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The Effectiveness of Basin Tillage on Maize Production in the Semi-Arid Dayataya Ward of Southern Zimbabwe

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ABSTRACT

This study examines the effectiveness of basin tillage in maize production in Dayataya ward located in the semi-arid district of Zvishavane ward in southern Zimbabwe. The study was based on questionnaire surveys and interviews with key informants, field observations, and secondary data sources. The major findings of the research were that even though many small scale farmers have adopted basin farming in the Dayataya ward, most of them have not fully implemented the requirements of basin tillage. Not all farmers have incorporated mulching as a special requirement in improving soil moisture in basin tillage. Basin spacing and plant population fall far below the regional standard. Plot fencing is also an area of concern since farmers need to protect their mulch from livestock during the winter season. Yield of maize per hectare has shown some improvement. The research recommends farmers to take a holistic approach towards basin farming. A full basin tillage package that comprises proper basin spacing, plant per hectare, and other on-land rain water harvesting techniques, such as deepening of contours and placing infiltration at strategic positions, may also help farmers to improve soil moisture.

Keywords: basin farming, mulching, basin spacing, water harvesting, holistic approach

INTRODUCTION

Generally, the semi-arid areas of Africa receive average rainfall of not more than 650 mm per annum and temperatures are as high as 27 degrees Celsius. The water stress causes dry spells and agricultural droughts are not primarily caused by low rainfall, but by poor partitioning in large losses of water in the water balance. High runoff levels, high drainage, and high evapotranspiration rates all contribute to about 60% to 70% loss of water from a rainfall event, hence the need to wisely use the scarce water resources available. In Zimbabwe, climate records are neither constant nor long enough for one to ascertain whether the decline in the country's seasonal rainfall is temporary or here to stay (Bagchee, 1994). If the declining trend persists, as is the indication, then the demand for mitigation measures is even greater and more urgent, particularly measures to increase food production in the face of increasing population and environmental degradation.

Chronic droughts in Zvishavane communal lands of Zimbabwe are a stumbling block to the eradication of hunger and extreme poverty that ravaged the whole ward over the past few decades. Zvishavane district is a semi-arid district with an average rainfall of 450 mm per annum and temperatures that reach 30 degrees Celsius in extremes. These conditions greatly affect maize production, particularly in the Dayataya ward. Hunger is a common phenomenon and is widely pronounced

through the whole ward (Dayataya). Women, children, and people living with HIV/AIDS (PLWA) are among the worst affected as they have fewer opportunities and resources for pursuing alternative livelihood options as their maize crops fail periodically. In order to improve maize productivity in the Dayataya ward, cultural practices that conserve the fragile soils and extend the period of water availability to the crop need to be developed.

The government and non-governmental organizations (NGOs) have tried to develop and implement various conservation methods in the ward. Unfortunately, many of these techniques, though, are technically sound, have failed to bring better results in the ward, as far as maize production is concerned, and many households are still under nourished. The methods were developed and tested in research laboratories, with very limited considerations of the priorities of small scale farmers and their physical environment. The question that is yet to be answered is whether basin tillage, as a maize production method, could benefit the locals in the short term as well as the long term. Despite the lack of technical support, small scale farmers, in semi-arid regions of Sub-Saharan Africa, have been growing crops for many years and the major crop has been sorghum. However, even though sorghum and other small grain crops, such as rapoko and millet, are widely recognized as well adapted to semi-arid regions, they tend to fail completely in some extreme seasons. Despite this, small scale farmers in semi-arid regions are shunning drought resistant crops, such as small grains, in favor of the maize crop, a less drought resistant crop. The best way to produce the maize crop in the semi-arid regions could have been through irrigation. However, the high cost of setting up irrigation schemes means that maize production will continue to depend on rain-fed production. This, therefore, means that success in cropping (maize production) depends on using agronomic techniques, which conserves the use water to enable the crop to survive under the low rainfall conditions and to go through the long dry spells, which are common in the semi-arid area of Dayataya ward.

In Zvishavane, like in any other semi arid district of Zimbabwe, conservation tillage is widely used. In the Dayataya ward, conservation farming was first adopted in the late 1980s in the form of small scale gardening, infiltration pits, crop rotation, mixed cropping, and the recent basin/pit tillage. Many small scale farmers in Zvishavane district had, by the 1990s, adopted these water harvesting techniques mostly from the northern parts. Yield differences between basin tillage and conventional methods are significant and large during the driest years, which is an indication of the water harvesting effect. Soils in the Dayataya ward are poor sands, which cannot sustain reasonable crop yields without an application of large amounts of fertilizers. Drought has been occurring frequently in the past, for instance, in 1981/1982, 1983/1984, 1991/1992, 1994/1995, 1997/1998, 2001/2002, 2004/2005, and 2007/2008.

Pressure on land in the area is high and is partly due to high population growth rates of 3% per year. Sizes of land holdings per household are very small with an average of 1.2 hectares per household with some households being landless. In the Dayataya ward, marginal land settlement is rampant and is also associated with poor grazing land. There are low numbers of cattle due to limited pasture land and the direct impact is scarcity of draft power. The Central Statistics Office (2002) noted that 50% of the households in Zvishavane district own at least a single beast and the remainder had neither cattle nor donkeys.

It is, against this background, that small scale farmers in the Dayataya ward attempted to adopt diverse conservation farming techniques. This study, therefore, seeks to assess the sustainability of basin tillage as a method to increase maize yield under semi-arid conditions of Southern Zimbabwe. The study looks at both the immediate and future prospects of basin tillage in eradicating hunger and extreme poverty in the Sub-Saharan Africa.

STUDY AREA

The Dayataya ward is one of Zvishavane's nineteen rural wards (Fig.1). It is located 15 km west of Zvishavane town and 115 km from Gweru, the provincial capital. The ward also shares boundaries with the Ngomayebani ward to the southeast, the Mhondongori ward to the southwest, the Ture ward to the north, and the Vukuso ward to the south. The ward comprises a total population of 3,488 people in 661 households with an average of 5 people per household (Central Statistics Office, 2002). The Dayataya ward falls under natural region five of Zimbabwe, with an average rainfall of 450 mm per annum, which is erratic in most instances. Temperatures rise to above 30 degrees Celsius in summer season.

The dominant group of soils in the ward is orthoferallitic derived from the granite rock. The soils have a sand fraction, which is coarse, particularly in Zvegona sub-cluster, and the clay content, which varies according to the degree of weathering and catena position. The only major river is Ngezi, which borders the ward with Mhondongori ward to the southwest. Ngezi is a perennial river that could have been used for irrigation purposes in the Dayataya ward, but the lack of capital to initiate the project has left farmers to watch the water flow downstream whilst their crops wilt in most seasons. The Shavi stream is to the southeast and borders the ward with Ngomayebani.

The economy of the ward is mainly agro-based and production is partly for subsistence and partly for commercial purposes. Farming activities are based on labor intensive techniques, simple technologies in water harvesting, and utilization. Marketing of produce, particularly horticultural products, is of paramount to the ward, both within the ward and in Zvishavane town and other wards.

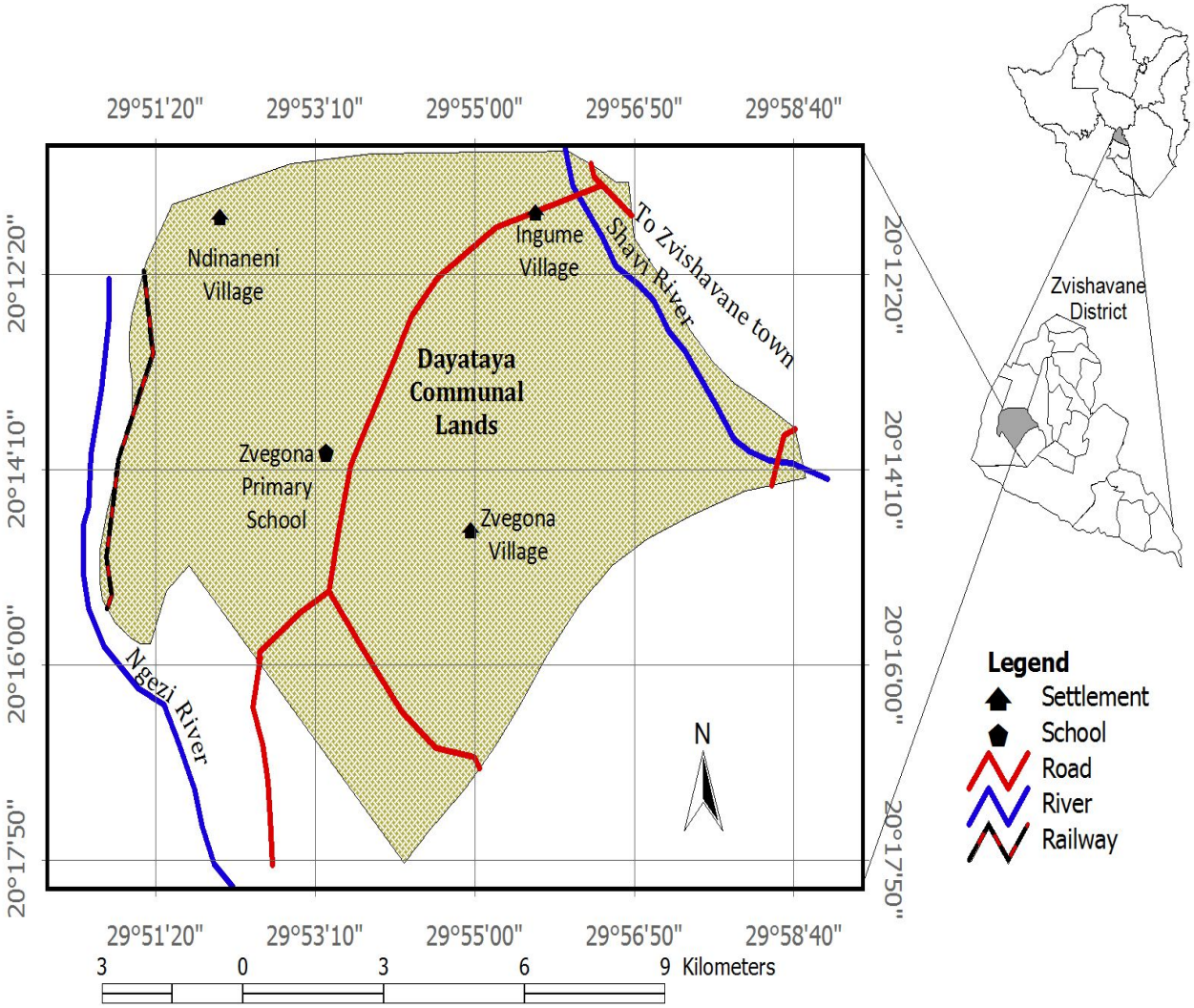

Fig.1: The location of Dayataya ward in Zvishavane district of Zimbabwe

LITERATURE REVIEW

The central component of basin tillage package is the planting basin. Seeds are planted, not along furrows, but in small basins/pits/micro-catchments (Tomlow and Hove, 2006). In the Middle East, these basins are referred to as negarims and are used, not only in crop, but in fruit production where fruit trees, such as almonds, are grown (Molden, 2007). The basins can be dug using hand hoes without having to plough the field. This is quiet helpful given that the majority of small scale farmers in Southern Africa struggle to cultivate their fields in a timely manner due to the lack of draft power. To be more precise, in the area under study, 50% of the total households do not own cattle (Central Statistics Office, 2002).

The initial basin tillage concept was developed by Oldrieve in Zimbabwe in 1993 and it was subsequently modified and promoted in Zambia by the Zambian Farmers Union for Conservation Farming Unity (ZFUCFU) and was finally modified in

Zimbabwe by the Zimbabwean Conservation Agriculture Task force (ZCAT), convened by the Food and Agriculture Organization for Southern Africa (FAOSA) (Twomlow and Hove, 2006). Today in Zambia, over 120,000 farmers have already benefited from the adoption of basin tillage and an estimation of 250,000, about 30% of Zambia's small scale farmers, will be practicing basin farming by 2011. In addition, farmers spread any crop residues that might be available as surface mulch to protect against soil losses early in the season, conserve moisture later in season, and enrich the soil with nutrients and organic matter as the residues decompose. In order for mulching to be effective, it should leave at least 30% of the crop residues.

Maize is a warm weather crop that requires high temperatures of about 24 degrees Celsius during the growing season. Low temperatures reduce growth and extremely high temperatures may retard germination of seeds, particularly when it is combined with moisture deficiency. Generally, maize favors long seasons (110-140 days) in which there should be adequate moisture. Rainfall during three to five weeks before silking to three weeks afterwards is important. If severe moisture deficits coincide with tussling and silking, crop failure is to be expected due to poor pollination. According to the Agronomy Research Institute (ARI) (2002), the average national maize yield in the small holder sector of Zimbabwe is one ton per hectare in communal areas and two tons per hectare in resettlement areas, compared to about four tons per hectare in large scale commercial farms. It is recommended that on selecting cultivars one has to consider the agro-ecological region and growing season length (ARI, 2002). In low rainfall areas, like agro-ecological region four and five, where the Zvishavane district lies in which the Dayataya ward is found, farmers are recommended to grow maize varieties that quickly mature and biologically have some form of resistance to drought.

Maize is susceptible to drought and it rapidly shows signs of wilting, particularly in semi-arid areas where rainwater is limited (Jackson, 1989), hence the need for frequent irrigation. Studies, carried out in Lebanon, found that maize yields were considerably reduced if the irrigation interval is exceeded one week and increasing moisture stress tends to delay maturity, leading to premature deaths of the crop. The same studies showed that if the irrigation interval was increased from one to two weeks, then the maize yield was reduced by about 47%. Greer and Schoenan (1996) added that any serious reduction in water availability, reduced plant growth to some extent. He also noted that the growth reduction is more pronounced as the time of dryness increases, the rate of transpiration is greater and the rate of water movement from drying soil areas to root surfaces is slower. According to Jackson, Turner and Matanda (1997), natural region five of Zimbabwe has erratic rainfall of around 300 mm to 450 mm with very limited possibilities for non-irrigated crop production. The Dayataya ward experienced frequent dry spells. The most severe dry spell is the January to February 2008, which greatly reduced maize yield in the ward, hence the need to harvest rain water for maize production.

The issue of climate change has received so much attention at global, regional, and national levels with policy makers at all levels resolved to adopt proactive measures as a way to mitigate negative impacts on agriculture (The Herald, 2009). The International Panel on Climate Change (IPCC) of 1992 had focused the prospects of a changing climate as well as the known challenges of continuing to feed the world's population, which is projected to double the 1990s figure of 5 billion by 2060, according to The International Bank for Reconstruction and the development of The World Bank. The prospective of climate

change is global warming, with associated changes in hydrological regimes and other climatic variables, induced by the increasing concentration of radiation active green house gases, according to the IPCC. To help prepare for the uncertain but challenging future, this study, therefore, examined the potential of basin farming in raising maize production to counter the adverse effects of climate change.

Small scale farmers, in semi-area of Southern Zimbabwe, Dayataya ward included, are already marginalized and climate change imperils their survival. Yet strategies to increase production already exists (Downing, 1992). The strategies are to switch to drought resistance crops, such as rapoko and sorghum millet. Many agricultural regions have already warmed and we are beginning to see that these warmer temperatures are suppressing yields. There is evidence of declining yields in countries that are found in the Tropics, particularly in the Sub-Saharan region (Darwin, 2006).

The issue of climate change is viewed differently in some quotas of the world. Some have argued that the countries affected should adapt to the changing climate (Darwin, 2006). Other scholars are of the view that adaptation does not guarantee that farming will be able to continue in an area, or if it does, that farmers' incomes will remain unchanged, some adaptation will involve shifting of production from one location to another area of comparable advantages. At this point in time, it is too early to vacate affected areas; technologies to adapt to the changing climate should be developed and correctly implemented in relation to the physical and socio-economic status of each area.

Maize is a staple crop in Zimbabwe and a significant crop in food security because it forms of the dietary needs of Zimbabwe. Maize ranks first in terms of the number of producers, area grown, and total cereal production in Zimbabwe (Rukuni, Taonezvi and Eicher, 2006). Maize is the staple food crop in Zimbabwe and is also an important cash crop to most communal farmers. Maize production is a major enterprise on small scale farms in Zimbabwe, but exhibits year to year variations in relation to rainfall variability. This means that water harvesting techniques play a critical role in planting water for crop use. Maize production has moved through great cycles of surplus and shortfalls in the country and this has been exacerbated by the global climate change. Between 1981 and 1982, drought reduced maize production in Zimbabwe by about 70% (Rukuni, et al., 2006) and again, in 1991 to 1993, the country registered the worst seasons in as much as maize production was concerned. In 2001 to 2003, the drought left 720 million people malnourished and the nation imported more than two million tons of maize. Total maize production fell to 1.4 million tons in the 2001/2002 agricultural season from the previous season. This, therefore, means that an efficient method that harvest the little rainfall during drought seasons needs to be increased or maintained in order to keep the maize production levels.

METHODOLOGY

The Research Design

In this research, both qualitative and quantitative research designs were used. These designs were meant to minimize errors by maximizing the reliability and validity of data. The researcher used the Dayataya ward as a case study. A quantitative research design was used because the type of data that was generated needed to be quantified. That is, a different yield of maize in different seasons, the amount of seed used per unit area of land, and livestock owned by farmers in the Dayataya

ward. Qualitative research was also employed in this research. This design was aimed to obtain descriptive information and was used gather data on the opinions of both the primary stakeholders, the farmers themselves, as well as from secondary stakeholders who are the AGRITEX officials and officials from the Grain Marketing Board.

Interviews

In interviews, the researcher gathered data directly from respondents in a face to face contact. Semi-structured interviews were conducted with selected key informants. These interviews were pre-arranged with the respective key informants, dates and times were set, and each was interviewed in their respective offices. The interviews were conducted are shown in Table 1.

Table 1: Organizations and interviews directed at them

Organization	Purpose of interview
AGRITEX officials	To assess the crop situation between 2006 and 2009 under different conditions of tillage
Grain Marketing Board officials	To evaluate the trends of input and distribution in Dayataya ward
Zvishavane Water Project	To gather data on how basin tillage is carried out in the area as well as the farming calendar that is followed

Questionnaires

The questionnaire gathered information on the demographic features of the Dayataya ward, such as crops grown, methods of fertilizing the soil, and principles of basin tillage. The questionnaire, which was used in this research, was designed in such a way that it directed the questioning process and promoted proper recording as it was tabulated in most of its sections. However, the authenticity of the questionnaire was somehow compromised by some respondents who failed to provide the required information. This was due to the fact that respondents lacked information or lapse of memory, particularly on the maize yield, for past seasons. Semantic difficulties also made respondents state a given question in such a way that it meant exactly the same thing to every respondent.

In trying to deal with the perceived above shortcomings of the questionnaire used, the researcher pre-tested the questionnaire in a pilot survey in order to identify any sources of misunderstanding of the instrument. This, somehow, enabled simplification of the language, where necessary, in order to try to ensure uniformity of data supplied for easy analysis.

Field observations

This data collecting instrument was used to record conditions and general activities that were used in basin tillage plots. The researcher, with the company of the Agricultural Extension Worker (AEW), randomly visited five plots in the whole ward. The purpose of these visits was to observe the actual basins where maize is grown, the spacing of these basins. Also on target were conservation works, fencing, steepness of the slope, soil types, mulching, and infiltration pits. The researcher got the opportunity to establish, through calculations, the total number of basins in a hectare, the number of seeds planted at each

basin, leading to the total number of seeds planted per hectare. This was done to come up with the plant population per hectare. Literature is pointing out that low maize production, among small scale farmers, is a combination of many factors including low plant population per hectare. The information was then used to augment the data collected through interviews and questionnaires.

Secondary data sources

Documents and reports to gather for information had already been collected for other purposes. Information on grain and seed distribution was from the Zvishavane district's Grain Marketing board (GMB). Information on annual crop situation, based on different tillage methods, was from AGRITEX. In order to analyse compliance and commitment to basin tillage, the farming calendar obtained from the Zvishavane Water Project (ZWP) was used.

Annual crop situation assessment reports by AGRITEX (2007-2009)

These annual crop situation assessments reports provided information about the rain fall situation, area planted pests and disease situation, and the average expected yield for areas where maize was put under traditional methods and basin tillage. The information that was gathered, combined with information that was collected from interviews and field observations, was analyzed to draw answers on the impact of basin tillage as a method to improve maize production in semi-arid areas.

Annual grain distribution reports by GMB (2007-2009)

The annual grain distribution reports provided a summary of quantities of grain distributed as a relief for the Dayataya ward and the amount of grain that was received by the national silo during the same period. The two reports were weighed to determine the ward's maize yield situation. More grain from the ward to the national silo meant high maize production in the ward. High maize from the national silo to the ward was an indicator for poor maize production in the ward. This enabled the researcher to weight basin tillage for the stated period.

The basin tillage calendar from Zvishavane Water Project (ZWP)

The calendar specified on what basin tillage activities shall be done and on what time of the year. The calendar enabled the researcher to assess whether farmers follow the correct procedures of the basin tillage.

RESULTS AND DISCUSSION

Adoption of basin tillage

Basin tillage has been practiced in the Dayataya ward for the past three seasons. During the first season, no farmer practiced basin farming without the back up of the usual conventional tillage. Only 28% of the respondents adopted basin farming in the first season. The low adoption rate is attributed to farmers' attitude towards a new tillage method. Those who adopted it during the first season never lost their traditional tillage systems. During the second season (2007/2008), a significant number of farmers adopted the basin tillage, but only on a trial basis because only 2% totally left the traditional tillage methods in favor of basin tillage. After a poor 2007/2008 agricultural season a notably number of farmers abandoned the basin tillage

method and reverted back to conventional methods of tillage with the numbers declining from 82% to 79% by the 2008/2009 season and an increase from 16% to 19% on farmers who practiced conventional tillage methods only.

Crops grown under basins

In other places, a variety of crops were grown in basins. Maize dominated the crops that are planted in basins with 78 respondents indicating a level of the use of basin tillage in maize production. Six respondents indicated that they have also tried groundnuts in planting basins. The remainder represents those farmers who did not practice basin tillage. None of the respondents seemed to have tried small grains, like sorghum, rapoko, and pearl millet, even though the AGRITEX department revealed that workshops for planting small grains in basins has been undertaken in the ward. Most small scale farmers in the ward shun small grains in favor of maize, despite the fact that small grains strive better in drier conditions than maize.

A comparison of basin tillage and conventional tillage

A comparison of basin tillage and conventional tillage is shown in Tables 2 and 3.

Table 2: Area planted maize, amount of seed used, and yield under basin tillage

Season	2006/2007	2007/2008	2008/2009
Area planted (ha)	2	6	12
Amount of seed used (kg)	40	120	250
Yield (tons)	2	1.8	10

Source: Field data (2009)

Table 3: Area planted maize, amount of seed used and yield under conventional tillage

Season	2006/2007	2007/2008	2008/2009
Area planted (ha)	200	185	175
Amount of seed used (kg)	4000	3700	3500
Yield (tons)	40	28	35

Source: Field data (2009)

From table 2, the total area that was planted maize, under basin tillage, increased by 66% in the 2007/2008 agricultural season from only 2 hectares in 2006/2007 season, then doubled the following season. Ironically, the area which was planted maize in 2008/2009 agricultural season increased with a decreasing number of adopters. This, therefore, means that farmers who left practicing basin tillage expanded their land by increasing the number of basins. These could have noted the potential of basin farming in the previous two seasons and hence wanted to increase their yields.

The amount of seed used in basin tillage is 20 kg, on average. This, however, falls short by 5 kg to the recommended 25 kg seed per hectare in conventional farming. A decline in yield for maize under basin tillage was noted during the 2007/2008 season. The decline may be attributed to a prolonged dry spell that was incurred in January to March in 2008. The decline in maize yield was noted in maize under conventional farming, which declined from 40 tons to 28 tons (Table 3). This was alternated by a sharp increase in maize yield the following season, which was on average 0.83 tons per hectare for maize under basin farming, compared to an average of 0.2 tons per hectare.

Field observations

Instead of using Southern Zimbabwe's recommended basin spacing of 90 cm x 60 cm, the farmers are using the 90 cm x 75 cm spacing, and instead of placing three or four plants per basin, most of the farmers place an average of two plants per basin. The 90 cm x 75 cm measurement results in 14,763 basins per hectare, instead of the 18,537 basins per hectare under the recommended 90 cm x 60 cm. This means that the currently adopted basin space is reduced by more than half the expected yield of maize under the normal and recommended basin spacing in southern Zimbabwe.

Methods of fertilizing the soils under different tillage systems

Soil fertility is second to moisture availability in crop productivity. Poor fertility means low yield and good fertility means high yields, hence the need to consider this aspect in improving maize productivity in basin tillage. Most farmers in the Dayataya ward (52%) use compost to fertilize soils under basin tillage. This is attributed to that most farmers who practice basin tillage do not own more than 50% (Central Statistics Office, 2002) livestock, hence have no other options for manure, except making their own composts. However, it was revealed from the field observations made that the type of compost used is partially decomposed. One could simply pick by hand live pieces of groundnuts stalks. Some farmers in the ward do not consider supplementing nutrients to their soils, even though they know very well that their soils are infertile and without supplementing nutrients, the maize yields are greatly reduced.

Neither compound D nor top dressing fertilizers are used in basin tillage. This is attributed to the type of training that farmers received from their AGRITEX officers, which promotes organic farming.

Livestock situation in the ward

Livestock is a source of manure, which farmers in Dayataya depend on to fertilize their soils. This sub-section assesses the livestock situation in the Dayataya ward to support the findings on the above sub-section. Considering that the basin farming in small holder farmers, such as in Dayataya ward, rely on manure as a source of fertilizer, the above graph gives a clear summary of the livestock situation in the ward. Agricultural extensionists promote manure over chemical fertilizers for agricultural sustainability. Manure increases soil water holding capacity, thereby making water available for crops, maize in this case. However, livestock in the Dayataya ward has been affected by droughts, most notably the 1992 drought, leaving many farmers with very little or no cattle. This makes farmers more vulnerable to hunger and poverty.

Basin farming principles

These are the conventional principles to be followed when practicing basin tillage. An insignificant number of farmers in the ward, even though they know more about water conservation practices, such as deepening of contours and infiltration pits. For any conservation tillage to be successful, it should leave at least 30% mulch of crop residue covering on the surface. In basin tillage, mulching is useful in that it reduces the impact of sunlight on soil moisture. The soil moisture is important in any crop production. The information that was obtained from both questionnaires and field observations showed that most plots (81%) had contours with the exception of a few that need renewal since they are now old and do not hold enough runoff for crop utilization. This significance of contour ridges owes back to the colonial period when contour digging became compulsory in all communal lands of Zimbabwe.

Only 2% of the respondents have fenced their basin tillage plots. This, therefore, means that even if the Stover is left out for mulching, it shall be eaten by livestock during winter time as they are left to roam in the fields. Practicing sound basin tillage in the ward shall continue facing these challenges as plots go unfenced.

Climate change has also greatly reduced maize yields in Southern Zimbabwe, either due to droughts or excessive rainfall. The study aimed at developing a unique basin tillage package for small scale farmers in the Dayataya ward, based on special considerations of the ward's physical and socio-economic factors and possibly to other areas in the region that contain more or less similarities.

CONCLUSION

The general conclusion, in as far as basin tillage is concerned, in the Dayataya ward is that apart from irrigation, small scale farmers can survive by growing rain-fed maize. This can be achieved through following the appropriate basin tillage package which, on its own, uses water sparingly in order for maize to survive the long dry spells, which are common in the ward. The changes that have been noted so far should give farmers hope.

Basin tillage does not consider draft power hence its adoption in Dayataya ward has been due to this cause. Basin spacing need to be revised if the yields per are to be increased. Mulching is known to a very few who at this time in moment haven't implementing it. Basins are dug to harvest water for on spot irrigation, by mulching the period of moisture retention is increased for the benefit of the maize plants.

Furthermore, most plots have not been fenced and livestock consume all crop residues that could have been used for mulching. The farming calendar is not adhered to by many farmers, hence they do not use the first rains to plant their seeds as they take this opportunity to dig basins when others would have already planted. For the past three seasons, some farmers have been planting seeds that had been saved from the previous seasons, due to the unavailability and un-affordability of seeds in retail shops. No one has attempted to use chemical fertilizers in basins.

RECOMMENDATIONS

Based on the findings and the conclusion made the following recommendations, the following recommendations can be made:

- The revision of the basin spacing and plant population per area
- Plots that are used for basin tillage should not be accessible to livestock.
- Farmers in the Dayataya ward be capacitated on compost making
- Infiltration pits be placed, not only along contour ridges, but on strategic positions to benefit all crops.
- Maize grown in basins should be top-dressed if high yields are to be accrued. Ammonium nitrate shall supplement manure and compost
- Each farmer should have a basin farming calendar and follow it strictly in order to be always on time and reduce accumulative demand for labor, which leads to unnecessary pressures.
- Contour ridges should be renewed and deepened in order to harvest maximum run off and increase infiltration.

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