THE COST BENEFIT OF THE EFFECTIVE CONTOL OVER UNWANTED AQUATIC WEEDS IN IRRIGATION DAMS FOR THE PRODUCTION OF AGRICULTURAL PRODUCE, WITH SPECIFIC REFERENCE TO STERILE GRASS CARP.

For some time now, we have known that evapotranspiration of aquatic weeds are responsible for huge water losses. It was only recently that we have changed our understanding of the problem. The key to understanding the problem is to change our way of measuring agricultural production. In the past we have always used a hectare of cultivated land as the unit of measurement for agricultural production, efficiency and of course ultimately profit per hectare.

With the advent of climate change, available water resources became unreliable and insufficient to sustain agricultural production in certain areas. In practical terms, the restricting factor now being water and not land, forces us to protect the water we already have. That is the water in our farm dams and large reservoirs.

It is imperative, that we utilize and manage our water resources to their maximum. Only if we start measuring our losses in financial terms and job losses, will we understand the scale of the challenge presenting itself.

WHAT IS DIFFERENCE BETWEEN EVAPORATION, TRANSPIRATION AND EVAPOTRANSPIRATION?

Evaporation of water is an important part of the water cycle and plays a prominent role in the economy of water. Evaporation is a passive process through which water in its liquid form, on clear water surfaces, is transformed into a gas, through factors like temperature, wind and humidity. Transpiration refers to the active displacement of water from water surfaces covered with aquatic plants. In this case, energy in aquatic plants is used to release water into the atmosphere as a gas through metabolic processes. Evapotranspiration is the combined loss of water through evaporation and transpiration.

The rate of water loss through evaporation and transpiration is seasonal, with the highest losses recorded in the summer months.

In the agricultural regions of South Africa, the annual evaporation is between 1, 8 and 2, 2 meters of water per year. The water loss varies between the respective areas, depending on climate. This loss represents an average water loss of 5,5mm of surface water per day. Put differently, 55 000 litters per hectare water surface area per day. (10 000 square meters x 5, 5 mm) per day.

A large amount of research was conducted on this topic overseas to determine the evapotranspiration rate of the different aquatic weeds. The following findings were made by **Dr John D. Madson of the U.S.A.**

PLANT	**Evapotranspiration tempo**
“WATER HYACINTH	1.26 – 3.67”
“CATTAIL	1.75 – 2.50”
“SOFTSTEM BULRUSH	1.90 – 2.50”
“DUCKWEED	0.90 – 1.80”
“AMERICAN PONDWEED	1.80 – 3.50”

For the purposes of making this comparison between different agricultural crops, a random evaporation rate of 2, 0 was used. The annual cumulative water loss in this case would therefore be 40 150 cubic meters, with the amount directly attributed to weed infestation is 20 075 cubic meters per year.

The lack of local research in this field prevents us from making the right decisions timeously to adapt our agriculture businesses to the new challenges facing us. The table below was therefore compiled by conducting a telephonic survey with a group of ten farmers.

THE COST BENEFIT OF STERILE CHINESE GRASS CARP FOR AGRICULTURAL PRODUCTS

CROP	AVERAGE LABORERS NEEDED/HA	AVERAGE TURN OVER PER HA/YEAR	AVERAGE WATER NEED PER HECTARE/YEAR IN CUBIC METRES	TURN OVER PER CUBIC METRE WATER PER YEAR	LOST PRODUCTION CAPASITY IN HECTARES DUE TO EVAPOTRANSPIRATION	LOST POTENTIAL INCOME PER YEAR	LOST POTENTIAL INCOME FOR A TEN YEAR PERIOD *	LOST POTENTIAL JOBS PER YEAR PER HA WEED	COST BENEFIT RATIO FOR A 10 YEAR PERIOD. *
IRRIGATION WHEAT	0,03	R24 000	5000	R4,80	4,02	R96 360,00	R963 600	0,12	101,43
ALFALFA	0,05	R80 000	10000	R8,00	2,01	R160 600,00	R1 606 000	0,10	169,05
WINE GRAPES	0,06	R50 000	6000	R8,33	3,35	R167 291,67	R1 672 917	0,20	176,10
MILK	0,05	R108 000	10000	R10,80	2,01	R216 810,00	R2 168 100	0,10	228,22
VEGETABLES	1,5	R150 000	8000	R18,75	2,51	R376 406,25	R3 764 063	3,76	396,22
APPLES	0,35	R200 000	8000	R25,00	2,51	R501 875,00	R5 018 750	0,88	528,29
PEARS	0,25	R200 000	8000	R25,00	2,51	R501 875,00	R5 018 750	0,63	528,29
PEACHES	0,08	R250 000	9000	R27,78	2,23	R557 638,89	R5 576 389	0,18	586,99
CITRUS	0,04	R300 000	10000	R30,00	2,01	R602 250,00	R6 022 500	0,08	633,95
PRUNES	0,08	R260 000	8000	R32,50	2,51	R652 437,50	R6 524 375	0,20	686,78
POMOGRATE	0,08	R360 000	7000	R51,43	2,87	R1 032 428,57	R10 324 286	0,23	1086,77
TABLE GRAPES	1	R400 000	7500	R53,33	2,68	R1 070 666,67	R10 706 667	2,68	1127,02
AVERAGE	0,32	R216 545,45	8773	R26,88	2,84	R539 694,50	R5 396 945	0,83	568,10

Values used, were obtained by conducting a telephonic interview with a diverse group of farmers. The aim of the table above is only to illustrate the impact of evapotranspiration on the production of different crops and not supported by any formal research. All values were averages based on the information received. The evapo-transpiration rate used for the table above was 55 000 liter per hectare per day for a dam 100% invested with aquatic weeds. It is the same as normal evaporation which is 55000 liters per hectare per day. A cost of R9500 per hectare weed was used for the stocking of grass carp.

Note: * The ten year period referred to in the table is the realistic effective life time expectancy from grass carp in which they will effectively control aquatic weeds.

From the table above, the conclusion can therefore be made that for a citrus producer, the loss of water due to evapotranspiration of aquatic plants, is equivalent to the amount of water needed to produce two hectares of citrus. A potential gross annual turnover of R602, 250 is therefore lost. For the prospective effective life span of grass carp, (ten years) the expected potential gross income loss would be R6 022 500.

Apart from all the practical benefits of using grass carp, (*Ctenopharyngodon idella*), the cost benefit to the farmer will eventually influence his decision to stock grass carp or not. Grass carp is a herbivore which can effectively control aquatic weeds. They do however have a preference to certain aquatic plants. In general, most emergent aquatic plants in South Africa can be controlled by grass carp, with the exemption of lilies, common reeds, water hyacinth and a few other exceptions. To effectively control these plants, an integrated approach should be taken and other management options like chemical and biological solutions should be considered. Combined all the management tools should form an integrated management plan.

As long ago as the 1950's, German research has determined that common reeds, (*Phragmites australis*) are responsible for evapotranspiration rates seven times that of normal evaporation. The fact that we have plants like water hyacinth (*Eichhornia grassipes*) with an evapotranspiration rate of 3, 5

should be cause for concern. Under such conditions the table above presents a stark reality of the current situation. Regardless of the management tool used to control aquatic weeds, it has become a necessity in a water scarce country.

As stated, the method for determining cost effectiveness and measurement of performance has always been cost and profit being measured per hectare. *Here we need to broaden our thinking and also measure production per cubic meter of water, since water is becoming a scarcer production factor that land.*

The question comes to mind whether there is a difference in our response to losing 110 cubic metres of water per day through a hole in a dam, or losing the same amount to evapotranspiration. Is our apparent apathy about evaporation and evapotranspiration due to the fact that we cannot see it?

Above is a comparison of a dam before stocking grass carp and 18 months later.

Taking the above into account, a point can be made for the use of grass carp in the control of nuisance aquatic weeds and could be regarded as an investment in water preservation rather that a production cost. Any expenditure with a possible cost benefit ratio of a 1000:1 or more could be regarded as a critical and strategic tool for success.

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