Spatial Dimensions of Poverty within an Irrigated Agricultural Setting: The Case of Uda Walawe Left Bank Irrigation Development Project

Deeptha Wijerathna

International Water Management Institute, Battaramulla.

ABSTRACT

This paper analyzes spatial variation of poverty within an irrigated agricultural setting, using poverty maps. It explains the importance of understating spatial variations of poverty in policy interventions and resource management, and identifies conditions under which irrigation has greater anti-poverty impacts. A poverty map for left bank irrigation scheme of Uda Walawe development project was generated based on poverty figures estimated with household level data collected for 2000-2001 agricultural year and ground coordinates obtained for each sample households, with Global Positioning Systems (GPS). Poverty situation in the area was estimated with commonly used Foster-Greer-Thorbeake (FGT) poverty estimation technique. Two maps are created to depict the spatial variation of poverty. Firstly, distribution of poor and non-poor sample households was plotted on a map. Secondly, a poverty map with concentrated colors, to indicate spatial variation of poverty within the project area was created by using average poverty head count ratios estimated for each Grama Niladhari Dvision. Both maps clearly indicate access to irrigation has significant poverty reducing impacts. Poverty is low in irrigated areas, compared to adjoining non-irrigated areas. Within irrigated areas, poverty varies across locations in irrigation systems. Poverty is low in head of the irrigation system and it is comparatively higher in middle and tail parts of the system. Further poverty is comparatively low in town areas where there are more diverse economic activities, compared to less diversified rural areas. Access to well established supporting services also contribute to low poverty. A poverty map is important in identifying most vulnerable areas with higher level of poverty. It provides some guidance for researchers to target their further research to understand underlining causes of poverty. Understanding areas with higher level of poverty and the underlining causes of poverty is important for policy makers and implementing agencies to target their poverty reduction initiatives and safety net programs to most vulnerable areas.

INTRODUCTION

Persistent poverty is a common problem in most of the agricultural settings in Sri Lanka. About 25 percent of the households of Sri Lanka are below the poverty line (Department of Census, 2002). The level of poverty varies across districts. It is the lowest (6 percent) in the Colombo district and the highest (38 percent) in the Moneragala district. District level values show that poverty is high in districts

where major part of the population depends on agriculture (Wijerathna, 2004). In recent history, Sri Lanka has implemented a number of land and water resources development initiatives and population resettlement programs, with the objective of reducing long lasting poverty among rural farmer communities. Those programmes were expected to play a key role in the rural poverty-alleviation strategies of the country by promoting equitable growth, improved access to land and increased land productivity with the development of water resources (Nijman, 1991). Though these programmes have made significant contribution in achieving the expected objectives, according to recent findings, a considerable proportion of people within those agricultural settings are still living under poverty line. Variations in resource availability can be identified as one of the main reasons for variation of poverty status within an agricultural setting. Availability of Irrigation has been identified as one important factor which reduces poverty. To device some targeted progammes to alleviate prevailing poverty among certain groups, it is very important to understand spatial dimensions of poverty within an irrigated agricultural setting.

Poverty maps are considered as tool to analyze spatial variation of poverty. A poverty map can be created with poverty assessment information coming from a variety of sources and can be presented at various spatial levels (global, national and local) (World Bank, 2004). Indicators of income poverty (such as GDP per capita or daily subsistence levels), or of well-being (such as life expectancy, child mortality, or literacy) are most frequently used in poverty maps, and are derived from national census data or household surveys (Amerasinghe *et al.,* 2004). Poverty maps also allow easy comparison of indicators of poverty or well being with data from other assessments, such as access to infrastructure or services, availability and condition of natural resources, and distribution of transport and communications facilities (www.povertymap.net).

In this background, the objective of this study was to produce a poverty map based on poverty head count estimates assessed with household level data to understand spatial variation of poverty, and underline causes within the Uda Walawe left bank development project area.

Characteristics of the study area

Uda Walawe development scheme is one of the major multipurpose development projects implemented by government of Sri Lanka after the independence. The Uda Walawe reservoir is located on the boundary of the Wet and Dry Zones of Sri Lanka, around 200 km southeast of Colombo (Hussain *et al.,* 2003) (Figure 01).

This reservoir is built across the Walawe Ganga, which is the fifth largest river in Sri Lanka. The river is 136 km long and has a catchment area of 1200 square kilometers. The Uda Walawe reservoir was constructed during the period 1963 – 1967, as part of a plan to develop irrigation infrastructure in 32,000 ha of land in the dry zone of southern Sri Lanka (ADB, 1969). It is an earth fill dam, with a live storage capacity of 240 Million Cubic Meters (MCM). There are two main canals,

the Right Bank Main Canal (RBMC), and the Left Bank Main Canal (LBMC). The original plan was to develop 20,000 hectares of land for irrigation under the project (Nippon Koei, 1996). Command area was planned to irrigate with a net work of canals based on 42 km long RBMC and 31 km long LBMC. Even though the construction of tank was completed in 1967 development of downstream area has taken place in steps (Nippon Koei, 2005). Right bank was given the first priority in development agenda and left bank has been given the second priority. The total area actually developed up to the end of 1997 was about 12,900 ha, comprising 8,500 ha under RBMC and 4,400 ha under LBMC. At present, the area irrigated has increased to 11,000 ha in the RBMC and 6400 ha in the LBMC.

Both left and right bank canals of the system flow in ridges of the valley identified for development and they provide water only to inside. Right and left bank command areas are separated with the original Walawe River, which now acts as the main drainage canal of the irrigation system. This study was carried out in the left bank command area of the Uda Walawe development Project.

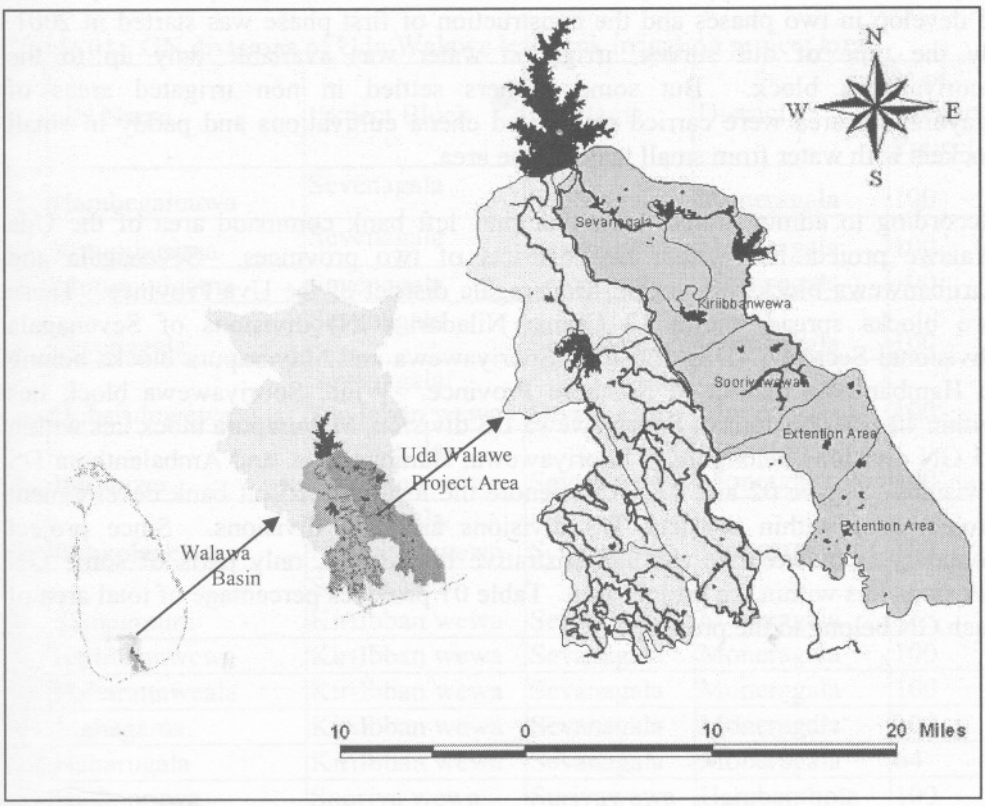

Figure 01: Location of Uda Walawe left bank irrigation system

Initial construction of left bank main canal was completed up to Kiriibbanwewa tank by 1969. Command area of the left bank was divided into four blocks and scheduled to develop in five steps. Head reach or the first block was identified for

sugarcane cultivation and developed under Sevenagala sugar cane project in 1983 (Thennakoon, 1993). Under this project, a total of 2,300 households were settled in 2,000 hectare (ha) of irrigated lands. Another 1,200 farm households were settled in 2,100 ha of un-irrigated lands. Households in irrigated area were provided an allotment of 0.75 ha of land to do sugarcane and 0.25 ha of paddy. Settlers in un-irrigated area were provided an allotment of 1.75 ha of lands to do sugarcane cultivation under rainfed condition. Second block Kirriibanwewa was developed for paddy cultivation. Construction of field level canal system of the block was completed in 1993. About 2,000 farmers were settled in the area and two acres of irrigable lands and half an acre of highlands for homestead were provided to each farmer household. Development of third block Sooriyawewa was completed in 2000. About 3000 families were settled in the area within 2300 ha of irrigated lands (Hussain *et al.,* 2002). While majority of the lands in the area were developed for paddy cultivation some lands were developed to grow Other Filed Crops (OFC). Considering the limitations in water availability, farmers with irrigable low lands were also encouraged to cultivate OFC instead of paddy in their irrigable lands. Developments in fourth block named as Mayurapura was planned to develop in two phases and the construction of first phase was started in 2001. By the time of our survey, irrigation water was available only up to the Sooriyawewa block. But some farmers settled in non irrigated areas of Mayurapura area were carried on rainfed chena cultivations and paddy in small pockets with water from small tanks in the area.

According to administrative classifications, left bank command area of the Uda Walawe project lies within two districts of two provinces. Sevenagala and Kiriibanwewa blocks are within Moneragala district of the Uva Province. These two blocks spread within 12 Grama Niladari (GN) divisions of Sevenagala Divisional Secretary (DS) division. Sooriyawewa and Mayurapura blocks belong to Hambanthota district of Southern Province. While Sooriyawewa block lies within 12 GN divisions of Sooriyawewa DS division, Mayurapura block lies within 15 GN divisions belonging to Sooriyawewa, Hambanthota, and Ambalanthota DS divisions. Figure 02 and Table 01 denote the location of Left bank development project area within districts, DS divisions and GN divisions. Since project boundary is different to the administrative boundaries, only parts of some GN divisions lies within the project area. Table 01 provides percentage of total area of each GN belong to the project.

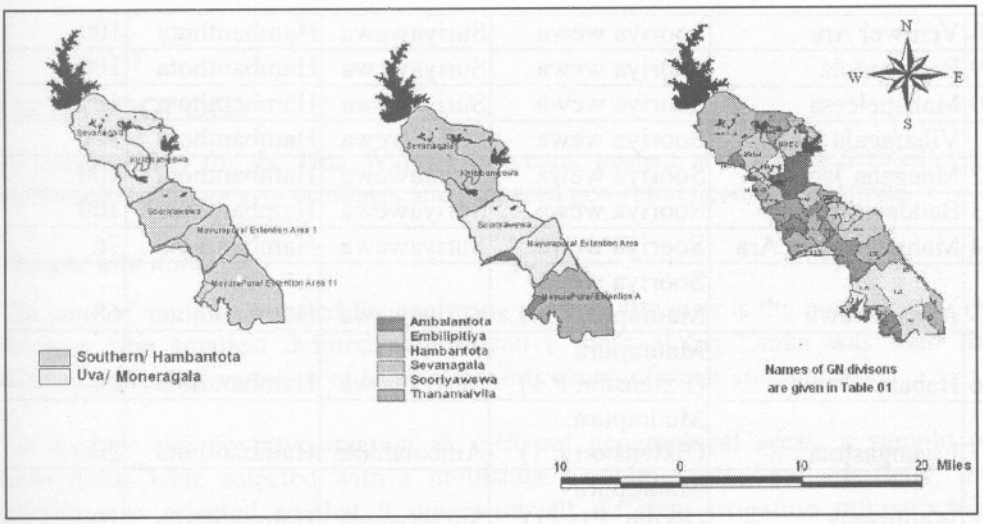

Figure 02: Location of Uda Walawe left bank irrigation system within Provinces/ Districts/ DS Divisions and GN Divisions

Table 01: GN divisions of Uda Walawe left bank irrigation project area

	GN Name	Project Block	DS Name	District	% of Area in Project
1	Hambegamuwa	Sevenagala	Sevenagala	Moneragala	100
2	Katupilagama	Sevenagala	Sevanagala	Moneragala	100
3	Mutuminigama	Sevenagala	Sevanagala	Moneragala	100
4	Sevanagala	Sevenagala	Sevanagala	Moneragala	100
5	Habaruluwewa	Sevenagala/ KiriIbban wewa	Sevanagala	Moneragala	100
6	Bahirawa	Sevenagala/ KiriIbban wewa	Sevanagala	Moneragala	100
7	Indikolapelassa	Sevenagala/ KiriIbban wewa	Sevanagala	Moneragala	100
8	Samagipura	Sevenagala/ KiriIbban wewa	Sevanagala	Moneragala	38
9	Kiriibbanwewa	KiriIbban wewa	Sevanagala	Moneragala	100
10	Habarattaweala	KiriIbban wewa	Sevanagala	Moneragala	100
11	Mahagama	KiriIbban wewa	Sevanagala	Moneragala	100
12	Habarugala	KiriIbban wewa	Sevanagala	Moneragala	64
13	Hathporuwa	Sooriya wewa	Suriyawewa	Hambanthota	100
14	Weeriyagama	Sooriya wewa	Suriyawewa	Hambanthota	96
15	Samajasewapura	Sooriya wewa	Suriyawewa	Hambanthota	31
16	Sooriyawewa Town	Sooriya wewa	Suriyawewa	Hambanthota	100
17	Aliolu Ara	Sooriya wewa	Suriyawewa	Hambanthota	100

18	Veniwel Ara	Sooriya wewa	Suriyawewa	Hambanthota	100
19	Bedigantota	Sooriya wewa	Suriyawewa	Hambanthota	100
20	Mahapelessa	Sooriya wewa	Suriyawewa	Hambanthota	100
21	Viharagala	Sooriya wewa	Suriyawewa	Hambanthota	100
22	Meegaha Jadura	Sooriya wewa	Suriyawewa	Hambanthota	100
23	Beddewewa	Sooriya wewa	Suriyawewa	Hambanthota	100
24	Mahawelikada Ara	Sooriya wewa	Suriyawewa	Hambanthota	76
25	Andarawewa	Sooriya wewa/ Maurapura	Suriyawewa	Hambanthota	68
26	Habarattawala	Maurapura (Extension P 1)	Suriyawewa	Hambanthota	94
27	Liyangastota	Maurapura (Extension P 1)	Ambalantota	Hambanthota	20
28	Wediwewa	Maurapura (Exten. P1/ 11)	Suriyawewa	Hambanthota	100
29	Galwewa	Maurapura (Extension P 11)	Hambantota	Hambanthota	100
30	Bellagaswewa	Maurapura (Extension P 11)	Hambantota	Hambanthota	100
31	Koggalla	Maurapura (Extension P 11)	Ambalantota	Hambanthota	72
32	Modarapiliwala	Maurapura (Extension P 11)	Ambalantota	Hambanthota	42
33	Siyabalagasvila North	Maurapura (Extension P 11)	Hambantota	Hambanthota	70
34	Walawa	Maurapura (Extension P 11)	Hambantota	Hambanthota	20
35	Udaberagama	Maurapura (Extension P 11)	Hambantota	Hambanthota	42
36	Arawanamulla	Maurapura (Extension P 11)	Hambantota	Hambanthota	100
37	Manajjawa	Maurapura (Extension P 11)	Hambantota	Hambanthota	80
38	Samodagama	Maurapura (Extension P 11)	Hambantota	Hambanthota	90
39	Siribopura	Maurapura (Extension P 11)	Hambantota	Hambanthota	79
40	Saliyapura	Maurapura (Extension P 11)	Hambantota	Hambanthota	16

METHODOLOGY

A poverty map for the Uda Walawe left bank project area was generated with household level poverty estimates and gathered geo-referenced information.

Sample and data

The unit of analysis selected for analyzing poverty situation is the household. GN division, the smallest defined administrative units of Sri Lanka was used for describing spatial variation of level of poverty among farmer community.

To analyze the poverty situation in different geographical areas, a sample of households were selected with a multistage sampling technique. Initially, the sample was selected so that it represents all different irrigation infrastructure conditions and cropping pattern. Considering the differences in availability of irrigation infrastructure, cropping pattern and time of establishment of irrigation infrastructure, the study area was stratified into five strata as detailed in Table 02.

Table 02: Main strata of sample and criteria for classification

	Availability of irrigation infrastructure	Cropping pattern (main crop)	Establishment of irrigation infrastructure
Sevenagala	✓	Sugar cane	1983
Sevenagala rainfed		Sugar cane	
Kiriibbanwewa	✓	Paddy	1993
Sooriyawewa	✓	Paddy and banana	2000
Mayurapura		OFC	

At the second stage, one to two clusters representing each of the strata were selected. For the purpose of this study, a cluster is defined as a distributary canal in the case of irrigated areas and a village or division in the case of rainfed areas. While the clusters within a stratum may be more or less homogeneous in terms of the above criteria/ characteristics, there could be variations in clusters within a stratum in terms of access to water (locational differences). These clusters were chosen to represent potential differential access to water within a stratum, if any. For example, in irrigated areas, head, middle and tail end canals were selected to represent the variations due to the differences in access to irrigation water across locations within a stratum. In rainfed areas, criteria such as size of village or division, access to markets, period of residence of settlers were used for the selection of representative clusters.

At the third stage, systematic random sampling procedure was adopted in selecting households from each selected cluster. The systematic random sample was drawn

from a sampling frame of a complete list of all households within a cluster. The number of households selected within each cluster was based on the sample size adopted for the survey. It was decided to use a sample size of around 4.5 percent of total households for the study. Factors such as, adequate representation of the variations within the study area, adequacy of sample for statistical validity, cost and time frame for completion of surveys were considered in selecting an appropriate sample size.

A semi structured questionnaire was used in collecting data from households. Data on all income and expenditures were collected to estimate level of poverty of each household. Location of each sample household is demarcated with recorded GPS coordinates.

Digitized maps of development project area with layers for project blocks, districts provinces and GN divisions according to 2001 classification were collected from Mahaweli authority, Department of Census and statistics and from IWMI database.

Analysis

Commonly used Foster-Greer-Thorbecke (FGT) classes of measures were used in estimating incidence and depth of poverty among selected farmers.

$$P(\alpha) = \frac{1}{n}\sum_{i=1}^{q}\left(\frac{z - y_i}{z}\right)^{\alpha} \qquad (01)$$

Where,

yi is the income of the i th poor individual/ household, z is specified poverty line, n is total population and q is the number of poor individuals/ households. When parameter $\alpha = 0$, it gives the Head Count Index (HCI) as

$$HCI = q/n. \qquad (02)$$

HCI measures the incidence of poverty; the share or proportion of the population, which is poor or whose income is below the specified poverty line (Foster, 1984).

Poverty figures are estimated based on monthly income level of households. Poverty line for Sri Lanka announced by Department of census and Statistics, which is Rs. 1,423 in 2002 prices was considered as the level of reference (Dept. of Census and Statistics, 2004) in estimating poverty. Since collected data is referred to year 2000, the poverty line was adjusted for 2000 prices by using Consumer Price Indices given by Central Bank of Sri Lanka. Adjusted poverty line of Rs 952 per person per month in 2000 prices is equivalent to US$1.04 in Purchasing Power Parity (PPP) or a dollar a day poverty line (Hussain et al., 2004). In this study, household income is defined as income from net cash costs of crop production, non-crop farm income, agricultural wage income, and non-farm income (income from trade, services and other nonagricultural activities such as shop keeping, petty

trade, business, etc.), and income from all other sources. All nominal values on incomes and expenditure are converted and reported in real terms (in October 2000 prices).

Poverty mapping

Poverty maps for the study area were created by plotting estimated poverty status of households in a map of the area. Firstly, locations of all sample households were plotted in a map to understand distribution of sample households. Then those households were categorized as poor and non poor according to their level of income and plotted in two colors.

A map with concentrated colors was created to depict variation in GN level poverty. GN level averages of poverty head count were estimated after clustering sample households into GNs. A GN layer was overlaid on a map of sample households to identify GN division of each household. This method was used in identifying correct GN of the household, since GN boundaries have been changed time to time and the layer of GN boundaries used for mapping is generated with 2001 classification. In case of GN divisions where there were hardly any households to represent poverty situation of the GN, estimated poverty values for adjoining GN divisions with similar characteristics were used.

RESULTS AND DISCUSSION

According to estimates based on household income, the average incidence of poverty in the Uda Walawe left bank irrigation project area is 25 percent. This varies with the different strata and GN divisions. Table 03 provides level of poverty in five strata.

Table 04: Variations in poverty situation with strata

Strata	Poverty Head Count
Sevenagala	19
Sevenagala rainfed	27
Kiriibbanwewa	28
Sooriya wewa	35
Mayurapura	55

Figure 03 depicts the location of poor and non-poor households with respect to sample households. It shows that concentration of poor households increases with the distance from the main tank. Further, it shows that the concentration of poor households is comparatively high in currently non-irrigated tail end of the system (Maurapura area).

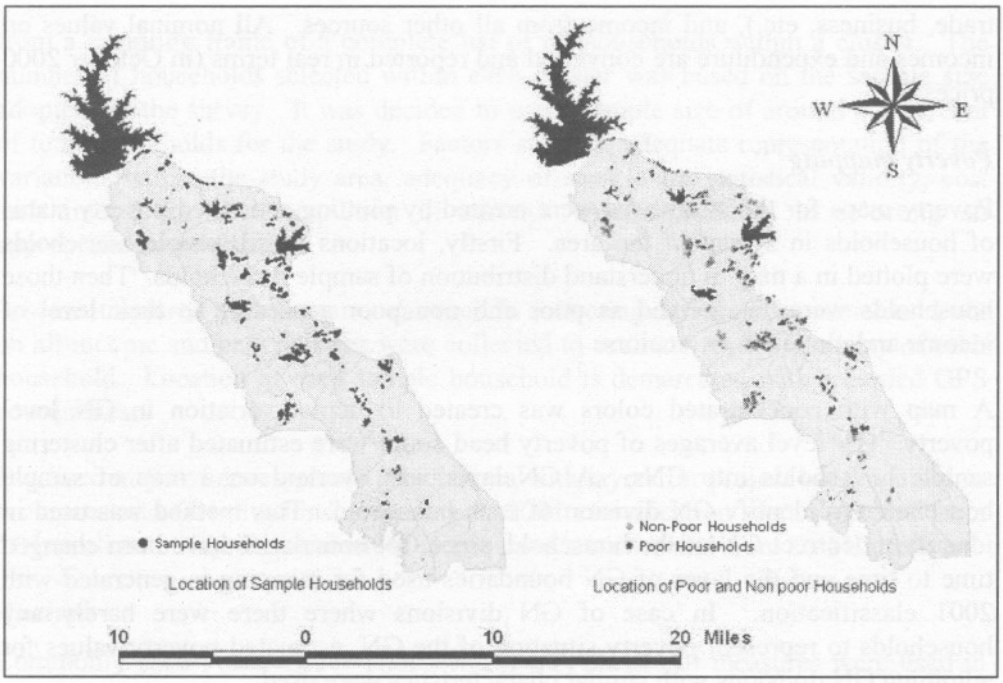

Figure 03: Spatial variation of poverty within Uda Walawe left bank development project area.

Figure 04 indicates spatial variation of chronic poverty within Uda Walawe Left Bank development Project area. Each GN is colored according to average poverty head count index estimated for the GN. Higher the poverty head count, the higher is the color intensity.

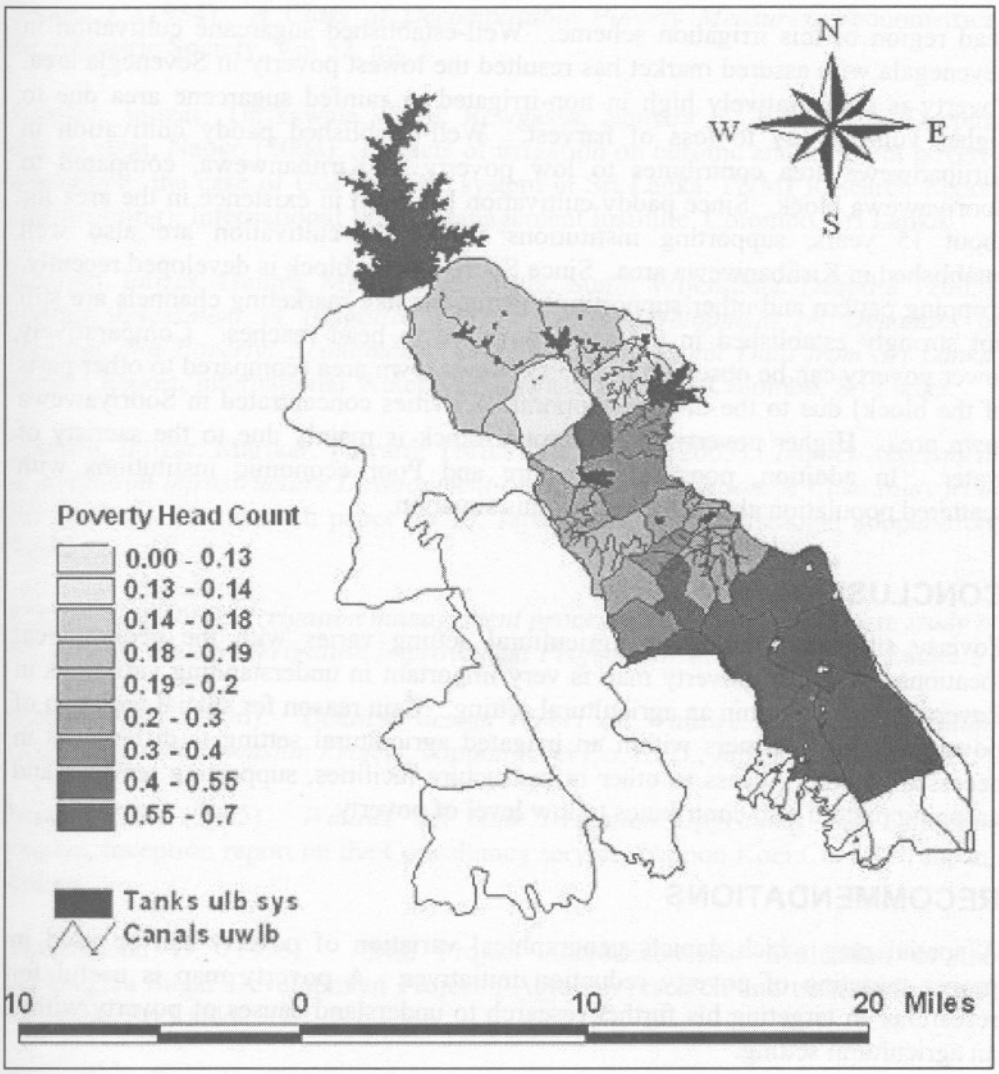

Figure 04: Spatial variation of chronic poverty within Uda Walawe left bank development project area

Both maps indicate that poverty situation is considerably low in irrigated areas compared to adjoining non irrigated areas. Within irrigated areas it is low in head reach of main canal and areas close to main canal while it is higher in tail end of main and branch canals.

Scarcity of water in down stream is one of the main reasons for higher poverty in downstream. Though the system is designed to allocate equitable amount of water to each farmer, practically farmers in the head-end always enjoy more water. In addition to availability of water, cropping pattern and strength of established economic institutions and experience of farmers also contribute to low poverty in

head region of this irrigation scheme. Well-established sugarcane cultivation in Sevenegala with assured market has resulted the lowest poverty in Sevenegla area. Poverty is comparatively high in non-irrigated or rainfed sugarcane area due to higher vulnerability to loss of harvest. Well-established paddy cultivation in Kiriibanwewa area contributes to low poverty in Kiriibanwewa, compared to Sooriyawewa block. Since paddy cultivation has been in existence in the area for about 15 years, supporting institutions for paddy cultivation are also well established in Kiriibanwewa area. Since Sooriyawewa block is developed recently, cropping pattern and other supporting institutions like marketing channels are still not strongly established in the area compared to head reaches. Comparatively lower poverty can be observed in Sooriyawewa town area (compared to other parts of the block) due to the diverse economic activities concentrated in Sooriyawewa town area. Higher poverty in Maurapura block is mainly due to the sacristy of water. In addition, poor infrastructure and Poor economic institutions with scattered population also contribute to this situation.

CONCLUSIONS

Poverty situation with in an agricultural setting varies with the geographical locations. A spatial poverty map is very important in understanding variations in Poverty situation within an agricultural setting. Main reason for spatial variation of poverty level of farmers within an irrigated agricultural setting is differences in access to water. Access to other infrastructure facilities, supporting services and cropping pattern also contributes to low level of poverty.

RECOMMENDATIONS

A spatial map which depicts geographical variation of poverty can be used in proper targeting of poverty reduction initiatives. A poverty map is useful for researcher in targeting his further research to understand causes of poverty within an agricultural setting.

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