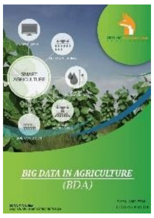
ZIBELINE INTERNATIONAL™ PUBLISHING
ISSN: 2682-7786 (Online)
CODEN: BDAIDR

Big Data in Agriculture (BDA)

DOI: http://doi.org/10.26480/bda.02.2024.152.158



CrossMark

RESEARCH ARTICLE

LAND SUITABILITY ASSESSMENT FOR SOYBEAN (*GLYCINE MAX*) IN BARDAGHAT MUNICIPALITY USING GIS TECHNIQUES

Pragyan Ghimire* and Ramesh Kumar Ghimire

Institute of Agriculture and Animal Science, Lamjung Campus
****Corresponding Author Email: pragyanghimire57@gmail.com***

ARTICLE DETAILS

Article History:

Received 23 July 2024
Revised 18 August 2024
Accepted 03 September 2024
Available online 19 October 2024

ABSTRACT

The Bardaghat Municipality, situated in the Nawalparasi West district, grapples with reduced agricultural productivity owing to inadequate land management practices and the absence of thorough land assessments for crops, notably soybean (Glycine max). This has resulted in meager soybean yields and constrained opportunities for small-scale farmers to diversify into more lucrative crops. The central aim of this research is to assess land suitability for soybean cultivation within the study area, with the overarching objective of boosting crop productivity and refining land use planning strategies. The research employed a comprehensive methodology, combining Pair-wise Comparison Matrix (PWCM) and Weighted Multi-Criteria Analysis via Analytical Hierarchy Process (AHP) to consider various biophysical criteria. Thematic maps were generated using Remote Sensing, Geostatistics, and Geographic Information Systems (GIS). Expert input guided the assessment of three primary criteria and eleven sub-criterion parameters, with weighted assigned through PWCM and integrated into a weighted overlay tool for thorough analysis. The research findings underscored the critical importance of Climatological factors (58.115%), Topographical features (30.9%), and Edaphological conditions (10.94%) in determining the suitability of land for soybean production. The resulting land suitability map revealed that the entire study area, accounting for 100% (162.05 km^2), was highly suitable for soybean cultivation, with no land deemed unsuitable. Notably, built-up regions such as rivers and road networks were excluded from the research scope. The research seeks to advance sustainable agriculture by guiding land planning and empowering local small- scale farmers through optimized soybean cultivation, ultimately bolstering agricultural productivity in Bardaghat Municipality and fostering regional sustainability.

KEYWORDS

Analytical Hierarchy Process, Geographic Information System, Land Suitability, Pair-Wise Comparisons Matrix, Soybean.

1. Introduction

The qualitative and quantitative understanding of variability among numerous genesis related soil variables, as well as their link with properties that have a direct influence on crop choice, is critical (Meena et al., 2014). This assists in determining the yield regulating elements across sites as well as their spatial distribution on the soil-scape. This also allows for a more equitable balance between input resources and yield-determining parameters, maximizing plant performance while minimizing off-site environmental consequences. Soybean is regarded as one of the most produced crops in the world, presenting a source of high-quality protein for human and animal diets. Soybean is a leguminous plant mostly grown in the temperate and sub-tropical regions (Munene et al., 2017). Soybean, Glycine max is a short-day flowering crop originating from Asia. Its grain is used worldwide as a human and animal food source, and for the production of oils and plastics. World soybean production was 320.2 M metric tons in 2015, which represented a 47% increase worldwide since 2005, and accounted for 29.0% of the world's vegetable oil consumption and 70.9% of the protein meal consumption in 2015 (www.soystats.com). According to the statistics MOALD, the production rate of soybean has been decreasing. It is usually incorporated in cropping systems to improve soil fertility and increase yields. This leads to increased crop production, further resulting in increased food security and income generation (Munene et al., 2017). There is potential for soybean production in Nepal, however productivity is usually limited by many factors that include climate change, decline in soil fertility, low availability of improved seed and low usage of microbial inoculum. Other factors limiting soybean productivity include limited availability of inputs, expertise and market opportunities. Crop selection based on land capabilities has been used in several studies to assess the suitability of land for specific crops in order to determine the optimal cropping system (Rahman and Saha, 2008).

Land suitability assessment (LSA) is a tool for categorizing appropriate regions by evaluating land qualities and matching them with available resources. They must meet the standards of a given land use category (Food and Agriculture Organization [FAO] (Mustafa et al., 2011). It is used as an agricultural planning tool to identify viable sites for crop cultivation as well as the key limiting constraints for agricultural production. The systems used to assess land suitability enable the integration of several parameters that influence suitability. Soil, rainfall, temperature, topography, and other non-biophysical elements such as social, economic, and political governance are examples of these. Land suitability assessment is thus a complex process, and such complexities necessitate the use of several decision support tools at the same time, such as Geographic Information Systems (GIS) and multi-criteria decision analysis (MCDA), which are unavoidable in determining suitable land for crop production (Malczewski, 2006b; Mendas and Delali, 2012). The analytic network process (ANP) was suggested in to deal with the issue of dependency and feedback between criteria or alternatives. The ANP is the all-purpose The analytic hierarchy process (AHP), which has been utilized

Quick Response Code	Access this article online	
	Website: www.bigdatainagriculture.com.my	**DOI:** 10.26480/bda.02.2024.152.158

Cite The Article: Pragyan Ghimire and Ramesh Kumar Ghimire (2024). Land Suitability Assessment for Soybean (*Glycine Max*) in Bardaghat Municipality Using Gis Techniques. *Big Data in Agriculture, 6(2): 152-158.*

for multi-criteria decision making (MCDM), to release the restriction of hierarchical structure, and has been applied to project

selection , product planning, strategic decision and optimal scheduling is a type of the analytical hierarchy process (AHP) (Yu and Tzeng, 2006).

The low production and productivity were due to infestation of disease on standing crop. Incidence of insect and diseases, lack of irrigation facility, unsuitable soil properties, climatic condition, topography and unavailability of road and river sources for irrigation are the problems that are seem in the research area through the preliminary survey. This study adopts a multi- dimensional approach that takes soil attributes, topographic features, and climate data into account to assess site suitability for soybean cultivation in a comprehensive manner. Organic matter content, soil pH levels, nitrogen percentage, available phosphorus, available potassium, slope, aspect, elevation, temperature, precipitation, and mapping of land use and land cover are among the important variables that were looked at. Geographic Information System (GIS) techniques are used in this study to identify regions that are good and inappropriate for soybean growing. The research findings have noteworthy consequences for regional authorities and policy-making organizations, with the objective of augmenting the yield of potato crops and improving the socio-economic standing of farmers in the Bardaghat municipality. The broad objective of utilizing GIS in soybean cultivation is to enhance agricultural decision-making and production of soybean crop by integrating spatial data for optimized site selection, precision farming, resource management, risk assessment, and sustainable practices.

2. Fundamental Scale of Absolute Numbers

We depend on the opinions of experts who have contributed for a long time in the specific sector, various qualified professionals, and they give a technique of scaling the individual criteria according to their expertise and knowledge of soybean. Many scenarios exist throughout the judgment in which the elements are equal or nearly equal, and the comparison should be made not on how many times one is bigger than the other, but on what fraction it is more than the other (FAO,1997).

Table 1: Fundamental scale of absolute numbers (Saaty, 2002).

Intensity of Importance	Definition	Explanation
1	Equal Importance	Two activities contribute equally to the objective
2	Weak or slight	
3	Moderate importance	Experience and judgement slightly favor one activity over another
4	Moderate plus	
5	Strong importance	Experience and judgement strongly favor one activity over another
6	Strong plus	
7	Very strong or demonstrated importance	An activity is favored very strongly over another; its dominance demonstrated in practice
8	Very, very strong	
9	Extreme importance	The evidence favoring one activity over another is of the highest possible order of affirmation
Reciprocals of above	If activity i has one of the above non-zero numbers assigned to it when compared with activity j, then has the reciprocal value when compared with 1	Reasonable assumption
1.1–1.9	If the activities are very close	May be difficult to assign the best value but when compared with other contrasting activities the size of the small numbers would not be too noticeable, yet they can still indicate the relative importance of the activities.

3. Land Suitability Classes

FAO classifies land suitability based on land potential and land use pattern. Each class received a standardized score of 1, 2, 3, or 4. All classifications were assigned a value ranging from 1 to 4, with 4 being the highest and 1 representing the lowest. The highest number indicates most relevance or influence, while the lowest value indicates little influence, and values 2 and 3 indicate moderately and marginally suitable for Soybean growth.

Table 2: Land Suitability Classes

Order	Class	Description
Suitability (S)	**S1 (Highly Suitable)**	Land having no significant limitations to sustained application of a given use, or only minor limitations that will not significantly reduce productivity or benefits and will not raise inputs above an acceptable level.
	S2 (Moderately Suitable)	Land having limitations which in aggregate are moderately severe for sustained application of a given use; the limitations will reduce productivity or benefits and increase required inputs to the extent that the overall advantage to be gained from the use, although still attractive, will be appreciably inferior to that expected on Class S1 land.
	S3 (Marginally Suitable)	Land having limitations which in aggregate are severe for sustained application of a given use and will so reduce productivity or benefits, or increase required inputs, that this expenditure will be only marginally justified.
Non- Suitability (N)	**N (Permanently not suitable)**	Land with so severe limitations which are very difficult to be overcome.

4. Materials and Methodology

4.1 Study Area

Bardaghat Municipality is located in Nawalparasi West District in Lumbini Province, Nepal. It is situated in the lap of Chure range. There are 16 wards inside its boundary which are scattered across 162.05 square kilometers of geographical area. Bardaghat Municipality is located between 27.5404° N, 83.7943° E at an elevation of 91 meters to 1936 meters above sea level.

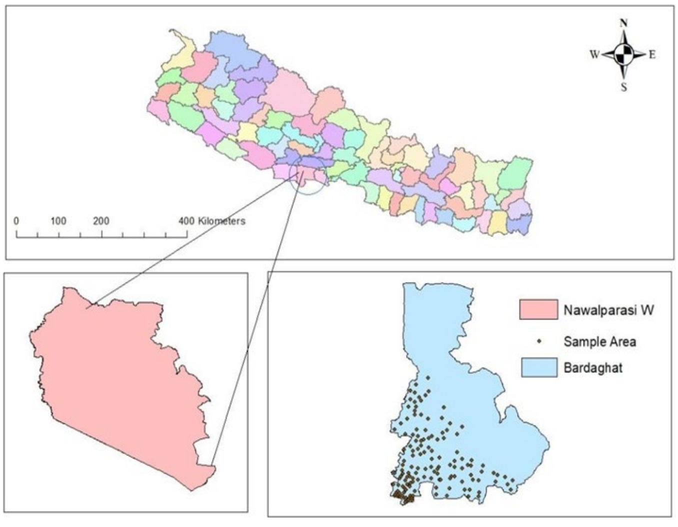


Figure 1: Study area

4.2 Selection of Suitable Crop

Through field observation and questionnaire surveys, primary data on the landform, vegetable condition, and farming techniques were gathered. It works well for prioritizing requirements and identifying challenges within the study area. In order to select the most promising crop for Bardaghat Municipality, a committee including of municipal authorities, agri-entrepreneurs, agricultural technicians, and stakeholders met afterwards. Due to the loss in production/output over the past ten years and its essential daily consumption, soybeans were chosen in the Bardaghat Municipality. The availability of soybeans is mostly impacted by the Indian market, which satisfies customer demand. The primary contributing elements to the possible decrease in soybean productivity and production are pests, fertilizer, crop management, insects, and so on.

As an oilseed crop, soybeans can improve bone health and lower the risk of a wide range of illnesses, such as heart disease, stroke, coronary heart disease (CHD), and some types of cancer. After evaluating the outcomes of the organized discussion and observation, we made the decision to begin the study in order to examine the soil's nutritional quality and appropriateness for the cultivation of soybeans in the Bardaghat municipality.

4.3 Data Source

Table 3: Data source used in analysis

S.N.	DATA SETS	SPATIAL RESOLUTIONS	SOURCES
1	**DEM**	30m	https://earthexplorer.usgs.gov/
2	**Land Use Land Cover Data**	10m	https://hermes.com.np/
3	**Soil Map**		https://soil.narc.gov.np/soil/soilmap/
4	**Climate Map**	0.5°	https://crudata.uea.ac.uk/cru/data/hrg/
5	**Boundary Map**		https://nationalgeoportal.gov.np/#/

4.4 Generation of Thematic Map

The slope, aspect, elevation, land use, land cover, temperature, precipitation, soil texture, soil organic matter, pH, N, P, and K thematic maps were made using the IDW interpolation tool of the Arc GIS 10.8 application. Inverse Distance Weighted (IDW) interpolation calculates cell values by combining a set of sample points that are linearly weighted. The inverse distance determines the weight. Using IDW, the user can alter the importance of known points on interpolated values based on how far away they are from the output point.

4.5 Criteria

The core of the suitability study lies in criteria selection, assessing land suitability based on the research area's biophysical conditions. Choosing primary and sub-criteria is an iterative process. Selection methods include literature review, analytical analysis, and local input. These criteria establish climatic, soil, and topography needs for the chosen land use. Variability of land, soil, and climatic parameters falls within a specific range in the area. The requirements are provided in the table, which includes ranges and threshold values for relevant land qualities as well as suitability ratings for soybean cultivation.

Table 4: Suitability criteria

Requirement	S1	S2	S3	N	N1
P	>60	60-35	19-10	<10	
PH	6-7.5	6.0 – 5.5, 7.5-8	5.5-5.2	<5.2, >8	
slope	1– 4	4-8	8-12	12-16	>16
Aspects					
Elevation					
Land use / cover	Crop land	vegetation	Bare land	Build up	Water bodies
Temp.	>21	-	-	>34and <19	
Organic Matter	>2.5	1.70-2.5	1.70- 0.5	<0.5	
rainfall	>800 - <700	-	-	<700	
N	>0.5	0.1-0.5	0.05-0.1	<0.05	

4.6 Generation of Hierarchy Structure

The research identifies four main criteria—Soil, Topography, and Climate—each subdivided into various sub-criteria. The selection and refinement process, detailed in the provided table, integrates farmer opinions, expert knowledge, and stakeholder input to ensure a comprehensive evaluation. The hierarchical structure features topography, soil, and climate as primary components, with detailed sub-criteria beneath each. This design illustrates the intricate interplay of elements affecting decision-making. It integrates critical perspectives and expert insights, creating a comprehensive assessment framework that captures the subject's complexity and ensures a thorough evaluation process.

4.7 Development of Comparison Matrix at Each Level of Hierarchy

The hierarchical organization supports a structured comparison process for evaluating alternatives based on criteria and sub-criteria, including climate, soil, topography, and socioeconomic factors. Pairwise comparison matrices were created using a 1-9 scale through surveys and expert interviews. These matrices, translating verbal comparisons into numerical values, assess factor significance in soybean cultivation suitability. Values between 1 and 9 indicate parameter importance, with reciprocals used for lower significance. The Consistency Ratio (CR) measures the reliability of these comparisons, ensuring robust and credible decision- making by validating the consistency of the weightings at each hierarchy level.

To avoid the bias from the pairwise comparison, a consistency ratio (CR) was calculated and was expected to be less than 10% for the weights to be approved (Baniya, 2008).

$$CI = \frac{\lambda \max - n}{n - 1} \quad (1)$$

$$CR = \frac{CI}{RI} \quad (2)$$

Where:

λ max: The maximum eigenvalue CI: Consistency Index

CR: Consistency ratio

RI: Random index

N: The number of criteria or sub-criteria in each pair-wise comparison matrix.

According to the Random Index (RI), the average consistency of a comparing matrix in pairs is 1- 10, as determined by an experiment conducted by Oak Ridge National Laboratory and Wharton School. According to Huynh Van, (2008), the higher the level of inconsistency, the larger the matrix.

Table 5: Fact value for criteria/sub-criteria

N	1	2	3	4	5	6	7	8	9	10
RI	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49

The requirements needed are:

- If CR ≤ 10%, AHP is consistent and AHP can be continued.
- If CR > 10%, the Assessment requires revision because the matrix is not consistent.

4.8 Computation of Weighted Factor of Criteria and Sub- Criteria

The weights of the criteria and sub-criteria were determined through an analytical hierarchy process (AHP). Horticulture professionals, soil scientists experienced in horticultural crops, and ecologists provided input to establish the relative importance of one criterion compared to another. Each feature was assigned a knowledge-based weight, which was then synthesized and analyzed using a weighted aggregation method.

In the AHP technique, the weight of each criterion was quantified in numerical values after conducting pairwise comparisons for all interconnected combinations of criteria. The assessment of weight estimation involved evaluating the consistency ratio. If the consistency ratio was found to be below 10%, the limited acceptance level of the performance matrix was considered. On the contrary, if the consistency ratio exceeded 10%, the pairwise relationships of the criteria were deemed unacceptable and subject to rejection.

The weight of the criteria is determined based on the acceptable performance matrix relationship and maintains the total of factor weights to be 1 to meet the requirement of the weighted linear combination (WLC) procedure (Eastman, 2006).

Table 6: Pair wise comparison matrix showing the calculated consistency ratio within criteria

a. PWCM within criteria at CR=0.4%, RI=0.58

Criteria	Climate	Topography	soil
Climate	1	2	5
Topography	1/2	1	3
Soil	1/5	1/3	1

b. PWCM within criteria at CR=1.8%, RI=1.12

Soil sub criteria	N	P	K	pH	OM
N	1	¼	1	1/6	1/5
P		1	4	1/3	½
K			1	1/6	1/5
pH				1	2
OM					1

c. PWCM within criteria at CR=0%, RI=0

Criteria	Rainfall	Temperature
Rainfall	1	
Temperature	4	1

d. PWCM within criteria at CR=2.1%, RI=0.90

Criteria	Elevation	Slope	Aspect	LULC
Elevation	1	5	4	6
Slop		1	1/2	1
Aspects			1	1
LULC				1

4.9 Computation of Weight Factor of Criteria and Sub-Criteria

Weights for criteria and sub-criteria were estimated using the Analytical Hierarchy Process (AHP). Agronomy professionals and soil scientists provided relative weightings, which were then aggregated and analyzed. Pairwise comparisons determined the numerical weights, with consistency ratios used to validate these estimates. A consistency ratio below 10% indicates acceptable results; otherwise, comparisons are revised. The final weights are adjusted to ensure they sum to 1, meeting the requirements for the Weighted Linear Combination (WLC) method, ensuring a balanced and reliable evaluation framework.

Table 7: Analytical hierarchical process results after assigning weights to the individual

Parameter	Weightage sub-criteria	Rank	Overall weightage
Climate	100%		58.115%
Temperature	80%	1	46.492%
Rainfall	20%	2	11.623%
Topography			30.9
Altitude	61.58	1	19.02%
Aspects	15.86	2	4.90%
Slope	10.55	4	3.25%
LULC	12.01	3	3.71%
Soil	100%		10.94%
N	5.58%	4	0.61%
P	17.88%	3	1.95%
K	5.5%	5	0.60%
pH	43.18%	1	4.72%

5. Result and Discussion

5.1 Climate Parameter

5.1.1 Temperature

According to temperature data from the previous ten years, the average temperature in Bardaghat municipality was 25.14 °C – 25.19C. The temperature map revealed that the study area was ideal for soybean crop growth and development.

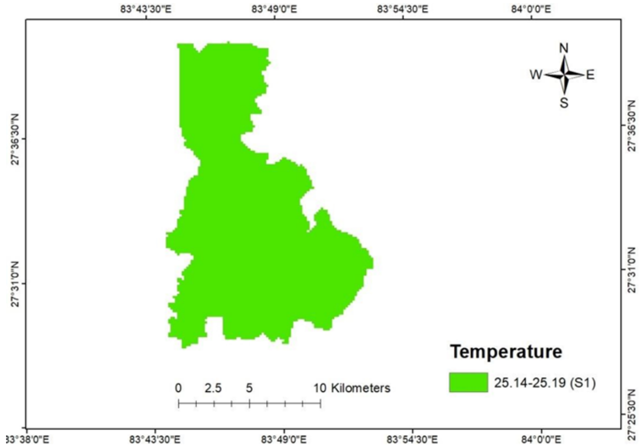


Figure 2: Temperature Criteria

5.1.2 Rainfall

According to 10-year rainfall statistics, the average precipitation in the research area was 563.5-676.9 mm. The precipitation chart revealed that the location was appropriate for soybean cultivation.

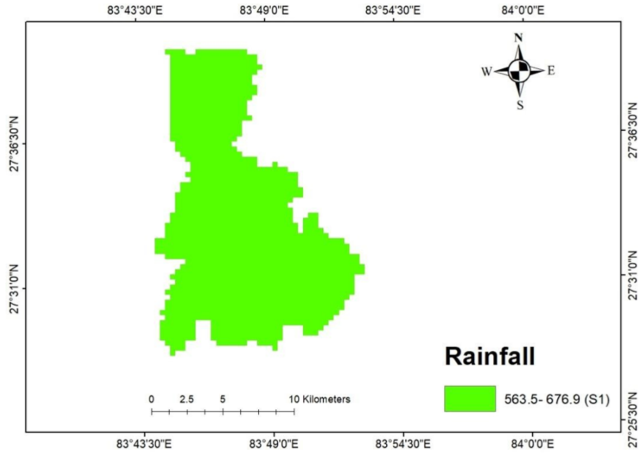


Figure 3: Rainfall Criteria

5.1.3 Climate Final Map

About 162.05 km 2 i.e. all land is highly suitable.

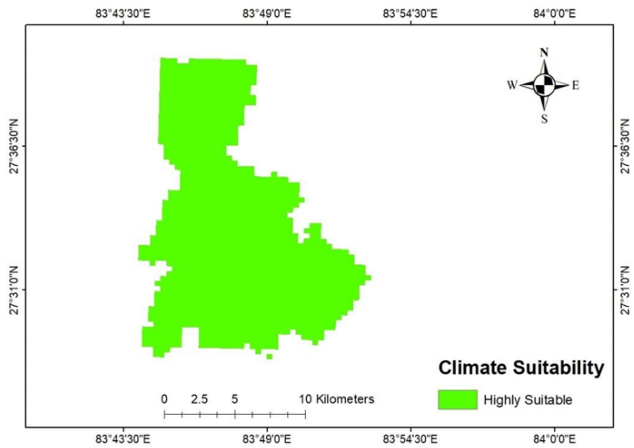


Figure 4: Climate Suitability

5.2 Topography Parameter

5.2.1 Elevation

Figure 5: Elevation Map

5.2.2 Slope

About 80.68 km2 of total land is highly suitable for Soybean cultivation with a slope of 0-4%, while 8.39 km2 of total land is moderately suitable for soybean production with a slope range of 4-8%, 9.27 km2 of total land is marginally suitable for soybean production with a slope of 8-12%, and 63.71 km2 is unsuitable for mandarin cultivation with a slope of >12 %. Slop influences the amount of runoff, erosion, and sediment accumulation in nearby river networks and associated ecosystems. The removal of topsoil is the most significant consequence of slop. The longer the slope, the great sedimentation, and erosion will be there which results in a decrease in soil fertility.

Highly suitable- 80.68 km2

Moderately suitable - 8.39 km2

Marginally suitable- 9.27 km2

Non suitable (N) - 63.71 km2

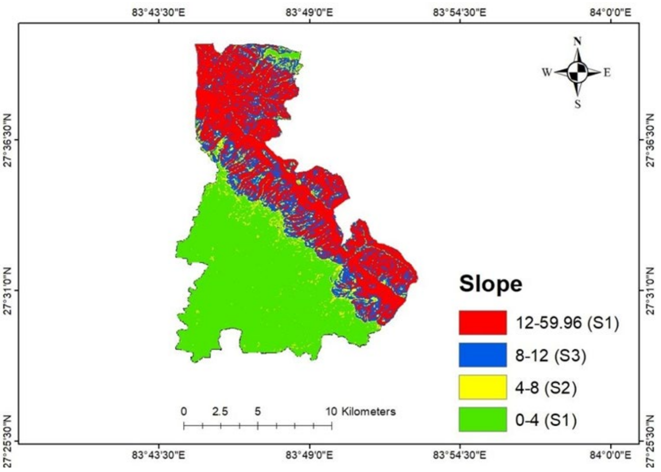


Figure 6: Slope map

5.2.3 Aspect

In the research region, the north facing aspect accounts for50.82 km2, followed by the south and southwest with 36.09 km2 and the east-west facing aspect with 45.86 km2 and 29.29 km2 of land facing south-west, respectively.

Highly suitable: 29.29 km2

Moderately suitable: 36.09 km2

Marginally suitable: 45.86 km2

Non suitable: 50.82 km2

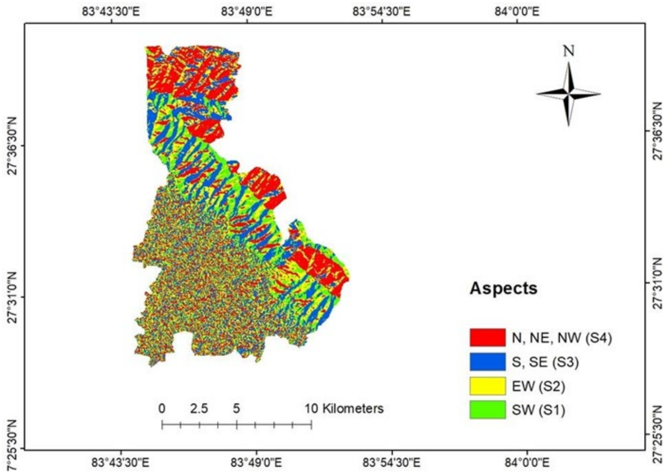


Figure 7: Aspect Map

5.2.4 Land Use Land Cover

There are built-up areas, grassland, forest, bare land, woody land, and cropland in the research area. Cropland covers 6.91 km2, which is extremely or highly suitable, while woodland and bare land cover 65.68 km2, which is marginally suitable. Vegetation land encompasses 9.22 km2 and is moderately favorable for soybean cultivation, while built-up areas and water body cover 80.24 km2 and are unsuited for soybean cultivation, according to the LULC analysis in the research region.

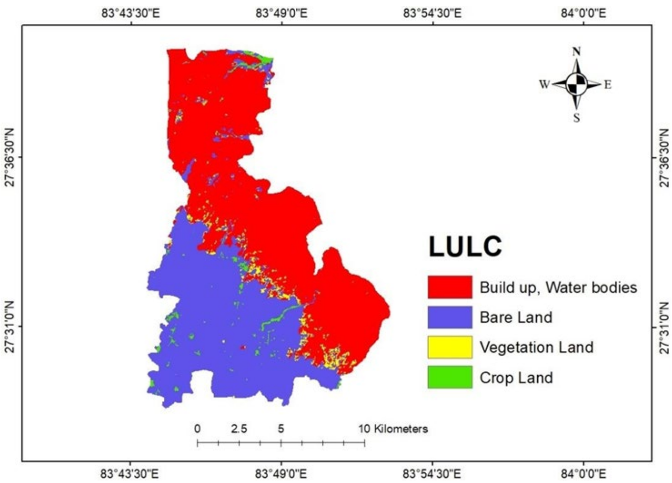


Figure 8: Land use land cover map

5.2.5 Topography Final Map

Moderately suitable- 31.05 km2

Highly suitable- 131.05 km2

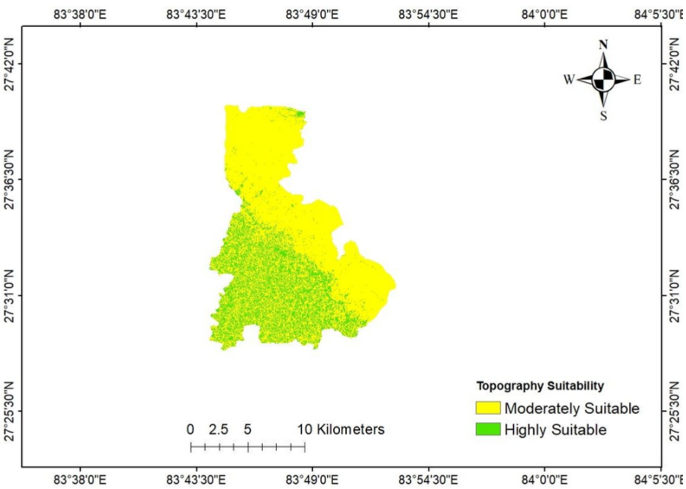


Figure 9: Topography Suitability Map

5.3 Soil Parameters

5.3.1 Nitrogen

Approximately 160.95 km2 of the total land is marginally suitable for soybean cultivation with nitrogen 0.05-0.1 % and land with 1.13 km2 area is moderately suitable for soybean production with nitrogen 0.1-0.13 % and the land with area 0.01 km2 is not suitable for soybean production having nitrogen content less than 0.05%. Nitrogen deficiencies affect the transpiration, stomata conductivity, and chlorophyll content of plant leaves (Kalaji et al., 2016).

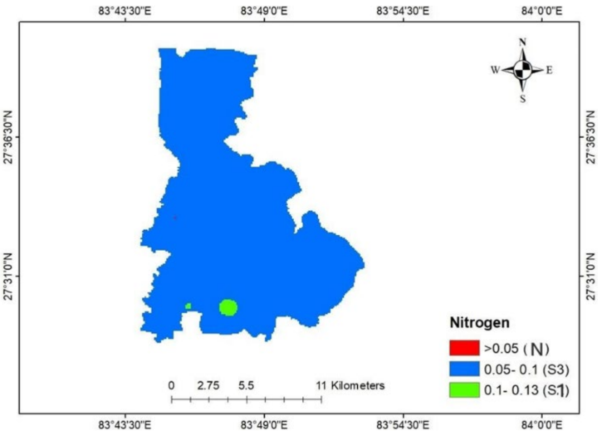


Figure 10: Nitrogen Map

5.3.2 Phosphorus

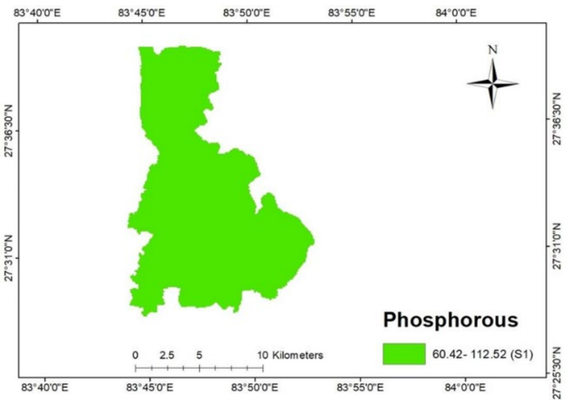


Figure 11: Phosphorous Map

5.3.3 Potassium

Approximately 161.18 km2 of total land is marginally suitable for soybean cultivation with a phosphorous range of 100-124.24 kg/ha, while 0.15 km2 of total land is moderately suitable for soybean production with a phosphorous range of 0-100 kg/ha. Good availability is critical during vigorous root growth phases, such as spring and between vegetative flushes

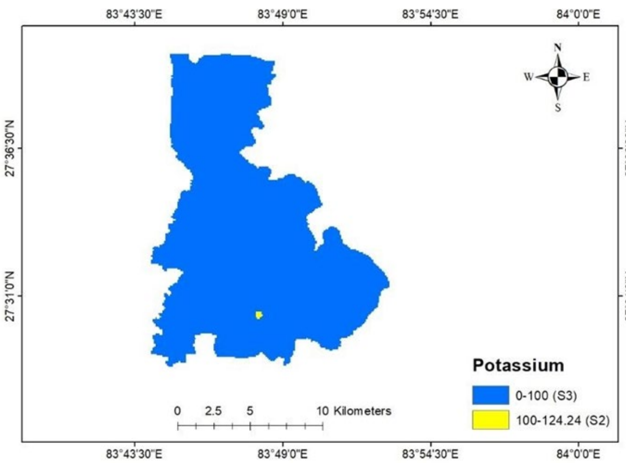


Figure 12: Potassium map

5.3.4 PH

160.86 km2 of total land is highly suitable for soybean cultivation with pH 6-7.5, 1.19 km2 of total land is moderately suitable for soybean production with pH range 5.85-6, 7.5-7.89. Because it affects the chemical forms of different nutrients and their chemical responses, soil pH is a master variable in soil science, governs a multitude of chemical and biological processes that take place in the soil and limits plant nutrition availability. Thus, soil pH affects agricultural productivity and soil quality. (Odutola Oshunsanya, 2019).

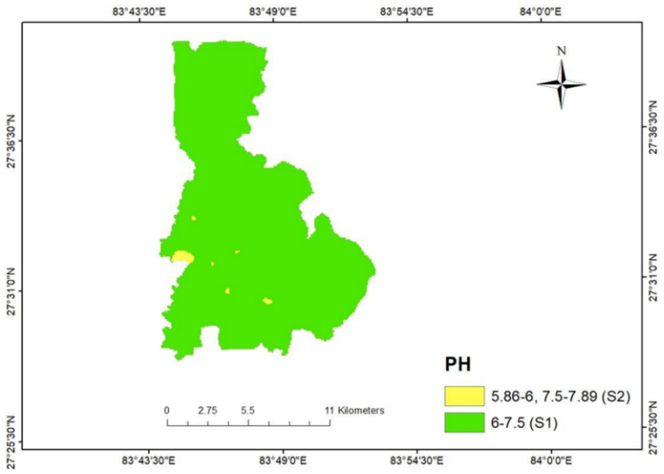


Figure 13: PH map

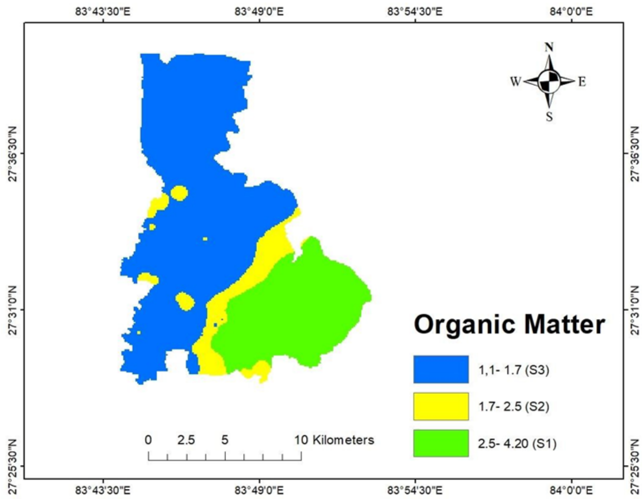


Figure 14: Organic matter

5.3.6 Final soil map

About 59.48 km2 land was highly suitable for soybean cultivation whereas 102.57 km2 was moderately suitable.

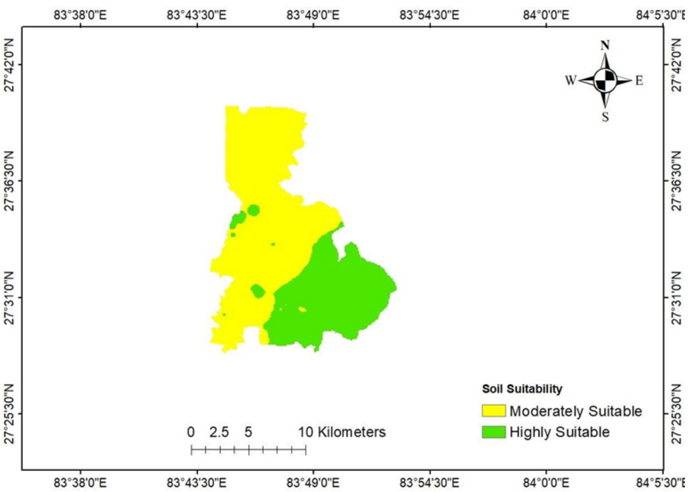


Figure 15: Soil Suitability Map

5.3.7 Final Land Suitability Map for Soybean Cultivation

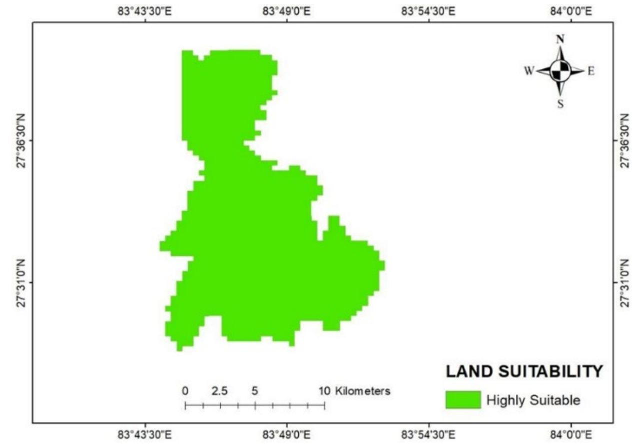


Figure 16: Final land suitability map

Suitability Class	Area	Area %
Highly suitable	162.05 km^2	100

a. Highly suitable

S1 denotes highly suitable class. Approximately 162.05 km2 area is suitable for soybean production this account for 100% of research area. The highly suitable area is characterized by a south and south-west facing aspect, a slope of 0-4, an elevation of 103-1164 MASL, a land use and land cover of pasture and cropland, an organic matter (OM) percentage of 2.5-4.20, a pH of 6-7.5, and available phosphorus of (>94.56 kg/ha). Soybean farming can be performed in this highly suited region, but growers must spend more money on inputs and plant protection due to bug and pest infestations, water-logging conditions, and fruit quality decline due to adverse climate and topography. The available nutrients are limited in this location, so farmers should concentrate on nutrient management strategies. Sloppy land may result in nutrient loss, and loss of the uppermost layer of soil limits the possibilities of soybean cultivation, limiting profit and crop output. Soybean growing in this category is said to be more efficient, both economically and environmentally. Farmers must seek a better alternative to boost yield while maintaining sustainable soil management methods.

6. Conclusion

The final map results showed that 100% (162.05 km2) of the total area was found to be highly suitable for soybean cultivation. We were able to develop Multi Criteria Decision Making using AHP logic and Weighted Overlay Analysis. Result showed that land use of the area for soybean was suitable for commercial production since about 100% area was highly suitable and for generating additional income suitable land use practices should be adopted.

References

Baniya, N., 2008. Land Suitability Evaluation Using Gis for Vegetable Crops in Kathmandu Valley / Nepal. Dissertation, Pp. 1–259. https://www.deutsche-digitale-bibliothek.de/binary/MUK43CAYVEGQW4VV3OPN5ZSQKPIVO354/full/1.pdf

Feizizadeh, B., Blaschke, T., Akinci, H., Özalp, A. Y., Turgut, B., and Malczewski, J., 2013. Journal of Environmental Planning and Land suitability analysis for Tabriz County, Iran: a multi-criteria evaluation approach using GIS. J. Environ. Plan. Manag, 97(1), Pp. 3–65.

Huynh Van, C., 2008. Multicriteria land suitability evaluation for selected crops in hilly region of central Vietnam Agricultural Climate Change View project Master Project in HUAF View project. https://www.researchgate.net/publication/269799354

Kalaji, H. M., Jajoo, A., Oukarroum, A., Brestic, M., Zivcak, M., Samborska, I. A., Cetner, M. D., Łukasik, I., Goltsev, V., and Ladle, R. J., 2016. Chlorophyll a fluorescence as a tool to monitor physiological status of plants under abiotic stress conditions. In Acta Physiologiae Plantarum, 38 (4). Polish Academy of Sciences. https://doi.org/10.1007/s11738-016- 2113-y

Malczewski, J., 2006a. GIS-based multicriteria decision analysis: A survey of the literature. International Journal of Geographical Information Science, 20(7), Pp. 703–726. https://doi.org/10.1080/13658810600661508

Malczewski, J., 2006b. Ordered weighted averaging with fuzzy quantifiers: GIS-based multicriteria evaluation for land-use suitability analysis. International Journal of Applied Earth Observation and Geoinformation, 8(4), Pp. 270–277. https://doi.org/10.1016/j.jag.2006.01.003

Meena, G. L., Singh, R. S., Meena, S., Meena, R. H., AND Meena, R. S., 2014. Assessment of land suitability for soybean (Glycine max) in Bundi district, Rajasthan. Agropedology, 24(02), Pp. 146– 156.

Munene, P., Chabala, L. M., and Mweetwa, A. M., 2017. Land Suitability Assessment for Soybean (Glycine max (L.) Merr.) Production in Kabwe District, Central Zambia. Journal of Agricultural Science, 9(3). https://doi.org/10.5539/jas.v9n3p74

Mustafa, A. A., Singh, M., Sahoo, R. N., Ahmed, N., Khanna, M., and Sarangi, A., 2011. Land Suitability Analysis for Different Crops: A Multi Criteria Decision Making Approach using Remote Sensing and GIS. Water Technology, 3(12), Pp. 61–84.

Nabarath Baniya, M. S., Markschies, C., and Kaufmann, N. C. O. (n.d.). Land Suitability Evaluation Using Gis for Vegetable Crops In Kathmandu Valley /Nepal Dissertation.

Odutola Oshunsanya, S., 2019. Introductory Chapter: Relevance of Soil pH to Agriculture. In Soil pH for Nutrient Availability and Crop Performance. IntechOpen. https://doi.org/10.5772/intechopen.82551

Rahman, R., and Saha, S. K., 2008. Remote sensing, spatial multi criteria evaluation (SMCE) and analytical hierarchy process (AHP) in optimal cropping pattern planning for a flood prone area. Journal of Spatial Science, 53(2), Pp. 161–177. https://doi.org/10.1080/14498596.2008.9635156.

Saaty, T. L., 2002. Decision making with the Analytic Hierarchy Process. Scientia Iranica, 9(3), Pp. 215–229. https://doi.org/10.1504/ijssci.2008.017590.

Sumarsono, J., Widhiantari, I. A., and Saputra, S. E., 2023a. Analysis of land suitability of leading commodities tomato and chili in the sub-district of Moyo Hilir, Sumbawa Regency, West Nusa Tenggara. Proceedings of the International Conference on Sustainable Environment, Agriculture and Tourism (ICOSEAT 2022), 26. https://doi.org/10.2991/978-94-6463-086-2_8

Yu, R., and Tzeng, G. H., 2006. A soft computing method for multi-criteria decision making with dependence and feedback. Applied Mathematics and Computation, 180(1), Pp. 63–75. https://doi.org/10.1016/j.amc.2005.11.163

Cite The Article: Pragyan Ghimire and Ramesh Kumar Ghimire (2024). Land Suitability Assessment for Soybean (*Glycine Max*) in Bardaghat Municipality Using Gis Techniques. *Big Data in Agriculture, 6(2): 152-158.*