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Rural Land Use Change and Its Effect on Livelihood of Natima Union, Jhenaidah

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Abstract: Land is an infrequent and essential resource in Bangladesh. Over the last few decades, the rural land use pattern has drastically changed mainly in settlements, waterbodies, and agricultural land use. This study illustrates the changes of land use and its effect on livelihood at Natima Union. Land use data were analyzed to historic variation and changing patterns of land uses in Natima Union. The approach used in this study to classify satellite imagery and change detection based on Satellite Imageries Landsat TM 1987 to 2017, Landsat TM, and Landsat ETM for using supervised classification methods and maps consisted of four land use categories. In the comparison of classified imageries, there were massive changes in waterbodies into agricultural land. About 20%, 8%, and 2% of waterbody were changed to agricultural land and settlement in the decades respectively 1987-1997, 1997-2007, and 2007-2017. The economy of Natima Union is mainly based on agriculture, besides this with the increase of settlement area trade and business, service sectors, etc. are up-rising sources of household income. A questionnaire survey was also conducted to know about cropping patterns and its changing nature in the study area. Although grain crops like paddy and wheat cultivation are decreasing, due to modern technology rice production is quite good. Now farmers are gradually interested in mango and leguminous crops like pulse cultivation as use of their land in more productive way. Population pressure was found as one of the major driving forces to determine land use and land use changes in the study area effects on livelihood patterns. On the basis of changes, new policy has to implement for better land management.

Key words: Land use change, Effect, Livelihood, Satellite imagery, Agriculture.

1. Introduction

Bangladesh is a developing country with massive population pressure and rapid population growth effect on land use pattern (Alphan, 2003; Aspinall and Hill, 2008; Lopez et al., 2001). Over the years, land use pattern of Bangladesh has evolved in many ways. Agricultural land converts into settlements, roads and other infrastructure, water

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bodies also filling to building infrastructure (Ellis, 2000). Moreover, the productivity is low in Bangladesh comparatively to many countries of the world (Hossain, 1984; Kabir, 1995). Although, the proportion of agricultural activities and land use is still higher in the rural areas compared to settlements, homestead vegetation, water bodies, industries etc. However, the changing nature of land use is also influencing people's livelihood (DFID, 1999; Dalal-Clayton et al., 2003). Once, this country was mainly based on primary economic activities like agricultural work; however, nowadays, people are changing their life style and livelihood from agricultural worker to industrial worker, services holder, and trade and commerce (Hossain and Rahman, 2003). Moreover, rural people are trying to cultivate more profitable crops with the help of modern technology in Bangladesh. As a results, different types of new agricultural activities or crops are grown, especially maize.

Natima is one of the significant Union of Jhenaidah district of Bangladesh, where cultivable land use has been changing drastically in the last few decades. People were used to cultivate different types oagricultural crops, but recently the people of this area tried to seek alternative strategies to cope with the poverty, and they found a new way of using their scarce resources. Along with rice production, they are involving in commercial mango gardening. Due to these changes in land use the livelihood pattern has been altering over the past years, having a substantial impact on the rural economy of Natima Union. However, actual condition of this land use change has not studied yet. Therefore, it is significant to conduct a study to find out the consequences of last thirty years' land use change including the parameters such as employment pattern, production, cropping pattern for proper land use planning, better land management and sustainable development activities at regional level. In this study, remote sensing based change detection method is used (Abd El-Kawy et al., 2011; Gadrani et al., 2018; Gregorio and Jansen, 1998; Lillesand et al., 2008), and questionnaire survey also conducted to validate the results.

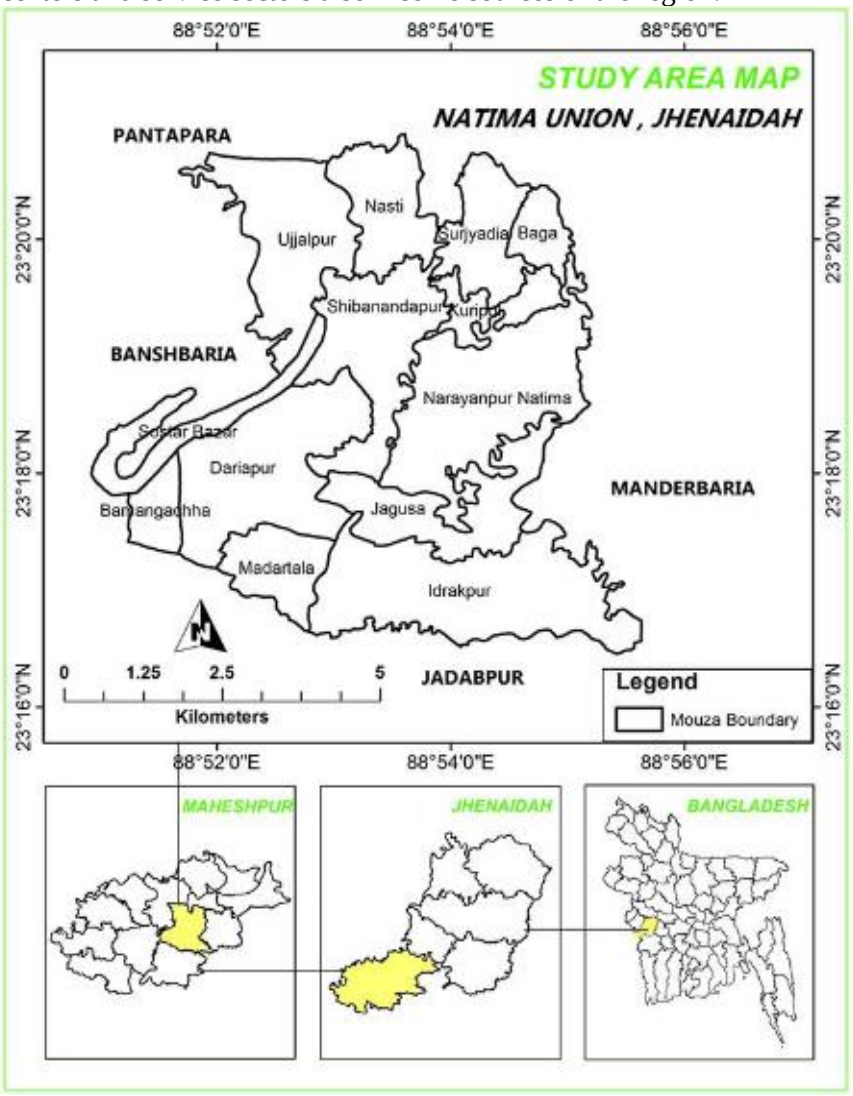
2. Aim and Objectives

This study aims to know the changing pattern of rural land use and its effect on livelihood of Natima union, Jhenaidah: a) to delineate the changing pattern of land use of Natima union in Jhenaidah district; b) to find out the causes of land use change in the study area; and c) to analyze the relationship between land use change and livelihood of the study area.

3. Study Area

Natima union is the study area situated in Maheshpur Upazila under the Jhenaidah district of Bangladesh. It is located in the Ganges river floodplain between 23°15'N to 23°21'N latitude and 88°50'E to 88°57'E longitude (Map 1). It resides by Jadabpur Union to the South; Maheshpur Paurashava to the North; Mandarbaria Union to the East; Bashbaria Union to the West and approximately Natima Union covered an area of 36.58 km² or 3658 hectares (BBS, 2021). The total population of the union is 25,520 (BBS, 2011). In this Union, fertile plain land is precise and appropriate for cultivation. Paddy is the main crop; other crops are jute, sugarcane, wheat, cotton, banana, oil seed, vegetables, and so on (BBS, 2021). Annual average temperature ranges from 9 ^{0}C to 41 °C (48 to 106 °F). The annual rainfall is 1,537 millimeters (60.5 inches). Agriculture is the main land use

within the union and serves as the main economic activity in the area. Most of the agricultural and economic activities are vegetables, fruits, wheat, and extensive cattle farms. Besides, mentionable lands are used for business purposes. Along with agriculture business centers and service sectors also income sources of the region.



Source: LGED; Prepared by Author, 2022

Map 1: Location of the study area (Natima Union).

4. Data and Methodology

This study is based on both primary and secondary data sources. Landsat satellite time series imageries were collected from the freely available United States Geological Survey (USGS) website (https://earthexplorer.usgs.gov), including two Thematic Mapper (TM) imageries respectively in 1987, 1997, and two Enhanced Thematic Mapper Plus (ETM+) imageries respectively in 2007, and 2017. Along with satellite imagery data, a

questionnaire survey was conducted for the acquisition of primary data to know about land use change and its effect on socio-economic conditions, agricultural patterns, occupational changes, their future plans for cultivation, and effects on livelihood. A total number of 30 farmers were selected from this union for the questionnaire survey. Among the selected farmers, there were mixed groups of marginal, poor farmers and day laborers. Their thinking regarding the problems they face in cultivation and the way they are planning for solutions of their problems were also addressed in this study. Besides, UP-Chairman and members of local government were also interviewed. All the collected data were summarized, processed, and scrutinized carefully. Then data were analyzed by MS Excel and satellite images were classified by supervised image classification method of Erdas Imagine software 2014. Finally, land use maps were prepared to detect the changing pattern of land use by using ArcMap 10.3 (Fig. 1).

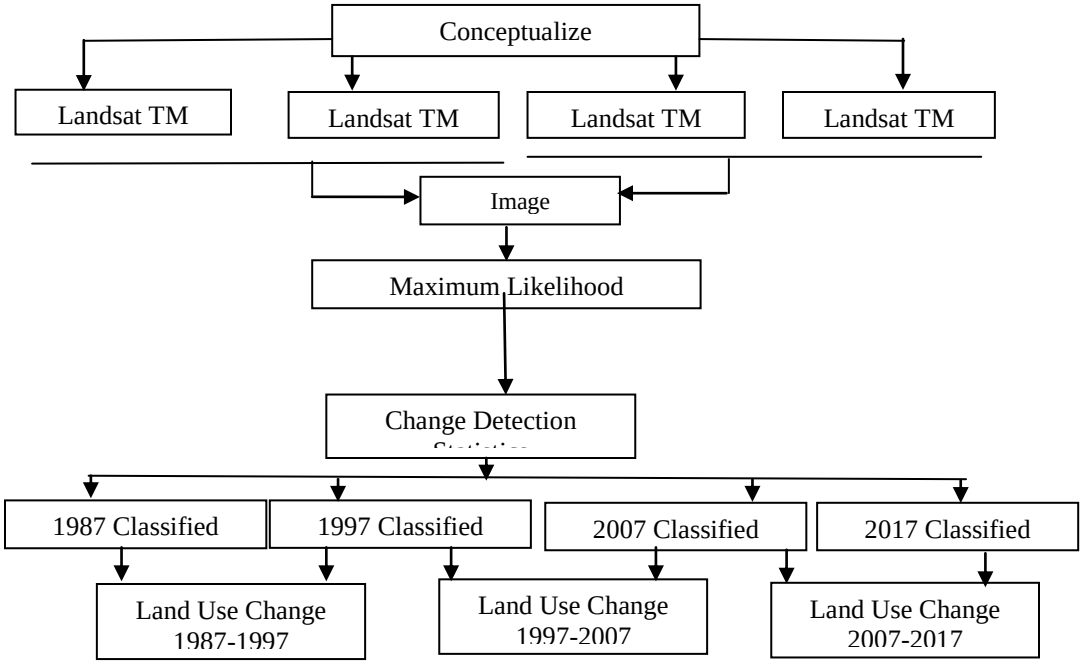


Figure 1: Methodological flow diagram for land use change analysis.

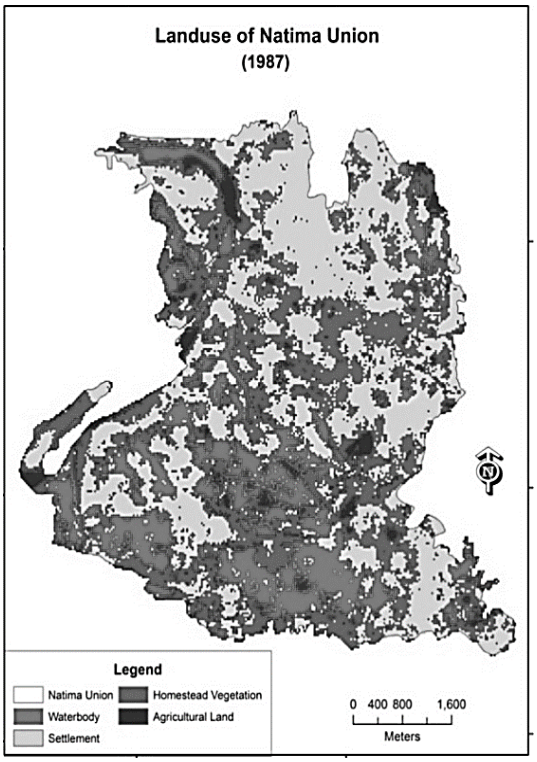
Table 1: Conceptualization of land use categories in Natima Union

Land use type	Description
Water bodies	Most of the areas are covered in water bodies and those areas are submerged during the rainy season and dry during the summer season.
Settlement	Settlement mainly uses in house making, different construction, business center, etc. In rural areas, settlements are closely associated with cultivated fields.
Cultivated land	In cultivated land, different types of crops cultivate like paddy, jute, wheat, pulse, mango, etc. both annual and perennials season.
Vegetation	The area is covered by trees both natural and planted with shrubs, bushes, and small trees.

5. Results and Discussion

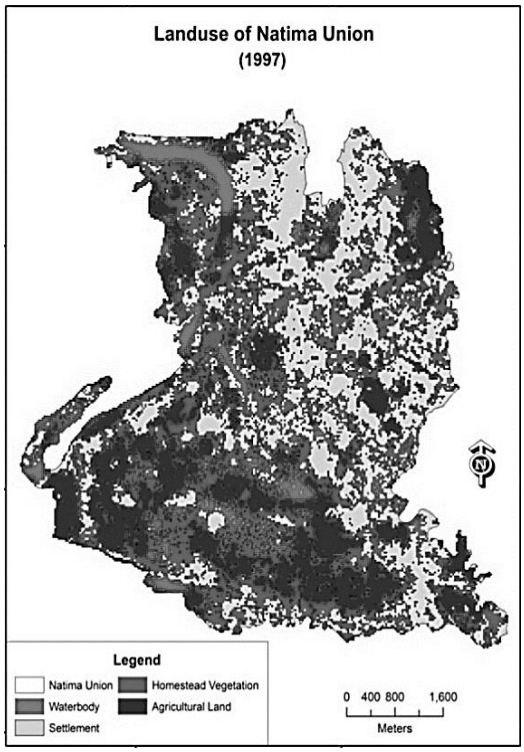
a) Changing Pattern of Land Use of Natima Union (1987-2017)

Land use is classified into four broad categories like waterbody, homestead vegetation, settlement, and agricultural land in the Natima union and each of the categories comprises a different land use type (Map 2). In 1987, waterbody covered a higher percentage of the total land use at 39% compared to other land use as homestead vegetation at 36%, settlement at 22%, and agricultural land at 4% in the study area (Table 2). As a low-lying flat area, most of the area was covered by waterbody, settlements, and homestead vegetation and the area of agricultural land was a very small percentage of the total area. Mainly at that time, a little amount of agriculture was practiced in the Natima Union.



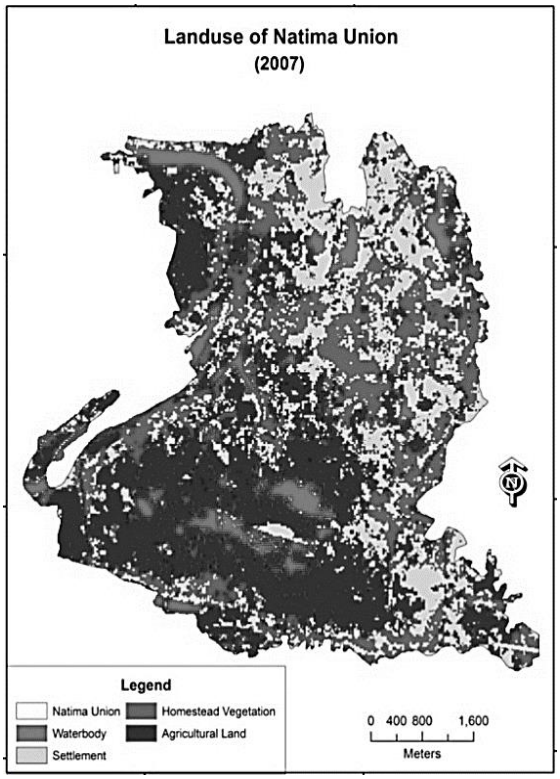
Source: USGS, Analysis by Author, 2022

Map 2: Land use of Natima union (1987)

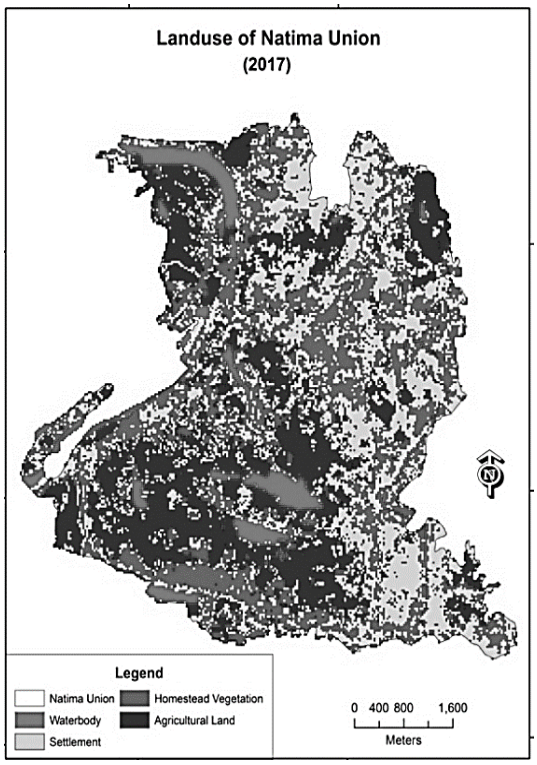


Source: USGS, Analysis by Author, 2022

Map 3: Land use of Natima union (1997)



Source: USGS, Analysis by Author, 2022
Map 4: Land use of Natima Union (2007)



Source: USGS, Analysis by Author, 2022
Map 5: Land use of Natima Union (2017)

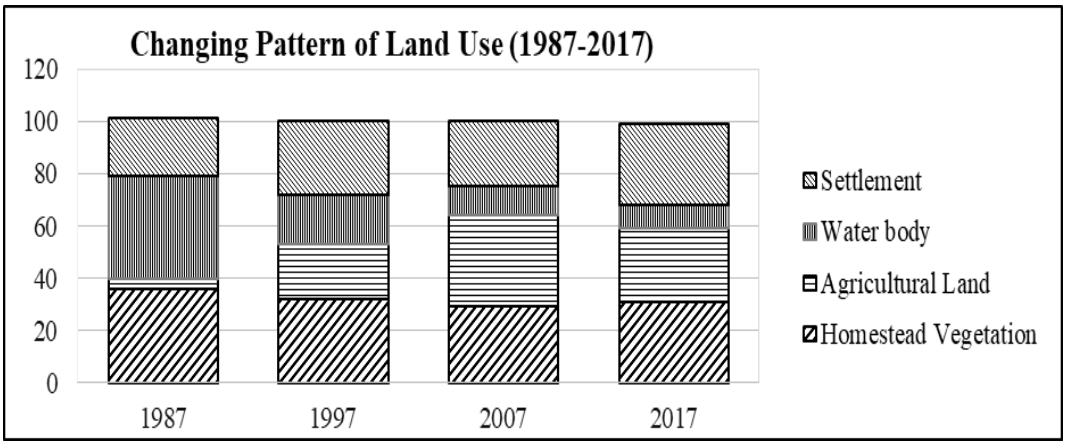
From data table 2, it is seen that homestead vegetation was higher of the total land use which peaked at 32% compared to other land uses like settlement at 28%, agricultural land at 21%, and waterbody at 19% at Natima Union in 1997. However, agricultural land raised from 4% to 21%, settlement raised from 22% to 28% where waterbody gradually decreased from 39% to 19%, and homestead vegetation decreased from 36% to 32% from 1987 to 1997. Map 3 depicts that this decade (1987-1997) was characterized by flourishment in the agricultural sector and diminished waterbodies. People transformed waterbodies into agricultural land and settlement areas.

Table 2: Changing pattern of land use of Natima Union from 1987 to 2017.

Class Name	**1987**		**1997**		**2007**		**2017**	
	Area (Acres)	**%**	**Area(Acres)**	**%**	**Area(Acres)**	**%**	**Area(Acres)**	**%**
Homestead Vegetation	1307.567	36	1,192.29	32	1063.105	29	1158.802	31
Agricultural Land	130.294	4	766.07	21	1292.119	35	1027.751	28
Waterbody	1,423.34	39	698.992	19	407.978	11	344.715	9
Settlement	878.85	22	1023.638	28	917.79	25	1,149.74	31

Source: USGS, Analysis by Author, 2022.

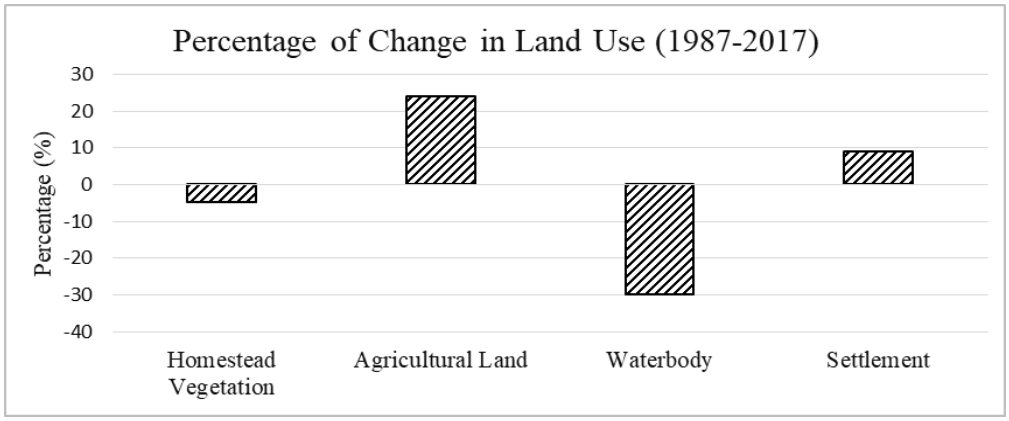
In 2007, the land use pattern has undergone tremendous transformations due to the impact of urbanization and the expansion of agricultural land at the Natima Union (Map 4). The gradual increase of agricultural land use was a higher portion at 35% than other land uses like homestead vegetation at 29%, waterbody at 11%, and settlement at 25% (Table 2). In a similar way to the previous decade (1987–1997), in this decade (1997–2007) the land use of waterbodies and homestead vegetation was low-rising and waterbody, homestead vegetation, and settlement decreased respectively by 8%; 3%; 3%. Like the past decade, agricultural land use was up-rising and increased by 14% in this decade (1997-2007).



Source: USGS, Analysis by Author, 2022.
Figure 3: Changing pattern of land use of Natima union (1987 to 2017).

In the Natima Union, due to a rapid increase in population density (697.6/km^2 in 2011) in recent years, the settlement was higher at 31% of the total land use in this period (2007-2017). From the data table 2, it is shown that there was a gradual increase in land use of settlements as home and business centers in likewise earlier two decades (1987-2007). Along with the settlement, homestead vegetation expansion constitutes the same percentage (31 %) which decreased in the last decade (1997-2007). As well as the last two decades (1987-2007), there is a gradual decrease in the waterbody and now it is at 9%. During the decades (1987-2007), there was a rapid increase in agricultural land use but last decade (2007-2017) it decreased by 7% and is now at 28%.

Overall, from 1987 to 2017, within thirty years among the four land use categories agricultural land and waterbody have undergone massive changes. In the Natima union, waterbody decreased by 30%, and it transformed into agricultural land and settlement where agricultural land increased by 24% in the last three decades (1987-2017). Slight changes in homestead vegetation and settlement land use. Mainly figure 4 illustrates that a low-lying physical feature and waterbody dominant area Natima Union expressed as an agriculture and settlement-based land use region in thirty years (1987-2017).



Source: USGS, Analysis by Author, 2022.

Figure 4: Percentage of Change in Land Use of Natima Union (1987-2017).

b) Effect of Rural Land Use Pattern Change

i) Changing Pattern of Crops

As an agricultural country, paddy is the primary and most cultivated crop in Bangladesh. Earlier in the Natima Union, the number of farmers who cultivated paddy was very high level (43.33% in 1990). Along with paddy cultivation, jute and wheat cultivation were also at high levels respectively 26.66% and 20%. In the past three decades (1990-2020), almost 50% of paddy farmers changed their crop patterns for a high cost of cultivation than the selling price. Jute cultivation also reduced in the 1990-2000 decades.

There is a remarkable change in wheat cultivation and its cultivation rate turns to a very low level (3.33% in 2020). In the last two decades (1990-2010), with improvements in transport and marketing systems farmers interested in mango cultivation and 30% of respondents in the past decade (2000-2010), 16.67% of respondents in the last decade (2010-2020) involved in mango cultivation. Grain crops like pulse are newly cultivated crop in the last decade (2010-2020) and now it is cultivated at a higher level than other crops peaking at 33.33%. Other crops cultivation also at 10%. Table 3 portrays that, in the Natima union, Jhenaidah there are changes in agricultural patterns and cultivation in the last two decades (1990-2020) and it is being influenced by environmental and social parameters. Farmers are more motivated and interested in mango and pulse cultivation than main crops like paddy, jute, and wheat.

Table 3: Changing of Cropping Pattern in Natima Union (1990-2020).

Crops	1990		2000		2010		2020	
	Respondent	%	Respondent	%	Respondent	%	Respondent	%
Paddy	13	43.33	10	33.33	7	23.33	6	20
Jute	8	26.66	9	30	5	16.66	5	16.66
Wheat	6	20	8	26.66	6	20	1	3.33
Mango	0	0	0	0	9	30	5	16.66
Pulse	0	0	0	0	0	0	10	33.33
others	3	10	3	10	3	10	3	10
Total	30	100	30	100	30	100	30	100

Source: Questionnaire Survey, 2022.

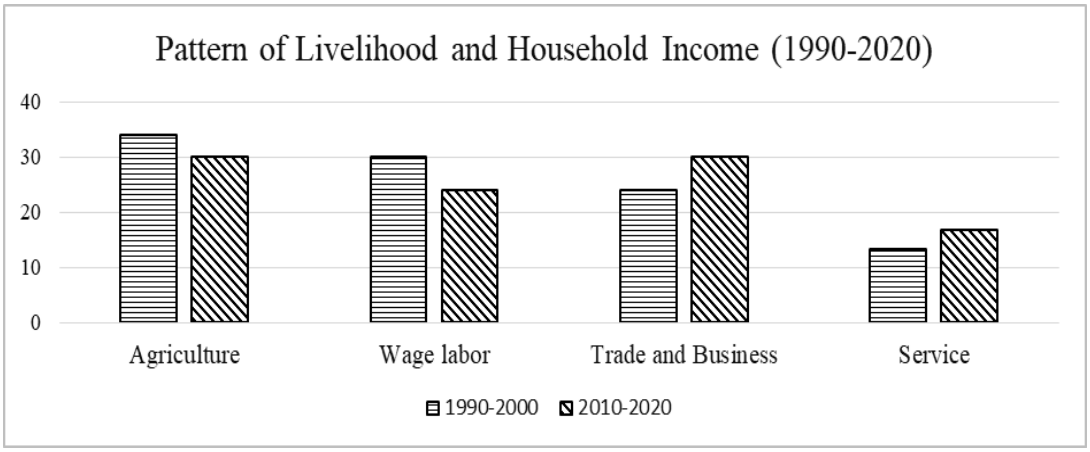
ii) Changes in the Pattern of Livelihood and Household Income

In Natima Union, household income patterns are changing from time to time (Figure 9). In 1990-2000 people were mainly engaged in primary economic activities for instance farming, wage laboring, etc. and as income sources agriculture and wage laboring were higher respectively 33.33%, and 30% comparatively other sources of income like trade and business (23.33%), and service sector (13.33%). Within two decades from 1990-2000 to 2010-2020, household income patterns have been changing.

Source: Questionnaire Survey, 2022.

Figure 9: Changes in the pattern of livelihood and household income in Natima Union (1990-2020).

In 2010-2020, there is a sort of diversion in income sources from the agricultural sector to the trade and service sectors. Agricultural income reduces from 33.33% to 30%, and wage laboring reduce to 23.33%, as opposed to the trade and business sector remain a higher peak at 30%, and the service sector at 16.67%. In two decades (1990-2010), there was a gradual increase in land use of agricultural fields and settlement in Natima union but in the last decade (2010-2020) only the settlement area increased like before. This enhancement in settlement flourishes the livelihood in trade and business, and service sectors. The changes in land use of Natima Union especially newly build business centers and service sectors brings changes in livelihood patterns as people diverted primary economic activity to secondary activity.



6. Conclusion

From the overall analysis, it is depicted that land use pattern of the Natima Union has been changed in the last thirty years. With the increase of population, the land resource of the study area undergoes successive changes. Mainly, agricultural land and settlement area have increased considerably whereas water bodies altered drastically. Local people switched their cropping pattern and are trying to cultivate new types of commercial crops mainly mango gardening and corn types crops. Consequently, their household income become better over the years. All the respondents are concerned about their better livelihood and economic conditions but not much aware of proper land management.

However, variations in rainfall and temperature along with other climatic hazards will be the biggest threat to producing a good yield which may affect the future economy of Natima Union. Therefore, people of the Natima Union should be more conscious about the sustainable livelihood system and policy planners should take necessary steps for better land management considering the future impact of land use changes and changing nature of cropping patterns.

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