IRRIGATED AGRICULTURE IN THE YEAR 2000

C. R. Panabokke

Dr C. R. Panabokke has provided leadership to land and water management research in Sri Lanka over a period of 25 years in his previous positions as Head, Land Use Division, Irrigation Department and later as Director of Research, Department of Agriculture. He was an agronomist with IIMI from 1985 to 1989, and now serves IIMI as a Senior Associate. He was formerly Director of Agriculture, Department of Agriculture, and was also a Senior Research Fellow at the International Service for National Agricultural Research (ISNAR) at the Hague, Netherlands. The views expressed in this paper are those of the author alone.

Introduction

Irrigated agriculture in Sri Lanka prior to the 1960's had been synonymous with asweddumized irrigated rice culture. Irrigation development in the dry zone of the country during this period was mainly conceived in terms of advancing the country towards a goal of achieving self sufficiency in its rice requirements. The restoration of the ancient network of abandoned irrigation schemes together with the construction of new ones during this period was an integral part of the strategy for the attainment of self sufficiency in rice.

The initial stages of a shift in irrigated agriculture from its traditional moorings of asweddumized rice culture took place around the early 1960s. This was prompted by the interaction of several considerations, chief among them being a recognition that water, rather than land, was the main limiting factor to a further expansion of the irrigated extent in the dry zone. Options other than high water demanding irrigated rice had therefore to be properly examined and tested.

The policy environment of that period was conducive to the experimentation and testing of non-rice or other food crops (OFCs) in irrigated land during the dry yala season. By the late 1960s the essential base of research information and extension experience was available for launching a program of diversified cropping on irrigated land. Significant progress has since been registered in the field of diversified cropping both in major and minor irrigation schemes over the last two decades.

However, the present gap observed between the potential and achievement, as well as a recent slowing down of the rate of expansion in diversified cropping in some favoured project areas is a cause for concern and needs to be carefully examined. Recent research carried out on irrigation management for crop diversification in Sri Lanka and elsewhere (Philippines, Indonesia) has shown that the major constraints to farmers adoption of diversified cropping are located more within the realm of institutional, organizational and management aspects of the irrigation systems rather than within the technological domains of irrigation practices. This, in the writer's view, has important implications for how we should set about to guide and shape the future of irrigated agriculture in this country.

An attempt is made in this article to address some of the presently identified problem areas that should be the concern of policy makers, senior administrators, irrigation system managers, engineers and agronomists in pushing irrigated agriculture in Sri Lanka along a progressive trajectory of development into the twenty first century.

The Contemporary Irrigated Agriculture Environment and Potential for Change

This section briefly describes the physical and biological aspects of the diverse irrigated agriculture environments encountered in the country, and the presently identifiable potential that exists for future change or modification according to our present understandings. The institutional, organizational and socio-economic aspects are adequately discussed in the other companion articles of this issue and will not be dealt with in this section, except in the latter sections of this article where the implication of, and the interactions among, the relevant aspects will be considered.

Wet Zone

Asweddunized [1] rice lands of the wet zone make up approximately 25 percent of the total rice growing lands of the country. (see figure 1) These lands are, for the greater part, located in inland valleys of varying size and form, as well as along the alluvial plains of streams and rivers. Although in common parlance these are referred to as 'rainfed' rice lands, it must be recognized that there are varying measures of irrigation activity practised on these lands according to the nature of their hydrology. The proper term for most of this land should be "phreatic' rice lands rather than rainfed.

In view of the position of these rice lands in the landscape as well as their associated hydrology, wet-lowland rice is the preferred and economically acceptable land use option for these phreatic lands. No shift in the present use of these lands from double cropped wet-lowland rice is envisaged over the next decade.

Rice yields in the mid-country and in the less wet parts of the low country presently exceed 3 t/ha, and this is yet advantageous for part-time farmers. Recent studies that characterize the land systems and land sub-systems of the wet and semi-wet rice lands, **Somasiri and Ratnayake (1988),** have helped to advance our understandings of the true potential of these lands in the framework of changing technological and socio-economic circumstances. In the light of these recent findings, it is possible to foresee that those lands which presently yield more than 3t/ha per season will

1 Asweddumized refers to land that is shaped and bunded to receive rain and irrigation water and to maintain ponded conditions for wet-land rice.

continue to be double cropped with wet-lowland rice, while those which will not be able to attain yields of more than 2.5 t/ha per season will probably move out of rice and be replaced by other enterprises by the 21st century. Increasing industrial and urban development in the low country regions will result in many of the first order inland valleys being transformed to other non-agricultural uses such as human settlements and industrial establishments.

Intermediate Zone

Only the asweddumized rice lands of the mid-and up-country intermediate zone which make up no more than 8 percent of the total rice growing lands, but yet constitute a very special production region, are discussed here. The rice growing lands of the low country intermediate zone will be discussed in the subsequent section along with those of the dry zone.

These rice lands are located mostly on terraced slopes of the mid and up-country regions and also partly in some inland valleys which are not subject to acute water logging. Irrigation supply is mostly from simple stream diversion, and this supply is usually adequate for a full extent of wet season rice in maha, and for a partial extent of non-rice crops in the drier yala season. High value vegetable crops at higher elevation and tobacco in the mid-elevations is the common cropping pattern in the yala season. The temperature and humidity is ideal for exotic vegetable crops in the higher elevation and these climatic parameters are exploited to the maximum. No changes are envisaged in the present cropping pattern over the next decade and beyond, except for a further intensification of production in the more advantaged areas.

Dry Zone

The asweddumized rice lands of the low-country dry zone together with those of the low-country intermediate zone account for close to 67 percent of the total rice growing lands of the country, and are located in broad inland valleys, minor flood plains and in the coastal plains. The rice growing lands of the eastern and northern coastal plains are the true rainfed or 'pluvial' rice lands which are also commonly referred to as the 'manawari' paddy lands. Only the irrigated rice lands will be taken up for discussion in this section.

Based on the stability of the water supply the irrigated lands of the dry zone can be grouped into five broad categories according to the nature of water source and supply as follows.

Nature of Irrigation Source and Supply

Category I
Major [2] irrigation schemes with either trans-basin diversion (eg. Mahaweli Systems) or those where the upper catchment of the reservoir is located in the wet zone (eg.UdaWalawe, Gal Oya).

Category II
Major irrigation schemes with catchment of the reservoir located mainly within the dry zone (eg. Kirindi Oya, Padaviya).

Category III
Minor [2] irrigation schemes with moderately stable water supply that ensures cultivation of full or part of the command area in 3 out of 4 maha seasons.

Category IV
Minor irrigation schemes with unstable water suply that permits cultivation of full or part of the command area in 1 out of 4 maha seasons.

Category V
Lift irrigation from shallow open wells or channels and other miscellaneous types. (Jaffna, Vavuniya, Kalpitiya).

Irrigation supply is most favourable in **Category I,** with adequate supply in all years for irrigated rice during maha, and an adequate supply in yala (in most years) except in System H of Mahaweli and in the lower parts of the Uda Walawe system. On account of the high stability of the macro-irrigation supply, the greatest opportunities for intensive dry season crop diversification and production of export oriented irrigated crops lie within this category. Although the past performance of crop diversification within this category has not been very impressive, its comparative advantage for stable production of high value crops should be exploited to the maximum in the future.

Irrigation supply is less favourable in **Category II.** In years of normal rainfall irrigation supply is adequate for the full extent of maha irrigated rice, and for between 25 to 50 percent of the extent for a yala rice crop. Over the last two decades there has been a striking response to crop diversification during the dry yala season in the irrigation schemes falling within this category. One of the more difficult management problems is the forward planning for the extent and range of OFCs to be grown during the yala season because of the very high order of year-to-year variation in available irrigation supply. Past data show a high order of variation in the cultivated extent. Dry season diversified cropping in this category should therefore be mainly geared to the domestic rather than the export market. In the drier south-east and north-west of the country, the potential for diversified cropping even during the maha season could be successfully exploited as recently demonstrated in the Kirindi Oya project and H5 area of Mahaweli system.

Minor irrigation schemes with moderately stable water supply, namely **Category III,** are mainly located in the intermediate zone, and a few in the dry zone where the reservoir catchment area is sufficiently large. The wet season maha crop will essentially remain as irrigated rice in these schemes over the next decade, but a marked shift will take place towards diversified cropping for the yala season in the future.

Category IV is the least endowed of the various types of irrigation systems in the dry zone in terms of the quantity and reliability of water supply. Past attempts at intensification of rice production in these schemes have not proved successful. However a marked increase in the cultivation of OFCs on some portions of the irrigable area during the yala seasons has taken place over the last decade. No effective interventions have yet been evolved to enhance or even

2 The terms major and minor are used here in accordance with the Irrigation Department criteria.

sustain this development. It is now quite evident that a new approach based on an organic integration of the associated upland rainfed cropping with the irrigated component would have to be worked out in order to achieve some measure of stability in farmer incomes even at a lower base.

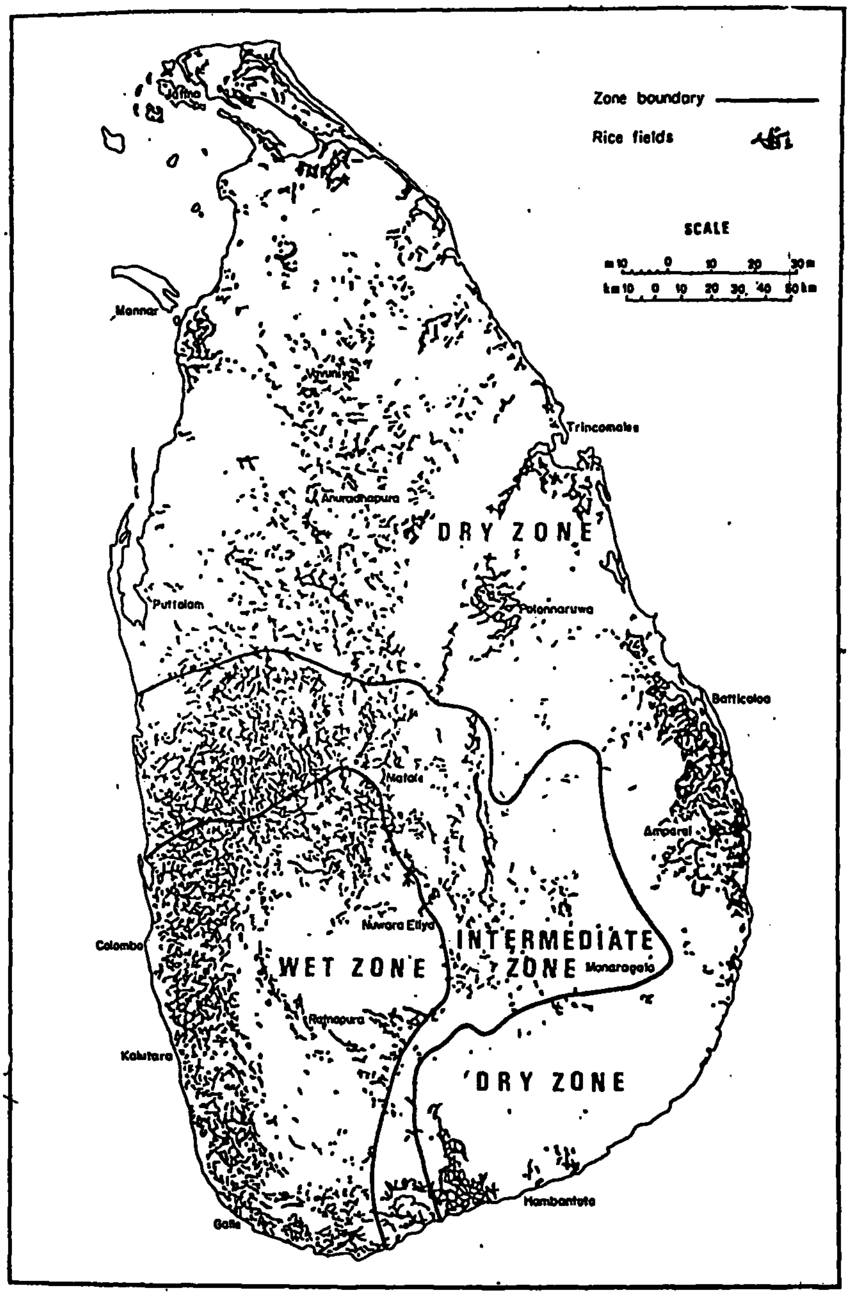
Category V is made up of the traditional lift irrigation types as found in the karstic Jaffna peninsula, open dug wells around Vavuniya in the fractured hard rock area, shallow wells on the coastal regosols of Kalpitiya, and the more recent pump lift irrigation schemes from main channels as in Rajangane. Because of the increasing costs of lifting irrigation water, shifts in technology and a use of modern drip irrigation practices could be foreseen, with a shift to more profitable high value crops. There will also be increasing use of low-head lift from shallow seepage wells located within the major irrigation schemes.

Past Performance and Future Directions

Two contrasting trajectories of growth have been observed over the recent past, one in respect of irrigated rice and the other in respect of diversified irrigated agriculture. Over the period of the last one-and-a half decades the annual production of rice had doubled. This was brought about by an increase in area under rice by 30 percent, and an increase in the average yield by 44 percent, **Ranaweera et al(1990)**. Total production has now reached a plateau as a result of the area and yield levels of rice reaching a ceiling. The main challenge ahead as pointed out by **Ranaweera et al** will be to meet the growing demand for rice in the face of the apparent flattening out in domestic rice production. They reinforce the view expressed ten years earlier at the **1980 Rice Symposium** that the solution lies in changing the emphasis from self sufficiency in rice to self-sufficiency in calories made up of an increasing proportion of other grain and starchy staples.

A recent study in the analysis of irrigation investment trends in Sri Lanka by **Aluvihare and Kikuchi (1990)** places in clear perspective the possible options

Figure 1. Distribution of Rice Fields in Sri Lanka.



for any further expansion of the irrigated rice extent. It is observed that the total irrigated extent of paddy land in the country had increased from 253,000 ha in 1950 to nearly 500,000 ha in 1985, and that ninety percent of this increase was made up of new irrigated land under major irrigation systems located almost exclusively in the dry zone of the country. The more significant feature associated with this expansion, as shown by the authors, is the change observed in the benefit-cost ratio for investment in new irrigation construction over the same period, and the impact that the new seed-fertilizer technology had at different stages of this period.

It has been shown by these authors that irrigation construction was a lucrative investment opportunity soon after independence with benefit-cost (B/C) ratios as high as 2.3 even with traditional rice technology. With an increasing trend in unit construction costs the B/C ratio remained around 1.7 for most of the 1950s, with a decline to below 1.5 by 1958. However, the introduction of the old improved varieties of rice (OIV) restored the B/C ratio to a level of more than 2.0, and again around 1968 the same process was repeated by the introduction of the new improved varieties of rice (NIV) as shown in Figure 2.

With further increasing trends in unit construction costs in the 1970s, the rates of return on construction investments continued to decline to a point that by the very early 1980s even with the highest level of technology the B/C ratio had declined to less than 1.0 as shown in Figure 2.

The authors of the above study quite rightly conclude "now that the irrigated land base has been well established, attention in the irrigation sector should be directed to an concentrated on the rehabilitation and modernization, and the improvement in water management of the existing systems".

Integrating the foregoing body of information it could be inferred that the previously envisaged national goals of achieving a 100 percent self sufficiency in rice would have to be modified to one that accepts the present varying range of between 80 to 90 percent self sufficiency; and, at the same time, have it also linked to a goal of achieving a fuller utilization of the irrigated land and water resource base in respect of non-rice crops.

Diversified Cropping

A significant expansion in the extent of irrigated diversified cropping had taken place over the last one-and-a half decades. In yala 1987 the total extent of OFCs in major and minor irrigation systems was around 17,000 ha, while that in the Mahaweli system H was around 12,700 ha [3]. A downward trend has been observed in the extent of OFCs grown in yala during the past three years, with a sharp decline in system H to 2300 ha in 1989. This decline has been attributed to the recent disruption in the supporting services that are so critical to the sustenance of OFC production as compared with that for rice.

A clear lesson to be drawn from the above is that the progress in future expansion of OFC production will largely be determined by our ability to build and sustian those supporting institutions that are vitally essential to diversified agriculture. As far as our recent experience shows these, in the main, include the nature of the organization and the management institutions, the quality of the extension services, the effectiveness of credit and marketing facilities, and an adequate technical backstopping to counter new generations of pest and disease problems.

The importance of a proper organization structure has been amply demonstrated in the case of Mahaweli system H, which was able to achieve almost its full potential extent of OFC cultivation on the well drained soils within a period of 8 years (1979-1987). The role of irrigation management institutions have been discussed in the other articles in this issue, but a point that must be stressed here is that a timely and reliable delivery of water is a pre-requisite for promoting cultivation of OFCs. There is an adequate body of agronomic research and a very wide range of crop options that have been already tested in the dry zone environment. The present gaps in credit and marketing constitute two of the more important problem areas that have to seriously addressed by senior level administrators. Next to land and water, farmers identify credit and marketing as the major constraints to diversified cropping **Panabokke et al (1987)**.

Dimantha (1987) estimates that there is a total extent of around 80,000 ha of well drained land under the command of major irrigation schemes alone which is best adapted for yala season diversified cropping. Based on the amount of non-rice food crops including sugar, required by the country to ensure a balanced nutrition level as recommended by the Medical Research Institute, he estimates a need of around 200,000 ha of irrigated land to accomodate this requirement. Although the latter is a theoretical figure it yet gives an indication of the potential for diversified cropping.

In overall summary, it could be stated that by the year 2000 significant changes and trends in respect of crops, cropping calendars and patterns would have taken place in the dry zone irrigated agricultural landscape. These changes will largely be driven by the need for having to stretch the limited water resources as far as possible by recourse to improve water-saving practices in irrigated agriculture, and also by the need to raise farmer incomes. Innovative uses of irrigation supply, and adoption of more profitable crops and cropping patterns will accompany such changes. Little or no change is foreseen

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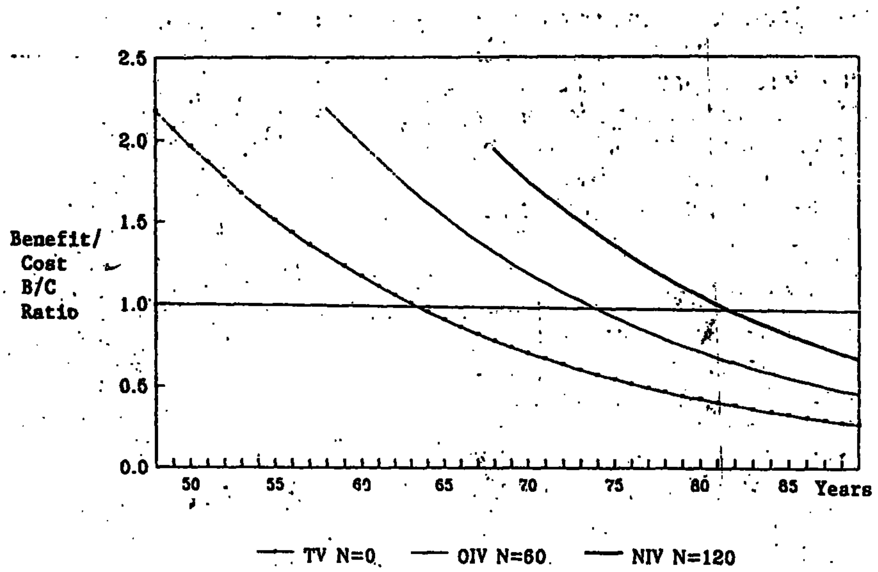

Figure 2. Changes in the benefit - cost ration of irrigation new construction investments, 1948-89, by level of seed-fertilizer technology, 1986 constant prices.

3 Source – Department of Agriculture, Peradeniya

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in the present cropping patterns in irrigated agriculture in the wet zone and upcountry intermediate zone except for an intensification of cropping on the existing land.

Conclusion

Bearing in mind the nature of the diverse irrigated agriculture environments across the country, the degree and nature of shifts or changes that will take place by the year 2000 will be different in the respective environments. Relevant aspects of this have been discussed in the preceding sections.

Irrigated rice will however, in the writer's view, continue to play a dominant role in the country's irrigated agriculture for overriding reasons of food security. There will be no lessening or evening out of the present high degree of yearly variation in annual rice production corresponding to variation in annual rainfall. A moving average of around 75 percent self reliance in national rice production beyond the year 2000 would be a pragmatic and feasible goal.

Crop diversification in the dry zone environment will develop and expand to the extent that we shall be able to build effective and sustainable supporting institutions for irrigation management for crop diversification. As previously mentioned a shift from rice to diversified cropping calls for changes in planning, water allocation, operation and maintenance, most of which are not adequately provided by the existing institutions.

In the final analysis, however, the pace of change in irrigated agriculture, like that of any biological system has its own internal logic and its own limits in rate of transformation determined by several factors some more controllable than others. But if the essential supporting institutions and services for a productive irrigated agriculture could be set in place over the next decade, then a more rapid pace of growth and transformation could be realized beyond the year 2000. This surely is the main task for the decade ahead.

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