Evaluating the Effectiveness of Land Use Zoning in Preserving Agricultural Land for Food Security in Nepal

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KEYWORDS

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ABSTRACT

About 673 million people experienced hunger in 2024, underscoring the immense challenge of achieving the SDG goal 2 "Zero Hunger" target by 2030. To combat this goal, security of food must be assured which are categorized in four components: access, availability, utilization and sustainability. Linking components of food security with land use planning, availability of food seems associated with production of food, which is dependent upon availability of agriculture land. Therefore, aim of this study is to evaluate the land use zoning implementation at local level focusing on preservation of the agriculture land considering the case of Banepa Municipality. The methodology adopted for this study is desk review and of key informant interview (KII) and focus group discussion (FGD). For desk review, research articles and policies related to food security and land use has been reviewed to understand its linkages. Freely available remote sensing imagery and maps were used to map the existing land use, while land use zoning guidelines developed by Banepa Municipality were referenced in the preparation of the zoning map. The comparison of existing land use and proposed land use zoning based on legal document reflects that there are bottlenecks in legal arrangements and intituitional arrangements for the land use zoning. Current policy provisions and institutional arrangement is unable to preserve agriculture land that directly impacts on food availability and ultimately affects food security. This study concludes that policy revision and local level capacity building is required to implement the land use zoning and planning for agricultural land preservation. It also recommended for effective implementation of land use policy for preservation of agricultural land and optimum utilization of land for food security.

1. INTRODUCTION

Now a day fertile agricultural lands are an irreplaceable natural resource (Paster, 2004). Considering the loss of agriculture land as a challenge of food security, the increase in population and aspirations impacts on land becomes scarce resource. Land is limited so there is conflict between the competing use of it with interests of individual land user and the common good. As highlighted by Ikerd (2011), land use planning is important for protection of agricultural land such that it contributes in combating food insecurity.

In addition, the study of (FAO, 1993) mentioned that Land use planning is complex subject that needs to be combining with physical, social and economic aspect. Therefore, it seems that land use planning and its implementation is must to protect the productive potential agricultural land for sustainable food systems. Land use planning is not easy task it is complex subject needs to combine physical, social and economic aspect of use with foreseen for future (FAO, 1993).

Land use planning is the process of carefully deciding how portions of the earth's surface should be used considering both present and future conditions based on established goals and criteria (Richardson, 1989). It involves assessing, regulating, and arranging land resources to balance competing demands, promote sustainable development, and maximize social, economic, and environmental benefits. Its purpose is to designate land for specific use: such as agriculture, residential areas, industry, infrastructure, recreation, and conservation for reducing conflicts and safeguarding natural resources (FAO, 1993).

Food security deals with the people's access to sufficient food based on physical and economic perspective for healthy life of them. There are various actors playing role in land use and food security system from local to global scale. The main actors are farmers, citizens in urban area, government institutions and thematic organizations as well as local institution, financial intuitions providing credits to agriculture or agribusiness, International institution like UN providing aid & advice, agriculture based enterprises, Non-government organizations, media (Mouël & Forslund, 2018).

In the global context, rapid population growth increases the demand for food as well as agricultural and forest products. Meeting food security needs using current farming methods is likely to intensify competition for natural resources, raise greenhouse gas emissions, and contribute to greater land degradation and deforestation (FAO, 2020). The challenges of food security and sustainable agriculture are; loss of arable land, limited land for agriculture, food and drought, rural poverty, increase food demand (Jia & Dosdogru, 2021).

Urbanization in Banepa Municipality increased gradually from 1992 to 2012, followed by a rapid surge that reached approximately 18% of the total land area by 2020, accompanied by a significant loss of agricultural land and other existing land uses (Twayana et al., 2020). Government of Nepal has been initiated the action for the protection of agricultural land through land use zoning based on land use policy 2015 but its effectiveness and impacts has not been analyzed yet. Hence, this study aims to evaluate the current land use zoning at local level and its outcome in terms of preserving the agriculture land considering the case of Banepa Municipality.

2. LITERATURE REVIEW

2.1. Land use and food security

World food summit 1996 defined food security as the situation where every person, at all times, has both physical and economic access to enough safe and nutritious food that fulfills their dietary requirements and food preferences, enabling an active and healthy life. Food security requires the consistent fulfillment of four interconnected dimensions: availability where sufficient food supply via production, stocks, and trade, access as households' ability to obtain food influenced by income, markets, and prices, utilization is effective nutrient use shaped by diet, care, and food preparation, and stability- reliable access despite shocks or disruptions (FAO, 2008).

Food security is the key contemporary challenge of the global community (Rockson et al., 2013). *The State of Food and Agriculture: Leveraging Food Systems for Inclusive Rural*

Transformation highlights that food systems encompass not only agricultural production but also processing, distribution, and consumption, all of which contribute significantly to employment and income generation in rural areas. It argues that the strengthening and modernization of these systems can foster inclusive rural transformation by integrating smallholder farmers, women, and youth into value chains, thereby reducing poverty and improving food security (FAO, 2017). The food security heavily depends on agricultural productivity growth (Baldos et al., 2014). Every piece of land need to utilize to feed 30 million citizen of Nepal (Bhattarai et al., 2023).

Land use is the dynamic phenomenon so need to have efficient land evaluation system during land use zoning (Pandey, 2023). There are several studies that emphasizes on combating food insecurity required preservation agriculture land. In this regards, Sustainable Land Management (SLM) theory emphasizes the coordinated and efficient use of land resources to satisfy present human needs while maintaining long-term land productivity and ecological health. It highlights the need to balance agricultural production with environmental protection and socio-economic development by promoting practices that reduce land degradation, improve soil fertility, and conserve water and biodiversity. The approach also advocates for adaptive, participatory, and context-specific land-use strategies that are responsive to local conditions and community priorities (Lininger et al., 2011). According to (Timilsina et al., 2019), in country like Nepal, land management practices had a substantial impact on soil quality and agricultural productivity. It also, highlighted the need for urgent interventions to curb land degradation while sustaining land productivity through the adoption of sustainable land management approaches including horizontal coordination and local level capacity building for local level land use planning is also highlighted in (Shrestha et al., 2021) Towards Sustainable Land Management : State of the Art in Land use Policies of Nepal.

2.2. Land use planning initiatives in Nepal (1990- 2015)

The concept of land use planning through land use zoning was initiated in Ninth Development plan of Nepal (1997-2002) in which focus has given to achieve sustainable land use by implementation of land use plan through zoning and aware people on role of land use plan in agriculture, environment and development activities (Nepal et al., 2020). The legal milestone on Implementation of land use plan, controlling fragmentation and encourage consolidation has been introduced during amend of Land Act 1964 in 2000. Nataional land use project was established in 2000 to carry out the land use plan of country. Land use planning through zoning at national and district level was initiated in land use policy 2001(Nepal et al., 2020). Provision of Central land use coordination council, land use program committee and central land use project at central level and land use action committee decided by government in 2000. The role of national land use project is to prepare land use plan of each VDC/Municipality based on District level land use plan (Oli, 2001) National land use policy was formulated in 2012 focused on sustainable socio-economic and environmental development through the optimum utilization of land resources. There is provision of classification agricultural, residential, commercial, and industrial, forest, public utility and other 7 zones.

2.3. Land use implementation initiatives (2015 onwards)

After devastating earthquake of 2015 and adaptation of new constitution of Nepal in 2015, realization for need of incorporating the risk and hazard of natural or manmade disaster during land use plan was incorporate in revised

Land Use Policy 2015. The policy is committed on the ideology for achieving sustainable, economic and environmental development through the optimum utilization of agricultural land and land resources (MoLRM, 2015). This policy aimed to formulation of federal, Provincial and local level land use plan and their implementation to protect agricultural land, forest area, religious and cultural area etc. Land Use Policy 2015 added 4 more land use zones and number of zones reached to 11.

The Land Use Policy 2015 proposed the responsibility of implementation to Ministry of land management, cooperative and poverty alleviation (Nepal et al., 2020). Implementation of land use is supported by institutional provision for federal to local level land use council (MoLRM, 2015).

Land Use Act, 2019 has been enacted with provision of classification of land, preparation land use zoning map and hand over those maps to local level for implementation of essence of land use policy 2015. The formation of institutional framework of federal to local level land use council including local level execution committee and their role and responsibility has been defined in the Act. Concept of land bank is also included in the act (Uprety, 2021).

Land Use Regulation, 2022 has been formulated and implemented for effective implementation of land use policy. The major provisions are focused on land use classification guidance (based on local need, data received from federal ministry and regulation annex-8), provisions of changing land use classes (zones), parcel fragmentation control & consolidation are included (NLC, 2023).

According to report of land ministry of Nepal-federal government prepared land use zoning maps of all local level in 1:10,000 scale including documents and handed over them to all 753 local governments in 2023. The Land Use Regulation, 2022, gave authority of updating those maps within six months were provided to respective local government. However, many local governments were unable to meet this deadline, prompting the government to extend the timeframe through amendments in 2023 and 2025. Despite technical support from the Survey Department, only around 350 local levels have completed land use zoning, others local level are unable to complete the process.

2.4. Land use & food security in Nepal

Nepal is facing declining in food security situation due to national and international crisis (Bista et al, 2013). In Nepal, the total area of agricultural holdings increased from 1.68 million hectares in 1961/62 to 2.65 million hectares in 2001/02. However, it declined to 2.52 million hectares in 2011/12 and further decreased to 2.22 million hectares by 2021/22 (GoN, 2023). There is urging for protection of agricultural land for production of food which triggered for the government policy that should be focused on protection of agriculture land. The research carried out by forest research and training center shows that the 26.31% crop land in 2000 decreases to 24.21% in 2019 (Aryal, 2022). This indicates that reduction of agriculture adversely affected the food security of country due to decrease in productivity.

Land management practices in Nepal have had a substantial impact on soil quality and agricultural productivity, highlighting the need for urgent interventions to curb land degradation while sustaining land productivity through the adoption of sustainable land management approaches (Timilsina et al., 2019). Expansion of agricultural area can be done by using fallow land in agriculture purpose (Paudel et al., 2019).

3. STUDY AREA

Banepa Municipality is situated approximately

21 km east of the capital, Kathmandu, in Kavrepalanchok District, Bagmati Province. It lies at 27°38' N and 85°31' E, about 1,500 m above sea level, covering an area of around 55 km² and divided into 14 administrative wards (MoFAGA, 2026). The Araniko Highway and well-connected local roads have enhanced accessibility, attracting businesses, tourists, and residents. The municipality hosts numerous religious and historical sites, educational institutions, and healthcare facilities, contributing to its social and economic development as well as tourism. Total population of Banepa is 55628 in 2011 census whereas 67,690 in 2021 Census, reflecting a population growth rate of 1.7–2 % per year and a 10-year growth of 17.3 %.

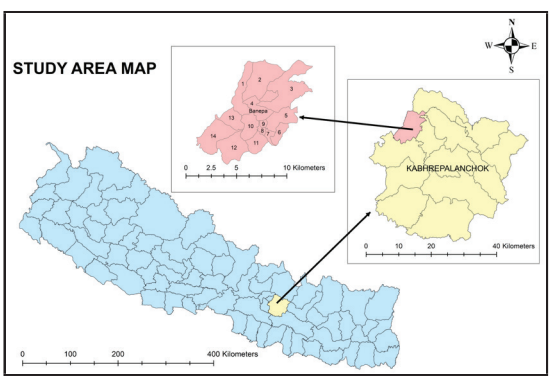

Figure 1: Study area map

4. METHODOLOGY

4.1. Data used

This study is based on mixed method approach using both primary and secondary data including literature review. The primary data used in this study are; Focus Group Discussion (FGD), Key informant interview (KII) whereas secondary data are; satellite imageries (Sentinal2A), administrative boundary data from national geoportal of Nepal. The land use zoning classification guideline approved from municipality has been used for preparation of proposed land use zoning classification map. Similarly, the literature related to land use and food security are collected from various web sources like Google Scholar, ResearchGate, ScienceDirect, JSTOR, SprinkLink, NepJOL, FAO, UNDP etc. The Policies, Act and Regulations related to land use are collected from website of Law commission and land Ministry of Nepal.

Primary data were collected through key informant interviews with members of the local-level land use council, policy experts (5) number. In addition, focus group discussions were conducted in Banepa Municipality wards no 2 and 6 including farmers and relevant stakeholders (ward representatives). Secondary data were obtained from the National Population Census 2011 and 2021, collected from the website of National Statistics Office (https://nsonepal.gov.np/). Administrative boundary data for local level and ward map of Banepa Municipality was downloaded from the National Geoportal (https://nationalgeoportal.gov.np), Survey Department of Nepal. Proposed land use zoning classification guidelines is sourced from the website of Banepa Municipality Office (https://banepamun.gov.np). Satellite imageries are collected form Copernicus website (https://dataspace.copernicus.eu/data-collections/copernicus-sentinel-missions/sentinel-2).

The literatures are search with key words-land policy, land use act, regulation, land use planning, institution related to land, responsibility of land management organization, food security, protection of agricultural land etc. A case study is carried out in Banepa Municipality to study the effectiveness of land use zoning classification practiced by local level focusing on agricultural land use change. The implementation status of land use zoning classification and bottlenecks on policy has been explored based on key informant interview and focus group discussion with members of local level land

use council and policy experts.

The tabular data analysis is done using MS Excel, whereas spatial analysis and mapping is carried out in GIS platform. Policy effectiveness assessment result is based in literature as well as KII (key informant interview) and focus group discussion (FGD).

5. RESULTS

The result of this study is subdivided in three dimensions as existing land use of study area, Proposed land use zoning, and Guidelines for land use zoning of study area;

5.1 Existing land use of the study area

Land use map of Banepa has been prepared based on the freely available satellite image (Sentinel-2) of 2024 and administrative boundary (shape file) downloaded from National geoportal, Survey Department of Nepal. **Figure-2**: shows the existing land use of Banepa Municipality in 2024 with major land use categories agricultural land, forest and residential or non-agricultural area.

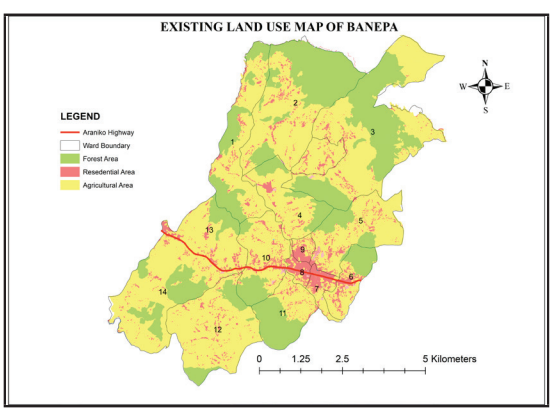

Figure 2: Existing land use map

The area of major land use categories is listed in **Table-1;** The total area of municipality is 5465.59 hectare where the coverage of major land use category are; agricultural land 3356.04 hectors (61.4%), forest area 1666.38 hectares (30.49%) and residential or non-agricultural area 284.34 hectares (5.20%).

Table 1: Existing Land use of study area

S.N.	Present land use category	Area (hectare)	Percentage
1	Agricultural	3356.03	61.40
2	Forest	1666.38	30.49
3	Residential or non-agricultural	284.34	5.20

5.2 Proposed land use zoning

Proposed Land use zoning map of Banepa Municipality is based on land use zoning guidelines approved by local level land use council. The proposed land use zoning map prepared in GIS environment is shown in **Figure-3**. During the mapping process there is complication due to inconsistent guidelines among the wards. Almost wards prepared the guidelines focused on the majority of land to be grouped in residential or non- agricultural land. The zoning criteria are mainly based on the buffer distance from roads.

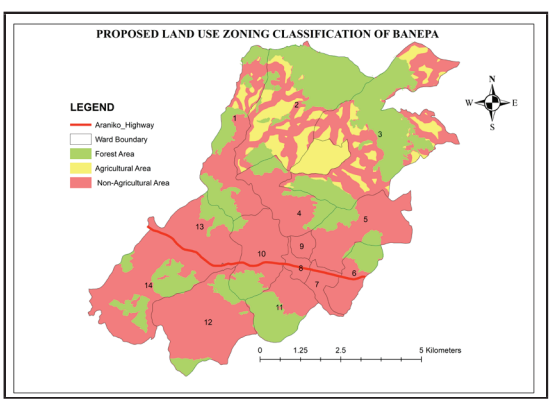

Figure 3: Proposed land use zoning classification map

Preparation of proposed land use zoning map is difficult due to unclear guidelines and conflicting provisions of the Local level land use council decision. Based on council's decisions the area of major land use classification zones are listed as; agricultural land (509.32 ha, 9.32%), forest area (1666.38 ha, 30.49%), and residential or non-agricultural land area (3289.88 ha, 60.19%). The area of major land use categories are shown in **Table-2**.

Table 2: Proposed Land use zoning

SN.	Land use zone category	Area (hectare)	Percentage
1	Agricultural	509.3247	9.32
2	Forest	1666.38	30.49
3	Non-agricultural/ Residential	3289.87	60.19

5.3. Guidelines of the land use zoning class of the case study area

The land use classification made by local land use council is based on the decisions received from the wards. The major criteria for classification is seem to be buffer distances from roads. Classification priority is residential rather than agricultural. The council decision is included in **Table-3** below;

Table 3: Proposed land use zoning guidelines of Banepa

Ward No	Local land use council decision
1	• Residential Area: Past Tukucha VDC ward no 1-4, Past Tukucha ward no 5: 100m from main road center, 50m from other road and river Residential • Remaining Agricultural
2	• Residential Area: 10m or more wider road either side 90m, 6-10m road either side 80m, 4-6m road either side 70m • Other area as present land use; Forest, water, tourism, School , commercial area • Remaining area agricultural
3	• Residential Area: Road 11m, 7m & 5m either side 150m, 100m, 30m • Other area as present land use; School, commercial, cultural, forest, water, Playground, tourism area • Remaining Agricultural area
4	• Up to *Dumtar ghatera dol* Agricultural area • Residential Area: *Akas devi* main road and *Rameshwor* road either side 100m
5	• Residential Area: Previous Banepa ward no 1& 2- residential area, main road 500m, 400m,300m either side • Other classes as present land use; Commercial, Forest, Public utility, river, cultural area etc.
6	• Commercial area: *Araniko* highway either side 150m • Other land use as present land use; Forest, Cultural • Remaining land focused to classify into residential area
7	• Residential area
8	• Residential area
9	• Residential area
10	• Commercial Area: *Arinako* highway 500m either side • Residential area: various road either side 300m/200m
11	• Residential area: Road either side 350m/300m/250m
12	• Non-agricultural/Residential area; Touches with road & river • Agricultural area: other than residential area
13	• Whole ward residential area
14	• Commercial: *Arinako* highway either side 700m • Commercial and Residential area: 500m either side of road

6. DISCUSSION

6.1. Comparison of existing and proposed land use

Based on the results obtained in section 5, a comparative analysis is conducted to understand the status of agriculture land that will be preserving. The **Table-4** shows comparison of existing land use and proposed land use zoning classification based on local level land use council decision.

Table 4: Comparison of existing and proposed land use zoning classes

SN	Land use zone	Existing Area (ha)	Proposed area (ha)	Difference area (ha)
1.	Agricultural	3356.03	509.3247	-2846.71
2.	Forest	1666.38	1666.38	0.0
3.	Residential or non-agricultural	284.34	3289.87	3005.53

It reveals that proposed land use zoning classification prepared based on the guidelines approved by the local level land use council shows that there is significant decrease of agricultural land area 2866.71 hectares (52%) in comparison with agricultural land area in existing land use of 2024. The residential land area- 3005.53 hectares in existing land use seems to be increased by 55% of total area in proposed land use zoning classification. It shows that the guidelines prepared by local level land use council is given priority to residential area rather than agricultural area without assessment of population growth & other parameters required for calculating demand of residential area. This reveals that land use zoning classification decisions has not followed the provisions of classification specified in existing legal provisions of land use policy, act and regulations. The focus has been given to classify lands into residential area due to high residential land value compared to agricultural land. This result shows that of major threat on the preservation of agricultural land in future. UN Food Security Atlas of Nepal, 2019 also highlighted the shrinking agricultural land results lower crop yield production reduces sufficiency of food, which affect the availability dimension of food security (NPC, 2019).

6.2. Challenges in protection of agricultural land

Referring to the Land Use Act, 2019 & Land Use Regulation, 2022-the Authority to updating and approval of land use zoning map and data prepared by federal government is delegated to local level land use council. The data from study area highlighted that the land use zoning classification carried out by local level is only focused on local needs whereas violating the provisions, land use map and data handed over from federal government & the guidelines of annex of land use regulation. In addition, the criteria formulated for preparation of land use zoning in land use regulation (2022) seems to have some technical flaws that has created room for maneuver to assign majority of land in non- agriculture categories. The study of (Timilsina et al., 2019) also mentioned that there were numerous flaws and negligence in the land use planning which in fact unable to access the land for agriculture purpose.

Considering the result obtained from FGD and KII, there is lack of control & monitoring mechanism during the approval process of the local level land use council led to misclassification and undermining the intent of the Land use policy, 2015. Lack of political commitment & proper alignment with coherence between sectorial policies—such as policy related to agriculture, forestry, urban development and food security has been seen unable to protect agricultural land. Limited technical capacity of local government & weak coordination among stakeholders; urban development, agriculture, climate involved in land use planning process is barrier for effective implementation of land use zoning which is also mentioned in (Subedi et al., 2025) present land use and land use zoning of Kushma Municipality . Lack of consistency between federal & local level land use plan is result of non-functionality of the federal and provincial land use council. Implementation of land use zoning faced lack of policy provision on institutional setup to check and approve final zoning carried out by local level land use council. It also highlighted unclear guidelines,

fragile environmental degradation due to unsystematic infrastructure development, more land value in residential land compared to cultivation land, influence of selfish group (mediator and plotter etc.), weak control provision for conversion of land use are major challenges in reduction of agricultural land impacting in food security to meet SDG goal 2.

The pertinent factors highlighted during KII is about political instability at the federal level, characterized by frequent government changes, created volatile policy environment that hinders long-term planning. Institutionally, local levels are hampered by weak capacity and poor coordination with higher tiers of government. This is compounded by a critical shortage of technical expertise, financial resources, and human resources. Furthermore, overlapping jurisdictions between local and federal governments, alongside a plethora of conflicting land-related policies, created legal complexities that stall the zoning process.

Similarly, other important factors highlighted during FGD and KII is the socio-economic issues and technical capacity is another major constraint for local governments to handle and update land use data. High population pressure, widespread poverty, and traditional land rights often conflict with formal zoning frameworks. The prevalence of informal settlements further complicates implementation and enforcement. Weak legal enforcement, low public awareness, and the absence of straightforward compensation mechanisms undermine compliance and foster resistance. These challenges are exacerbated by the compounding effects of climate change and rapid, unplanned urbanization, which made land use zoning task complex.

7. CONCLUSION

The evaluation of effectiveness of land use zoning carried out in the case study of Banepa Municipality during land use implementation showed that there is a major difference between the existing land use and the proposed land use zone around 52% agricultural land is allocated in non- agricultural area supports that the focus of land use zoning is to classify land into non-agricultural area and less priority has given to allocate land in agricultural category means unable to protect agricultural land in future.

The strategies for protection of agricultural land can be achieved by adding provision of control & approval of local level land use council decision by Province or Federal Council. Political awareness regarding land use planning for the members of local level land use council is also required. Assurance of participation of various stakeholders (Agriculture/Industry/Urban development etc.) including land use expert during update of land use zoning is required for effective implementation of land use zoning.

There is need of delegation of authority to district level organization dedicated to look over land use classification and implementation including technical support to local level. Need of coherence between various policies related to land should be established like; land policy, forest policy, agricultural policy, food security policy etc. The protection of agricultural land initiated by land use policy is essence of constitution of Nepal for food security (NLC, 2015). Proper implementation of land use policy can contribute in protection of agricultural land which is the base for SDG goal 2- Zero hunger.

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