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VOLUMETRIC WATER PRICING: A THREAT TO SUSTAINABLE PEASANT AGRICULTURAL PRODUCTIVITY IN SMALL SCALE IRRIGATION SCHEMES

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ABSTRACT
Institutional reforms and induced institutional changes are important contemporary issues that have brought opportunities and constraints to small scale irrigation schemes in Zimbabwe. Volumetric water pricing brought about by ZINWA to Mushandike in 2000 had constrained irrigation productivity. This paper seeks to assess how the commercialisation of water by ZINWA has impacted on agricultural productivity in the scheme. Both quantitative and qualitative methodologies were used in the research. Quantitatively questionnaires were employed while interviews, group discussions, observations and secondary documents were used as qualitative data collection methods. The research revealed that water pricing has resulted in the deterioration of irrigation agriculture productivity. This was as a result of reduced scheme performance emanating from farmers abandoning the scheme, desputes over water allocation, deterioration of infrastructure, indiscriminate water cuts, low incomes and farmer dissatisfaction by the budget-straining water charges out of reach by peasant farmers in the scheme. Therefore the multi-billion investment by the government of Zimbabwe since independence would be waste unless something is done and done urgently to reverse the situation.

Keywords: volumetric water pricing, irrigation productivity, sustainable agriculture

INTRODUCTION

Moll, etal (2004) postulated that institutional reforms and induced institutional change are important contemporary issues in Zimbabwe as its water laws and agricultural agencies are reformed and as belief in decentralisation and privatisation drive the transfer of responsibilities, once held by public agencies, to local user groups. Zimbabwe faces transformation in both its agricultural agencies and water agencies, and also the interfaces between them, at field, ministry and policy levels. With this come potential, financial and personal struggles that need to be understood in the context of the way these new institutions function. Large scale irrigation tends to be treated by government as a public good. The budget for recurrent operation and maintenance was provided by central government and was rarely related to fees paid by farmers. A number of policy problems have been observed with respect to management and resource use efficiency of irrigation schemes located under this type of administrative structure. Farmers had little incentive to contain their water demand, comply with rules or to contribute to scheme maintainance.Farmers used to pay a charge (levy or fee) for participation in a scheme on the area irrigated but this charge bears no relation to the amount of water used and since it is typically not paid directly to the local irrigation office there was no economic relationship between the costs of scheme management and farmer use of water resources. The supply and demand for water are disconnected in the typical public irrigation scheme. As a solution to problems, motivation, incentives and lack of adequate operation and maintenance in the supply side of water provision, water pricing was introduced to mushandike irrigation scheme. Farmers would be charged a price per litre for the volume of water used, sufficient to cover operating costs and to provide a rate of return to capital invested .This in turn make farmers efficient in their use of water. They would only use water up to point where the marginal return to water use equalled the price per litre that they were paying for water .A proper market for irrigation water would be created and efficiency insured. Mushandike irrigation scheme was started in 1986 after the Lancaster house conference where it was proposed that land is allocated on willing buyer willing seller bases. The Zimbabwe government bought Mushandike farm with both irrigable and dry land farming area. According to water act 1976, 1998 ZINWA was given the authority to all water bodies of which Mushandike dam is one of them. The 1998 water Act encompassed a statutory board ZINWA which operates along commercial lines, generating its own resources for operation and maintenance of infrastructure. What this meant though was that the price charged for providing water to consumers had to shift from being a levy or fee which had to be in relationship with the amount of water used to that of volumetric water pricing .Therefore it is against this background that the paper seeks to assess the impact of this volumetric water pricing on productivity in Mushandike irrigation scheme, Masvingo District, Zimbabwe.

PROBLEM STATEMENT

Resources for the operation and maintenance of the irrigation scheme infrastructure were dwindling resulting in a sharp decline in crop production in Mushandike irrigation scheme in 2000.This coincided with the coming in of ZINWA in 2000 which started operating along commercial lines to generate its own resources for operation and maintenance of infrastructure. Farmers who were used to levies were introduced to volumetric water pricing on their crop production .The implication of this approach is Mushandike irrigation as a small scale irrigation scheme has not been traced to check the challenges and opportunities that had emerged as a result of charges .Therefore the paper seeks to assess the influence of water pricing on agricultural productivity in Mushandike small scale irrigation scheme.

OBJECTIVES

- To determine the rationale for volumetric water pricing in the scheme.
- To assess the impact of water pricing on agricultural productivity in the scheme.
- To recommend the implication of water pricing on productivity for policy and planning.

JUSTIFICATION OF THE STUDY

The paper would pre-empt the efficiency and effectiveness of farmers in the scheme. The paper would demonstrate the user pay principle in practice. This paper would test whether volumetric water pricing to farmer is economically viable or not even if technically feasible. If its not, then other types irrigation pricing would be devised in order to give farmers a better sense of the economic costs of the water resources. It would also assist newly resettled farmers in the Zimbabwe’s on going land reform programme to check whether they should be in A1 or A2 farmer category restoring Zimbabwe’s bread basket status of

Southern Africa. The Government, NGOs and Private sector would easily identify areas of intervention in Zimbabwe's land reform and resettlement.

CONCEPTUAL FRAMEWORK

Irrigation water has a price by which the management costs must be covered. Irrigation water prices are controlled by the government. During the planned economy period, agricultural irrigation projects were subsidized by the government and farmers contributed their labour, so there were no or minimal water fees. Since reform and liberalization, the water price of irrigation comprised partial cost and farmers' compulsory labour as well as farmers' voluntary labour as investment. According to Moll etal, (2004) Irrigation charges began around 1970 in Zimbabwe, under the permit charge regulations in the control of irrigable areas regulations. District commissions saw them as a way of ensuring performance and as a cost recovery mechanism. Two costs were charged, first, dam maintenance which was a long-term recurrent cost based on the staffing and activities required for the maintenance of the hydraulic and water delivery of the structure.Secondly, it relates to the capital redemption associated with financing the structure. Charges were raised by ZINWA in 2001 after given the responsibility. It took into account calls from agricultural policy makers to price water in a way that reflected its scarcity as suggested in the Zimbabwe Agricultural Policy Framework (ZAPF) and draft irrigation policy document of 1994. Economists also advised that concepts of long-term marginal costing be adopted, (Moll etal, 2004). The ZINWA was created as parastatal for planning and maintain water resources, overseeing catchment councils, taking over the technical secretariat of the then Department of Water Development, which was mandated to develop a water resources management strategy. ZINWA reports to a new Ministry of Rural Resources and Water Development (RRWD) which now have a new department for irrigation, (Moll etal, 2004).

ELEMENTS OF WATER PRICING

Water pricing consists of consistency in water charging across sectors and jurisdictions, full recovery of the costs of delivering water (upper/lower bound pricing), consumption based pricing management of environmental externalities, pricing and attributing costs of water planning and management, consistency in pricing policies, benchmarking of pricing and service quality, public reporting on cost recovery, benchmarking and pricing use. On implementation of water pricing in agriculture, successful pricing reforms needs: understanding "legacy" issues, negotiation at the scheme level ,understanding commodity issues, price pathing to mitigate shocks, transparency of process, sequencing of elements (the "must" do versus the "nice" to do), (Parker,2007).

PRICING SCHEME DESIGN

There are three major methods for pricing water i.e.: area-based pricing, volumetric pricing, and market equilibrium pricing. Emphasis is placed on the first two categories, including extensions, modifications, and combinations of the two.

Area-Based Pricing

Area-based water charges are fixed charges, based on the area irrigated or "supposed" to be irrigated. They are often calculated by dividing the total area irrigated into the Operation and Maintenance (O&M) costs of providing irrigation water, which basically follows the average cost pricing principle. Defining O&M costs is important because the water supply entity may have an incentive to inflate the costs charged to farmers. In addition, the use of irrigated area varies from year to year and season to season. For example, the area irrigated during the wet season is usually much larger than during the dry season. In addition, the project area is usually larger than the area actually irrigated. Therefore, irrigation officials will need to estimate the area actually irrigated each season. The disadvantage of this pricing method is that, once the irrigated area decision is made, the water charge will have no effect on farmers' water consumption, because the marginal cost of applying additional quantities of water per hectare is zero. Thus, the demand for water is usually higher than it would be under a price or charge that varied by the quantity of water used, and it is likely to lead to overuse of water by farmers near the head of the canal. The advantage is that it is simple to calculate, easy for farmers to understand, and the implementation costs are lower than for volumetric pricing because water deliveries do not have to be measured. Also, assuming 100 percent collection rates, charges per hectare, based on average direct cost; result in full recovery of direct costs. Although it gives farmers no incentive to reduce water use per hectare, it is still widely used in many systems throughout the world due to the simplicity of its implementation. In Haryana, India, irrigation water is priced at US$2.50 /ha5 (Cornish and Perry 2003), while in Pakistan, prices range from $2 to $8/ha but are set to cover only part of the O&M costs (Ahmad 2002). Pure area-based pricing is appropriate in places where water is not scarce, where crops are not varied, and where meter installation is difficult or costly. However, pure area-based pricing systems are becoming less and less popular, and most of the recently designed area-based pricing systems are adopting new features. The extensions of area pricing include area-crop (the most widely used modification), area-irrigation, area-season, and area-technology–based pricing. Area-crop–based pricing systems vary the charge per hectare irrigated by type of crop. The water price variation among crops depends on the policymakers' objectives. If they want to encourage efficient use of water, the high water-consuming crops such as rice, should have higher prices per hectare. If the price differences are large enough, farmers are likely to switch to alternative crops. In contrast, if the government is pursuing a low food price policy or wants to encourage production of commercial crops, the water price for these crops could be set lower than for other crops. However, care must be taken in subsidizing inputs such as water to increase crop production because it often leads to inefficiencies and overuse of the resource, particularly with crops such as rice and sugarcane.

The Area-Crop-Based Pricing and Its Impact in India and Egypt

Haryana, India: An Empirical Illustration of the Performance of Different Water Pricing Methods

A numerical example using data from Haryana, India, illustrates the impacts of two different pricing methods. Farmers can choose to grow cotton or wheat; cotton is more profitable but uses more water than wheat. Two pricing methods are considered: area-crop–based pricing, with a higher price for irrigating cotton, and volumetric pricing. For area-crop–based pricing, the implementation cost is low, but high for volumetric pricing. Area-crop-based water charge of $231/ha for cotton and nothing for wheat induces the farmers to switch from cotton to wheat. Farmers' profit decreases by one fourth, but the social benefit increases almost sevenfold. This example illustrates how a simple method, area-crop–based pricing, can be more effective than an efficient but complicated volumetric pricing, when implementation costs are high. The implementation costs include both the fixed costs of installing meters and the added variable costs required for water delivery and monitoring,(Cornish and Perry,2003).

Egypt: The Impact of Different Pricing Methods on Irrigation Water Consumption and Farm Income

Several studies in 1995 by International Irrigation Management Institute (IIMI) measured the impact of different pricing alternatives on the agricultural sector in terms of irrigation water used and farm income. Three pricing schemes were tried. First, a fixed rate of $52 per hectare, irrespective of crop or water use, resulted in a fall in farm income of 4.5 percent but had no effect on the choice of crop or technology. Second, an area-crop–based charge, proportional to the calculated average water consumption of each specific crop, resulted in a 2.4 percent fall in farm income. The demand for irrigation was water reduced by 3.5 percent and the returns to water increased by 2.7 percent. Third, a volumetric charge based on the quantity of water delivered resulted in virtually identical impacts as those obtained in the second case. The key factor explaining the different responses appears to be the availability of a range of crops that farmers can choose to grow. (Tsur and Dinar 1998; Perry, 1995; Cornish and Perry, 2003).

In the area-irrigation method, water charges usually reflect the differences in water delivery costs among different irrigation methods. For example, most gravity-based irrigation systems have much lower variable costs than pump irrigation. The advantage of pump irrigation is that water control and measurement of water delivery is generally much easier than it is for most gravity flow systems. Thus, area charges are usually higher for pump irrigation because irrigation costs and net income per unit of water are generally higher. Some countries also use area-season–based charges. For example, a higher price is charged during the dry season, when water is scarce, and a lower price is levied in the monsoon or wet season, when water is relatively plentiful. If the price is set high enough in the dry season, it will help limit the number of hectares irrigated in that season. In France, the pricing structure was based on different costs for off-peak and peak water use. The peak season lasts five months in the summer, and the water price reflects the long-run marginal cost of supplying water. The long-run marginal cost is usually the cost of future expansion. In reality, it is often difficult to estimate the cost of the next big supply-capacity-expansion project (McNeill and Tate 1991). During the off-peak seasons, France includes only operating costs. This pricing structure has helped reduce water use during summer when demand is high compared to supply (Tiwari and Dinar 2003; Johansson et al. 2002). Another possible combination is area-technology–based pricing. Although it has not received much attention, theoretically it should promote selected irrigation technologies. The basic idea is similar to area-crop–based charges, with farmers using water-saving technology paying lower per hectare water charges. For example, drip and sprinkler irrigation generally allow better water control and more output per unit of water delivered than flood irrigation. Therefore, a higher per hectare fee could be levied on farmers not using these technologies to encourage them to switch. If area-based charges can be established that reflect differences in water use by season, crop, or irrigation technology, area pricing would have some of the benefits of volumetric pricing. This would be the case if, after controlling for crop, irrigation technology, and season, there was little variation in water uses per hectare. Problems are still likely to exist because farmers at the head of the canal tend to over irrigate their fields when water charges are based on area. However, if farmers can be assured that each scheduled water delivery will be on time and in the quantity demanded, they will have much less incentive to over irrigate than with irregular deliveries.

Volumetric Pricing

With volumetric water pricing, the charge is based on the amount of water delivered. The economic optimal pricing rule requires that price should be set equal to the marginal cost of providing the water, and it requires accurate measurement of water through meters. The advantage of this pricing method is that it encourages farmers to limit their water use. Also, it is easy to understand in the sense that you pay for the quantity of water delivered to your farm. However, it has several disadvantages. First, the implementation costs can be high because meters are required, and they have to be honestly read and reported. Second, marginal cost pricing does not allow full cost recovery in the case of decreasing average costs (e.g., large canal systems). Once the infrastructure is in place, the marginal project costs will be lower than average costs, thus pricing based on the marginal cost will not achieve full cost recovery. In contrast, for the case of pump irrigation using groundwater, the marginal project costs are likely to be higher than average project costs, particularly when marginal costs include the marginal user cost. Thus, for some groundwater projects, marginal cost pricing could result in over collection as well as high water charges relative to farm income. For example, in a deep tube well project in Gujarat India, the water fee is 37 percent of net farm income and does not cover O&M costs because electricity is heavily subsidized. In contrast, for gravity-based systems the water fee is usually a much smaller percentage of net farm income. To address the concerns about the impacts of water charges on farm income, two different modified versions of volumetric pricing can be used (World Bank, 2005)

Block pricing

Block pricing involves varying the water price when water use for a set time period exceeds a set volume (e.g. 5,000 m3 per hectare per season). If high water charges are a concern, an increasing block charge can be used. The price of the first block can be set below O&M costs. The second and later blocks are raised to higher rates that cover O&M costs and reflect the marginal cost of operations. Israel (Yaron 1997) and Botswana (Thema 1997) both use this pricing method. The amount of the first block is often considered the basic amount of water needed to support a farm family, so this method also attempts to address equity issues. Farmers pay a low rate for the first block but a much higher price for any water used that exceeds the first block. In Botswana, the price of the second block is twice the price of the first block. This pricing method operates similarly to a quota. In fact, a quota is an extreme case of increasing block pricing. Even when an official quota exists, farmers can still obtain additional water by paying irrigation officials or private sources a high enough price. Both Botswana and Awati in China call their first block a "quota" and state that farmers have to pay double the price if their consumption exceeds the quota. In Israel, the quota includes three blocks, and charges are agreed to in signed contracts with the water provider6. If the price difference between blocks is large enough, farmers will try not to use more than the first block of water. The disadvantage of block pricing is that it is not easy to decide the price level for each block or the quantity range of each block (e.g., should the low price apply to the first 5,000 m3 used per season per hectare or the first 6,000 m3). In addition, the revenue is unlikely to cover the O&M costs, particularly if the range for the first block is large. It is appropriate to use in cases where water is scarce, farm incomes are low, and water charges are high relative to net farm income. The advantage of the two-block pricing is that you have, at least, three instruments for influencing water use and cost recovery:

the first and second block prices and the quantity (e.g., 4,000m3/ha. vs. 5,000m3/ha.) at which to start the second block price(World Bank,2005).

Two-part tariff

The second modification is a two-part charge, which is a combination of volumetric pricing and a fixed admission charge (sometimes based on size of the area irrigated). For the block pricing methods described above, the two objectives—full cost recovery and reduced water use—are often in conflict. The advantage of a two-part charge is that it can reconcile the conflict. The volumetric part can be based on marginal cost, which encourages less water use, while the fixed part can be used to make up any deficits and ensure a certain revenue flow regardless of how much water is available and delivered. Even for O&M costs, there is a fixed component that does not depend on the amount of water delivered, and these fixed costs have to be paid even when water is not used for one season. The disadvantage is that it is relatively hard to calculate and difficult for farmers to understand. In addition, the administrative costs of a block-pricing scheme are likely to be somewhat higher than a single charge scheme. In the Jaiba project in Brazil, the pricing scheme is a revised two-part charge, consisting of two components, K1 and K2. The first component, K1, reflecting the project's capital cost, is calculated based on a 50-year repayment period and a subsidized interest rate. The second component, K2, is supposed to cover all the O&M costs and is estimated as a function of the volume of water used. The second component is further divided into two components: one representing the fixed O&M costs and the other, the variable costs. Farmers choosing not to grow crops for one season are still responsible for the fixed O&M costs (Azevedo 1997; World Bank, 2005)). Besides the above pricing methods, Johansson et al. (2002; World Bank, 2005)) also suggest using output-based pricing methods. They also summarized many case studies from around the world, using different pricing methods to allocate irrigation water. Mushandike small scale irrigation scheme uses block system under volumetric water pricing (World Bank, 2005).

WATER CHARGES TO FARMERS

Ellis (1992) revealed that there is general agreement in the literature that farmers should be charged realistically in economic terms for their participation in irrigation schemes. It is also agreed that capital costs need to be separated from recurrent operation and maintenance costs in devising and implementing farmer payment methods. In principle, farmers should be required to repay the capital cost of irrigation, and the most practicable way to do this is to apply a uniform repayment levy-perhaps payable over several years –per hectare of cultivated land irrigated by the scheme. A side effect of this would be less political pressure from farmers for expensive irrigation schemes, and more awareness from the outset concerning the value of the canal infrastructure that has been created. In practice, it is rare for governments to recoup more than a small fraction of the capital cost of large –scale schemes. The issue of capital repayment is academic since the capital is a sunk cost. Recurrent operation and maintainace costs can be met by an irrigation service fee. For capital cost recovery, the most practicably and equitable method of fixing the service fee is to set a rate per irrigated hectare. Some variation in the rate may be desirable to reflect visible differences in water access by farmers at differing distances from the outlets. However, this has the disadvantage that some farmers would then feel entitled to receive more water than other farmers, and cooperation between farmers as a group becomes more difficult. The typical practice of most governments is to collect only a proportion of o and m costs in the form of service fees, and to pay these into central government funds. Sometimes the cost of collection .from an economic point of view it would be more effective to make the income of the local o and m service agency dependent on the collection of fees from farmers. This creates the necessary link between payment and quality of service that is missing due to the inability to price water. The payment of fees by farmers to the local branch of the o and m agency gives farmers at least a superficial means of registering discontent with the service ,for example by withholding fees. Better still if o and m management involves some type of farmers' representation, since then a direct interpersonal connection exists between farmers and scheme management. It is widely agreed that these problems could be alleviated by a combination of farmer involvement in some aspects of operation and maintenance, institutional separation of operation and maintenance from new construction, charging farmers the full cost of o and m in the form of area –based irrigation service fees and making the operating income of local o and m agencies dependent on the collection of irrigation service fees from farmers. The slogan of farmer participation is not a panacea for the problems of canal irrigation. The central point is to create conditions of trust between farmers and between farmers as a group of irrigation officials, such that the first –best rather than the worst outcome of prisoners' dilemma type situations is obtained.

Irrigation in resource –poor environment confront special difficulties like failure to increase total output, widening the divergence between farm household goals and state goals ,failing to achieve output gains due to a shortage of labour at peak periods I agricultural calendar, may prove unsustainable in the face of collapse of supply lines and lack of forex. Lack of fuel, spare parts, transport, cement, and so on can result in the rapid deterioration of the infrastructure to the point that it becomes unworkable.

IMPACT OF WATER PRICE REFORMS ON AGRICULTURAL IRRIGATION IN CHINA (FAO, 2002)

Water Price Reform Affects National Food Security

Grain production is a high-risk industry and the total grain output of the state has experienced major fluctuations. Grain production reached 512.3 billion kg in 1998 but dropped to 430.65 billion kg in 2003, declining by 16 percent. To address this serious situation, the government adopted a series of effective measures that improved grain output to 469.45 billion kg in 2004. This indicates that China's agricultural infrastructure is still fragile. More than half of the country's land occupies arid or semi-arid areas and rainfall cannot meet crop needs so crops must be irrigated. In the south of China, due to rainfall anomalies that impact on stable agricultural production, irrigation and drainage facilities are also needed. Irrigation in China plays an important role in agricultural production. If water prices are unreasonable and farmers fail to make profits, they will marginalize grain crop cultivation. Subsequently the grain security strategy is jeopardized and crop diversification will disappear (FAO, 2002).

Water Price Reform Impact on Water-Saving Irrigation and the Water-Saving Society

Agricultural irrigation is a major water user. If the price is too low, the farmers will not be compensated for their water-saving activities and they will not cherish water resources; thus flood irrigation will resume and further serious water wastage will result. So the farmer is the mainstay of water-saving irrigation and economic interest is the only real impetus. If the water price is raised to a certain level and the farmers receive water-saving compensation, they will restrict their water use. Shultz, the Nobel-winning economist, indicated that the world's farmers calculate costs, benefits and risks. In closed, isolated and scattered areas, they are prudent "economists". The fundamental way to solve the problem of water shortages in China is to build a water-saving society. No matter how strong the demand is for state water conservancy, if the water price mechanism is unreasonable, not only farmers but also water management departments will use more water to maximize revenue for their own interest9FAO, 2002).

Water Price Reform will affect Farmers' Economic Interests and Rights

If the pricing mechanism is inequitable, farmers' profits and income will drop. Although non-farming income accounted for more than 50 percent of farmers' average income in recent years, agricultural production is still the main source of income for farmers in the central and western regions. Imbalanced development in China between urban and rural areas is worsening and the income gap between urban and rural residents has grown, from an absolute gap of 209 Yuan in 1978 to 7 283 Yuan in 2005 and a relative gap from 2.57: 1 to 3.22: 1. If the water price rises, farmers' profits will decline. Farmers' benefits will not be ensured without water-saving compensation.

Water price reform affects the wages and welfare of employees and the stability of the staff

Water fees are the main income of water management departments. If the water fee drops sharply, it will be very difficult for water management departments to survive and develop. Most water management departments are self-supporting institutions and water fees are the only source of revenue to pay for employees' wages and maintenance of water infrastructure. With lower water charges, many water management departments find it difficult to guarantee wages for employees; this generates staff instability, poor management and increasing appeals to higher authorities for support. The aforementioned survey revealed that about 70 to 80 percent of revenue from water charges is used for personal costs and 20 to 30 percent for project maintenance (FAO, 2002).

In Zimbabwe, recognizing the water pricing situation in 2001,agritex noted :the policy of total responsibility for o and m costs by the famer with government only providing technical and extension services .The result has been a total break down of good crop-culture practices such as block farming and rotations as farmers try to grow anything that will help them meet the scheme operating costs ,this seem to be giving good margins(Agritex,2001,Moll etal 2004).Some were diversifying into horticulture as a profitable farming strategy, neglecting other crop guidelines and often only using the irrigation system for part of the year,(Moll etal,2004). They concluded that the above problems have resulted in irrigation schemes that are decaying and dying all over the country of Zimbabwe. The multi-billion investment by government since independence is going to waste unless something is done and done urgently to reverse the situation, (Agritex, 2001,Moll etal,2004).

Other Factor Productivity in Small Scale Irrigation Affecting

Irrigated agriculture is one of the major economic activities for generating employment, income and foreign currency earnings. It contributes towards the achievement of food security in semi-arid areas where mid season droughts are experienced and offers a chance to modernise peasant agriculture. Most governments in arid and semi-arid regions are supporting the development of irrigated agriculture either at small or large scale levels. This is aimed at mitigating the adverse impacts of climate and variability on the social, economic, political and environmental well being of their populations. Irrigation development serves to achieve double or treble cropping per year, utilise land and water resources more efficient than rain fed farming (Makadho, 1994, Pazvakavambwa and van der Zaag, 2002). Despite the considerable potential of irrigation, several smallholder irrigation projects in developing countries have been labelled 'socio-economic failures' (Makadho, 1994; Chancellor and Hide, 1997). Poor performance of most smallholder irrigation systems (assessed in terms of water delivery, agricultural production and socio-economic indicators) is largely affected by socio-economic and biophysical factors.

(Figure. 1).

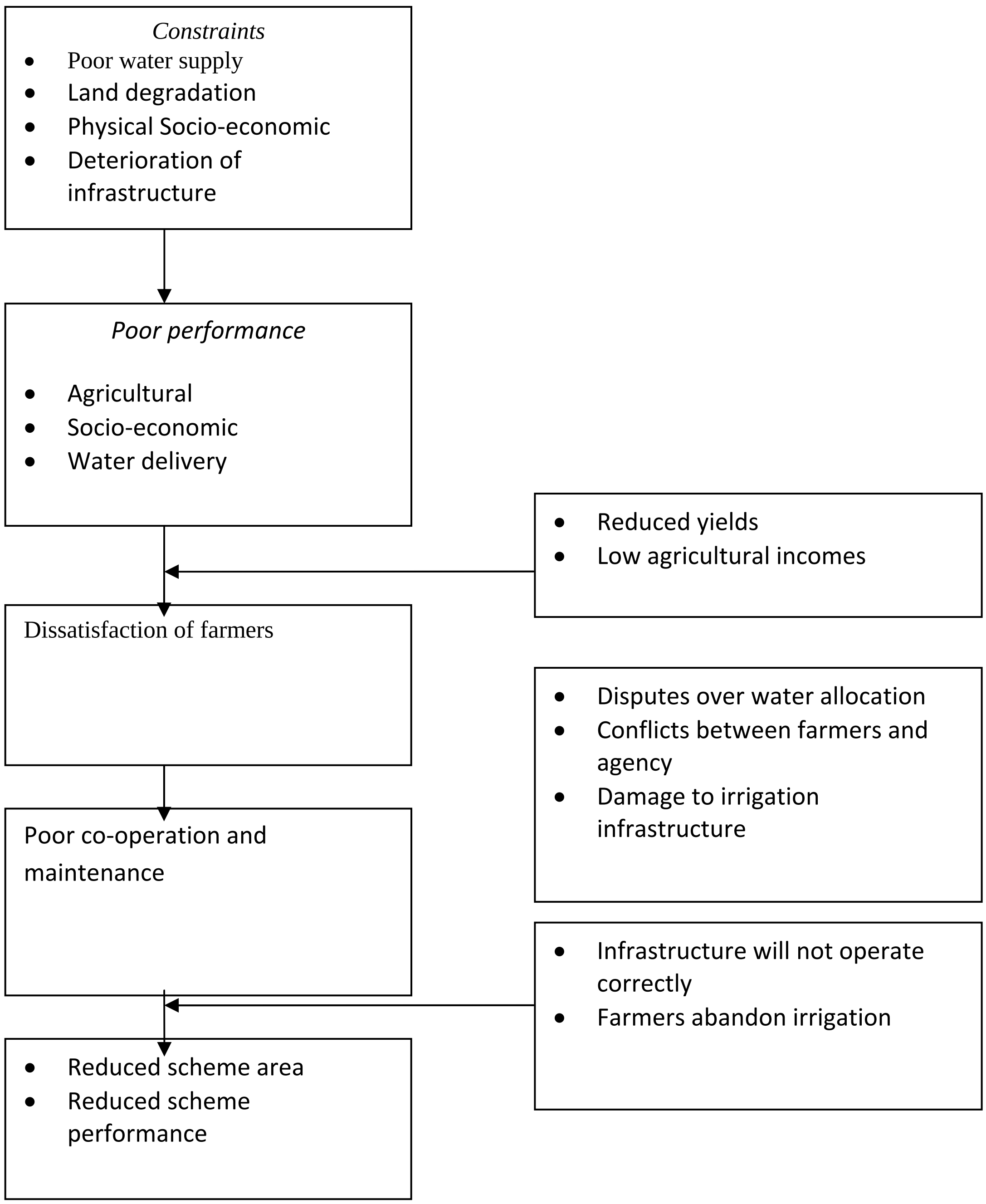

Figure. 1. Causes and Effects Poor Irrigation Performance in a Smallholder Irrigation Scheme

Source: Chancellor and Hide (1997: 8).

The under-performance of smallholder irrigation schemes in most developing countries is largely a result of complex interrelated factors. These include; inadequate inputs, inaccessible markets (Adams, 1990; Meinzen et al., 1994; Makadho, 1994; Rukuni et al., 1994), government policies on land tenure which do not create a conducive environment for successful operation of irrigation schemes (Tafesse, 2003), sub-standard infrastructure (Croxall and Smith, 1984; Motsi et al., 2001; Manzungu, 1999a). Poor water management, unclear irrigation scheduling and inefficient water use at the scheme and plot levels are cause of concern for the success of smallholder irrigation schemes in Africa (Motsi et al., 2001). Studies found that inequitable water allocation often result in farmers close to water sources achieving crop yields twice as compared to those located at tail ends of distribution channels (Manzungu, 1999b; Pazvakavambwa and van der Zaag, 2002: Samakande, 2002). In addition, due to poor water management, water delivery to tail end farmers was unpredictable, and thus adversely affecting their crop yields. At the plot level, some farmers have been observed to apply 50%-150% more water than needed by the crops although excess water depressed crop yields due to water logging, erosion of land and soil salinisation (Seckler, 1999; Motsi et al., 2001; Tafesse, 2003). Environmental factors such as water scarcity, poor soil fertility, poor water quality, land degradation, temperature, pests and diseases also adversely affecting crop production. Thus, environmental factors such as; water scarcity, poor water quality, land degradation, planted area, temperature, soil fertility, pests and diseases have adversely affected crop production in some smallholder schemes in Zimbabwe (Manzungu and van der Zaag, 1996; Mate 1996). According to Mujere, Chazovachii etal, (2010) the smallholder irrigated agriculture is a panacea for achieving the Millennium Development Goals (MDGs) in most arid and semi-arid regions, is of socio-political significance and a flagship of national development. Benefits derived from irrigation projects include; modernising peasant agriculture, reducing government food relief, providing economic growth and employment opportunities in rural areas, export earnings, more varied diets and better health standards government.

MATERIALS AND METHODS

In order to explore the demands of this research, both quantitative and qualitative methodologies were used. The questionnaire was the major tool used quantitatively and these were administered to plot holders in Mushandike resettlement scheme. It collected information on number of plot owned by the household, plot size cultivated, levels of production before and after water pricing, period of stay in the scheme, hardships faced by farmers. A relev́e sheet was designed and used to gather data pertaining agricultural productivity and confounding factors within the scheme before and after water pricing cropping seasons. The type of data that the relev́e sheet was intending to capture comprised farming experience (number of years the farmer had been practising irrigated farming), yields (t/ha), size of plots (ha), fertilizer supply (kg/ha) and seed sowing rates (kg/ha). Farmers were randomly selected and interviewed in the scheme as they were engaged on preparing their plots for maize cultivation in October 2010. It was assumed that recall data by farmers on crop yields and factors of production was reliable. Field measurements were done to estimate distances of irrigation plots from the main canal using a measuring tape. The ages of the respondents varied from 18 years to 68 years, with the average age being 47 years. Interviews were done with government officials, ZINWA, Agritex officials, NGOs and community leaders. It expore more technical issues on constrains and feasibility of irrigation water pricing. Focused group discussion and documentary evidence were also done with plot holders looking at challenges of water pricing bedeviling productivity. A sample of 10% of the total population of 445 households in the ward with 30 villages was used in the research. A systematic sampling was used in the research for the respondents to have an equal chance of being selected in the sample. A computer package called excel was used in presentation and analyses of the data in the form of graphs, charts and tables.

RESULTS AND DISCUSSIONS

Rationale for Water Pricing

Water fees are collected from farmers for two main reasons. The first is to cover the O&M cost so that the project is financially sustainable. In many cases, fees will also need to include a charge for the cost of capital required to construct the project. This charge for capital is important for future irrigation investments. The second objective involves pricing to encourage farmers to use less water per unit of output or produce greater net economic returns per unit of water, or both. Historically, the first objective has been paramount, but as water scarcity increases, the water use efficiency objective is likely to grow in importance and be given a higher priority. Efficiency is used in the economic sense: maximizing benefits subject to technical and physical limitations (Prato 1998; World Bank, 2005). Efficiency in water use means maximizing society's benefits over time from the water and technology available. In practical terms, improving water use efficiency means increasing the value of crop output per unit of water consumed through evapotranspiration (ET) by plants.

The Zimbabwe government (1994) postulated that "it is policy that in future, costs of operation and maintenance of irrigation systems be met directly by beneficiaries. Any subsidies in operation and maintenance costs should be justified and targeted on a case by case basis, (Zimbabwe, 1994). This was viewed by commissioners as a way of ensuring performance and as a cost recovery mechanism. The costs of dam maintenance and capital redemption associated with financing the structure are the summed costs to be paid by the farmer in Mushandike. It was revealed that there are economic and environmental aspects of water pricing in agriculture. "Economic" elements of price are the operation, maintenance and depreciation (lower bound), and return on assets (upper bound). "Environmental" elements of price are the scarcity value, externalities and the water management costs. Farmers in the scheme are paying using the block system .The total figure is divided among the ten blocks each with 30 farmers, 1, 5 acre plot each. Some have more than one and the payment system takes cognizance of the number of plots a household has.

Related to the lack of a connection between water use and charges, farmers had little incentive to contain water demand, comply with rules, or contribute to scheme maintenance. Irrigation water pricing was done to influence agricultural outputs, to achieve desired changes in income distribution and influencing the role and contribution of the agricultural sector to the overall process of economic development and generation of government tax revenue either from export taxes or imports taxes. ZINWA officials commented that all water bodies were under their authority. The maintenance and operation of these water bodies are supervised by ZINWA in accordance with the Water Act of 1998.

Impact of Water Pricing on Irrigation Productivity

The problem which farmers are facing is the breaching or malfunctioning of canals which caused some areas to have water shortages like village 21 which finally resulted in the decline of yields. Farmers were now complaining that they were the ones repairing it which becomes expensive for them since they also pay water bills. Farmers thought ZINWA is supposed to repair the canals but however, the responsibility of ZINWA is only on provision of water not repairing the canals. This reduced scheme performance since about 25 plots x 1.5 acres were not functioning.

Mushandike irrigation scheme was established in 1986 with 445 households and each farmer holds 1, 5 acres. From 1986 to 1999 farmers used block system type of farming where they grew crops of the same type at the same time in all their plots. Each farmer was devoted to particular crop determined by the state, which recovered the costs through a stop order system. This arrangement ensured not only that settlers produced but also that they did so in ways that meet the requirements of the state. This type of farming was easy to manage in terms of pest and disease control. Farmers could spray or fertilised their crops at the same time which reduced the spread of pest and diseases. Also block system produced high production which attracted buyers like COTTCO and GMB to come and buy their harvest. These organisations supported farmers by providing them with inputs such as fertilisers, seeds and pesticides freely. These finally encouraged farmers to utilise their plots hence high yields were produced. Also 1986 to 1999, farmers were not paying for the water usage so they used all their moneys to meet their needs and wants. From 2000, ZINWA introduced water pricing and there was a decline in crop yields starting by that time as shown on the table 1 below:

Table 1: Change of Yields Obtained

Crop	**Average yield per ha (tonnes) 1986-1999**	**Average yield per ha (tonnes)2000-2011**
Maize	5	4
Wheat	6	4
Cotton	8	6
Tomatoes	7	6
Beans	2	1.8

The introduction of water pricing started to affect the way the farmers used to carry out their irrigation practices. Because of water pricing, most farmers decided to practice individual farming system where farmers grew different crops at the same time. The result has been a total break down of good crop-culture practices such as block farming and rotations as farmers try to grow anything that will help them meet the scheme operating costs, this seem to be giving good margins (Agritex, 2001 .Moll, etal, 2004).Some were diversifying into horticulture as a profitable farming strategy, neglecting other crop guidelines and often only using the irrigation system for part of the year, (Moll etal, 2004). They concluded that the above problems have resulted in irrigation schemes that are decaying and dying all over the country of Zimbabwe. Individuals farming produced low yields which caused Grain Marketing Board (GMB) and Cotton Company of Zimbabwe (COTTCO) to withdraw since it was not economic for them to come and buy few farm produce .Withdrawal of these organisations resulted in farmers facing problems of input shortage since they were getting inputs from them. This resulted in farmer using retained seeds (uncertified seeds) which were less resistant to harsh conditions, easily affected by pests and diseases and finally this led to low yields. The impact was felt by Kaseke (1999) when he said inputs delivery to small scale farmers is a weapon for their prosperity, it is a social security need which must be provided to the farmers at right time. High yield depends on availability of inputs. Therefore lack of inputs was a demise of farmers in the scheme.

The withdrawal also led to loss of market to local farmers. This discouraged them to cultivate all plots hence hectare shrinked resulting in low productivity. Perishable crops perished before getting to the markets. Market for maize dwindled to an extent that burgs attacked them in storage and no chemical were available to rescue them. All these contributed to reduction in efforts by farmers in producing, hence reduced crop yields. Dissatisfaction by farmers as a result of water pricing was echoed by Chancellor and Hide (1997) as a causes and effects poor irrigation performance in a smallholder irrigation scheme.
The way permits were allocated by ZINWA to farmers also caused decline in crop yields. ZINWA charged its bills per village or block rather than per household. This caused some farmers who paid, unable to get the service since their counterparts were not paid up. For instance in village 10 at first 19 people paid for using the irrigation water but only six households were unable to pay the charges but at the end, all suffered. If a farmer fails to pay, ZINWA would automatically stop to supply its water and this happened in village 10 and 16 irrigators .They went for two years without water since 2009 up to February 2011. Those who failed to pay the bills resorted to rain fed water which is not reliable. Famers are supposed to pay an average of US$ 30 per month per household. It resulted in disputes over water allocation between local farmers and ZINWA officials.

The fast track land reform programme which was at its peak in 2000, gave additional burden to the irrigation farmers and ZINWA. They were against payment saying those who are advocating for the charges are western imperialists derailing the land reform programme. So every progress was thrown to the dust bin of development. The stalemate resulted in the deterioration of infrastructure like cannals, vandalisation of pumps, hydrants and garden tapes. According to Dzingirai (2000) pump breakdown is a biggest challenge which is prevailing in this irrigation scheme. The misunderstanding between ZINWA and farm invaders (war veterans) over water price payments is bringing the scheme to a halt since invaders do not want to pay.

Disruption of field day programmes after some productive farmers abandon the scheme due misunderstandings on water price payments, which promoting competition and productivity amongst farmers was put to an end. The fact that ZINWA only allocate water to a block or village that is fully paid resulted in some farmers abandoning their plots opting for other off-farm activities. Field day was such a promotional event, showcasing the capacity and capability by certain farmers in the scheme to try and give others, a participatory action and learning through observation, focussed group discussion in an effort to boost the image of resettlement done just after independence. Therefore water pricing to a greater extent impacted negatively to the productivity and sustainability of small scale irrigation schemes.

Low income was also a problem identified by farmers as a result of water pricing which led to school drops of their children. This was also revealed by the international irrigation management institute (IIMI) that in Egypt irrigation scheme there was a fall in farmers' income to 4,5% as result water pricing(World Bank ,2005). There are more outflows than cash inflows. Out flows are in form ,water bills, council rates ,electricity to an extent that monthly total range from $160-$450 excluding maintenance of the infrastructure like cannals,hose pipes etc. Hence these affect the welfare of the family of the farmer resulting in poor performance of the scheme.

CONCLUSION

Although the introduction of volumetric water pricing was in an endeavor to encourage farmers to use less scarce water per unit of output or to produce greater net economic returns per unit of water or both and to cover operation and maintenance costs for the sustainability of the project, the practice became more of a threat than a panacea to sustainable peasant agriculture in small scale irrigation farming .this was revealed by the accelerating levels of water cuts, reduced scheme performance due to disputes over water allocation, farmer abandonment from the scheme,deterioration of infrastructures and shrinking of farmers' incomes. Therefore, the multi-billion investment by government since independence is going to waste unless something is done to avert the decay of the scheme. Sustainability of peasant agriculture is rife through government reinforcements, otherwise Mushandike irrigation scheme is sitting on a time bomb creating serious problems both for irrigation agencies and, in the long run, for farmers. If the fees collected do not cover the costs of an irrigation project, its sustainability, without continued government subsidies, may be at risk. The development of new irrigation schemes became technically, financially and organizationally so complicated that they fell outside the capabilities of the smaller communities

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