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Fayetteville State University, Fayetteville, North Carolina

Sustainable Use of Wetlands: A Case for Mwaonazvawo Village in Mutasa District of Manicaland Province of Zimbabwe

Svotwa, E., I.O Manyanhaire and P. Makombe

Abstract

A research was undertaken to investigate sustainable utilisation of a wetland in Mwaonazvawo Village in Mutasa District of Manicaland Province. A questionnaire survey triangulated with interviews, field observations and measurements were used to collect data. The average land area per farmer was 352,9 m^2 and most farmers grew vegetables, citrus fruits, tubers, sugar cane and bananas and also reared cattle and fish to supplement their diets. Soil and moisture conservation practices identified included mulching; crop rotation and storm drain construction. These conservation practices and site-specific pressure state response indicators should be developed for monitoring sustainable wetland utilisation.

Introduction

Wetlands are sites of marsh, peat land or water, whether natural or artificial, permanent or temporary (The Ramsar convention 1971 and Matiza and Crafter, 1994). The water in the area may be flowing or static. In Zimbabwe, wetlands include dambos, pans, flood plains, riverine systems and swamps. Their sizes vary from the extensive systems along the High Veld to the small areas within the lower parts of the middle and low Velds. There has been a growing use of wetlands for agriculture. This practice dislocates the hydrological functions (wetland capacity to regulate stream flows) and subjects the wetland sites to high erosion risk. It was against this background that this research seeks to assess the sustainable use of wetlands in Mwaonazvawo Village of Mutasa District in Manicaland.

Wetlands are characterized by shallow water tables, which control the degree of saturation of the sites. Water flows into the wetlands through underground and direct seepage and direct rainfall. It flows out through the surface and subsurface plus evapotranspiration (Eyles, 1980). The depth of the water table has a significant influence on evapotranspiration and discharge. The deeper the water table the lower the evapotranspiration and discharge. Water tables in Zimbabwe are lowest in the month of May to October during the dry season. Zimbabwe's wetlands are generally of gentle slope, making the sites suitable for crop cultivation. The soil found in the wetlands is the sticky, blue-greyish, boggy type, formed through gleying. Gleying occurs in waterlogged conditions when anaerobic activity is prevalent due to absence of oxygen (Mukwada, 2000). The dark colour of the hydromorphic soil fades as one moves from wetland core to the periphery. Wetlands vary in terms of clay content of the soils. Clay content increases down the slope as the impermeable clay layer meets the surface. Since clay soils are generally more resistant to erosion than sandy soils, the sandy upland area is eroded, with much of the eroded material deposited on the lower valleys.

During the pre-colonial era, cultivation on dambo and riverine wetlands was a well-established agricultural practice in which communal farmers were involved in an all year round cropping. The farmers employed the hand hoe tillage system and localized drainage using the ridge furrow system or pits on the margin of the wetland. Major crops grown on wetlands included vegetables, maize, tsenza (edible tuber), yams (madhumbe or magogoya, local names) and rice. No archival evidence of wetland degradation of a high magnitude during this period is available (Moyo, et al, 1991). The control on the utilisation of the wetland was mainly through beliefs and taboos. Areas with excessive water were considered as sacred and had to be used sparingly so that the ancestors are not molested by the over utilisation of the resources. The level of sustainable utilization of wetlands began to decline after the creation of reserves where overcrowding, poor climatic conditions and infertile soils in the reserves forced the communal farmers to scramble for wetland sites. The pressure factors leading to exploitation of the wetland resources include: need to increase income levels, decreasing soil fertility in the upland soils, recurrent drought episodes and increasing land scarcity among the rural communities. Consequently, the state of the wetland ecosystem changed from the natural to modified state. The state indicators show that most wetland resources have been modified by particularly through the expansion of modern agriculture and the urban sector along the highveld of Zimbabwe. Biodiversity has been lost and consequently there is shortage of pastures and water. Wetland exploitation and particularly cultivation has been noted to be associated with food security, health and changes in river flow regimes. They cultivated them to supplement family produce. In the 1970s the situation became even worse due to the increased tension between the settler Government and the so-called Natives caused by the liberation struggle (Martin and Johnson, 1981). The conflict paralysed the settler Government's ability to monitor its policies on wetland cultivation. They had been alienated from their traditional resource and were bound to create conflicts over the use of wetlands a scenario that was responded to through the enactment of policies and laws that inhibited the maximum utilisation of the wetlands. Such landmark policies included the natural Land Husbandry Act and the Tribal Trust Lands Acts of 1967.With the advent of majority rule in the 1980 the sense of responsibility in the management of wetlands improved. The decentralization of the services of the Department of Natural Resources (Environmental Management Agency) to the district level resulted in stronger policing and monitoring of wetland cultivation (Sithole, 1995). The Government has also attempted to integrate into the conservation strategy the indigenous technical practice, limited success has been achieved in the form of sustainable wetland utilisation. Demands for wetlands continue to rise against the limited stock of resources that the wetlands can provide.

The angle and the length of the wetland slope play a significant role in the erosive process. The dislodged material is transported down the slope by the moving water. Effective conservation mechanisms become instrumental in controlling the influence of the slope to enhance sustainable cultivation of the wetland. In sites where the gradient is gentle, conservation strategies are easier for farmers to apply. Soil erodibilty becomes a key factor in the sustainable use of wetlands for cultivation. This phenomenon acts as a measure of resistance of the wetland site to erosive forces. Erodibility of a soil is affected by soil structure, texture, infiltration capacity, soil shear strength, and organic matter content and soil aggregate stability. All of which are affected by management practices. Soils with high organic matter naturally develop an open structure. This encourages water infiltration into the soil at the expense of surface run off, and hence the soil becomes resistant to soil erosion. Wetland sites with such soils need higher-level management. Some communal farmers however lack the necessary skills and knowledge to maintain the sustainable use of soils of wetland sites. Common strategies like construction of storm drains and contour ridges have received very little attention because of the labour that is involved in their construction (Otzen and Gumbo, 1995). Given the deteriorating condition of the state of the wetlands it becomes imperative that existing examples of wetland utilisation be documented and be transferred to other locations where wetland degradation is accelerating.

Objectives of the Study

The study sought to achieve the following specific objectives:

- Identify agro economic activities done by the farmers on the wetland areas of Mwaonazvawo Wetlands in a year.
- Estimate the angle of slope of the wetland site
- Assess the methods that are employed by the farmers to protect the wetlands from environmental degradation.
- Examine the crop livestock interactions in wetland cultivation in Mwaonazvawo Area

The study area

The Mwaonazvawo Self-Help Project is located in the Sanyamandwe Ward XI in Mutasa District of Manicaland Province, about 51 km from the City of Mutare. The Project involves agro economic activities on twelve hectares of riverine wetlands along the Chinyamutoro River Valley. Sanyamandwe Ward has high land that is dry which alternate with low areas that have excess moisture or wetland sites. The Mwaonazvawo area is located in the Natural Region II of Zimbabwe. This agro-ecological zone experiences an annual total rainfall that ranges between 1000 to 1500 mm. Most of the rainfall is received in summer that stretches from November to March. The mean annual temperature is around 20 ^{0}C although high temperatures of up to 35^{0}C can be recorded during the hot months of October to December. Winters can also be extreme in some years to reach –3 and 0 ^{o}C in winter between May and July.

Method

A descriptive random survey triangulated with questionnaire, in depth key informant interviews, field measurements, field observations covering 40 households (63% of households in the area) whose members have garden allotments on Mwaonazvawo Wetland was done with a view to establish the sustainability of the practiced agricultural activities. A household included those members normally living and eating together at the same home site. The questionnaire technique targeted heads of households or the manager/farmer of the wetland plot during time of visit. The data variables generated included types of crops grown, incomes realized and the soil and moisture conservation works and was compared with field observations, measurements and personal in depth key informant interviews with the farmers. Interviews enabled the collection of data from a cross section of farmers with plots on the wetland. Specific data categories collected through this method included a description of the production systems within the wetland; production levels and farmers' views on the sustainable utilization of the wetland. This was an open-ended approach aimed at maintaining maximum flexibility so as to obtain as much information as possible about farmers' livelihoods. The interview technique enabled probing the perceptions, attitudes, beliefs and feelings of farmers about sustainable wetland utilization. It was critical to determine the roles of farmers within the wetland as well as areas that surround the wetland.

Field observations were important in compiling an accurate description of the characteristics of the wetland and the agricultural production systems within the perimeter of the wetland and its uplands. A closer field understanding provided accuracy in field measurements of plots and gradient. It was critical to identify the types of crops grown and their cycles as well as establishing their value to the local community. To facilitate observation a descriptive checklist of the major attributes (size, slope, soils, vegetation, water table levels etc) of a wetland in Zimbabwe was generated as baseline information that was then compared with existing conditions within the wetland. This ensured that with the limited time vital information and factors were not neglected. The inherent limitation of this method though is that it provides a tunnel vision in exercise and limits consideration to items on the checklist. Triangulation of data collection tools was intended to minimize errors that are inherent in each method that could affect the accuracy of the data collected.

Qualitative data are typically verbal or written descriptive accounts of an issue. Thus, data were analysed by looking for themes and re-occurring issues in the data. Thus, social data from the questionnaire and the interviews were edited and coded immediately after the fieldwork. This was done to reconcile data collected by research assistants. The logic of different sets of responses was checked for insincere responses and codes were created for open-ended questions. A listing of the main categories of answers was done and the number of responses recorded against each other. The data generated from the questionnaire was both nominal and ordinal and thus the non-parametric Chi statistical tests were suitable for analysis of association of variables. The number of respondents was determined and the percentage of the total sample computed. These were then transcribed into a computer package for the construction of graphs and tables.

Results and Discussions

Agro economic activities on Mwaonazvawo Wetland

The study revealed a dominance of females on the wetland (32,5% male farmers and 67,5% female farmers). Women actively participate in agro economic activities as laborers and farm managers. This scenario resembles the features of agriculture in terms of plot management in Zimbabwe. The males in most cases are in towns in search of employment and the women work the field as a means for survival and to boost family incomes. With 55% of the Mawonazvawo farmers below 40 years, readiness to accept new technology and ideas could be high. Similar findings were made in surveys carried out in identical environments in Sanyati area of Zimbabwe (Charlotte and Madison 1998) quoted in Svotwa (2001). The adoption of new skills and knowledge has been instrumental in developing the potential of smallholder farmers. It is basically the use of appropriate technology in a balance, well managed and environmentally responsible system that is economically viable.

The majority of the farmers (87,5%) on the Mwaonazvawo Wetlands were married. Households that fell in the widowed and separated categories were 5% and 7,5% respectively. The chi-square test on marital status of the Mawonazvawo farmers and income in a year ($P < 0,05$) however, showed no significant association (Table 1). The mean income in a year for the married and “non-married” farmers was not significantly different. This shows that marital status has no direct influence on farmers’ financial returns. In agribusiness, noted (Downey and Erickson, 1987), initial capital, material inputs and machinery are factors of production. The question of the farmers’ financial returns is determined by the farmers’ decision on how much farm product to sell and prevailing market conditions.

Table 1: Chi - Square Test on Farmers’ Marital Status and Income in a Year in Mwaonazvawo Area

INCOME IN A YEAR	SEPARATED, DIVORCED OR WIDOWED FARMERS	MARRIED FARMERS	TOTAL
Below Z$300 000	1 (1.75)	13 (12.25)	14
Above Z$300 000	4 (3.25)	22 (22.75)	26

TOTAL	5	35	40

NB: Numbers in brackets are expected values

With an average family size of five in Mwaonazvawo Village, use of child labour in agro-economic activities could be a major factor in agricultural productivity. This practice is common in rural communities of developing nations. In these communities, children are regarded as an economic asset and valued source of labour (Clark, 1981). In African rural agrarian communities, households have successfully used child labour to enhance production (Pritchards, 1979). On a similar note, Jones (1990) noted that due to low mechanization much emphasis in communal areas was placed on manual work and many hands made work lighter. In this case the concept of 'child labour' among the rural poor does not exist but work part of socialization and growth of the child. Most rural communities are living on the capital stock of their investments when ideally they should live on part of the interests derived from these agricultural investments. A business that feeds on the capital is destined for bankruptcy. Thus, the question of sustainability has to address the issue of the vicious cycle of poverty entrapment among the poor. The chi - square analysis on family income against family size ($P < 0{,}05$) however showed no significant association (Table 2). Varying family consumption patterns of farm products and different product sales could account for this trend. In 85% of the households the family sizes ranged between 4 and 8 members per family giving an average of 6 members per family that is similar to the national average. This could be a further confirmation of the use of 'child labour' as large families are perceived ideal for rural peasant communities.

Table 2: Chi - Square Test on Farmers' Family Size and Farmers Income in a Year in Mwaonazvawo Area

INCOME IN A YEAR	<3	4	5	6	6>	TOTAL
Below Z$300 000	6 (3.5)	5 (4.2)	1 (3.5)	1 (1.4)	1 (1.4)	14
Above Z$300 000	4 (6.5)	7 (7.8)	9 (6.5)	3 (2.6)	3 (2.6)	26
TOTAL	10	12	10	4	4	40

NB: Numbers in brackets are expected values

There are great spatial variations in the sizes of land cultivated by the farmers with the majority (57,5% of farmers) cultivating on land pieces varying from 101 – 500 m^2. The remainder of the farmers work on land portions of 15 - 50 m^2 (2,5% of the farmers), land pieces of 51 – 100 m^2 (10 % of the farmers) and land pieces above 500 m^2 are worked on by 30% of the farmers. The small land portion sizes are indicative of the high rate of land fragmentation that is associated with the general increase in the size of the population and the number of families that need to survive on the wetland. The increase in population density within the perimeter of the wetland can also be attributed to the land degradation expressed as pronounced soil erosion and decrease in soil productivity. In Sub-Saharan Africa, claims

Waugh (2000), due to rapid population expansion, small plots are further divided. This provides a threat to sustainable utilization of the wetland and is at risk of degenerating into ‘the tragedy of the commons’ as postulated by Hardin in 1968’. The land size becomes too small for mechanization and output is limited. The Mwaonazvawo Wetland was originally meant to sustainably support 32 families. The variation of sizes of the farmers’ garden portions could be a result of unsystematic and uncontrolled fragmentation of fields as farmers shared their land portions with their next of kin. Farmers tend to densely populate areas whose physical environment support agricultural production (Jooste et al, 1987; Whynne-Hammond, 1990). The physical conditions could include fertile soils, low slope angle, moderate temperatures and reliable rainfall. Such a scenario is associated with reduced farm yields and financial income per individual farmer.

The high farmer population density on Mwaonazvawo Wetlands may not be accountable for any environmental degradation-taking place in the area. At local level, the farmers’ knowledge and skills on conservation and commitment to environmental management are instrumental in the maintenance of the environmental quality. Whitlow (1983), reported this trend in a survey of environmental degradation in Chikwakwa and Mangwende communal lands of Mashonaland Provinces. At national scale there, however, exists a core relationship between population density and land degradation.

Field measurements of slope angles of the plots established that (Figure 2) 43,5% of the households in the Mwaonazvawo Village cultivated land of slope angle below 10 degrees, 12.5% cultivated land of slope above 30 degrees, 7.5% on slope ranges of 11 - 20 degrees and 37,5% on slope ranges of 21 - 30 degrees. The average slope angle of 14 ± 9 degrees on the Mwaonazvawo Wetland could suggest some high erosion risk. The detachment of surface soil material due to raindrop impact and its transport under the influence of gravity are strongly affected by land slope (Morgan, 1979). However, with high conservation measures, sustainable utilization of the land resources has been achieved. In modern farming, reports Waugh (2000) crop cultivation is most suitable on land of maximum slope angle of 11 degrees. Contrary to this, in Zimbabwe’s Eastern Districts, farmers have broken the steep slopes through mechanical conservation. A traditional conservation component of the farming systems in the these Districts of Zimbabwe have been the construction of terraces as a mechanism to control the speed of water flow as well as to conserve moisture. Tea and coffee plantations thrive in the area with consistent and relevant environmental awareness programmes. Smallholder farmers have also utilized their land pieces sustainably (Vowles, 1993). Such could be the case of the Mwaonazvawo wetland farmers.

Figure 3 indicates that market gardening is the most important activity done by the farmers and this is mixed with cattle rearing for some of the farmers as well as fish farming. All the farmers in the area grow vegetables that include tomatoes, onions, cabbages, rape, and covo. These are an important component of the daily meals for the farmers and other people within the vicinity of the wetland. The majority of the farmers (62,5%)are into production of citrus like oranges and sugar cane. Other common fruits in the area are the bananas, which occupy a significant portion of each piece of land. Maize production is a common feature on the wetland since it is the staple food for the area. The farmers, are thus, guaranteed of two harvests of maize in one year since they can afford to irrigate during the dry season. For those who cannot afford to have two crops of maize they rotate this with wheat production. Wheat production was, however, not a popular crop with most farmers but it was an essential ingredient of bread for the community.

Cattle rearing was practiced by 47,5% of the farmers and the herds are in the majority of cases small, averaging 6 per household. This percentage is lower than the national average of 50 - 60 % reported by C.S.O. (1997) and Whingwiri et al (1992), quoted by Svotwa (2001). However, fish farming is a popular activity and is done by 65% of the farmers. The explanation to the small sizes of herds is within the framework of shortage of land for grazing. All the perennial availability of water can be argued to be a strong basis for the growth of suitable pastures for the herd but this is limited by the competing needs for sustainable food provision for the families. In 1991 - 2, Zimbabwe and the rest of Southern Africa experienced a devastating drought in which farmers lost their cattle herds (Munowenyu, 1999). Due to lack of financial resources, some farmers have never been able to restock. This could be the reason why a small percentage of Mwaonazvawo farmers have cattle. Cattle provide draught power, meat, milk and manure. Farmers can also sell them to supplement family financial resources. Given the limitation of land and the long profit return period for cattle farmers resort to fish farming that can be done on small ponds and the investment period is short. Within 6 months fish like tilapia would have matured and ready for harvesting. There were also varying fish carrying capacity of the fishponds. This is not an unusual trend. The carrying capacity of fishponds is determined by the farmers' ability to stock, capacity to feed the fish and consistence in monitoring pond water levels (Halley, 1983).

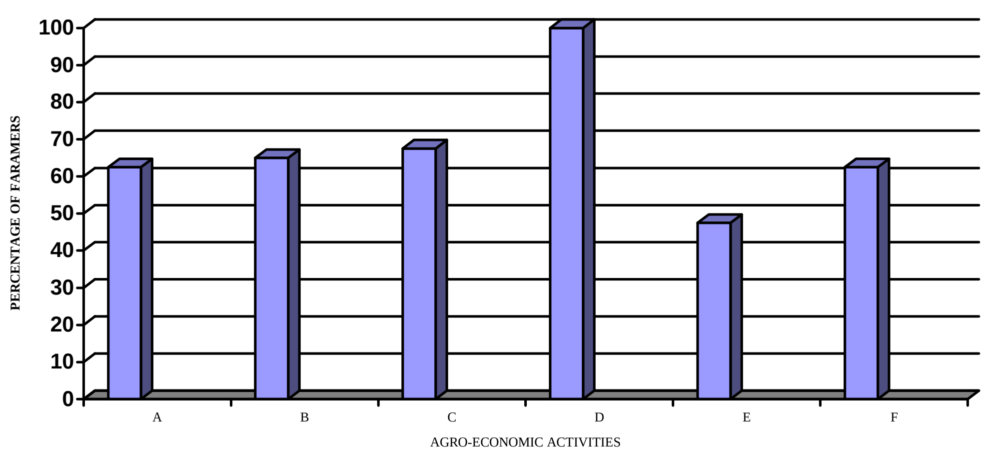

Figure 3: Major Agro Economic Activities of Sampled Farmers and Proportion of Farmers Involved

Key

A: Orange Production **B**: Fish Farming **C**: Banana Production **D**: Vegetable Production **E**: Cattle rearing **F**: Sugarcane Production

The distribution of farmer's income from the farm product sales showed a positive skew (Figure 6). Farmers who earned Z$151 000 **-** Z$300 000 in a year had the highest frequency (45%). The lowest (5%) ranged between Z$ 601 000 and Z$750 000. The proportion was the same for the farmers with income above Z$750 000. Farmers in the range groups A, C and D averaged 20%, 15% and 10% respectively. The average income of the farmers in a year was Z$300 400 ± Z$198 500 (n=40). The low-income mean could be explained in terms of high farmer population density on the Mwaonazvawo Wetlands. As stated earlier, the small land plot land size limits mechanization and types of production possible. The ultimate result is a reduced output and hence limited financial returns. This trend could also be explained in terms of communal farmers vulnerability to food shortages. The communal farmers have as top priority family survival. Most farm products are reserved for family consumption. Some individual farmers, however, mobilize adequate financial and material resources and boost production. From the same land piece, they produce enough for family consumption plus high quantities for sale. Application of sound management principles in production is also instrumental in the achievement of high yields and high financial returns (Beirlien et al, 1995).

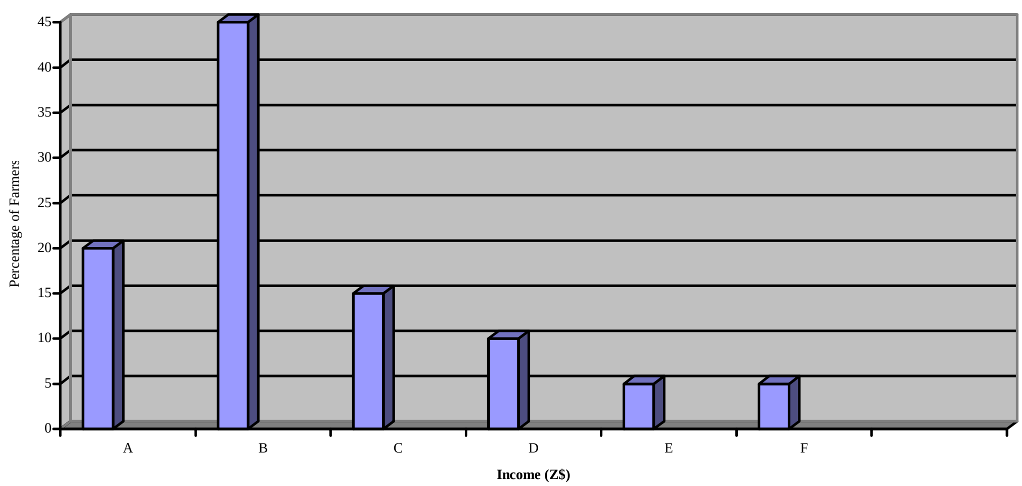

Figure 5: Distribution Of Income (Z$) From Sale Of Farming Products And Farmers Involved

Key: A: Below 150 000 **B** : 151 000 –300 000 **C**: 301 000 –450 000 **D**: 451 000–600 000 **E**: 601 000 –750 000 **F**: Above 750 000

Land use practices and sustainability

The broadness of the crop varieties grown on the Mwaonazvawo Wetlands could imply sustainable utilization of the wetlands and economic sustainability for the farmers. One of the major problems in communal agriculture today is the lack of diversity or agro diversity. In the traditional systems of farming local farmers produced a variety of small grains crops that included millet, sorghum, 'rapoko' (finger millet) as well as cowpeas, round nuts, groundnuts, cucumbers, pumpkins, okra and others. Today the agro scenario in these areas is characterized by the dominance of the maize crop. This has to do with the levels of production that can be realized on small pieces of land as well as the little labor that is required in the form of post harvest technologies of storage and processing. The traditional crops are labor intensive and yields are low per hectare. The shift to maize production in the marginal and dry areas of Zimbabwe has always been a challenge and farmers usually have food shortages and rely on handouts from the state and the non-governmental organizations. The maintenance of crop diversity as shown within Mwaonazvawo Wetland creates the basis for sustainable rural livelihoods. Most horticulturists produce vegetables because the crop is highly marketable and offers high immediate financial returns (Rice et al, 1986). Production on small scale can be easily planned and managed, so, it is with maize production. In rural communities of Zimbabwe, maize is the staple food (Encyclopedia Zimbabwe (Q), 1987). Production, in the last decade has been low particularly due to erratic rainfall and inconsistent human planning factors. Maize cultivation on Mwaonazvawo Wetlands could be instrumental for farmers to augment their staple food stocks.

The variety of crops grown by farmers (leaf, root, fruit and leguminous crops) formed the base for effective soil nutrient exchange. A well-planned rotation involving those crops could be useful in the prevention of soil erosion and maintenance of soil fertility. Crop rotation improves the nitrogen status of the soil by leguminous plants (Mukwada, 2000). It enhances the nutrient status of the soil when deep rooted crops draw nutrients to top levels of the soil (Grant, 1981) That the majority of the farmers (95 %) on the Mawonazvawo Wetlands added manure to the rotation seasonally could imply high rate of maintenance of the productive capacity of the fields. Manure is a good source of phosphorus necessary for plant development. Apart from maintenance of soil fertility, the manorial effect is important in the control of pests and diseases (Alwe, 1980; Grant, 1987). This would probably reduce the budgets for inorganic fertilizers and chemicals needed to control diseases.

Table 6: Wetland Protection Efforts On The Mwaonazvawo Wetlands

METHOD	NUMBER OF FARMERS	PROPORTION
CROP ROTATION	38	95
MULCHING	40	100
FURROWING	40	100
CONTOUR RIDGE USE	15	37.5
STORM DRAIN CONSTRUCTION	34	85

MAINTENANCE OF GRASS STRIP AROUND FISH PONDS	21	87.7

A health banana plant produces 200 - 400 main roots, which spread 4m - 5m. The root system anchors the soil. The banana suckers together with the parent plant form a mass of tightly clumped plants (Bittenbender, 1984). The leaf foliage creates a canopy effective in reducing evapotranspiration. The perennial nature of the foliage gives it advantage over the foliage of seasonal crops such as cereals, which are small and erect. Banana production protects the soil, which could be the reason why the Mwaonazvawo farmers are involved in the activity. The banana fruits could also be used for family consumption and sell. In Zimbabwe, banana production on small scale is quite significant although statistics are not readily available. Sugar cane production on the Mwaonazvawo Wetlands could yield similar results in soil and moisture conservation as well as enhancing environmental management, family food consumption and sale.

Most farmers grow yams. In crop classification, this crop falls under the miscellaneous category. Yams grow best in low-lying moist areas and develop a root system capable of absorbing much moisture from the soil. (Pritchards, 1979). The root system protects the soil from erosion. Its high rate of water absorption makes soil at the site more usable for growth of other crops. In the Eastern Districts of Zimbabwe, yams are grown for human consumption and sale. However, for Mwaonazvawo yam producers out put per farmer could be low due to limited area of cultivation.

With farmers on Mwaonazvawo Wetlands involved in furrowing and mulching, awareness on need for wetland conservation could be high among farmers. Environmental awareness enables community members to develop the commitment to constructively participate in transformation of the environment (Baez et al, 1987). The development of such an appreciation of environmental quality among wetland farmers promotes in them an attitude of care for their plots and a sense of responsibility for the well being of the wetland system as a whole. Mulching cushions the ground from raindrop impact and conserves soil moisture (Muler - Saman and Kotschi, 1994). Furrowing reduces runoff down slope. On the Mwaonazvawo wetlands, the seeming development of recognition of importance of wetland protection could suggest successful implementation of AREX and Environmental management Agency(Natural Resources Department) programmes.

Mulching and furrowing were common conservation methods applied by farmers. None did contour ploughing, strip cropping and use of no - till- tied ridges. The survey also indicated that 95% of the interviewed households practiced crop rotation. In terms of tillage, the majority of the farmers (70%) used the hand hoe, 30% draught power and none used tractors and zero tillage. This trend is contrary to the expectation of the AREX department. The contouring of the land serves to capture and divert run off from the arable land. The number and spacing of contour ridges as observed by Mukwada (2000) depends on the size of the land and its morphological properties. It will be difficult to give precise spacing between the ridges but the farmer should note that the steeper the slope the greater the run off, and the faster the water travel over the field surface (Elwell and Hussein, 1992). An individual farmer who cultivates an area of 500 square metres could find it difficult to effect meaningful contour ridge construction. The problem gets complicated if the area is part of a small field made up of several smaller portions owned by different farmers. Lack of emphasis on use of contour ridges on the Mawonazvawo Wetlands seemed dictated by the small size of garden allotments. Farmers also seemed to believe that biological conservation measures in conjunction with storm drain construction could suffice.

A minority of the farmers (15%) was not involved in storm drain construction. This trend, is however, not unusual in any situation of technology transfer. The rate of adoption of new technology and ideas by a community is influenced by a variety of factors, which include socio-cultural influence and social marketing strategies (Kolter and Zaltman, 1971). The number of adopters increases as awareness of the technology increases and the benefits become apparent. There are however, late adopters and laggards. The latter group of farmers is conservative and resists change (Rodgers, 1971). This could also account for failure of 12,3% of the fish farmers on Mwaonazvawo Wetlands to grow a grass strip around their fishponds. The grass strip limits the rate of fishpond siltation. The late adopters and laggards become the most possible target group for conservation education.

Considering the physical environment, of the Mwaonazvawo Wetlands, these strategies are not in anyway inappropriate conservation techniques if applied on the site. No - till - tied ridges reduce runoff and conserve soil. The tied ridges are widely used in Zimbabwe communal areas especially where soils are water logged, (Mukwada, 2000). Contour ploughing and strip cropping have similar impact. However, although the choice of tillage basically depends on the physical characteristics of the land site, the farmers' capacity and preference is a very influential dimension. A smallholder farmer who adopts particular conservation tillage should provide high-level management for it to work efficiently. That 70% of the Mwaonazvawo farmers used the hand hoe could suggest lack of draught power in some households. It could also be constrained by the small sizes of land that made it difficult to use draught power. On the other hand, the occurrence of fishpond siltation that affected all fish farmers seemed associated with land mismanagement in the catchment area. Hussein (1997) noted a similar trend for the Save Catchment area. Poor environmental management in the area has resulted in heavy siltation of the Save River. The upper catchment area, reports Chabwela (1991) is an integral part of the wetland system.

All farmers used garden by - products for compost making and bedding, cattle feeding and selling. The survey also revealed that 60% of the households applied more than 100kg of cattle manure per annum in their gardens. There was an apparent association between cattle ownership and crop production in the Mwaonazvawo area. Shumba (1984) quoted by Svotwa (2001) made similar findings on crop-livestock interdependence in some communal areas of Zimbabwe. However, with only 60% of households applying over

100kgs of cattle manure per annum, the crop-livestock interaction in Mwaonazvawo area seemed weak. In Zimbabwe's communal areas cattle manure is the chief fertilizer used in field crops. It is a mixture of bedding materials, dung and urine. The high carbon content enhances the moisture holding capacity of the soil (Mugwira, 1987). In Zimbabwe, currently chemical fertilizers have become costly and unaffordable to most communal farmers. In some cases, it is unavailable. Cattle manure has been a suitable substitute. Low cattle ownership among the farmers could be the possible reason for the revealed trend in Mwaonazvawo area.

Farmers on Mwaonazvawo Wetlands believe that AREX Officers have been very active in the Mwaonazvawo scheme. The majority of the farmers had developed consciousness on the natural value of the wetland resources. In terms of the role of traditional authorities, in the agro economic activities, farmers indicated that the authorities gave adequate support on wetland conservation strategies. Farmers were satisfied with the support they received from the AREX and Natural Resources Departments (the Environmental Management Agency). In Zimbabwe, the government has as top priority stimulation of the adoption of appropriate agriculture conservation and management practices among farmers. The small-scale communal farmers have been particular target. Such government attention on farmers cultivates in them confidence, will and zeal in sustainable production which boosts their yields and financial returns. In the process, the farmers develop the capacity to recognize factors, which determine the nature and quality of the human environment. Associated with this is respect and appreciation of environmental quality (Brienco and Pitt, 1988). This could be the determinant factor for the positive view of most Mwaonazvawo farmers on conservation in their area.

Conclusions

Mwaonazvawo Wetlands are multidimensional resources that provide the community with a range of inter-related environmental functions and socio-economic benefits, which support a variety of livelihood strategies. Because of the range of wetland use strategies at the local levels, there are often conflicting demands placed upon wetlands. In Mwaonazvawo Wetlands there is the potential for either wetland degradation caused by the over-cultivation of the wetland area particularly the dominance by one particular section of Mwaonazvawo Wetlands. Wetlands are also critical resources at the catchment level, providing hydrological benefits for downstream communities and their related socio-economic activities.

From the study, a number of ideas came to light. The chief agro - economic activities of the farmers on the Mwaonazvawo Wetlands included vegetables, oranges, and banana and sugar cane production. The farmers also did fish farming and cattle rearing. It was discovered that these activities paved way to both wetland protection and economic sustainability for the farmers. Variety in crops grown makes the farmers less vulnerable to the risks of seasonal shifts and related food stock decline in other parts of the country. The average income of the farmers in a year was Z$300 400± 198 500 which was low by Zimbabwean standards and this had to be supplemented through remittances from relatives in the urban areas or beyond our borders. The interesting part of the wetland utilization is that the farmers have reliable and nutritive source of food for their families. Crop rotation, mulching and furrowing were the most popular conservation methods practiced by the farmers. The establishment of a protected area has been tangible evidence of successful rehabilitation efforts.

The research also established that the farmer average field area was 352,9 square metres per farmer. This partly accounted for low productivity and reduced income per farmer in a year. The average slope angle of the wetlands was 14 (±) 9 degrees. With high degree of conservation, production with minimum environmental damage could be achieved. The community has constructed a main contour ridge on the upper reaches of the wetland that has an overall effect of controlling runoff and thereby minimising the rate of soil erosion and sediment load. This has an effect of extending the usability of the wetland by future generations and in this vein attaining sustainability as a basic principle of human development. A worrying observation, however, is the potential decline in the moisture content or levels of the wetland as a result of the growing of various crops and fruit trees whose implications on ground water has not been established. Repeated turning of the soil results in compaction a scenario that could lead to changes in soil water dynamics that could lead to the drying of the wetland with time. Usually, peasant farmers on this wetland are driven by the need to have subsistence for the family and could only understand the long term implications of their farming activities on hydrological characteristics of the resource if scientific advice is provided by specialists in the field.

The main crop - livestock interactions identified included use of cattle manure for crop fertilization, use of draught power for field preparation and use of crop stover for cattle feeding. Crops use soil nutrients at various rates resulting in the decrease of the quality of the soil and the reduction in yield per unit of land. Thus, the rearing of cattle by the community gives the opportunity for the soil nutrient levels to be maintained or improved. Though there is room for improvement to the quality of the soil the community has gone a long way in living on the 'profit of their investments' rather than on the 'capital.' A community that lives on the capital without reinvesting is likely to get broke within a short space of time and the achievement of sustainability becomes a pipeline dream and a disaster for the environment. The fact that the farmers are using the available cattle manure to enrich their soil demonstrates the understanding of the importance of the animal crop interactions. However, the multiplicity of small plots that are used by the farmers could be a limiting factor to the principle objective of sustainability. The history of wetlands use in Zimbabwe has shown sensitivity and fragility of these resources to degradation. However, the deliberate use of Mwaonazvawo Wetlands makes it possible to intensify production, to extend the periods of production, and to diversify production. This minimizes risks, and improves farmers' food security and economic standing.

At the same time there has been a high measure of economic sustainability for the farmers. The following were recommended.

Policy recommendations

1. Agricultural and Rural Extension (AREX) officers should continue to monitor the agro - economic activities of the farmers with a view to improve the capital stock available to the community.
2. To encourage and incorporate environmental education on soil and conservation works for those individuals who are not using conservation farming.
3. The officials from the Department of Natural Resources (Environmental Management Agency) should intensify their campaign on importance of protection of the wetland resource.
4. The government should introduce a programme that assists the farmers with loans for acquisition of cattle.
5. The establishment of communal grazing schemes will go a long way in improving the cattle herd for the farmers and thereby empower them.
6. From a policy and planning perspective, however, those communities who directly depend upon wetlands for their livelihoods are often those who have the least influence on wetland management policy. In promoting and implementing wetland management, which is environmentally, economically and socially sustainable, there is, therefore, a need to engage all stakeholders in discussions to facilitate effective co-operation, communication and participation of different interest groups. This is essential in raising awareness on crosscutting issues of wetland management. This could be done through the use of participatory research and implementation approaches.

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