Spatial Analysis of Agricultural Productivity by Irrigation in Kyaukse Township

Tin Tin **Moe**[1]

Abstract

The analyses were based on the area of discarding Yeyaman Range and unirrigated area. The remaining irrigated and irrigable area is only 1/3 of the total township area. Due to the study area lies in the central dry zone of Myanmar, insufficient and irregular rainfall may cause the failure cultivation or low productivity though the other physical conditions (such as topography, drainage system, soil, temperature) and other fertilizer consumption are favourable for various crops. By using irrigation method, the agricultural productivity will increase yearly. The result of the correlation analyses bring about the important of some variables indicating soil and socio-economic characteristics and their association with the productivity of selected crops. Among them only the fact that nearness to the water sources has more effects on the crop productivity.

Keyword : Irrigation, agricultural productivity, physical condition

Introduction

The World Food Summit has recognized that water control in general and irrigation in particular, are crucial for increased food production and global food security. The food supply of future generations will depend even more on the capacity of irrigated agriculture to produce food in an environmentally, economically and financially sustainable manner. However, increasing water consumption and acute competition among water use sectors seriously affect the possibility of expanding agricultural water use. Irrigated agriculture must use water more efficiently; it must face the challenge to produce more with less water.

Agriculture means cultivation of the land, including horticulture, fruit growing, crop and seed growing, dairy farming and livestock breeding;

Irrigation means the artificial distribution and application of water to arable land to initiate and maintain plant growth.

Accordingly irrigation is an artificial supplying and application of water to land with growing crops; new area of land must be brought under irrigation to meet the rising demand for food.

Productivity is defined in economics and agricultural geography that output per

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[1] Dr., Tutor, Department of Geography, Lashio University.

unit of input or per unit of area respectively, and the improvement in agricultural productivity is generally the result of a more efficient use of the factors of production, viz. environment, arable land, labour and capital.

Kyaukse Township is being drained thoroughly by the Zawgyi and the Panlaung rivers with their small tributaries. Therefore, irrigation for agriculture can be carried out widespreadly, by means of weirs from the rivers and of canals from the dams built across the rivers.

Interregional disparities of crops are most possible due to difference of rainfall, soil, use of fertilizer, topography and intensity of irrigation.

In the study of relationship between irrigation potentiality and crop yield of Kyaukse Township, it is found that crop yields differ from place to place. It is assumed that the inequality in crop yield depends on intensity of irrigation.

Aim and Objectives

Major aim and objectives are to study

(1)   to present the irrigation systems and the effect of irrigation

(2)   to access the regional agricultural productivities

Hypothesis

- Irrigation intensity plays an important role for the differences of crop productivity among the village tracts.
- Nearness to water sources determines the yield per acre of particular crops.
- In the study area, timely and sufficiently water supply can lead to the high production of crops.
- Moreover, the capacity of moisture content of the soil can vary with high production of crops.
- Proximity to the source of water may also determine the effective use of supply water and in turn it may affect the crop productivity.

Sources of Data

Secondary data on this research were obtained from the various township offices such as the Immigration and Man Power Department, the Meteorology and Hydrology Department, the Irrigation Department, the Water Resources Department, the Agricultural Department and the Land Records Department, whereas the primary data by means of face-to-face interviewing with the local farmers.

Methodology and Method

For the high productivity, the use of modern machines has strongly effect on the development of agriculture in the study area. To know the level of mechanization, Location Quotient Method adopted by Singh, J and Dhillon, S. S (2004) and it is originally use for level of modernization. The researcher has modified the formula to calculate the level of mechanization and that formula is as follows:

$$I_{ma} = \frac{Te}{Tr} + \frac{The}{Thr} + \frac{IPSe}{IPSr} = \sum LQs$$

$$\text{Degree of Mechanization} = \frac{\sum LQs}{n} \times 100$$

I_{ma} =   Index of level of mechanization

T   =   Power Tillers per 1000 acres of total cultivated area

Th   =   Threshers per 1000 acres of total cultivated area

IP   =   Irrigation Pump Set per 1000 acres of total cultivated area

e   =   enumeration unit (village tract)

r   =   entire irrigated area

Several techniques adopted for computing level of agricultural productivity per unit area, per unit of time, are derived by various researchers. Among these methods only two which were driven by Bhatia (1967) is applied to find out the indices of crop productivity in the study area.

Bhatia assumed that (1) hectare yields express all the physical and human factors connected with the production of crops and (ii) the sharing of cropland among the various crops reflects various factors involved in land utilization. The formula may be expressed as:

(1) $Iya = \dfrac{Yae}{Yax} \times 100$

Here,   Iya = Yield index of crop "a"

      Yae = hectare yield of crop "a" in the component enumeration unit (village tract)

      Yax = hectare yield of crop "a" in the entire region, (township)

After computing the result of crop productivity at the study area for some particular period, correlation relationship will be also applied with the data of soil properties and yield per acre of some selected crops. For that purpose, Pearson's Product Moment Correlation Method is most suitable and up to 90% of confidence level will be calculated.

Study Area

Kyaukse Township is located in the central Dry Zone of Myanmar and lies between latitude 21° 26' N and 22° 2' N and between longitudes 95° 57' E and 96° 58' E. The township has a total area of 725.278 square miles (464,178) acres; actually study portion is only 1/3 of the total geographical area, which accounts for about 30 % of the total area.

Topography of Kyaukse Township can be divided into (1) Kyaukse Plain and (2) Yeyaman Range. Kyaukse plain is 375 sq miles wide. The plain is composed mainly of alluvium but isolated hills are found. Yeyaman Range covers an area of 350.278 sq miles. Generally it is 4,000 feet high and is the south west continuation of the Shan Highland.

Major drainage of Kyaukse Township is the combined river system of Myitnge (called Dokhtawady), Zawgyi, Panlaung and Samon rivers. Zawgyi and Samon rivers have been serving as water resources for irrigation for agriculture since the regime of King Anawrahta.

Geologically, the rock of Kyaukse Township can be divided into five units are (5) Alluvium (4) Granite and Augen Gneiss (3) Metamorphosed Panlaung Formation (2) Upper Plateau Limestone (1) Chaung Magyi Group.

According to Koppen's climatic classification, study area is mainly influenced by Tropical Steppe type (BSh) of climate. According to 1986-2005 data, average temperatures of Kyaukse Township are 92.24° F in maximum, 69.69° F in minimum and 80.97° F in mean. For 1986-2005 periods, the average annual rainfall of Kyaukse Township was 27.68 inches.

Soil types mainly found in Kyaukse Township are (1) red earth (2) cinnamon soil (3) red brown savanna soil (4) primitive crushed stone soil (5) meadow gley soil and (6) meadow soil. As natural vegetation, most deciduous forest is found on Yeyaman Range; but are scattered on the undulating low land.
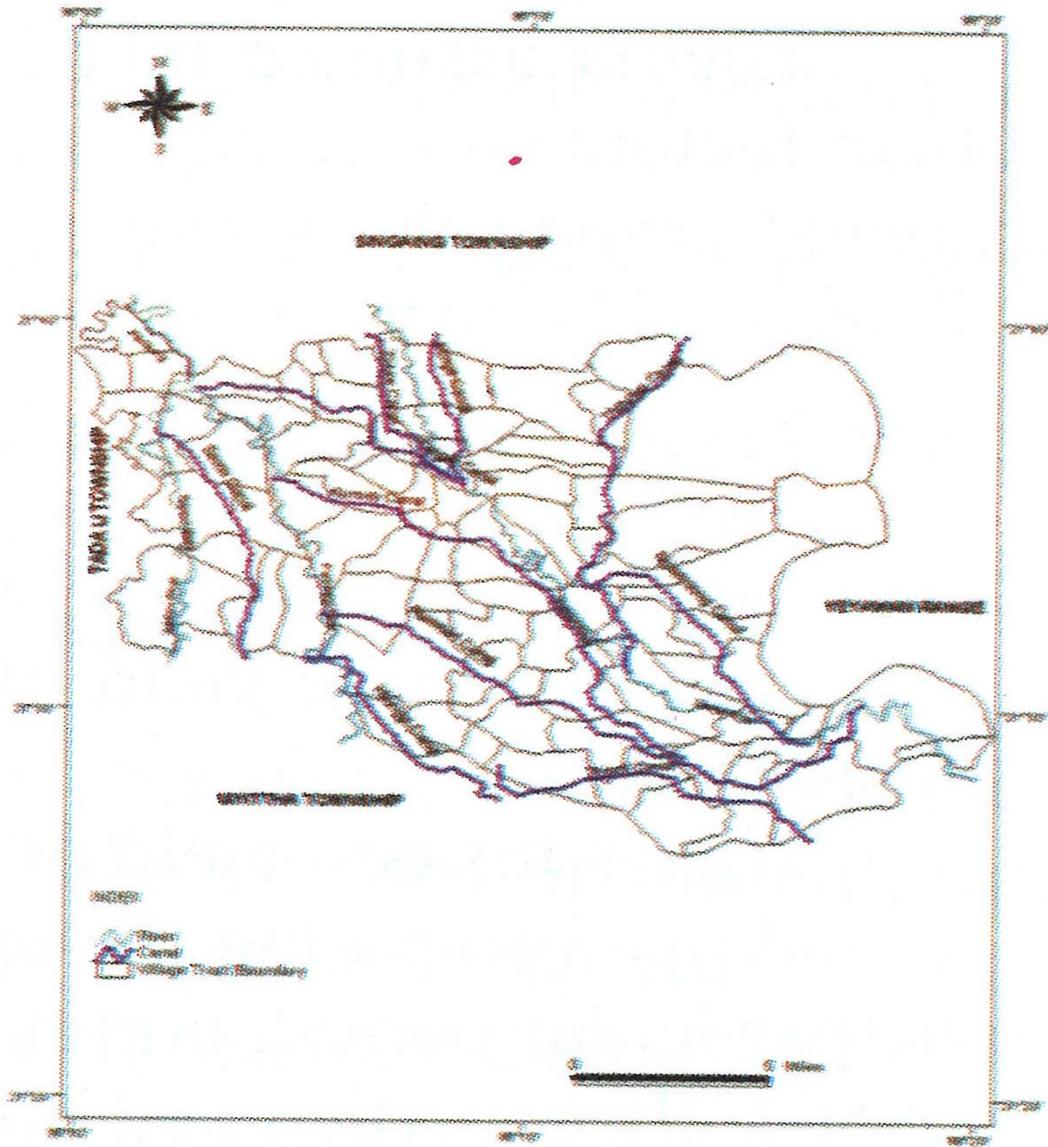
According to 2003 data, the total population in the entire township was 133,226. Among them 93,745 were engaged in agriculture, 230 in animal husbandry 12,903 in government services and other works. The remaining populations were the aged and children or dependent.

Map 2.1   LOCATION OF KYAUKSE TOWNSHIP
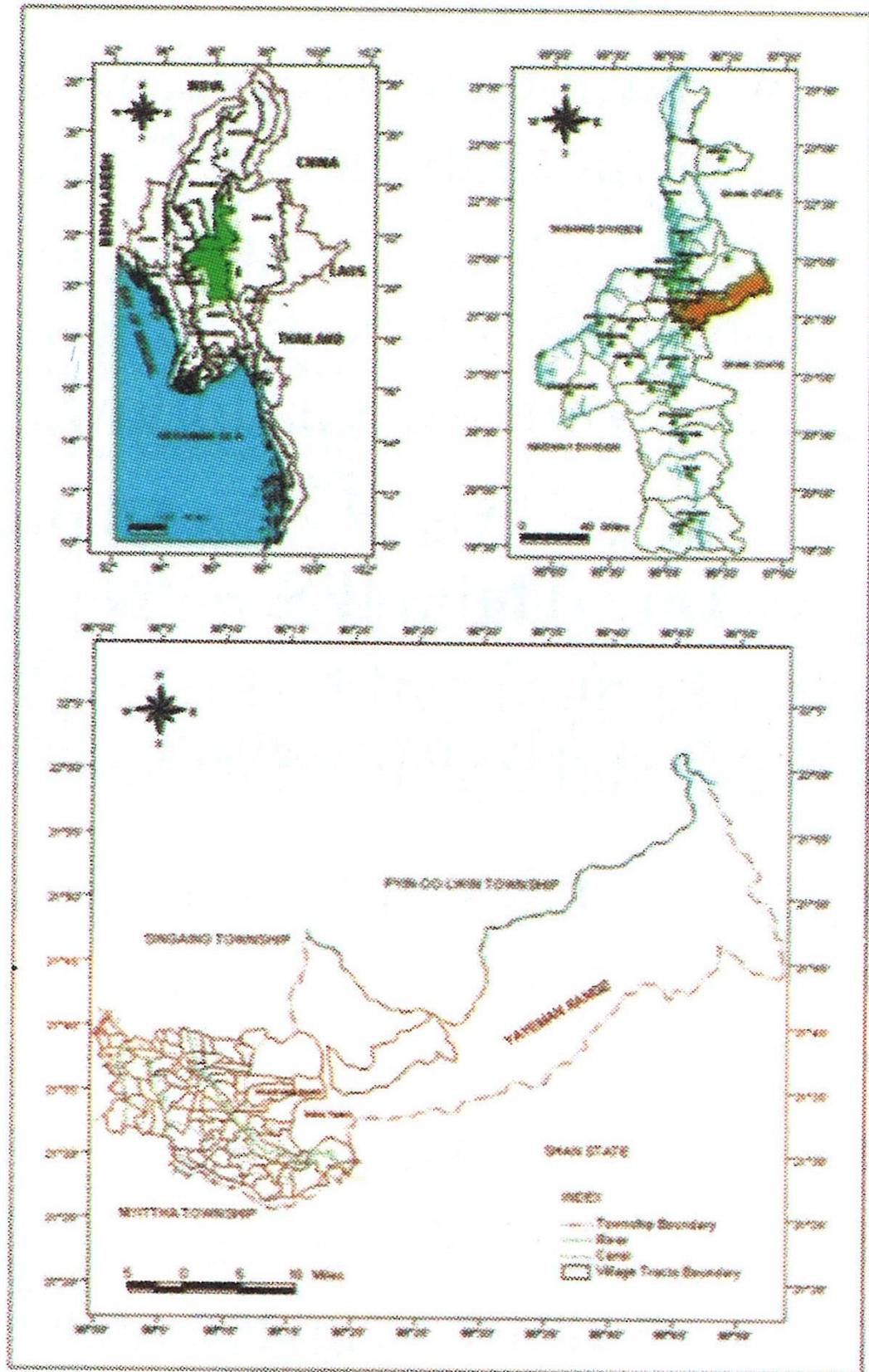
Map 4.1 DISTRIBUTION OF CANAL IN THE STUDY AREA

Finding

In the study area, most of the cultivation is small scale farmers having lesser cultivated land. Almost the whole family members are engaged in their farm lands. After finishing their works in their own field, they used to work in other fields. Because of this reason, it is difficult to identify as cultivators or agricultural labourers.

During 2006-2007, the machines which are used in agriculture were observed that there were totally 596 hand power tillers, 123 threshers and 663 pump sets. The village tracts which are economically strong have more tractors and there were no village tracts without modern tractors. Most of the pump sets are found in village tracts which lie at the end of the water sources.

In the study area most of the farmers have small size of land holdings less than 10 acres, which is a common phenomena in the study area.

Since the location of study area is in the Dry Zone of Central Myanmar, rainfall is scanty and unreliable. But the agriculture is dominant in this area since the reign of King Anawrahta. Irrigation canals of the township are formed as some networks diverging from the dams built across the rivers of Zawgyi and Panlaung. Hence, the water sources of those rivers are very important for agriculture in the study area. Since Panlaung and Zawgyi Rivers take their sources from the eastern highland, the inflow water to Kinda Dam from that river is used to supply water to cultivate for various crops. The inflow water to the dam is rainfall. Total rainfall during late monsoon season is higher than that the early monsoon period.

The Irrigated Area by Dams, Weirs and Canals in Study Area

| Dam	Weir	Village Tracts
Zawgyi	**Nwarted**	Minsu, Yema-U, Saingma-Lan, Koebin, Inyaung, Kalaingkaw, Tawtwin, Myesope, Hanmyintmo, Legyi, Ponenyetkye, Kyakar, Thanywa and Khatetkon.
Zawgyi	**Ngapyaung**	Thingaton, East Thagaya, Kalay, Hmaingpan, Pyidawtha and Shan Taung U.
Zawgyi	**Thindwe**	East Ngedo, Htanzindaw, Hngetkataung, Shwedah, Yebawgyi, Pahtoni, Kalagyaung, Pattar, Pintale, Pyidawtha, and Shan Taung U.
Zawgyi	**Minye**	Taungnauk, Indaing, Thindaung, Kyatminton, Paungywa, Letpan, East Ngedo, Htanzindaw and Hngetkataung.
Zawgyi	**Tamok**	Nyaungshwe, Zayatphyu, Thinpok, Letpanbin, Ywanan, Nga-Oo, Nyaungwun, Kyaungpankon, Maezebin, Puttaing, Myaung-U, Kada and
Zawgyi	**Zidaw**	Ywanan, Letpan, Thinpok and Zayatphyu.
Kindar	**Thindi**	Kyakar, Khatekon, Sulegon, Paukpingway, Myezomoe, Pekhin and Paunglaung.
Kindar	**Htongyi**	Minsu, Sabedaw, Shwein, Lesaekon, and Sulegon.
Kindar	**Samar**	Dantaing, Yanbetlo Pedawgyi, Bonkwin, Sinkun, Kyipyi, Thaymyo and Kyieik.
Kindar	**Thittetgone**	Dantaing.

Source: Department of Irrigation, Kyaukse

In the study area, the water supply for agriculture is from 4 weirs on Zawgyi and 3 weirs on Panlaung. There are 23 lateral and sublateral canals from Ngapyaung weir, 5 from Thindwe, 11 from Minye, 1 from Zeetaw, 6 from Kinda, 2 from Kyeeme and 1 from Htonegyi.

The projected irrigable sown area does not differ from year to year. According to the village tracts the actual irrigated area could be observed for 5-year period from (2000-2005) and 11 village tracts have total irrigated areas with less than 500 acres, 31 village tracts 500-1,000 acres, 19 had total irrigated area with 1,000-1,500 acres, 9 village tracts had 1,500-2,000 acres and 3 had total irrigated area with 2,000 acres and above.

The intensity of irrigation is not uniform in any agricultural region. According to 2005-2006 data, the highest value of irrigation intensity was found in Yebawgyi village tract and it has a total irrigated land of 4,127 acres (575.59%). That village tract lies very close to the water source, i.e. Thindwe canal. The study area covers a total area of 1/3 of the total township and the net sown area in 2005-2006 was about 70,955 acres and the total irrigable area for the same period was about 68,221 acres and was supplied by Kinda dam and Ngapyaung, Zawgyi, Zeedaw weirs. The main crops by irrigation are paddy, sesamum, pulses, garden crops and other food and non food crops. In Myanmar, various crops can be grown successfully not only for local market, but also for international ones. In the study area, all physical features except rainfall favour to grow both food and non food crops. Data of cultivated crops in the study area are collected for successive 5 years period (i.e. from 2002-2003 to 2006-2007). To eliminate some bias, the average and standard deviation values for 5 years period are considered for spatial analysis. The spatial distributions of crop cultivated area are shown based on the value of mean and standard deviation of cultivated area for each crop; the sown acreages are classified into five categories as very low, low, medium, high and very high. Most of the village tracts have medium sown acreage under various crops. Although the cropping system of the study area is planned by the Government, the choice of farmers is still dominant, so that the paddy cultivation and production are not much satisfactory yet.

Map 4.2   INTENSITY OF IRRIGATION IN VILLAGE TRACTS
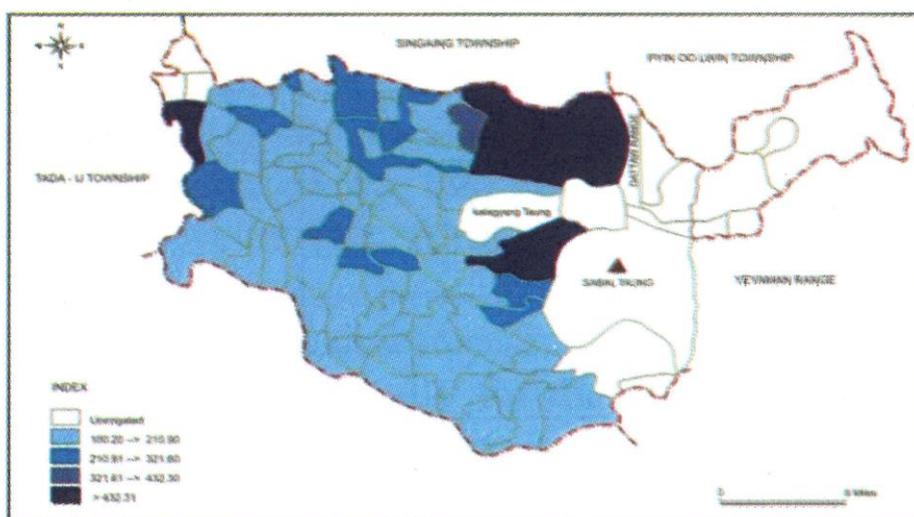
Source: Land Records Department, Kyaukse Township.

The average sown acreage of various crops

No	Various Crops	Average Sown Acreage	Percentage to the total cropped area
1	Cereals		
	(a) Monsoon Paddy	3329.05	45.61%
	(b) Summer Paddy	1315.4	18.02%
	(c) Wheat	69.45	0.95%
2	Oil Seeds		
	(a) Sesamum	1289.21	17.66%
	(b) Other oil seeds	150.97	2.07%
3	Commercial Crops		
	Pulses ((a) gram, (b) pigeon pea, (c) green gram.	284.14	3.89%
4	Industrial Crops		
	(a) Cotton	274.44	3.76%
5	Cash Crops		
	(a) Onion, (b) Chilli, (c) Vegetable, (d) Garlic.	371.61	5.09%
6	Other Food Crops		
	(a) Orchard	173.21	2.37%
7	Non-Food Crops		
	(a) Fodder, (b) Corn	42.01	0.58%
	Total	7299.49	100.00%

The cropping pattern of a region may be determined on the basis of areal strength of individual crop. The first, second and third ranking crops of an areal unit may be called as the dominant crops or major crops of that area. The crop with the largest percentage share of the total cropped area forms the first ranking crops and the crop with the next largest share becomes the second ranking crop. The calculation has been made up to 9 ranking crops for five-year period in the study area.

Agricultural productivity of an area is influenced by physio-socio-economic and technological factors. Agricultural productivity helps in identifying the low productive areas from high productive ones on which basic agricultural plans may be formulated to remove the disparities of a region.(Sadhana Kolhari and Anju Kohll 1-997).

As Per S S Bhatia's Acre Yield and Share of the Cropland Method, the productivity indices for various crops are worked out and plotted. The productivity regions are demarcated based on the values of mean and standard deviation for 5 continuous years (i.e. from 2002-2003 to 2006-2007).

To understand the yield per acre of major crops in the study area, the researcher had gone to meet the farmers personally for the growing season of 2006-2007. The range of yield per acre of monsoon paddy shows that, it varied between 60 and 96 baskets per acre. The yield per acre of summer paddy for the entire township varied between 76 and 110 baskets per acre. Yield per acre of sesamum productivity ranges from 10 to 25 baskets per acre for the whole township.

A micro level study attempted to understand the relationship between the crop productivity and physical and non-physical determinants. In taking soil samples, field study has been carried out for all village tracts after harvesting winter crops and before irrigating for next summer crop. Along the field study, interviewing with the concerned farmers is also made by the researcher to get reasonable data. Only 60 samples are considered out of 73 village tracts. Major dependent variable is the productivity of certain major crops and the considered independent variables are static variables like soil properties, and dynamic variables like amount of fertilizer input, nearness to the water sources and level of mechanization. Pearson's Product Moment Correlation Coefficient Method is used to determine the level of influence on the productivity or yield per acres of crops.

Discussion

Among physical and non-physical determinants which influence on the crop productivity the nearness to the water source plays a major role. According to the values of correlation coefficient, the nearer to the water source, the higher the productivity of a particular crop is. Based on the distances of water source and the fields, total sample sites fell under three main groups. The sample sites from Dantaing, Bonkwin, Sinkun, Thaymyo, Kyieik, Latpanbin, Maezebin, Thungedaw, Maung-U, Thinpok, Nyaungshwe, Zayatphyu, Nyaungwun, Kyaungpankon, Letpan, Taungnauk, Thindaung, Kyaukse, Pyayban, Thanmandelin, Indaing, Pattar, Pintale, Letpanzin, Shwedah, Thingaton, East Thagaya, Kalay, Minsu, Sabedaw, Lesaekon, Yema-U, Inyuang, Kalaingkaw, Myesope, Hanmyintmo, Legyi, Ponenyetkye, Kyakar, Thanywa, Khatetkon, Sulegon, Paukpingway village tracts are near to the water source, i.e. within 2 miles. The sample sites from Yanteblo, Pankwar, Kyipyi, Tazo, Ywapale, Puttaing, Kade, Ywanan, Nga-Oo, Myinkadet, Montbaung, Pahtoni, Hmainpan, Shan Taung U, Pyidawtha, Shwein, Saingma-Lan, Koebin, Tawtwin village tracts are located between 2 to 4 miles distance from the water source those from Pedawgyi, West Thagaya, Panan, East Ngedo, Htanzindaw, Hngetkataung, Yebawgyi, Kalagyaung, Myezomoe, Pekin, Paunglaung village tracts are far from the water source, i.e. more than 4 miles. Although the farmers from the sample sites said that there is sufficient supply water for crop cultivation, the productivity is definitely different from one sample site to another. Hence, it is noted that there is direct impact of water (irrigation) on crop productivity.

Productivity growth has been sustained through increased input use and more recently, through more efficient use of inputs. Degradation of the land resource bases due to intensive cultivation, declining infrastructure and research investment. Over time, farmer technical knowledge and management skill become the primary determinants of differences in productivity and profits between farmers. Increased mechanization is economically feasible, including the length of fallow period, the length of the growing season, and disease constraints to animal use. Two major investment possibilities outside the agricultural sector will condition the degree to which input use efficiencies, will contribute to greater cereal productivity. The first investment possibility is in agricultural research.

Governments may influence the trends by ensuring the adequacy of price incentives and other supports, but it is the farmer who made the ultimate decisions

which shape the pattern of crop cultivation. Policy reform can have a strong positive effect on productivity growth, however the effect is usually short term (3-5 years) infrastructure is an important factor, but difficult to operate.

Increasing need for measures to sustain soil fertility, linked with increasing farmer need for improved cash flow to meet operational costs as land use becomes more intensive ground water and continuously return water to the system. Some technologies that have been developed are not acceptable under local conditions. This is because of several factors, including a lack of funds for large infrastructure projects, a lack of technical skills to automate irrigation systems, and lack of adequate rainfall as one source of irrigation water.

Common problem in the study area with small farms is the hardness of collecting irrigation service fees. Most, if not all, experience a low rate of payment of fees. This low rate of collection leads to another problem, of poor infrastructure and irrigation facilities due to lack of capital. This in turn reduces the productivity of farms.

Conclusion

Natural resources, particularly land and water are increasingly restricted both in quality and quantity in most parts of the world. The FAO study of agriculture towards 2010 indicates that the expansion of arable land will continue and is expected to contribute substantially to increased food production particularly in developing countries as a result of the needs of food for the increases in population densities. It is estimated that production intensification is expected to contribute approximately 80 percent of the increases in crop production through increased yields and higher cropping intensities.

Developing countries particularly need better measurement of the factors of production and a clearer understanding of low the causes of productivity growth function and interact.

Governments may influence the trends by ensuring the adequacy of price incentives and other supports, but it is the farmer who makes the ultimate decisions which shape the pattern of crop cultivation.

In the study area, there is a need to enhance the efficiency of water use through various approaches such as water-saving technologies and improved cropping systems. Apart from technologies advances, innovative participatory approaches are

needed in irrigation management to provide support at the community level. There is also a need to consider policy issues related to valuation of water resources.

Water use efficiency involves a wide range of factors such as farm size, soil conditions, cropping patterns, agronomic crops as well as the interplay of socio-political and economic aspects of allocation, management and utilization of water. Improving the sustainability and productivity of existing and new irrigation schemes will require innovative approaches to the use and development of new water resources such as increase of the role of the private sector, institutional reforms and a framework of natural water policies, regulations, and economic application. At the farm level, declining yield trends are usually not observed because input levels are not held constantly overtimes.

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ကျမ်းကိုးစာရင်း

စည်ပင်သာယာရေးဦးစီးဌာန ၂၀၀၅ – ဩဂုတ်လ် ကျောက်ဆည်ခရိုင်အတွင်းရှိ မြို့နယ် စည်ပင်သာယာရေးအဖွဲ့များ၏ ကျေးလက်ရေပေးရေးဆိုင်ရာတင်ပြချက် အစီရင်ခံစာ။

ဆည်မြောင်းဦးစီးဌာန (၁၉၉၉–၂၀၀၀) ပန်းလောင်ရေသောက်စနစ်နှင့် ကင်းတား လက်ယာ မြောင်းရေသောက်စနစ်ဆိုင်ရာ မြောင်းမကြီးများနှင့် လက်တန်းမြောင်းများ ပြန်လည်ပြင် ဆင်ခြင်းလုပ်ငန်း။

ဆည်မြောင်းဦးစီးဌာန (၁၉၉၉–၂၀၀၀) ဇော်ဂျီရေသောက်စနစ်တူးမြောင်းများ ပြန်လည် ပြုပြင်မည့် လုပ်ငန်းစီမံချက်။

ဆည်မြောင်းဦးစီးဌာန ၂၀၁၂– ဇွန်လ ကျောက်ဆည်ခရိုင်အတွင်းရှိဆည်မြောင်း လုပ်ငန်းများ အခြေအနေတင်ပြချက်။