EXPERIENCES OF BULK WATER ALLOCATION IN LARGE SCALE IRRIGATION MANAGEMENT

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ABSTRACT

Irrigation Management Turnover (IMT) was introduced in major and medium scale irrigation scheme in Sri Lanka in early 1990s. After over a decade of experiences it has been found that, Water Users Associations (WUAs) have failed to mobilize adequate amount of resources toward system operation and maintenance (O&M) leading to inefficient water use and deterioration of irrigation infrastructure.

The concept of Bulk Water Allocation (BWA) was introduced in 2002 and pilot tested in the Mahaweli System-H to find out a methodology, which can be used as a complete solution for water management problems in large-scale irrigation schemes. Under the BWA quantity of water to be issued for a particular distributary canal (DC) and consequently for a particular user for the cultivation practices in a given season is fixed before commencement of the season. The concept provided the volumetric impression of water use and incentive to utilize the water in an efficient manner.

The research findings show that, water productivity, cropping intensity and extent of cultivation in dry season has increased significantly after implementation of BWA while using less amount of water to cultivate one unit of land has reduced. Farmer perception on BWA is also very positive in terms of increase in productivity and income.

BWA concept has been seen as a strategy to achieve the expected objectives of IMT. Adequate supply of water with reliability and timeliness has improved the farmers' confidence in water issues which has been a great incentive to motivate farmers to shift from traditional high water consuming, low return rice cultivation to less water consumptive, high return cash crops. Decentralized partial O&M cost recovery adopted with BWA has been successful in achieving targeted collection compared to past failed attempts of centralized water charges.

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1. INTRODUCTION

Allocation of finance for sustainable operation and maintenance (O&M) of irrigation systems has been decreasing over the years due to budgetary and fiscal constraints although irrigation systems have been expanding and improving in Sri Lanka after gaining independence in 1948. Failure to make necessary policy changes to generate and allocate sufficient funds to properly operate and maintain the irrigation systems has been one of the main concerns of policy makers to avert the deterioration of irrigation infrastructure and increase the efficiency of water use in irrigated agriculture in order to meet competing demand for water between different sectors.

Participatory irrigation management (PIM) policy was adopted in major irrigation systems in Sri Lanka in late 1980s as a measure of government cost reduction in operation and maintenance (O&M and improve the performance of the systems. However, after couple of decades of experience in PIM, it has been found that, WUAs have failed to mobilize adequate amount of resources toward O&M, and some of the maintenance responsibilities have become 'no body's' business and there is a serious under investment in irrigation system maintenance (Aheeyar, 1997, Samad and Vermillion, 1999). The situation has lead to not only poor irrigation performances but also deterioration of irrigation infrastructure than expected life period and leading to premature rehabilitation of the entire scheme.

Mahaweli H area is the first of the downstream area benefited by Mahaweli river diversion project. The system H has the longest history of settlement in the country and was relatively highly occupied before the Mahaweli water was diverted. System H contains about 60 percent of irrigable land with well-drained Reddish Brown Earth (RBE) soils, which require more water for the cultivation of low land rice. The total irrigation extent in the system H is around 31,500 ha allocated among equal number of farmers at the rate of one hectare per farmer. The cropping pattern in the system H is generally rice crop for entire extent during wet season and rice and Other Field Crops (OFCs) for 50 percent of total extent during dry season. Therefore annual cropping intensity rarely reaches over 150 percent in system H, which is lowest, compared to other parts of Mahaweli development area. Therefore water management is crucially important in Mahaweli system H for the successful cultivation especially during dry season. At the same time lack of a financial allocation for O&M due to fiscal constraints lead to poor performance of irrigation systems, which aggravated the problem of water scarcity and of proper management of limited available water. Mahaweli Authority of Sri Lanka (MASL) implemented various special water management packages in Mahaweli H area time to time to meet the challenge of water scarcity and to improve the water use efficiency.

The concept of Bulk Water Allocation (BWA) was introduced and pilot tested by Mahaweli Restructuring and Rehabilitation Project (MRRP) in Mahaweli system-H to find out a methodology, which can be used as a complete solution for water management problems in major irrigation schemes (Gunaratna, 2004). Under the BWA, quantity of water to be issued for a particular user and consequently to the distributory canal for cultivation practices in a given season is fixed before commencement of the season. Therefore, particular user has a legal water right and has to actively participate in water management and also provided incentive to save the water. A maintenance fund has been set up at DC level with farmer contribution in order to conduct the selfmanagement of canal system. Under this initiative in Mahaweli System it was expected to develop Mahaweli H to as a 'model demonstration system' in terms of both irrigation management and commercialized agricultural production system. The programme was implemented as a package which included rehabilitation of the system, IMT, allocation of water on pre fixed quantities at each seasons, capacity building of farmers and officials, institutional development and establishment of forward and backward linkages.

The concept was seen as a strategy to achieve the expected objectives of IMT and increases the water use efficiency and water productivity. The project started in 2001 dry season, on pilot basis in selected locations and later it has become a broad subject in Mahaweli H area with the improvements made in subsequent seasons. The other main features of the BWA is farmers have to pay a O&M fee of Rs 250 per ha per season to the respective WUAs which is to be used for the sustainable O&M of the turned over distibutory system. Farmers have to manage the crop with the agreed quota of water and the irrigation agency has the responsibility of supplying the promised amount of water. The failure to supply of agreed quota and consequent crop failure has to be compensated in double by the agency and the demand for additional amount of water by farmers will be charged.

2. OBJECTIVES

The major objective of the study is to assess the impacts of participatory irrigation management adopted through implantation of BWA concept on the performance of water distribution and agricultural production.

3. RESEARCH METHODS

3.1. STUDY SITES

Mahaweli H system is divided into nine blocks for the purpose of administration, in which two blocks were selected randomly for the detailed survey, namely Galnewa and Madatugama blocks. Two WUAs from each block selected randomly to represent head and tail areas of branch canals.

3.2. METHODS OF DATA COLLECTION AND ANALYTICAL FRAMEWORK

The study is based on the information and data collected from literature, secondary data maintained by MASL, key informant interviews, focus group discussions and structured questionnaire survey. Necessary data was also collected from WUAs records.

A multi stage stratified random sampling technique was adopted in selecting sample farmers considering the head and tail differences of the system and the selected canals. The total sample size was 120.

The main quantitative parameters used for the assessment are,

i) Cropping intensity=

$$\frac{\text{Area cultivated in the dry season} + \text{Area cultivated in the wet season}}{\text{Cultivable area}} * 100$$

ii) Tank Water duty (m)=

$$\frac{\text{Actual quantity of irrigation water used } (m^3)}{\text{Actual extent cultivated } (m^2)}$$

iii) Land and water productivity

Land productivity is defined as value of output obtained from a unit of cultivated area while water productivity is the value of output received from a unit of irrigation water supplied.

$$\text{Land Productivity (\$/ha)} = \frac{\text{Total Value of Production(\$)}}{\text{Total Cultivated area(ha)}}$$

$$\text{Water Productivity } (\$/m^3) = \frac{\text{Total Value of Production(\$)}}{\text{Diverted Irrigation supply(m3)}}$$

Standard Gross value of Production (SVGP) is used to measure value of production. SVGP is standardized estimates of production calculated using international price of rice (major crop cultivated under irrigated condition).

$$SVGP = \left(\sum A_i Y_i \frac{P_i}{P_b}\right) P_w$$

A_i - Area of crop i

Yi - Yield of crop i

Pi - Price of Crop i

P_b - Price of base crop (Rice)

P_w - Price of base crop traded at world price

4. RESULTS AND DISCUSSIONS

4.1. WATER SUPPLY PERFORMANCE

4.1.1. Gross water quota/ seasonal water duty at block level

Data was analyzed to find out the performance of water duty before vs after BWA in Mahaweli H area. The block level water duty gives an overall idea of the efficiency of the whole system in providing water to save crop needs.

Figure 1 illustrates the trend of tank water duty over the years in dry seasons, indicating the improvement in tank water duty after year 2002. As Mathmaluwa (2003) pointed out, lowering of tank water duty is a combined effect of restricted water quota delivered under BWA, cultivation of low water requiring crops, effective water management under IMT and rehabilitation of irrigation system before turnover.

Performance achieved in water duty is a result of the efficiency in water distribution and in utilization of water at secondary and tertiary level by WUAs and water supply performance in primary canal system by the irrigation agency. Therefore the study analyzes the data of main canal water duties of Mahaweli H to find out the trend of water duty in the main canals, where canal maintenance and water distribution is mainly handed by MASL. The average main canal water duty during dry seasons in the past 5 years prior to the implementation of BWA is 4.85ft, while the average value after BWA is 3.43ft. The main reasons for the lowered main canal water duty are reduced conveyance losses due to rehabilitation of canal system and strict management practices adopted in water supply after BWA as perceived by irrigation officials.

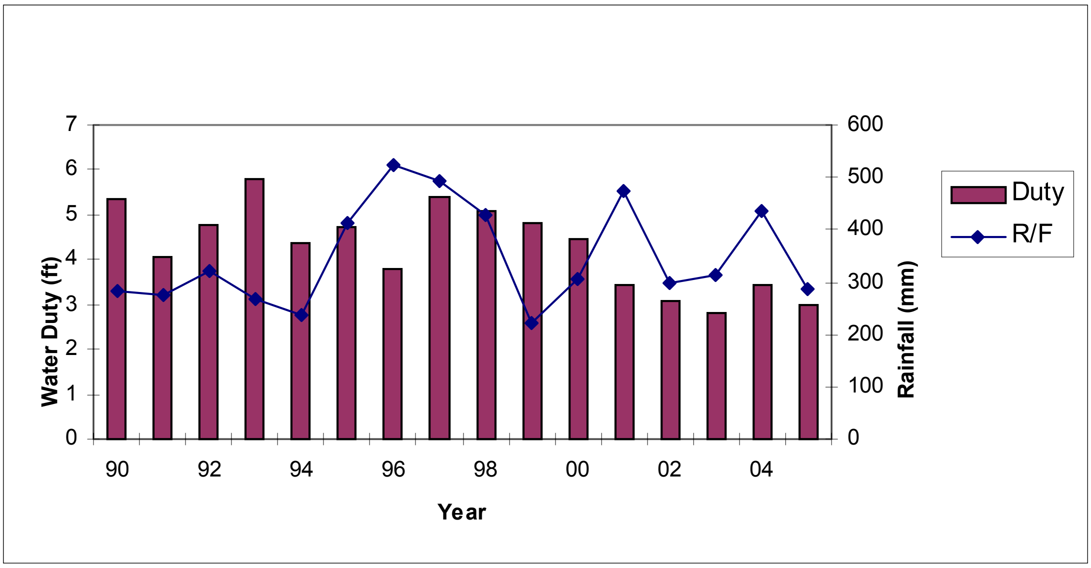

Figure 1. Average water duty in past dry seasons and rainfall pattern

4.1.2. Percentage of land extent cultivated in dry season

Area cultivated during the past dry seasons in Mahaweli H area before BWA was far below than planned extent in Mahaweli development programme and in many years it had been below 50 percent of total cultivable land. However, the extent cultivated in dry seasons after 2002 was over 60 percent of total land and shows an increasing trend except in year 2004 which affected by severe drought prevailed in the country. Figure 2 illustrates the percent of land extent cultivated in past dry seasons. The achieved performances is basically an outcome of the water saving of wet season due to strict water management policies adopted with the implementation of BWA and more farmers shifting to less water consuming crops.

The aim of the BWA programme is to reach 100 percent extent of cultivation in the dry seasons, but it is yet to be realized. The extent cultivated in 2005 dry season has reached to about 93 percent of total extent, which is a remarkable achievement compared to past seasons.

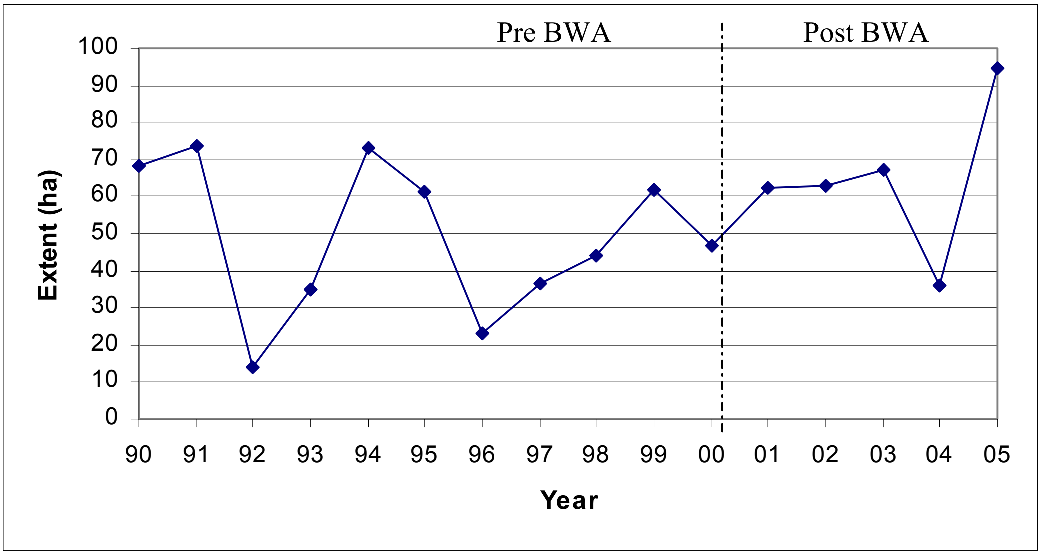

Figure 2. Percentage of land extend cultivated in past dry seasons

4.1.3. Cropping intensity

Annual cropping intensity (CI) for past 10 years of Mahaweli H area was examined to understand the change of CI over the years. The findings are shown in figure 3. The figure indicates the gradual increase of cropping intensity after implementation of BWA in 2002. One of the reasons for the lower CI before 2002 might be deteriorated state of infrastructure prior to rehabilitation. According to farmers and officials higher CI was achieved not only due to rehabilitation of the scheme, but also with cultivating less water consuming crops and efficient use of water in both seasons.

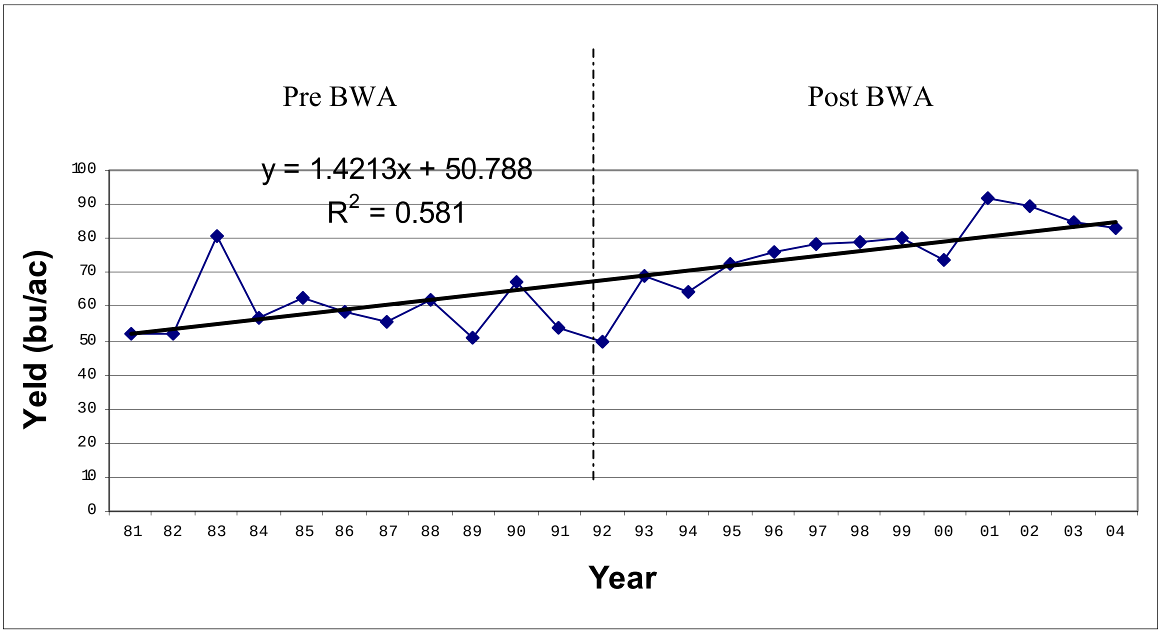

Figure 3. Changes in cropping intensity in Mahaweli H area

4.2. PERFORMANCE OF AGRICULTURAL PRODUCTIVITY

4.2.1. Changes in crop yield

The major crop cultivated in Mahaweli H system is rice both in wet and dry seasons. Therefore, the change in rice yield was observed to understand the trend of yield over the years. The findings are illustrated in figure 4. The figure clearly shows an increase of yield in dry seasons is very prominent after year 2002. The similar results are observed in the wet season yield data too. Though yield is an outcome of multiple factors such as variety improvement, access to extension, use of straw/organic fertilizers and timely cultural practices, the WUA leaders perceived that systematic water management and reliable supply is one of the main reasons for the increase in rice yield in both seasons. According to TEAMS (2003), the yield level was low before BWA programme and some tail end farmers received much lower yield during before BWA.

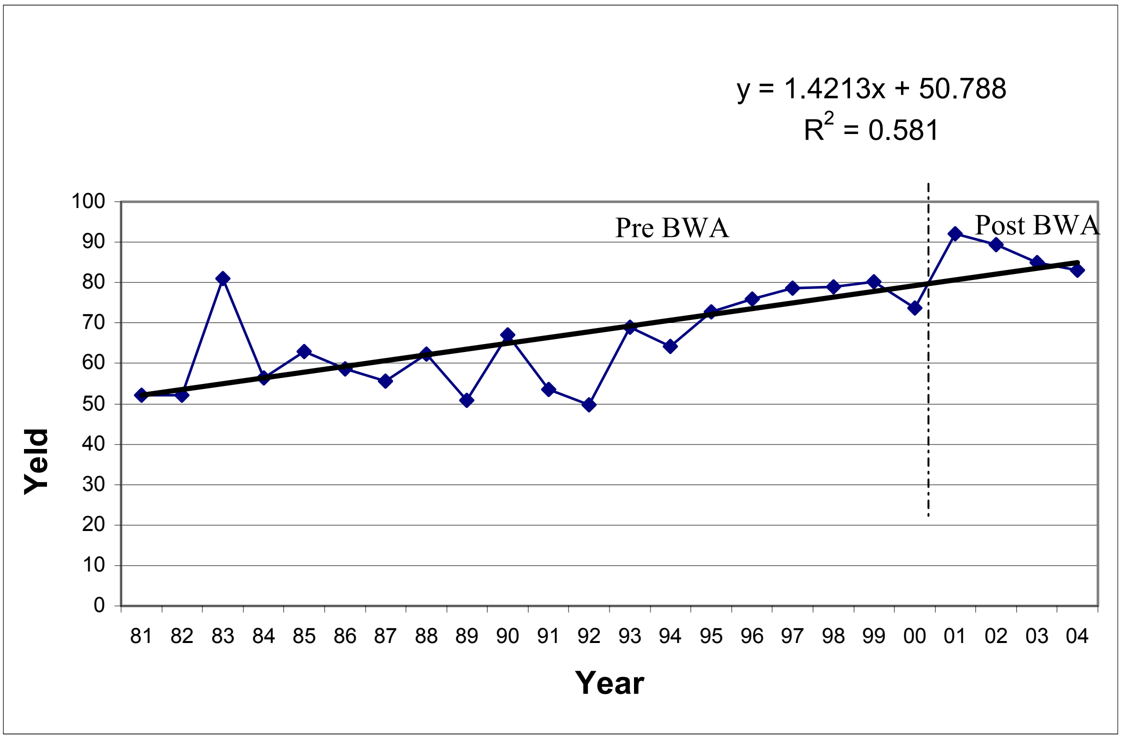

Figure 4. Changes in rice yield in Mahaweli H –*dry s*easons

4.2.4. Land and water productivity

Land and water productivity values are calculated in terms of gross value of output obtained per hectare of land and per cubic meter of irrigation water respectively. Rice is the major crop in the Maheweli H system in wet seasons. Although there is a small extent of land under OFCs during wet seasons, due to non-availability of reliable data on yield and price of OFCs, the valuation was limited to rice cultivation. The international price of rice was calculated at 2005 constant US dollars. Productivity values were estimated from 1999/2000 to 2004/2005 wet season. To avoid the effect of price fluctuation of rice in local and world market the average prices are used for the reference period (1999-2005).

The findings on land and water productivity are illustrated in figure 5. The figure shows that land productivity has not increased much over the time compared to pre vs post BWA. However water productivity values are showing an increasing trend after BWA indicating the performances in water distribution.

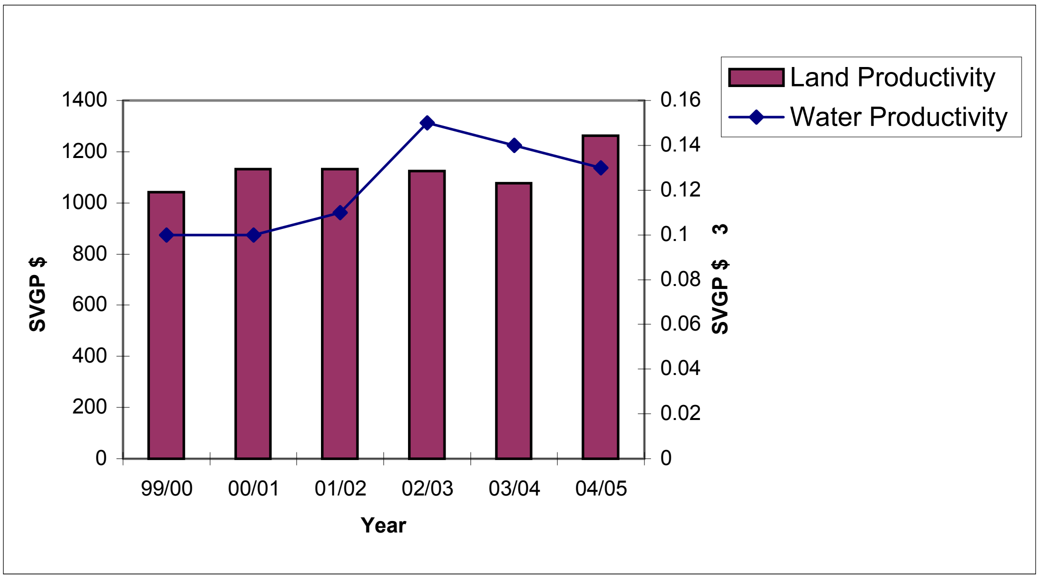

Figure 5. changes in land and water productivity

Table 1 highlights the summary of the findings of the irrigation system performances achieved with the implementation of BWA. The results show that there is a tremendous increase on the performances of the area irrigated per unit of water, extent under non rice crops and percentage area cultivated during dry seasons.

Table 1. Summary of selected performance parameters

Performance parameters		Performance before BWA (1996-2000)		Performance after BWA (2001-2005)		Percent change	
		Wet season	Dry season	Wet season	Dry season	Wet season	Dry season
1.	Tank water duty (m)	1.18	1.50	0.889	0.94	-24.6	-37.3
2.	Area irrigated per unit of water (ha/MCM)	88.9	81.39	119.36	119.96	+34.26	+47.38
3.	Water productivity (wet season) (US$/$m^3$)	0.1	-	0.13	-	+30	-
4.	Land productivity(wet season (US$/ha)	1087.5	-	1148.9	-	+5.6	-
5.	Rice yield (t/ha)	5.03	3.98	5.21	4.49	+3.6	+12.7
6.	Extent under non rice crops (ha)	865.75	5854	1041.75	8971	+20.3	+53.2
7.	% of land extent cultivated in dry season	-	42.45	-	64.63	-	+52.2
8.	Annual cropping intensity	148.25		164.11		+10.7	

4.3. FARMER PERFORMANCE INDEX

Pingali et-al (1990) has developed an index called farmer performance index, which was defined as the ratio of farmer yield to the location specific yield potential. The indictor provides an idea of farmers' ability to exploit the yield potential in the given circumstances. According to Deputy Resident Project Manager (Agriculture) of Mahaweli H, the potential paddy yield of the Mahweli H area is 6 metric tones per hectare. The performance index has been calculated separately for the rice farmers both in head end and tail end of branch canals and both wet and dry seasons. Farmer performance index developed for 2005 dry season is illustrated in figure 6. According to these findings, on average farmers have achieved 93% (5580kg/ha) and 80% (4796kg/ha) of the technical efficiency in paddy cultivation during wet and dry seasons respectively in year 2004/2005. The findings also suggest that about 31% of farmers during wet season both in head and tail end areas and 15 of the farmers during dry season were able to exceed the yield potential. About 55% and 38% of farmers achieved the technical efficiency of 85-110 during wet and dry respectively.

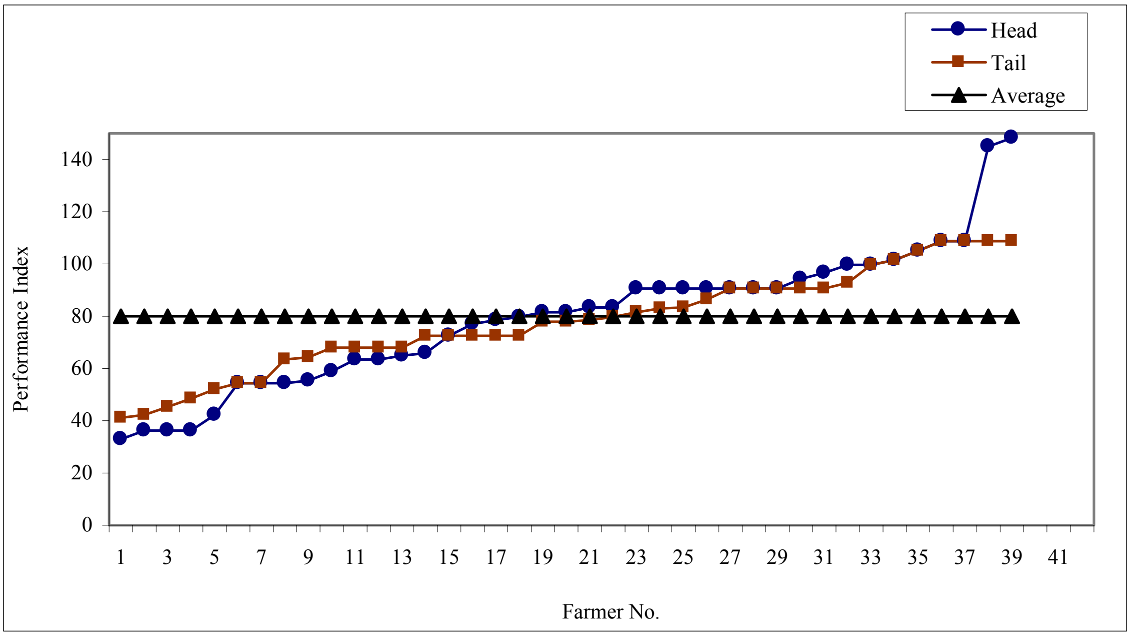

Figure 6. Farmer performance index for head end tail areas (dry season-2005)

4.3. FARMER PERCEPTIONS ON IRRIGATION SYSTEMS PERFORMANCE REALIZED AFTER BWA

Almost all the farmers were in favor of the performances realized from BWA compared to water management practices implemented in the past. The main benefit of BWA is farmers' know how about the water quota they are expected to get in the season in advance which has helped them to plan for cropping system and cultivation practices accordingly. About 95 percent of farmers perceived that they always or usually get their fair share of water while only 5 percent mentioned that they sometime get their fair share of water.

The perceptions on impacts of BWA on crop yield, income from agriculture and profitability of agriculture are positive for large proportion of farmers. About 50 percent of farmers perceived that, income and profitability of agriculture has increased after implementation of BWA. WUA leaders of all selected location perceived that, correct amount of water supply has lead to significant yield increase in paddy cultivation.

Increase of income has achieved by farmers during both seasons via increase in extent of cultivation and cultivation of high value crops. The achieved benefits from BWA programme have motivated framers to contribute more toward irrigation system O&M. The survey findings shows that O&M fee is regularly paid by 92 percent of farmers in head end areas and 100 percent farmers in tail end areas, showing the enormous concerns of farmers in sustainable O&M of irrigation system

5. CONCLUDING REMARKS

BWA programme has resulted in improving water supply performance and agricultural production performance. Performance of water supply after BWA has improved considerably in terms of gross water quota allocated during both wet and dry seasons at block levels. The block level water duty has reduced at the average of 24.6 percent and 37.3 percent respectively during wet and dry seasons. Extent cultivated during dry seasons after BWA has increased at the average of 52 percent, with an increase of annual cropping intensity by 10.7 percent.

Area irrigated per unit of water had increased by 34 percent and water productivity values has risen by 30 percent after BWA programme. Extent under less water consuming, high value cash crops has shown a 52 percent increase with the implementation of BWA.

The approach and methodology adopted for the implementation of BWA programme in Mahaweli H area provides good lesson of experiences for rest of the major irrigation schemes, which are having suitable infrastructure and experiencing water allocation problems. In addition to the hardware aspects of development by MRRP, the software parts of development activities including institutional development, private sector involvement in forward purchase arrangements and collaborative supports received from other government agencies are noteworthy features of this water management programme.

Comprehensive devolution policy for the irrigation sector with clear arrangement for roles and responsibilities and assured water supply provide tangible benefits which can encourage farmers to invest in the long term sustainability of their irrigation infrastructure. Allocation and sharing of responsibilities should be with clear policy demarcations on who is responsible for the specified activities and who can be made accountable if these activities do not take place. The irrigation management transfer should widen up the focus beyond mere cost recovery but in helping and creating an environment to generate the necessary development impulses for increasing agricultural productivity, marketing linkages, scale of production and farmers income.

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