Assessment of Different Irrigation Systems and Agricultural Productivity in Nawalparasi (West) District

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Abstract

Agriculture is the mainstay of people living in Nepal. The perception of agricultural yield has been broadly used to clarify the distributional organization and outline of agriculture. Irrigation is the practice of supplying water to the crops unnaturally to fulfill the water necessities. This study attempts to assess the different irrigation systems (surface irrigation, canal irrigation and ground water supply irrigation) practiced in Nawalparasi (west) district and their relation on agricultural productivity. Household survey with structural questionnaires, Key Informant Interview (KII)including field observation and marking on cadastral map has been used as primary sources of data and furthermore review of publications i.e., district profile, national agricultural census report, annual reports of district agriculture development office and research articles have been used as secondary sources of data. The result showed that the average productivity of different crops has affected by the reliability of sources of irrigation systems in all study sites. Further, diverse cropping patterns and cropping intensity were observed in different irrigation systems that ranging from 141 to 226.

Keywords: cropping pattern, cropping intensities, diversification, economy, employment

Introduction

Agriculture has becoming a key component as the important prosperity for most of the developing countries (Mongues, et al, 2012). Agriculture is the major sources of Nepalese economy and essential activity of a human being. Agriculture provides food security for the population in addition to bunch of goods and raw materials that is essential by the non-agricultural sectors. In Nepal, agriculture has been contributing employment to more than 66 percent households (MoAD, 2015) and 35.12 percent share to National Gross Domestic Product (GDP) (MoF, 2014). Land as a aspect of production and as a natural resource is a critical input in agricultural production (Raufu, 2010).

Irrigation is the practice of delivering water to the land at usual intervals by means of canal and other system to enhance agricultural development and preserve the landscape during the periods of less average rainfall. Irrigation assists to grow agricultural crops, preserve landscapes, and re-vegetated disturbed soils in dry areas and during periods of less than average rainfall.Underground sources of irrigation treatments significantly increased the grain yield when compared to the surface irrigation method (Rasool et al., 2020).

The accessibility of water and its organization are very important to enlarge farming productivity and cropping concentration in a specified agricultural land. Crop yields universally in the developing world are always higher in permanent irrigated areas than in rain-fed areas (Lipton et al., 2005). Surface irrigation method is the most important that utilized more than 80 percent of world's irrigated land. Surface irrigation systems are supported by a number of on- and off-farm structures which control and manage the flow and its energy. There are diverse types of irrigation method accomplished for humanizing crop yield. However, this study attempts to explore only surface irrigation, canal irrigation and ground water supply irrigation practiced in Nawalparasi (west) district and their relation on agricultural productivity.

Materials and Methods

Three study sites have been selected purposively based on utilization of different sources of irrigation system. Sunwal municipality has been selected for surface irrigation system and Bardaghat municipality has been selected for underground sources of irrigation system whereas Palhinandan rural municipality has been selected for canal irrigation system. Face to face household questionnaire survey method has been applied to gather the information on cropping pattern, intensity, area, production by major crops among the 93 households. KII has been performed with eleven personal for actual understanding about the use of irrigation system and agricultural activities. Similarly, field inspection has been carried out for recognition of parcels and marking on maps for the utilization of sources of irrigation system through cadastral and topographic maps. Similarly, review of publications i.e. district profile, national agricultural census report, annual reports of district agriculture development office and research articles, maps and images have been used to create secondary data. Both qualitative and quantitative techniques have been used for the data generation and compilation.

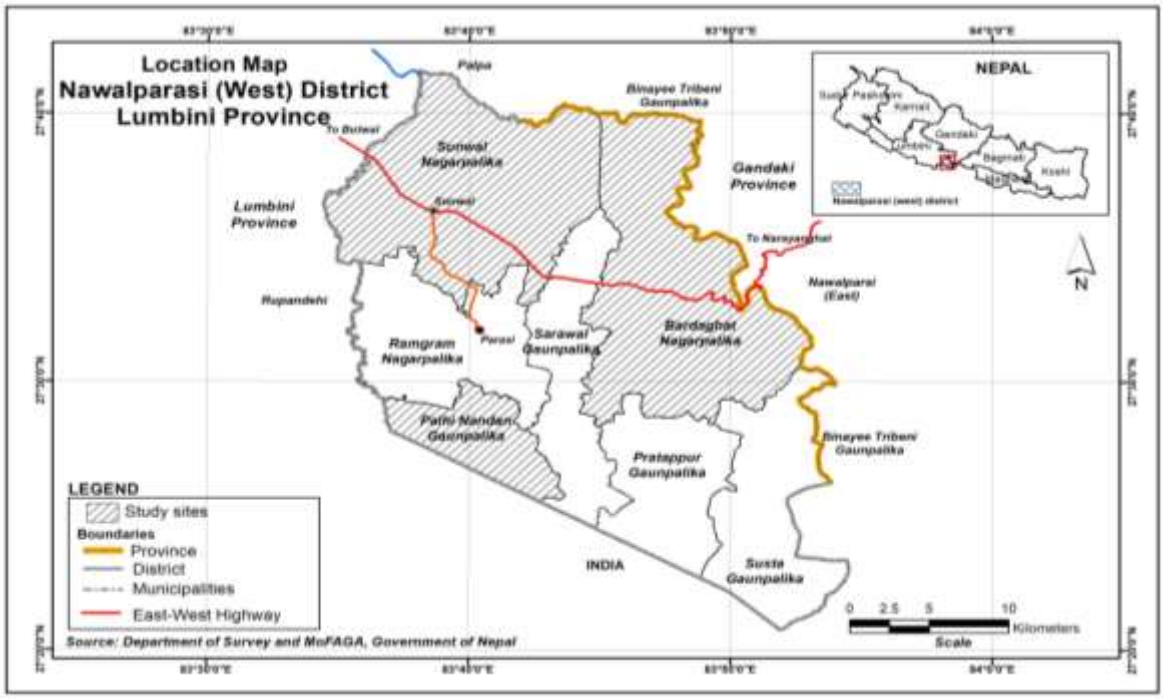
Geographical setting of the Study Area

Part of three municipalities of Nawalparasi (W) district has been selected for this study that is situated in Lumbini Province of Nepal and extended from 27^{o}20' 45'' to 27^{o}41'36'' north latitude and 83^{o}34'23'' to 83^{o}53'58" east longitude with 93 meters to 1156 meters altitudinal variation along the Tarai region of Nepal. Nawalparasi (W) district has integrated into three municipalities and four rural municipalities during the local level restructuring **(**MoFALD, 2017**)**. Total of 386,868 populations with 188,182 male and 198,686 are females are residing within 82,738 households and 750.6 sq km. of surface area. Household size (4.7) is noticed higher than national level (4.4) in this district (NSO, 2021). The population growth rate (1.47 percent) also recorded higher than the national average of 0.92 percent in the district between 2011 and 2021.

Similarly, the population density (527 people per sq km) is also higher than national figure of 198 people per sq km in this district (NSO, 2021). There are 76,703 population (35,675 male and 41,028 female) residing within 162.05 sq km land area of Bardaghat municipality, 72,085 population (33,793 male and 38,292 female) are settled in 139.1 sq km area of Sunwal municipality and 38,186 (19,016 male and 19,170 female) are living in 44.67 sq km area of Palhinandan rural municipality. The location map is displayed in Figure 1.

Figure 1

Location Map



Result and Discussion

Irrigation and Productivity

Irrigation is an essential aspect in farming improvement. Productivity depends primarily on the accessibility of irrigation facilities in addition to other inputs like labour, seeds, fertilizers, and pesticides. Table 1 indicates that productivity of paddy and vegetables has been found higher in large and small size of land holdings in Palhinandan area where the availability of canal irrigation system is reliable and sufficient during summer season. Further, the production and yeild of wheat, potato and oilseeds has been found higher in Sunwal area with having surface irrigation system with the unstable by land holding size. The productivity of all crops is higher in small and medium size of land holding than larger size of land holdings in Bardaghat (Dhakal, 2019).

Due to inadequate supply of water from ground water sources in addition to limited input of seeds, compost and chemical fertilizer use in large size of farms have been informed the main causes behind the less productivity in Bardaghat. Broadly, it has observed higher production from small size of land holdings to large size in paddy and wheat, but it has overturned in other crops in Palhinandan. It has been found that the productivity is different by crops and sizes of land holdings in all study sites with the availability different irrigation facilities as well as other input factors.

Table 1

Productivity (kg/ha) by Crops in Different Study Sites

Crops	Land holdings size (ha)	Bardghat		Palhinandan		Sunwal	
		Area	Productivity	Area	Productivity	Area	Productivity
Paddy	Less than 0.5	5.27	6607	1.42	6909	8.1	6545
	0.5 to 1.0	3.68	7025	4.39	4310	4.26	5410
	1.1 to 1.5	2.43	6410	10.55	5370	0.57	7710
	More than 1.5	7.27	6165	24.34	10285	0	0
Maize	Less than 0.5	0.1	1726	0	0	4.21	528
	0.5 to 1.0	0.1	1479	0	0	1.76	1027
	1.1 to 1.5	0.14	1183	0	0	0.14	740
	More than 1.5	0.24	1057	0.05	1282	0	0
Wheat	Less than 0.5	0.37	1022	0.81	2912	1.89	3682
	0.5 to 1.0	0.57	2193	2.13	2087	0.88	2777
	1.1 to 1.5	0.41	1775	6.05	2941	0.14	4734
	More than 1.5	4.06	3087	12.51	3084	0	0
Potato	Less than 0.5	0.33	5128	0.08	7561	0.45	7692
	0.5 to 1.0	0.2	3452	0.3	5095	0.25	4892
	1.1 to 1.5	0.08	4076	0.49	2755	0.02	2959
	More than 1.5	0.14	2737	1.08	3809	0	0
Vegetables	Less than 0.5	0.06	2536	0.05	6410	0	0
	0.5 to 1.0	0.07	740	0.36	6633	0.34	962
	1.1 to 1.5	0	0	0.27	3070	0	0
	More than 1.5	0.1	0	0.25	1913	0	0
Oilseeds	Less than 0.5	3.24	709	0.37	702	5.27	856
	0.5 to 1.0	2.23	614	0.85	469	2.03	838
	1.1 to 1.5	1.2	1000	1.54	1062	0.34	1420
	More than 1.5	1.93	753	3.82	634	0	0
Pulses	Less than 0.5	2.91	564	0.29	1312	0.88	674
	0.5 to 1.0	1.42	679	0.83	819	0.37	403
	1.1 to 1.5	0.15	592	1.42	1426	0.34	592
	More than 1.5	1.49	545	3.99	781	0	0

Note. Field Survey, 2019; Kg/Ha = Productivity Measured in Kilogram per hectare.

Cropping Pattern

The measurement of cropping pattern is fundamental to an understanding of spatial management of agriculture (Rahman and Shah, 2009). This study found that crop land is under different cropping pattern such as Paddy, Paddy + Wheat/Oilseed/Pulse and Paddy + Wheat / Vegetables / Pulse / Oilseeds + Maize. Paddy is the dominant crop in all the study sites like in other Tarai areas of Nepal (Dhakal, 2019).

The majority of the agricultural land in the study sites has been found as intense based on the cropping pattern. Cropping pattern has been found varies with the types and available irrigation system in the study sites. In Palhinandan area, it has been noticed that more than 80 percent area has occupied by two crops (paddy and wheat or paddy and oilseeds and pulses) based on the availability of water from canal irrigation system mainly in summer season whereas more than 48 percent of area has occupied by three crops in Sunwal area where the surface irrigation (kulo and rain-fed) is dominant. Furthermore, more than 64 percent area has occupied by two crops and 16 percent area has occupied by three crops annually. It is also clear that sources of irrigation system and availability of sufficient and timely water also one of the determinant factors for cropping pattern in addition to others.

Table 2

Cropping Pattern (Area in ha)

Number of crops	Crops	Bardaghat		Palhinandan		Sunwal	
		Area	Percent	Area	Percent	Area	Percent
Single crop	Paddy	5.533	19.3	1.314	3.2	0.92	6.4
Two crops	Paddy+Wheat / Oilseeds /Pulses	18.449	64.5	32.686	80.3	6.48	45.2
Three crops	Paddy + Wheat/Vegetables/Pulse/Oilseeds + Maize	4.612	16.1	6.694	16.4	6.949	48.4
	Total area	28.595	28.595	100.0	40.695	14.348	100.0

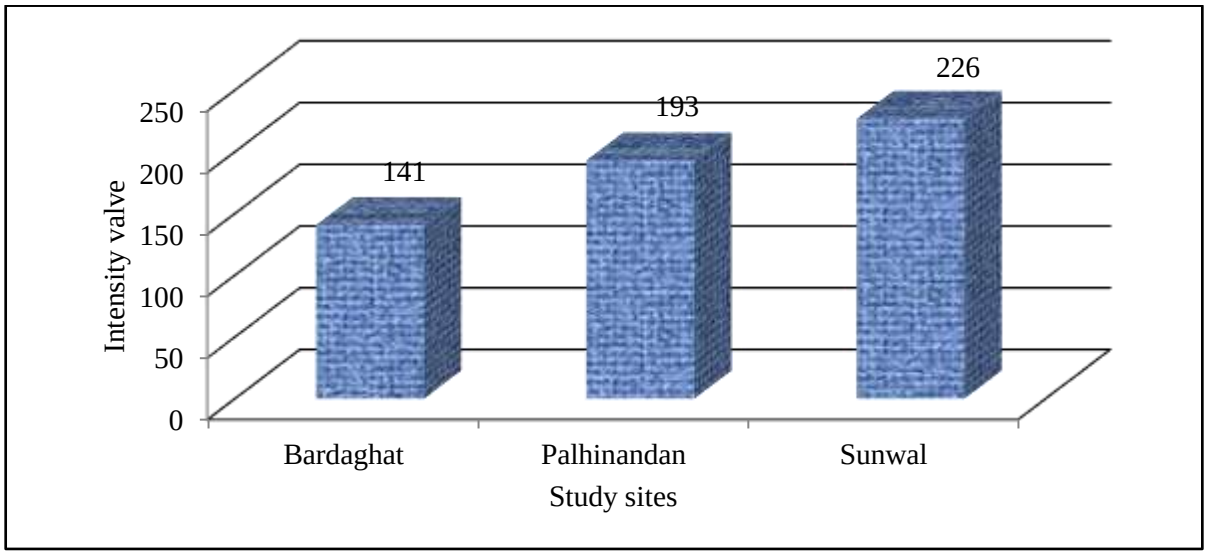
Note. Field Survey, 2019; land Area is measured in hectares.

Cropping Intensity

The intensity of crop refers to the use of a field several times during a cropping year. It is one of the types to measure of land efficiency, which is defined as the extent to which the net area is cropped or sown (Dhakal, 2019). The higher cropping intensity means that a higher portion of the net area is being cropped more than once during one agricultural year. This also implies higher productivity per unit of arable land during one agricultural year. The result shows different cropping intensity by the availability of irrigation facilities. The value of cropping intensity is ranging from 141 to 226 in the study area. It is found that cropping intensity is high (226) in Sunwal where the main source of surface irrigation whereas Palhinandan has second intensity value of 193 with canal irrigation system but it has least value in Bardaghat (141) where the availability of insufficient irrigation facilities from ground water (Figure 2). The cropping intensity has been observed diverse with the various sources of water supply and irrigation system used in the study sites. The cropping intensity is found less than national average (185) and district average (197) in Bardaghat but it is more than national and district average in Sunwal (Dhakal, 2019). Similarly, it is more than national average and nearly equal to district average value in Palhinandan (CBS, 2013).

Figure 2

Cropping Intensity



Discussion

It is noticed the differences in cropping area, productivity, cropping intensity and cropping pattern by study sites with various types of irrigation facilities. Such type of dissimilarity is also noticed by Rahman and Saha (2009) in Bangladesh; Kodiwo and Okere (2012) in Kenya;Li, Yu, and Gong (2013)in China; Salvati (2013)in Italy and Fu, Zhang, and He (2014) in China. Similarly, Pandey (2015) has found the crop diversity in Jutpani Village Development Committee in Central Nepal (cited in Dhakal, 2019). However, this study has found the variance in agricultural production in the study sites due to inaccessibility of reliable sources of irrigation water. This study found the divergence in cropping pattern in all study sites. Similar types of changes are also noticed by Paudel et al. (2014) in Chitwan district of Nepal. They have found intensified cropping systems and changed from rice-wheat-maize system to rice-vegetable-maize system. The area under single crop has less in all three study sites, whereas area under two or three crops has occupied higher in Bardaghat and Palhinandan but area under two crops has covered and area under three crops has significantly utilized in Sunwal (Dhakal, 2019).

Water is the main aspect that disturbing cropping intensity and cropping pattern. Cropping intensity has been noticed higher in Sunwal and Palhinandan having the admittance of irrigation facilities and market, whereas it has observed less in Bardaghat due to the inadequate access of irrigation facilities and market. It has noticed that paddy, maize, wheat, potato, pulses, oilseeds and vegetables are the major crops grown in the different landholding size in the study area. This study has found that the variation in the area occupied by different crops and cropping pattern by study sites.

Conclusions

Irrigation is a significant constituent in the agricultural production as rainfall is scarce, unsure and irregular in an agrarian country like Nepal. The availability of water for irrigation is an important determinant for the cropping pattern, cropping intensity and agricultural productivity. Water is a very important constituent for farming that control farmers' decision-making procedure a lot. Secured irrigation facilities give confidence to the farmers to carry out new innovation and strengthen farming system. Variation in the productivity of major crops and cropping pattern has been found. Furthermore, different cropping intensity has been noticed by diverse sources of irrigation facilities that have been ranging from 141 to 226. Cropping intensity has been noticed higher in Sunwal and Palhinandan where the access of surface and canal irrigation facilities and less observed in Bardaghat with the insufficient access of water from underground sources of irrigation facilities.

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