New wine in old bottles: a brief history of the use of economic incentives in natural resources management

V. Bjornlund[1] & H. Bjornlund[1,2]
[1]*University of Lethbridge, Canada*
[2]*University of South Australia, Australia*

Abstract

During the last two decades economic instruments have increasingly been introduced around the world to reverse the process of land and water degradation. This has been presented as a policy change and in the context of water management has been subject to heated debate. However, economic instruments have been used for more than 5000 years to achieve government policy objectives. Historically this has often resulted in environmental degradation and in some instances to the decline or collapse of cultures. Economic instruments are therefore nothing new, what is new is that the policy objective has changed from providing incentives to expand production, clear forest, increase water use, drain wetlands etc to now providing incentives to reduce resource use. While the expansionary use of incentives has mainly been seen as a positive among resource users and their communities, the new direction is challenging and threatening both for resource users and the communities depending on them as the economic engine for jobs, services and tax revenue.
Keywords: economic instruments, economic incentives, water, land.

1 Introduction

Since the Rio Convention there has been increased emphasis on the use of economic instruments and incentives for the management of water and other natural resources. This represents an acknowledgement of the scarce nature of these resources and the growing environmental impact of their extraction. The use of economic instruments has been presented as a major shift in policy direction, as if it is something new. In the context of water management this

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perceived policy shift has generated heated debate due to concern over environmental and socioeconomic impacts of the use of economic instruments.

In this paper we argue and illustrate that there is nothing new about the use of economic instruments to achieve policy objectives related to the use of natural resources, rather that they have been used for the last 5,000 years. What is new is a shift in what these instruments are trying to achieve.

In the past economic instruments have been used to encourage an increase in resource extraction and an intensification of their use. Clear more land, extract more water, fell more trees or catch more fish. These are expansionary objectives which most resource users and their communities find it easy to align themselves with as it increases their opportunity to create wealth. Resource depending communities i.e. fishing villages, irrigation districts, and forestry communities also find it easy to accept such policies as resource extraction constitutes the economic engine of the region creating jobs and prosperity. Saying that resource users always have supported these policies would be an overstatement. There are many examples of resource users trying to restrain these expansionary policies. Some examples are ground water irrigators in the Namoi Region of New South Wales, Australia and coastal cod fishermen in Newfoundland, Canada.

These policies were very successful and we are today faced with managing the accumulated effect of the deforestation, soil erosion, water logging and other environmental degradation caused by this success. We also demonstrate how previous societies since Babylonian times around 2000 BC have been in similar situations. They were largely unsuccessful in dealing with these consequences resulting in the decline and eventual collapse of societies.

In an attempt to reduce resource extraction and improve environmental conditions today's policy makers have again turned their attention to the use of economic incentive. However, the objectives are now reversed trying to reduce resource extraction to produce desired environmental benefits and to ensure the highest value output from the scarce resources. Many resource users and their communities do not favour this change in the use of economic instruments as it challenges the current economic and social structure, raises issues of stranded community assets, and threatens the value of the resource users' assets, their livelihood and in general the viability of their community.

2 The early agrarian societies

As the early city states and kingdoms developed in places like the Indus Valley, Mesopotamia and Egypt it became paramount to secure food production to feed an increasingly specialized society. Such societies developed a growing number of people not directly involved in food production such as noblemen, administrators and trades people in the cities. More land was therefore needed to come under production and to be more productive which often required irrigation; hence many of these early societies were also termed hydraulic societies [1]. Economic instruments in the form of penalties associated with farming were already introduced by the Code of Hammurabi in 1784 B.C. This Code introduced heavy penalties for neglecting irrigation infrastructure and

thereby causing damage or loss to other farmers, and if farmers left their land idle for too long, the owners forfeited their right to the land [2].

As these societies grew and competition among them for land resources intensified the rulers needed armies to protect the state and enable its expansion [3]. The rulers of these kingdoms needed to secure loyalty from the armies and the most influential families. This loyalty was often secured by granting the leaders of the armies and the most influential families, large land grants, access to irrigation and a supply of slaves captured in the wars [4]. They were in effect given as economic incentives to secure loyalty and to secure food supply. Soldiers for the armies were conscripted among free men who could be required to serve for lengthy periods and often did not return [2].

This resulted in increased pressure on land and water resources for at least two reasons: First, it created a class of absentee landlords which farmed their land with slaves and overseers with little long term interest in the productivity of land and hence introduced unsustainable practices for short term gain. Second, it increased the need for food production to raise tax revenue to fund and feed the armies. In response food production was intensified and the area under farming was expanded, often resulting in deforestation, and the construction of major irrigation structures which enabled continued or multiple cropping.

In Mesopotamia this process eventually resulted in the disappearance of a thriving culture. Deforestation in the upper reaches of Mesopotamia increased the silt load in the Euphrates choking the canals. The poor permeability and drainage capability of soils in combination with the introduction of continued irrigation caused water logging and brought salt to the surface. Detailed administrative records from the city states provide evidence of changing agricultural production and declining yield as these conditions worsened. The record suggests that '(a)round 3,500 BC roughly equal amounts of wheat and barley were grown in southern Mesopotamia. By 2,500 BC wheat had fallen to only 15% by 2100 BC wheat production was abandoned in Ur and had declined to just 2% of the crops grown in Mesopotamia' [5]. Eventually this resulted in the collapse of this once thriving society and the land has still not recovered.

3 Classical Greek Civilization

The same processes as in Mesopotamia took place in Greece. Already by the 8th century B.C Greece experienced extensive signs of degradation such as erosion of farmland, deforestation of the hillsides, and over grazing of the pastures [6]. Plato in *Critias* (360 BC) observed that *"what now remains compared with what then existed is like the skeleton of a sick man, all the fat and soft earth having wasted away, and only the bare framework of the land being left . .. There are some mountains which now have nothing but food for bees, but they had trees not very long ago . . . there were many lofty trees of cultivated species and . . . boundless pasturage for flocks. Moreover, it was enriched by the yearly rains from Zeus, which were not lost to it, as now, by flowing from the bare land into the sea; but the soil it had was deep, and therein it received the water, storing it up in the retentive loamy soil, and . . . provided all the various districts with*

abundant supplies of spring waters and streams, whereof the shrines still remain even now, at the spots where the foundations formerly existed." [7]

To replace the lost food production and keep meeting demand from a growing population, by the middle of the 8th century BC Greek started a colonization process which lasted some two centuries over which period they established colonies along the shores of the Mediterranean and Black Sea [8]. As an incentive to settle the colonies and establish food production the new settlers were given land grants and slaves.

By 590 B.C. rulers started to pay subsidies (bounty) to plant large areas of olives and grapes, which could still be produced on the depleted soils. Spurred on by these subsidies small farms spread into progressively more marginal areas prone to soil erosion [9]. They processed the olives and grapes into oil and wine for export to their colonies in exchange for the grain and other foods produced there which they could not any longer grow themselves. This process kept Greece prosperous for some two centuries but eventually the new colonies became wealthier than Greece and rebelled. There is geoarchaeological evidence to show that soil erosion caused the decline of several cultures and forced the relocation of settlements, changes to agricultural practices, and temporal abandonment of some areas [10].

4 The Roman Empire

Similar processes took place later during the Roman Empire with the variation that Rome did not colonize but instead conquered provinces. Roman soldiers were given rewards at the end of their service including cash, or land and slaves. Augustus fixed the amount in AD 5 at 3000 denarii and by the time of Caracalla (AD 210) it had risen to 5000 denarii. They did not settle these provinces with people from Rome but instead enslaved its inhabitants to work on land granted to syndicates of wealthy citizens living in Rome.

The aim of these syndicates was to make quick profits from the supply of grain to Rome; demand for this grain was driven by the policies and incentives introduced by the rulers in Rome. To finance this policy of conquest small farmers were heavily taxed. In order to pay these taxes they exploited the land more intensively than they might otherwise have done. This resulted in serious soil erosion and land degradation. This problem was exacerbated by the fact that many farmers were required to serve as soldiers in the armies leaving the land in the hands of slaves and overseers with no long-term interest in the land. Other economic incentives encouraged small farmers to leave the land and move to Rome. For example, only people living in Rome could vote, and votes could be sold; and citizens of Rome could buy grain at half the market price or less and later grain and other foods were given for free. Since senators were forbidden to participate in commerce many invested in large landholdings on state land on which they paid only a nominal rent. These absentee landowners further degraded the soil in pursuit of quick profit [11].

5 The Islamic Empire

During the spread of the Islamic empire in the 7th and 8th century A.D. a new agricultural revolution took place spurred by demand for better cotton for clothing, better and different food such as vegetables and fruit and new medical plants for the production of better medicine. Land became scarcer and less fertile land and areas with less hospitable climates were therefore taken into production. However agricultural science made significant advances in the understanding of different classes of soil types. More capital and labour were applied to each unit of land which therefore created a more stable and higher income for all farming categories. This was an economically rational response to growing land scarcity and to increasing availability of labour and capital.

To encourage these changes the state imposed a relative lower rate of taxation on certain land and products. Taxes were usually 1/10 or 1/5 depending on the status of the land or its owner. Indeed, the State frequently forgave the taxes of those unable to pay. Reflecting the objectives of the state, fruit and vegetable production were either not taxed or was levied a lower tax. Some authors argue that the same was the case for sorghum and cotton. Similarly, farmers who invested in water lifting devises such as the Shaduf or the Noira wheel to expand irrigated production were also taxed more lightly. On the other hand strong penalties were in place to prevent agricultural land from being left idle. For example if a farmer abandoned cultivable land the state could take possession and transfer it to a new farmer, and special taxes were levied on uncultivated land which could be irrigated.

While special levies were imposed in times of crisis, normal taxes could not legally be raised by rulers. This low taxation regime was one of the factors which maintained a class of smaller, independent landowners avoiding the problems associated with large absentee landowners so prevalent in Rome, Mesopotamia and other ancient societies [12].

6 Europe after the fall of the Roman Empire

Following the collapse of the Western Roman Empire no ruler had been able to guarantee security to the farmers of Europe. Instead, kings and emperors vested control of land in the churches and local lords which in turn established order and protection at the local level and provided revenue and soldiers to the ruler. To expand their agricultural land holding these lords and churches often needed to clear forest. Forest areas were given to able-bodied to cut down and cultivate. These peasants in return rendered services on the lords' land including payment of rent, labour and soldiers [13].

By the 11th century a feudal law and order system had been established in Western and Central Europe with land in the control of the Church and feudal lords. From the 11th to 13th century, the cultivated area quadrupled throughout most of Western Europe. This was driven by improved agricultural practices and the use of animal power and by the desire of the feudal lords and the churches to continue to expand their agricultural production. The improved technologies

made it possible to clear and till the heavier forest soils of Northern Europe and drain swamps.

The northern crusades were part of this process which resulted in 150.000 to 200.000 peasants from the west colonizing Prussia and what is now the Baltic States [14]. This area became the bread basket of Europe and allowed farmers in Western Europe to concentrate on better paid crops to supply the needs of the growing cities and raw materials for the emerging industries. To encourage this process many feudal lords granted serfs their freedom as well as parts of the land they helped to reclaim. This process caused the biggest transformation of natural vegetation in Europe since the Ice Age.

The industrialization process increased the demand for raw material such as cotton and desirable consumer products such as coffee, tea and tobacco. To continue expansion European countries started to look outside of Europe leading to the establishment of colonies around the world. For example the British King gave the East Indian Company control over the Indian Subcontinent ranging from today's Pakistan to Burma as their private domain.

7 The Americas

The colonization process intensified in the 15th, 16th and 17th centuries into South and North America. Much the same policies were applied as in Greece and Rome. Free access to land and cheap labour were economic instruments used by the colonial power to encourage settlement and the production of agricultural products and precious metals for the mother country. In South and Central America the Spanish government granted permission to use local labour as slaves to promote mining and agriculture [15].

The British initially used free access to land and provision of cheap indentured labour as economic incentives to increase production in the new colonies. People not able to pay their debt in England were sent to the new world to work for seven years to pay their passage. This initially supported the tobacco industry which soon became the biggest source of revenue for the English Crown. The incentive of free access to land caused the tobacco growers to abandon land after four to five harvests as it was then totally depleted of nitrogen and phosphorous and eroded due to the farming practices associated with tobacco growing. It was much cheaper to move to new virgin land than applying fertilizer and changing management practices. The English government discouraged the use of conservation farming as it would reduce productivity and tax revenue [10]. To secure a continued flow of cheap labour, and to resolve the problem of overflowing prisons in England, convicts were transported to North American, 50.000 from 1718 to the end of the independence were in 1776 [16].

After independence the new nation sought to expand agricultural production outside the original 13 colonies. To facilitate this process the Homestead Act was passed in 1862 by President Lincoln. Under this act anybody could apply for freehold title to up to 160 acres of undeveloped federal land. To eventually get freehold the applicant must first apply for the land, then live on it for five years and improve the land (that is clear native vegetation and till it) and upon having

done that file an application for a deed of title at a federal land office. This opportunity was a significant lure for many poor land strapped European peasants or farmers. By the turn of the 20th century the better more productive low-lying alluvial land had been taken up. The Enlarged Homestead Act was therefore passed in 1909 and the Stock-Raising Homestead Act in 1916. The purpose of these acts was to encourage the settlement of the poorer soil suitable for dry land farming and grazing. Under these acts applicants could claim 320 acres and 640 acres respectively. It was the impact of land clearing and tilling of these poorer soils which eventually caused the dust bowl of the 1930s and the associated hardship [17]. Only about 40% of the applicants starting the process of getting freehold succeeded.

In the dry parts of the American West irrigation was necessary to support agriculture. Originally irrigation was developed by private canal and ditch corporations. However, increased demand for water soon made it apparent that private/government partnerships were necessary. From 1890 to 1900 the area under irrigation increased from about 1.5 million acres to 6 million acres. However, these often failed due to lack of funds and engineering skills. Following extended droughts in the 1890s pressure mounted for the government to fund major storage and irrigation projects. This resulted in the Reclamation Act, 1902. The rationale for government investment was that irrigation would reclaim land for settlement and increase food production. From 1902 to 1907 the Bureau of Reclamation began some 30 projects in Western states putting 2.6 million additional acres under irrigation. The land and access to water was granted to farmers under favorable conditions. Many of the early projects encountered problems as the land included in the project was not suitable for irrigation and could only grow low value crops and land speculation resulted in poor settlement pattern. Further, farmers were inexperienced in irrigation resulting in water logging and reduced productivity. Given the relatively high cost of land preparation and construction many projects could not meet the payment schedules. As late as the 1930s, federal reclamation had not really succeeded, it had merely survived with numerous bailouts by government.

Such intensive irrigation generated its own social and environmental effects. From its inception, the Bureau of Reclamation operated much differently than its founders had envisioned. Very few irrigation projects were actually paid for by their beneficiaries, and so these public works quickly became subsidies. The proliferation of modest homesteads that had been so important to justify giving the federal government primary responsibility for irrigation never came to be. Land speculators bought much of the land where they anticipated dams might be built, and the bureau showed little interest in enforcing its 160-acre limit on what came to be some of the most powerful political interests in the West. In most areas served by the bureau's projects, it was actually impossible to purchase small tracts of land. The high productivity and costs of irrigated lands meant that such agriculture tended to be more market-oriented, more mechanized, and to employ more migrant labour than elsewhere. In practice, then, irrigation helped to solidify the dominance of large-scale agribusiness in the West [18].

Environmental problems have increasingly limited the effectiveness of irrigation and reduced its public support. The damming of most of the West's major rivers has destroyed salmon runs and river flows have been dramatically altered. The Colorado River, for example did not reach the Pacific from 1964 to 1983. Salinization, caused by perpetually water-logged soils, puts thousands of acres out of production each year [18].

In a similar way the Canadian government had great desire to settle the Western frontier and establish railways into the West. By 1872, the government had purchased the lands belonging to the Hudson's Bay Company and founded the Province of Manitoba. To attract settlers to open up the country and make possible the building of railways, the government began advertising grants of free land in the West. Free homesteads of 160 acres were granted to farmers on the condition that they clear ten acres and build a house within three years of registering their intent to settle [19].

8 Australia and New Zealand

Following loss of the American colonies in 1783 Britain lost a source of important raw material as well as place to deposit convicts. Britain therefore showed an increased interest in gaining a foothold in the Pacific and East Asia as a base for its growing interest in this region. Also the prison population started to mount again due to the loss of the American colonies and continued harsh social and economic conditions in the major cities. Britain therefore in 1787 established a penal settlement at Botany Bay in New South Wales. To ensure that the new settlement would be self financed the Government granted large areas of land to members of the British nobility and supplied them with convict labour, 150.000 convicts were transported to Australia between 1787 and 1840 [20].

The settlement of Australia by voluntary settlers was spurred on by a general economic collapse in Europe, particularly in Britain, after the end of the Napoleonic wars. A mixture of factors caused an economic depression. Government coffers were empty after an extensive period of very expensive wars. The labor market was flooded with thousands of returning soldiers and sailors as well as redundant workers as a result of improved mechanization in agriculture and industrialization in the cities. This caused a very high rate of unemployed and escalating expenditures on poor relief exceeding the capacity of the empty state coffers. Cities were filling with hungry unemployed people living in very poor conditions creating discontent and rising crime rates. The ruling class in Britain came to the conclusion that the country had a surplus population while its overseas colonies needed people [21].

People were encourage to emigrate to Australia and New Zealand by various economic incentives such as offers of cheap and financed travel to the colonies and favorable land purchases or land leases. However, these were again under improvement conditions. Failing to clear and till the land constituted breach of the lease conditions and loss of the land [22]. Historically, land clearing has been supported by the Commonwealth and State Governments as an essential part of

improved productivity essential for national economic prosperity. A range of institutional incentives for agriculture increased the economic gain from land clearing, with offerings of cheap land along with venture capital in the form of loans or tax concessions. Other incentives included the War Service Land Settlement Scheme, low interest bank loans and financial support programs such as drought relief assistance. These processes fueled a rapid land clearing process generating serious land degradation issues with raising water table and dry land salinity, 800.000Ha of agricultural land are now unsuitable for any agricultural use. Extensive clearing for agriculture occurred in the 1960s and 1970s, and significant clearing is still taking place. In effect, more land clearance has occurred in Australia since 1945 than in the whole of the period since European settlement in Australia. Particularly in the 1950s and 1960s, significant tax concessions existed for land clearing [23].

The spread of agricultural production to more marginal and fragile land was also encouraged by two other economic incentives, the wool and the wheat schemes which provided guaranteed markets and prices. This pushed wheat production into areas not really suitable for permanent cropping and increased stocking rates of sheep on fragile lands with severe long term impacts [24].

During the 1860's and 1870's settlement along the Murray River intensified. The combined impact of the drought from 1877 to 1881 and a fall in wheat prices encouraged dryland farmers to look for alternative land uses. The interest in irrigation increased as a cushion against drought and proved greater flexibility in crop choices. As in both the western part of US and in Alberta Canada initially irrigation project were private ventures aiming to combine irrigated and non-irrigated lands order to provide relatively extensive forms of farming still mainly relying on rainfall. However, also as in the US and Alberta these early project could not support themselves and failed financially. It became apparent that to make irrigation profitable intensive irrigation was needed.

Economic depression of the 1890's and the drought between 1897 and 1902 (the Federation drought) spurred the government to invest in large scale systems for intensive irrigation. This was made possible when a new water act was introduction in 1886 vesting ownership and control of water in the crown. This provided water for irrigators facilitating more intensive and higher value productions such as dairying and fruit growing. Under these schemes individuals were not granted water rights rather each landholding was registered on the districts books and as such secured water supply.

This was part of a closer settlement policy to encourage population of the dry interior area of Australia. This process was hindered due to not enough farmers applying for irrigation blocks. In response the government sent a delegation overseas and advertised in Europe and North America for settlement in Victorian Irrigation Districts [25]. This started the process of immigrant settlement along the river which in turn increased the take up among Australian farmers. After World War 2 the settlement process gained further momentum with soldier settlements where returning soldiers were granted land and water in newly developed irrigation districts.

The process of Dam building continued up until the 1980s, in Victoria most of the new capacity was used to increase the water available to existing irrigators rather than additional expansion. The purpose of this was to facilitate a transition from irrigation as a drought protection measure to fully support irrigated production. This continued and rapid expansion and intensification of irrigation, largely driven by substantial government economic incentives in the form of free water and land, was associated with a number of problems: i) many projects were established without proper soil and hydraulic surveys with the result that some areas suffered from raising water tables and salinization within a very short span of time, in some instance less than twenty years; ii) some states continued to issue new water licenses so that eventually most resources in the southeastern part of Australia was over allocated; and iii) access to cheap water resulted in inefficient water application exaggerating the environmental problems [26].

The Australian Government finally started to wake up to these realities in the later 1980 and in 1994 introduced a new waster policy framework starting to reverse the direction of economic instruments and incentives. As part of this process water markets were made compulsory in all states, land and water rights were separated, irrigation infrastructure was devolved to the irrigators; full cost recovery water pricing was introduced; and the environment was recognized as a legitimate water user.

9 Irrigation-schemes on the Indian Subcontinent

The Indian Subcontinent has 5-6 thousand years of irrigated agriculture with tanks, inundation canals, temporary bunds to trap drainage water, wells and water-wheels were used to harvest water. These techniques were essentially directed towards impounding precipitation, tapping river inundations or retrieving groundwater recharge. It could be argued that these methods were design to suit the local micro-climates, topography and hydraulic conditions. In the early 19th century British colonialism initiated a radical break in both technique and hydraulic principle by introducing perennial canal irrigation in several parts of the south Asian subcontinent [27]. These systems were often superimposed on and therefore destroyed existing irrigation infrastructure.

Canal irrigation was introduced as an investment opportunity for British capital and policies for their use was designed to secure the revenue necessary to service this capital and deliver produce to service British needs. The era of modern irrigation, witnessed the construction of several large canal irrigation schemes with permanent head-works such as the Ganges Canal (1854), the Godavery (1852) and the Krishna (1855). These large projects facilitated a dramatic increase in cropping intensity, growth of commercial farming and the spread of mono-cropping. When the production increases irrigation began to level-off early in the 20th century, salinization and water logging had turned large areas of fertile and cultivated lands into barren wastelands [28].

During the Green Revolution high responsive varieties of wheat and rice were introduced. These varieties however required a very intensive use of irrigation, fertilizers and other agricultural chemicals. The Indian Government heavily

subsidised agricultural input such as water, fertilizers, electricity, and credit. This quickly resulted in, soil degradation due to over-use of fertilizer and irrigation induced salinity, depletion of groundwater and to the extent that, at the turn of the century one million hectares suffered from irrigation induced water logging and salinity in northwest India alone [29].

10 Conclusions

There is clear evidence that economic instruments have been aggressively used by rulers and governments from the time of the fist organized societies and up until the last part of the 20th century to further political objectives such as settlement of colonies, closer settlement of otherwise unattractive areas, and increasing agricultural production. A common denominator throughout history has been that the results of these policies have in many instances resulted in serious environmental degradation and in some instances the collapse of whole societies. Not until the last decade of the 20th century did policy makers start to acknowledge that this development focused use of economic instruments had to change. Consequently more recently these instruments have been used to limit or change the way in which we interact with natural resources. Schemes to pay landowners to implement best management practices to increase the production of ecosystem services, to purchase water back from irrigators to leave more water for the environment, and to pay farmers to re-vegetate their land or create wetland are being implemented in many parts of the world and are examples of such economic instruments.

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