Farmers' Indigenous Cropland Management Practices in North Gondar Zone, Ethiopia

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Abstract

In Ethiopia, agricultural production and productivity are becoming low because of physical and biological soil degradation. To reverse this situation rural households use their indigenous cropland management strategies. Thus, the main objectives of this study were to identify the existing indigenous cropland management practices and to examine the integration of indigenous and modern cropland management practices in North Gondar Zone. Both qualitative and quantitative types of data were generated from primary and secondary sources using household surveys from randomly taken households. The findings of this study showed that crop rotation, multiple/intercropping, agroforestry practices and crop residues were found to be the most widely used indigenous cropland fertility improvement practices. Chemical fertilizers, tree planting, pesticides/insecticides, compost and area closure were, on the other hand, the most widely used modern soil fertility management practices. Contour plowing, construction of waterway, check dams, diversion ditches, stone bunds and terrace were the dominant indigenous physical cropland management practices. In the study area, there was no local development policies and strategies that support the conservation of indigenous cropland management strategies. Therefore, it is recommended that local supporting policies and strategies have to be enshrined and implemented to conserve, use and promote indigenous practices at greater scale and integrate it with modern practices.

Keywords: Indigenous knowledge, Cropland, North Gondar.

Background

Land degradation is a global problem and a great challenge to sustaining the biological, economic and social services provided by various ecosystems. According to the World Summit on Sustainable Development in September 2002, land degradation was reaffirmed as one of the major global environment and sustainable development challenges of the 21st Century. The negative impacts of land degradation undermine people's livelihoods and economic wellbeing, and the nutritional status of more than 1 billion people in developing countries.

Ethiopia has estimated to have total surface area of 112 million hectares (Bobe, 2004; Makombe et al. 2007) from these 60 million hectares is agriculturally productive. Out of the estimated agriculturally productive lands, about 27 million hectares are significantly eroded, 14 million hectares are seriously eroded and 2 million hectares have reached the point of no return, with an estimated total loss of 2 billion m^3 of top soil per year (Bewket and Sterk, 2005; Bobe, 2004).

To mitigate these situations traditional communities have continued to rely on their own indigenous knowledge systems in observing the environment and dealing with natural hazards. These communities, particularly those in hazard prone areas, have collectively generated a vast body of knowledge on disaster prevention and mitigation, early warning, preparedness and response. This knowledge is obtained through observation and the study is often based on cumulative experience handed down from generation to generation (Pareek and Trivedi, 2011). Indigenous people who are vital and active parts of many ecosystems may help to enhance the resilience of these ecosystems. The development of indigenous knowledge systems, including management of natural environment and crop land management has been a matter of survival to the people who generated these systems **(**Kumar, 2010**).**

However, the limitation in the use of indigenous knowledge and lack of effective linkage between indigenous and modern ones has been identified as one of the major problems that hinder the effectiveness of the development of agriculture and natural resource conservation. This is true especially for developing countries like Ethiopia where the economy is totally depends on agriculture (CSA, 2009).

It has been widely argued that documentation of the indigenous knowledge system will motivate wide use, application and easy integration of such knowledge system into other forms of knowledge systems (Msuya, 2007), whereas, lack of documentation has been contributing to its decline: elders have been dying without passing on their knowledge system to their grand children (Ellis, 2005), threatening its wide use, application and its integration with other forms of knowledge systems (Msuya, 2007).

On the other hand, equal valuation of the indigenous knowledge will increase its wide use and application and, therefore, its integration into other forms of knowledge systems: whereas stigmatization has been significantly influencing its decline (Cobb, 2011). Equal valuation of indigenous knowledge system as a complete body of knowledge system, therefore, will stimulate its wide use, application and its integration with the scientific knowledge system.

Despite these facts, the role of indigenous knowledge system in crop land management practices and its contribution in reducing land degradation and ecosystem management has been undermined. For example, Kruger et al., (1996) stated that an extensive work on indigenous knowledge in land management has poor record and there was a lack of appreciation of indigenous practices by soil conservation experts and policy makers. This agrees with review by Reij (1991) which shows less attention given to indigenous soil and water conservation by researchers and development agents in Ethiopia.

Even if different researches have been conducted on Land management system in North Gondar Zone, adequate research has not been conducted on the indigenous practices of crop land management. There is still much to be learned from the indigenous knowledge, yet there are inadequate national and organizational efforts to capture this knowledge. Thus, the objectives of this study were to identity the existing indigenous crop land management practices; and to examine the integration of indigenous and scientific crop land management practices in the study area.

Methods

Description of the study area

North Gondar zone is one of the eleven zones of Amhara region of Ethiopia. The zone has 23 districts and 2,929,628 of total population. The total area of the administrative zone is 50, 970 km^2. This study was conducted by taking samples from three districts in North Gondar Zone namely Gondar Zuria, Dabat and West Belessa.

Sampling Procedures and Techniques

In this study a combination of multi-stage purposive and simple random sampling technique were employed to select sample districts, sample kebeles and household heads. First, North Gondar zone was stratified on the bases of agro-ecology to create homogeneous stratum for the selection of districts. Accordingly, Dabat, Gondar Zuria and West Belessa districts were randomly selected from Dega, Woyina dega and Kola agro ecologies, respectively. In the second stage, two representative rural kebeles were selected randomly from each sample district.

Finally, a total of 120 sample household heads were selected from the updated list of sample frame through systematic random sampling techniques in proportion to their size from each kebele.

Data Collection

The data were collected from both primary and secondary sources. Primary data were collected through household head interviews, key informants interviews, focus group discussions in each district, and field observations. The interview schedule was pre tested among the 10 non sampled rural households. Then the necessary modifications were done based on the pre tested questionnaire. Qualitative data were gathered by using. Secondary data were collected from government annual reports, official statistical abstracts, and research results undertaken in the area.

Data Analysis

To analyze the quantitative data, descriptive statistics were used to analyze and categorize personal and socio- economic characteristics of the respondents. On the other hand, Qualitative data were analyzed through narration and descriptions. Management and analysis of the data were undertaken by using Statistical Packages for Social Sciences (SPSS version 20).

Results and discussion

Socio economic characteristics of the sample household heads

The unit of analysis in this study was a household. In the study areas, household heads were the ones who took decisions on the major matters, including the adoption of land management technologies. In this study majority of the sample household heads (85.8%) were male headed households (Figure 1). Male headed households were expected to adopt and implement land management strategies due to their information exposure. Male headed households were probably more exposed to visit different land management practices in the field. On the contrary, female headed households were confined to their home for household activities and hence, they have less exposure to farm land management practices.

The schooling period of farm household heads is an important factor that affects the adoption of land management technologies. Farm household heads that have opportunity to study formal educational institutions for a long period acquire more knowledge in relation to different land management strategies. In the study area majority of the respondents attended their education at least at primary school level (Table 1). Therefore, there is a tendency to increased adoption of technologies with increased schooling period of farm household heads. Better educated farmers were aware of several kinds of land conservation measures through their good personal contacts with agencies involved in land management. Illiterate and low educated farmers cannot get such opportunities, which inhibit them from the adoption of conservation technologies.

The mean age of the sample respondents was 48 years which clearly indicates majority of the respondents could be rich in farm experiences (Table 1). There is a tendency to adopt and implement land management technologies when the experience of the farmer increased. Marital status is also another crucial variable in the implementation of land management strategies. Among the total sample households, 87.5 % households were married (Table 1). This could help the household head to share labor and decision making with his/her partner to adopt and implement land management strategies.

Table 1: Socio Economic Characteristics of the Respondents

Sex	**Frequency**	**Percent**
Female	17	14.2
Male	103	85.8
Total	120	100.0
Education level	**Frequency**	**Percent**
Illiterate	49	40.8
Basic education	13	10.8
Primary school	55	45.8
Secondary school	2	1.7
Diploma	1	0.8
Total	120	100.0
Marital status	**Frequency**	**Percent**
Single	2	1.7
Married	105	87.5
Divorced	3	2.5
Widowed/er	10	8.3
Total	120	100.0
Socio-economic characteristics	**Mean**	**SD**
Age of the sample respondents	48.94	11.8
Family size in adult equivalent	5.17	1.8
Land size of the household in hectare	1.42	1.03

Farm plots distance in minutes	3.11	2.55
Livestock size in TLU	4.25	2.53
Frequency of extension contact in 12mths	3.15	2.35
Farm experience years	28.62	12.11

SD=Standard Deviation

Source: own survey, 2017.

The mean family size in the study area was around 5.2 in adult equivalent (Table 1). It is well known that the implementations of land management strategies are highly labor intensive. Hence, the active labor family members contribute a lot to adopt the land management strategies. The labor requirement is substantially increased if farmers want to construct check dams and prepare adequate amounts of green manure and compost to their farm lands. Therefore, there is a tendency to increased adoption of land management technologies with an increased number of household members engaged in agriculture.

Extension service provided to and training attended by farmers are important variables influencing the adoption of land management technologies. Extension officials had frequent contacts with the farmers and conducted training on natural resources conservation strategies.

Indigenous Cropland management Practices

In North Gondar Zone rural farm households employed a combination of modern and indigenous cropland management practices to maintain the fertility of their farmlands. The classification of farmland management practices into indigenous and modern (introduced) may be, actually, controversial. This is because an indigenous management system at a given locality may not be so in other localities. As a result, for this case, with the help of the information obtained from the sample households who were primarily engaged on farming, farmland management practices which are developed by farmers' experiences, and are time honored are categorized into indigenous methods. Contrarily introduced methods are grouped into introduced (modern) methods.

Crop rotation: In the study areas farmer's experienced in rotating legume crops with other non-leguminous crops for the main purposes of soil fertility improvement. Almost all of the sampled household heads (96.7%) practiced crop rotations on their fields for annual crops with a common rotation sequences (Table 2). Tef and finger millet were considered as soil depleting crops while faba bean, pea and haricot bean were legumes which enrich soil fertility.

From the farmers' point of view, crop rotation was an important indigenous crop land fertility improvement practices to improve soil fertility. For example, the role of leguminous crops like haricot beans, pea and faba beans in improving soil fertility are well understood by most farmers in the study area. The sequence of crop rotation in the study area are

Tef ⟹ Maize ⟹ Wheat ⟹ Faba Bean/Pea/Haricot Bean.

The key informants' interview result indicated that the importance of indigenous crop rotation practice is used to improve soil fertility through nitrogen fixation. Moreover, they explained that rotation was used to control pests and diseases infestation. Crop rotation has also ecological regulative functions in reducing drought effect, sequestering carbon in the soil and above ground, and reducing water stress.

Multiple/Inter-cropping: Farmers used to inter planting two or more crops together with some root edible. Farmers in North Gondar Zone grow multiple crops at a time. Around 81% of the sample households practiced multiple crop production system to improve the crop land fertility (Figure 2). Common intercropping practice in the area involves growing of maize with tef and maize with linseed/flax. Farmers realize that beans (haricot bean or pea) are good for cereals (maize and tef). Intercropping is locally described as "Asebatero mezerat". Farmers use this practice as a coping mechanism against effect of diseases, insect pest and/or drought. This age-old practice is valuable for soil fertility improvement, increasing yield and crop insurance at time of drought. The system is still widely practiced in the study areas especially in lowland areas.

Figure 1. Multiple/inter cropping practice in West Belessa District.
Photo by the Authors (2017).

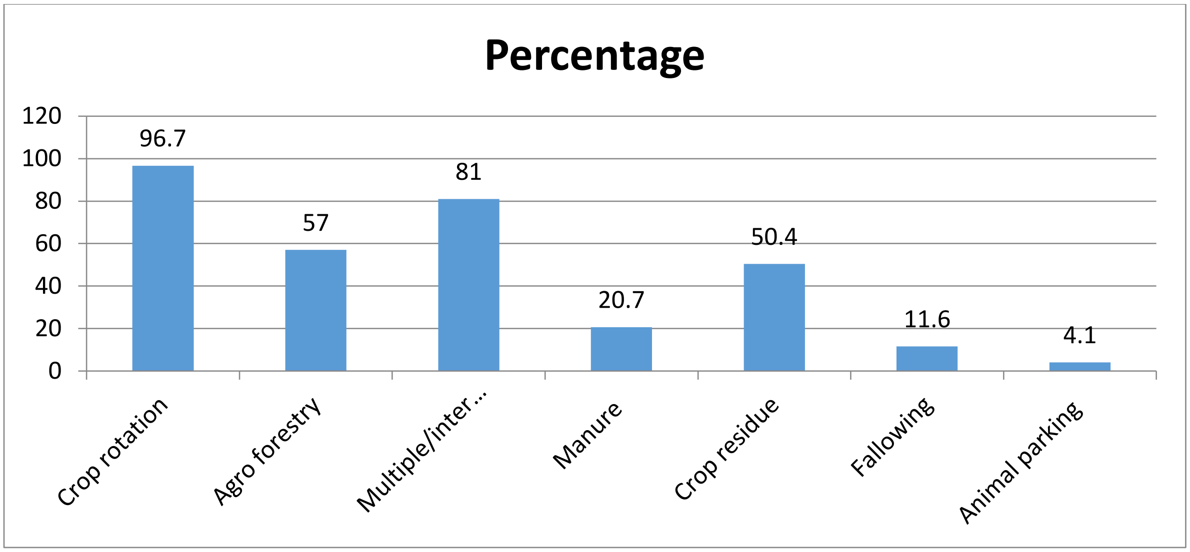

Figure 2. Indigenous Crop Land Fertility Improvement Strategies.
Source: Household Survey Data (2017).

Manure: It is an important practice in enhancing soil fertility. The survey result indicated that, about 20.7% of farmers use manure to maintain fertility of their backyard farm lands (Figure 2). Traditionally rural households add animal dung, ash and household waste to crop land to improve soil fertility. However, in the study area, it is well manifested in the homestead gardening or at backyards.

Crop residue: Crop residues are the remaining parts of crop production after harvesting crops. Around 50.4% sample households left the crop residues to their farm field to protect their land from flooding and wind erosion (Figure 2). It is deliberately left by farmers on crop land to increase soil fertility and organic carbon. Farmers stated that the residue decompose as termites use and keeps the soil moist, protect soil from direct effect of sun light, flood and wind. The protection of soil by crop residue was widely used in the area both by rich and poor farmers. Crop residue from cereals (maize, wheat, tef), pulses (haricot bean) were left for improving soil health on distant fields. However, it is becoming apparent that farmers harvesting crop residues for livestock fodder and cash purpose.

Agro forestry practices: Indigenous agro-forestry practice was often occurs at homesteads. On their homesteads, farmers grown different crops (cereals, pulses, spices and fruits) and different tree species. Farmers describe the importance of indigenous trees as a source of moisture and as source of animal feed. About 57% of the studied farmers practiced agro forestry practices

(Figure 2); however wealth status of the famer (poor, medium and rich category) seems to affect the management. As wealth status increased, the land holding, number and diversity of crops, trees and management increased.

Indigenous agro-forestry has role in increasing productive ecological function as it diversity food supply over the year. The practice has role in reducing the effect of famine, drought and plays significant role in climate change adaptations. The ecological supportive functions of the practice include improving nutrient and water cycling from a combination of crops and trees. The ecological regulative functions are in reducing drought effect, regulating micro-climate, sequestering carbon in the soil and above ground, reducing water stress through shades and it has role in overall ecosystem management.

Modern Cropland Management Practices

Compost: As it is indicated on figure 3, 66.1% of the respondent farmers prepare and apply compost. In the study area, compost had been prepared from animal manures, plant leaves as well as crop residues. However, the largest proportion of the inputs comes from animal manures. After its maturity, compost is added in to the soil as fertilizer like that of the dry manures. It cannot be utilized alone, without additions of chemical fertilizers, because farmers do not put their trust on compost to provide sufficient productivity unless it is utilized together with chemical fertilizers within the short productivity season as needed, especially for cereal crops.

The most important negative impacts or limitations of compost, standing from the farmers' point of view, were; it fails to practice efficient utilization of farm plots if it is applied without the addition of chemical fertilizers, it is time taking and laborious (to prepare, transport and address several farm plots). The raw materials, particularly animal manures were not easily available for those farmers who have small number of and/or no cattle.

Chemical (Inorganic) fertilizers: Application of chemical fertilizers was practiced by almost all of the respondent farmers (89.3%; Figure 3). The most prominent inorganic fertilizers which were widely and intensively being utilized in the study area were Di Ammonium Phosphate (DAP) and Urea. These fertilizers were added to the soil with seeding simultaneously. What is generally noticeable here, according to farmers, is that productivity without chemical fertilizers was not imaginable, but can be more effective if chemical fertilizers and organic fertilizers are combined together.

Area closure: More than half of the farmers (54.5%) do not allow livestock to graze on cropland after harvest, to avoid soil compaction and wind erosion (Figure 3). Regeneration of degraded grassland is often done through enclosure at household level. People value the forage and give less emphasis to grassland soil. Farmers do know the improvement of grass growth, reduction of soil erosion and improvement in soil fertility with grassland enclosure. This is widely practiced in privately owned grasslands and at homesteads.

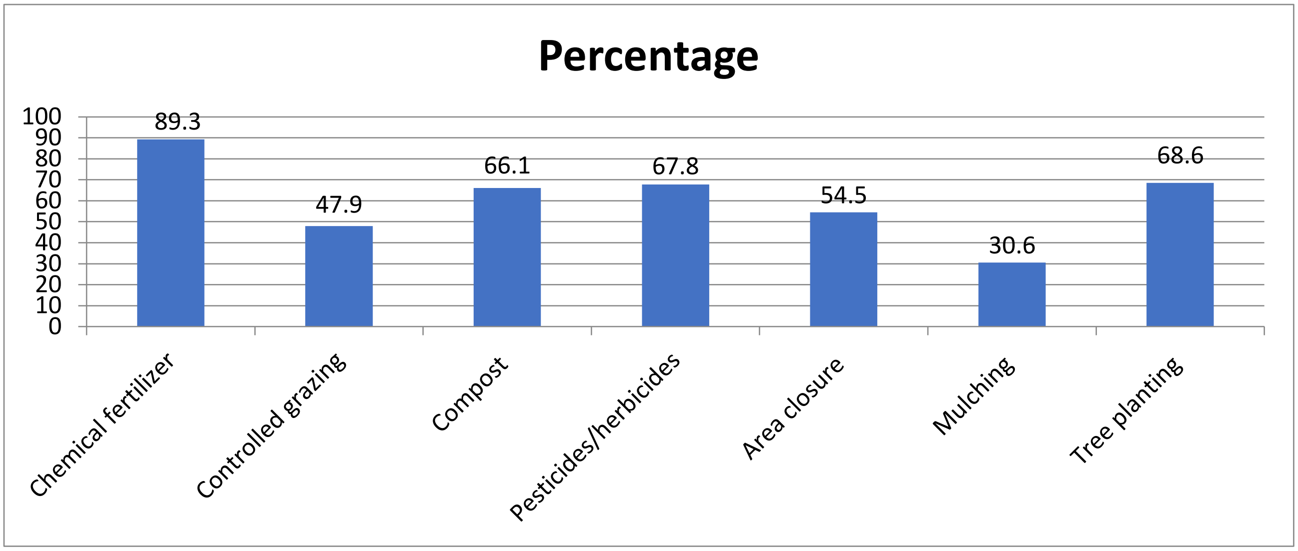

Figure 3. Modern Cropland Fertility Improvement Strategies.
Source: Household Survey Data (2017).

Pesticides and insecticides: In the study area, 67.8% of households apply insecticides and pesticides to control weeds and pests (Figure 3). A pesticide is any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest. Pests can be insects, mice and other animals, unwanted plants (weeds), fungi, or microorganisms like bacteria and viruses.

Soil stuffing locally known as chika beray, manual weeding and application of chemicals (2, 4-D) were common methods of controlling insects and pests. Soil stuffing was practiced on farm plots prepared for only tef and sorghum production, especially on red soils. However, applying insecticides and pesticides were not advisable due to their negative effect on the human and animal health as well as bee keeping agriculture. Even if farmers realized its negative effect most of the farmers were using chemicals to save their labor and time.

Physical Crop Land Management Practices

Contour plowing: Almost all sample households (95%) used the age old contour plowing system to conserve their crop land soil from flooding (Figure 4). Based on key informants discussion and focused group discussion, this system of plowing was valuable for drain off water without losing fertile soil. The sample households also stated that contour plowing was practiced especially in the rainy season to minimize the energetic downward flow of floods and facilitate rain water percolation. For steeply sloped farm plots, according to the respondents' explanation, it was mandatory to use other additional alternative measurement methods like terraces.

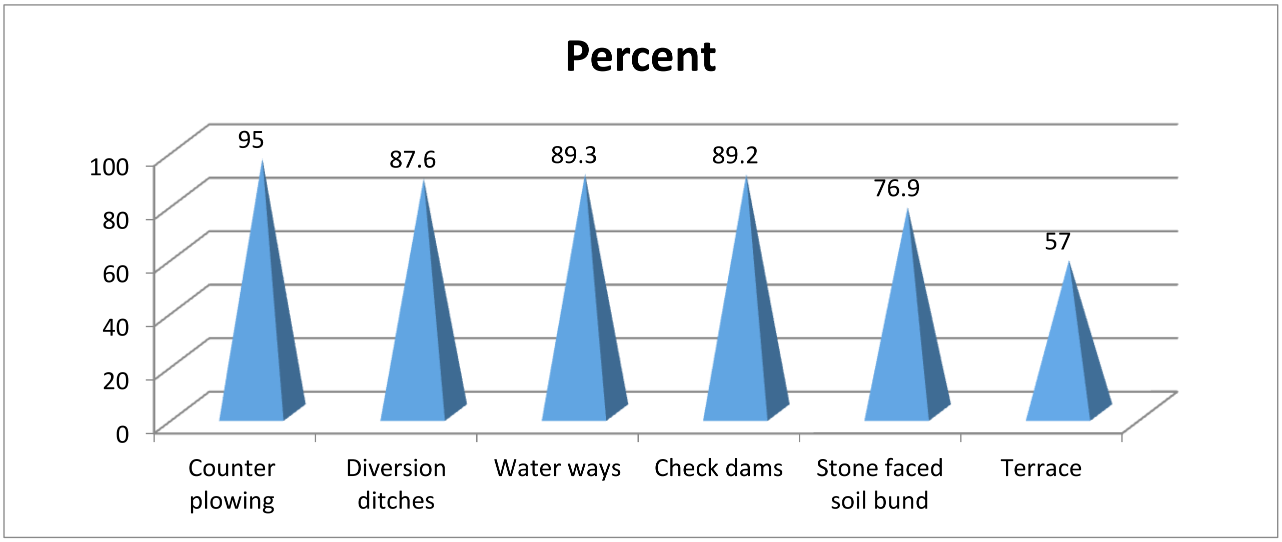

Figure 4. Physical Cropland Management Practices.
Source: Household Survey Data (2017).

Diversion ditches: There were also other indigenous cultivation methods in the area where farmers plow along the counter, construct ditch to divert excess water and harvest water. 87.6% of the respondent farmers used diversion ditches (Figure 4). Diversion ditches are micro-channels constructed on cultivated fields to drain off excess water. Construction involves pressing the plough deep into the ground and running it diagonally across the farm plot. Ditches are different from normal plough furrows (in dimension and orientation), and their construction is executed in every cropping season.

Waterways: 89.3% of the respondent farmers used waterways (Figure 4). These are ditches which are always constructed downward against the contour and to which diversion ditches are connected. They are permanent structures constructed alongside the cultivated fields. The deepness and wideness of water ways depends on the steepness of the slope and the amount of flood flowing from each diversion ditch, because the more steep the slope, the more will be the amount of flood.

Terrace: With regard to the importance of terraces, key informants explained that terracing of farm plots enables a farmer to minimize soil and water loss through facilitating water percolation (57%, Figure 4). If a little movement of soil happens, the terraces enable the soils to be deposited and accumulated along the terraces. The accumulated soils are fertile so that farmers reconstruct terraces at different production seasons to redistribute soil fertility throughout the farm plots.

However, they tried to aware the negative impacts of terracing for fragmented and small size farm plots terraces create extravagance and does not fit with the existing plowing technology and system. Terraces also make favorable conditions for bearing of rodents while they are not reconstructed in different cropping seasons and are labor intensive.

Figure 5. Stone faced soil bund in Dabat district.
Photo by the Authors (2017).

Check dams: It is the construction of dams by using wood, weeds, vetiver grasses, leaves and soils together. In the study area plants like Suspania were becoming appreciable to be planted along terraces (89.2%, Figure 4) particularly keters. It helps to decrease the amount of splash erosion, and flood to be added in to the horizontal ditches of the terraces. According to the respondent farmers and development agents' explanation, the roots of the plants provide strength for the terrace like structures of soils dig up and installed along the ditches such as keters not to be affected by torrential floods.

Figure 6. Check dams constructed from woods and gabions in North Gondar Zone
Photo by the authors (2017).

Existence of Indigenous Knowledge Documentation and Dissemination

The key informant and focus group discussants claimed that their agricultural offices had no documentation policy for agricultural indigenous knowledge materials. Moreover, the interview conducted revealed there was no comprehensive and well-articulated policy that could take care of all aspects of agricultural indigenous knowledge documentation and dissemination process. However, a policy is a vital requirement for the documentation and dissemination of agricultural indigenous knowledge. It not only confers authority on the institution but also creates an enabling framework and gives general direction for the documentation and dissemination of agricultural indigenous knowledge. But now a day there are some hopeful situations for the upcoming of disseminating indigenous cropland management practices through field days and observations of best practices.

Conclusions

The study assessed the existing indigenous crop land management practices in north Gondar zone of Ethiopia. The study showed that the most popular indigenous crop land fertility improvement practices in North Gondar Zone were crop rotation, inter/multiple cropping, agro forestry and crop residues. The introduced modern management practices with similar intention include chemical fertilizers, tree planting, pesticides and insecticides, application of compost and area closure. Contour plowing, construction of water ways, check dams, diversion ditches, stone bunds and terraces were widely accepted indigenous physical cropland management practices. The construction of stone faced soil bunds, check dam and trenches were the introduced modern forms of soil and water conservation mechanisms. The study further indicated that there were no efforts in documenting the indigenous knowledge available in the farmland.

Due attention should be given for adoption and proper implementation of organic fertilizers and other improved structural soil and water conservation measures in order to maintain sustainable soil fertility and productivity. Crop residues and animal dung (in the form of dung – cake) were used as a source of cash which largely reduces application of organic fertilizers. Hence, alternative energy sources should be developed to minimize wood and dung cake energy consumption.

Further works should be, generally, undertaken to develop farmers' awareness how to properly integrate indigenous and introduced farmland management practices and enhance the application of improved management practices throughout the study zone.

There are some promising situations to develop, conserve and use indigenous cropland management technologies. However, it is at the infant stage and hence, it is recommended that further local supporting policies and strategies have to be enshrined and implemented to document, conserve, use and promote indigenous knowledge at greater scale. The indigenous practices also need to be integrated with modern practices in order to give better results.

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