors influencing crop-livestock diversity, analyzing adoption of improved dairy cows, evaluating roles of key institutions, and assessing implications of crop-livestock diversification patterns for household food security. The study was carried out in Gudo Beret watershed of North Shewa, Ethiopia. Samples of 211 respondents were selected using systematic random sampling. Various data collection methods mainly remote sensing, household interview, focused group discussions and literature were used. A combination of descriptive statistics, multivariate statistical techniques, and econometric models were used for analysis. The mixed farming systems were evaluated in connection with production dynamics, socio-economic dimensions, technological innovations, and roles of institutions. The results of the study showed that high stocking rate and grazing pressure resulted in pressures on land resources. Bush land converted mostly to plantation and settlement areas. Yet, cropland and grazing lands showed oscillating trends. Several interacting forces caused for 51.5% of the land vulnerable. The results of principal component analysis indicated that sheep, grain crops, chicken, vegetables and oat-based productions were the major crop-livestock diversification patterns. Tobit regression showed that livestock size influenced decisions of the crop-livestock diversity positively and significantly whereas land rent-out and soil fertility influenced decisions of diversity negatively and significantly. Binary Logit model showed that hired labor, social status, and livestock found to have positive effects on the likelihood of the adoption of improved dairy cows whereas farm size influenced the technology significantly and negatively. Elementary school and multipurpose cooperative were the first level institutions, which had strong links with the farming systems in terms of its extent to support farmers. The incidence, extent, and severity of household food insecurity were 41.2, 16.6, and 1.2%, respectively. Linear regression showed that farm size, fertilizer, market distance, and male- headed households could increase food energy. In contrast, family size had negative effect on food calories. Crop patterns particularly grain-based farming showed significant and positive effect on household food security in connection with food energy. Overall, family planning, animal and human nutrition security, small-scale irrigation, effective extension service, and sustainable resource land management were important policy implications.

Keywords: Diversification pattern, institution, land pressure, production dynamics
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Agro-Morphological and Molecular Characterization of Enset (*Ensete Ventricosum* (Welw.) Cheesman) Landraces from Ethiopia

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Degree Received : PhD in Biology (Applied Genetics)
Completion Date : June 2018

Abstract : The study was conducted with the objective of assessing and documenting indigenous knowledge and perception associated with the distribution, diversity, Enset Xanthomonas Wil, its etiology and mode of transmission, and management of enset in the country, and the genetic diversity of enset landraces that were obtained from different geographical locations in Ethiopia, using Phenotypic traits and to develop a genome sequence data, identify and develop single nucleotide polymorpHism (SNPs) and genotyping of landraces that serve as molecular markers for future marker assisted breeding. Enset genetic resource utilization and management study was conducted in eight ethnic groups in the Southern Nations, Nationalities and Peoples' Regional State. The data was collected mainly through individual interviews and direct on-farm participatory monitoring and observation, key informant interviews. Relevant secondary data, literature and inter-personal data were collected from unpublished progress report from National Enset Research Project, elderly people and senior experts. Enset-based farming system is one of major agricultural systems in Ethiopia that serves as a backbone for at least one-forth of country's population. Farmers used three morphological characters, two growth attributes, disease resistance and five use values traits in folk classification and characterization of enset. A total of 312 folk landraces have been identified. The number of landraces cultivated on individual farms ranged from one to twenty eight (mean of 8.08 ± 0.93). All ethnic groups in the study area use five use categories in order of importance: kocho yield and quality, bulla quality, amicho use, fiber quality and medicinal/ritual value. Of the 312 landraces 245 landraces having more than two use types. Management and maintenance of on-farm enset diversity is influenced by systematic propagation of the landraces, exchange of planting material and selective pressure. Farmers' knowledge and perception of enset Xanthomonas wilt showed that a significant number of farmers are aware of EXW, its symptoms, etiology and transmission and spread, but they are not able to readily relate modes of spread to control methods. Since 2002, EXW became prominent in Hadiya, with the highest EXW incidence and severity, followed by Wolaita, and Kembata-Tembaro. Farmers identified EXW as the major cause for declining production and productivity of enset in the region. EXW has spread widely and rapidly in southern Ethiopia, with significant socioeconomic impacts in smallholders' livelihoods. There is a need for developing knowledge-based strategies and awareness-raising campaign for EXW management. In general, the existing farmers' knowledge on naming, classification and diversity should be complemented with maintenance of the creative dynamics of traditional knowledge and transmission of the knowledge are crucial for constructing sustainable management. Assessment of genetic diversity in enset using

Phenotypic markers were subjected to ANOVA and the variations among the landraces and regions were significant ($p \leq 0.01$) for all the 15 traits studied. Mean for plant height, central shoot weight before grating, and fermented squeezed kocho yield per hectare per year showed regional variation along an altitude gradient and across cultural differences related to the origin of the collection. Furthermore, there were significant correlations among most of the characters. This included the correlation among agronomic characteristics of primary interest in enset breeding such as plant height, pseudostem height, and fermented squeezed kocho yield per hectare per year. Altitude of the collection sites also significantly impacted the various characteristics studied. Cluster analysis grouped the landraces into five distinct groups, with two outlying landraces. Landraces originating from regions with similar agro-climatic conditions grouped together. Principal component analysis showed that the first four principal components accounted for ~74% of the total variance of the 387 enset landraces for the 15 quantitative traits studied. The linear discriminant analyses depicted about 40.8% (160 of the 387) and 45.2% (175 of 387) correct origin-based classification of the germplasm in terms of altitude zones and regions, respectively. Six qualitative morphological traits were also analyzed using the Shannon Weaver diversity index (H'). The Shannon-Weaver Diversity Index (H') for all sampled germplasm ranged from 0.50 to 0.89, with a mean of 0.73. Analysis of variance for H' revealed highly significant ($p<0.01$) differences among regions for all traits. Cluster analysis grouped the landraces into four clusters. A high proportion of landraces sourced from similar altitude classes and similar regions were grouped together. This indicated that there was wide variability among landraces studied. The Phenotypic differences in these 15 traits suggest significant degrees of genetic variation and that these traits can be exploited to identify potential donors for future enset improvement efforts. The implication of the current results for plant breeding, germplasm collection, and in situ and ex situ genetic resource conservation are discussed. Seventeen (for genome sequence analysis) and four hundred eighty (for SNP catalogue development) different enset landraces used were obtained from Areka Agricultural Research Center field germplasm. We present raw sequence reads and genome assemblies resulting from the sequencing of 17 landraces of the crop plant enset. Landraces having the same names but different origin showed different reads. For SNP detection, we considered only sites either homozygous or heterozygous for all 17 data sets. We were able to identify 33,200 singlenucleotide variant sites. We generated a series of phylogenetic trees and there was no sequence variation at this locus among the 17 genomes presented here. By examining the pattern of bands in agarose electrophoresis of the product after restriction digestion, it is possible to assess the genotype at that SNP location. We applied the 22 PCR-RFLP assays to single accession of E.ventricosum. Further, we then went on to apply 5 of these assays to several hundred E. ventricosum landraces. This findings will facilitate high-resolution studies to determine the genetic architecture of traits of economic and ecological importance, to study the structure of enset populations and to apply genomic selection in breeding programs. In general, farmers cognitive, morphological, sequence and SNP output clearly distinguished between all landraces, even though they were genetically similar.

Keywords: Enset, Ethiopia, Farmer's knowledge, In situ and ex situ conservation, Landraces, On-farm diversity and management, Phenotypic variation, Southern Ethiopia, SNP, Xanthomonas wilt

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Farming systems analysis with an emphasis on nutrition and gender. Case study: Sinana, Ethiopia and Northern Region, Ghana

Student name	:	Mirja Michalsceck
Supervisors	:	Tittonell Pablo and Groot Jeroen
Name of University	:	Wageningen University
Degree Received	:	PhD
Completion Date	:	May 2019
Abstract	:	
Permanent Link	:	

Apple tree morphology and physiology

Student name	:	Abayneh Melke
Supervisors	:	
Name of University	:	Addis Ababa University
Degree Received	:	PhD, Ongoing
Completion Date	:	
Abstract	:	
Permanent Link	:	

Economic impact of small ruminant market facilities in central and northern highlands of Ethiopia

Student name	:	Fresenbet Zeleke Abshiro
Supervisors	:	
Name of University	:	Haramaya University
Degree Received	:	PhD, Ongoing
Completion Date	:	
Abstract	:	
Permanent Link	:	

Exploring an ecosystem service rehabilitation status in a highland crop-livestock integrated system: the case of Ginaberet-Geda watershed, north Shewa, Ethiopia

Student name	:	Hailu Terefe
Supervisors	:	Dr. Mekuria Argaw, Dr. Lulseged Tamene, Dr. Kindu Mekonnen
Name of University	:	Addis Ababa University
Degree Received	:	PhD, Ongoing
Completion Date	:	
Abstract	:	
Permanent Link	:	

Land degradation assessment and eco-hydrological modelling under changing climate and management practices in Blue Nile river basin, Ethiopia

Student name	:	Tesfaye Yaekob Tesfamichael
Supervisors	:	Dr. Solomon Gebreyohannes, Dr. Solomon Seyoum, Dr. Lulseged Tamene
Name of University	:	Addis Ababa University
Degree Received	:	PhD, Ongoing
Completion Date	:	
Abstract	:	
Permanent Link	:	

Analyzing risks of the Ethiopian Rift Valley lakes and proposing suitable management options

Student name	:	Yonas Getaneh
Supervisors	:	Dr. Assefa Abegaz, Dr. Lulseged Tamene, Dr. Wuletawu Abera
Name of University	:	Addis Ababa University
Degree Received	:	PhD, Ongoing
Completion Date	:	
Abstract	:	
Permanent Link	:	

Application of agricultural innovation systems to smallholder sustainable intensification: lessons from Ethiopian Highlands

Student name	:	Zelalem Lema Moti
Supervisor	:	Lisa Lobry de Bruyn, Graham Marshall, Romana Roschinsky and Alan Duncan
Name of University	:	University of New England
Degree Received	:	PhD, Ongoing
Completion Date	:	
Abstract	:	
Permanent Link	:	

SUMMARY

Summary of the list of postgraduate (MSc and PhD) students supported by Africa RISING project in Ethiopian Highlands.

#	Name of student	Gender	Degree type	Title of Dissertation / Thesis	Status
1	Asemahegn Mersha	Male	MSc	Determination of Cultivar-Dependent Variation in Food-Feed Traits in Lentil (Lens culinary)	Completed
2	Fisahaye Abraha Woldu	Male	MSc	Indigenous Livestock Husbandry and Ethno Veterinary Practices in Endamohoni District of Tigray Region, Ethiopia	Completed
3	Sultan Usman Mahamud	Male	MSc	Analysis of Wheat Value Chain: The Case of Sinana District, Bale Zone, Oromia Region, Ethiopia	Completed
4	Teklu Wegi Feyisa	Male	MSc	Effects of Feeding Different Varieties of Faba Bean (Vicia faba L.) Straws with Concentrate on Feed Intake, Digestibility, Body Weight Gain and Carcass Characteristics of Arsi-Bale Sheep	Completed
5	Tamene Tadesse Tessema	Male	MSc	Effect of Faba bean (Vicia faba L.)-forage Intercropping: Benefits and Trade-offs to Improve Feed Resources in Lemo Woreda, Southern Ethiopia	Completed
6	James Ellison	Male	MSc	Spatial modelling of soil and water conservation activities for a catchment in the Ethiopian Highlands	Completed
7	Tena Alemu	Female	MSc	Variability in Food-Feed Traits in Chickpea (Cicer arietinum) Varieties	Completed
8	Meron Mengesha	Female	MSc	Effect of Graded Levels of Tagasaste (Chamaecytisus palmensis) Leaves Supplementation on Performance of Yearling Menz Sheep in Ethiopian Highlands	Completed
9	Feleke Tadesse Froche	Male	MSc	Growth Performance and Nutritive Quality of Tree Lucerne (Chamaecytisus Palmensis) Fodder under Different Management Conditions in the High Lands of Ethiopia	Completed
10	Meseret Woldeyohannes	Female	MSc	Estimating Water balance of Tegona watershed in south eastern Ethiopia using SWAT Model	Completed
11	Tesfaye Abiso Jatana	Male	MSc	Improving the quality and Quantity of Forages produced from intercropping of Faba Bean with Forage Oats in Lemo Worada, Hadiya Zone, Southern Ethiopia	Completed
12	Zenaye Degefu Agazhi	Female	MSc	Adoption and Welfare Impact of Improved Food Legume Technologies in Bale Highlands of Ethiopia: Intra and Inter-Household Empirical Analysis	Completed
13	Workalegn Asseffa	Male	MSc	Agrobiodiversity conservation practices and gender consideration in Sinana district, southeastern Ethiopia	Completed
14	Tigist Birhanu	Female	MSc	Assessment of surface water resource and irrigation practices in Gudo Beret Kebele, Amhara region, Ethiopia	Completed
15	Hinsa Hailesilassie Birlle	Male	MSc	The Effect of improved fodder production on livestock productivity in Endamehoni District, Southern Tigray, Ethiopia	Completed
16	Yeron Tekalign Beyene	Male	MSc	Analyzing Performances of Selected Sustainable Land Management Practices in Gina Beret Watershed, North Shoa	Completed

#	Name of student	Gender	Degree type	Title of Dissertation / Thesis	Status
17	Melese Mulugeta Gobena	Male	MSc	Mapping and Quantification of Crop-Livestock Interventions in Africa RISING Sites of Ethiopian Highlands	Completed
18	Fikadu Tessema Riga	Male	MSc	Biomass Yield and Nutritive Value of Sweet Lupine in Mid Altitudes of Lemo District, Hadiya Zone, Southern Ethiopia	Completed
19	Meron Tadesse	Female	MSc	The implications of Climate Smart Agriculture on soil fertility and productivity: the case of Tula-Jana landscape, SNNPR Ethiopia	Completed
20	Léo Gorman	Male	MSc	Improving the Efficiency of Agricultural Development: Can farmer typologies be used to predict the adoption of agricultural innovations for the poorest farmers, and therefore, increase the impact of rural development programs on the rural poor?	Completed
21	Tolesa Bedasa Abdisa	Male	MSc	Distribution and Management of Fusarium Wilt (Fusarium oxysporum f.sp. lentis) of Lentil (Lens culinaris Medikus) in Central Highlands of Ethiopia	Completed
22	Mohammed Ebrahim	Male	MSc	Adoption of Improved Potato Varieties and Its Impact on Household Nutrition: Evidence from Emba Alaje woreda, Northern Ethiopia	Completed
23	Anbessa Gebretsadik	Male	MSc	Species Richness and Diversity of Indigenous Fruit Trees and Shrubs in Tigray, Northern Ethiopia	Ongoing
24	Gebrehiwot Hailemikael	Male	MSc	Role of indigenous wild tree fruits trees in ensuring food security and their comparative nutritional values in comparison with commercial fruit trees	Ongoing
25	Emelda Miyanda Hachoofwe	Female	MSc	Local ecological knowledge of trees on farms, constraints and opportunities for further integration in Tigray Region, northern Ethiopia: A case study of smallholder farmers in Abreha Wa Atsbeha and Adi gudom	Completed
26	Anne Kuria	Female	PhD	Local knowledge and land use history in Debre Birhan	Completed
27	Ashraf Saber Alkhtib	Male	PhD	Influence of varietal selection and treatments on nutritive value of selected pulse crop residue	Completed
28	Vine Mutyasira	Female	PhD	Prospects for Sustainable Intensification of Smallholder Farming Systems in Ethiopian Highlands	Completed
29	Wuletaw Mekuria Kebede	Male	PhD	Diversification Patterns of Mixed Crop-Livestock Production in Smallholder Farming Systems and Its Implication for Household Food Security: The Case of Gudo Beret Watershed, North Shewa, Central Highlands of Ethiopia	Completed
30	Zerihun Yemataw Gebre	Male	PhD	Agro-Morphological and Molecular Characterization of Enset (Ensete Ventricosum (Welw.) Cheesman) Landraces from Ethiopia	Completed
31	Mirja Michalsceck	Female	PhD	Farming systems analysis with an emphasis on nutrition and gender. Case study: Sinana, Ethiopia and Northern Region, Ghana	Completed
32	Abayneh Melke	Male	PhD	Apple tree morphology and physiology	Ongoing
33	Fresenbet Zeleke Abshiro	Male	PhD	Economic impact of small ruminant market facilities in central and northern highlands of Ethiopia	Ongoing

#	Name of student	Gender	Degree type	Title of Dissertation / Thesis	Status
34	Hailu Terefe	Male	PhD	Exploring an ecosystem service rehabilitation status in a highland crop-livestock integrated system: the case of Ginaberet-Geda watershed, north Shewa, Ethiopia	Ongoing
35	Tesfaye Yaekob Tesfamichael	Male	PhD	Land degradation assessment and eco-hydrological modelling under changing climate and management practices in Blue Nile river basin, Ethiopia	Ongoing
36	Yonas Getaneh	Male	PhD	Analyzing risks of the Ethiopian Rift Valley lakes and proposing suitable management options	Ongoing
37	Zelalem Lema Moti	Male	PhD	Application of agricultural innovation systems to smallholder sustainable intensification: lessons from Ethiopian Highlands	Ongoing