



Changes in Land use of Maltidhari College, Naubatpur, Patna under Satellite Imagery Since 2007

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Abstract : Maltidhari college, Naubatpur, Patna of Patliputra University, Patna is an important place of higher education in the faculties of Science, Arts and Humanities. It lies at coordinates 25°28'47.69" N and 84°57'35.15" E. Its campus has undergone a progressive speedy developmental change from 2007 to 2022. This college has in total 6 buildings namely administrative block, Girl's Hostel, Arts Block, Multipurpose Hall, Physics department and Science block. Boundary walls have been made higher and stronger over these periods of time in all sides. Strong cemented roads have also been constructed connecting different buildings from the main gate. To make it environment friendly four different gardens have been established. The latest constructed garden is Gandhi Naitik Sthal which has a statue of our father of nation 'Mahatma Gandhi' in its center. Few minor constructions have also been done for the purpose of parking, temporary shelter for students, special occasions, and aesthetic value. The improvement in infrastructure is also getting reflected in increase in number of students in 2022 which is nearly more than 7 times compared to 2008. Here most of the faculties have already done their doctoral degree and have post-doctoral experience also.

IndexTerms - Buildings, Campus, College, Departments, Education, Gardens, Roads

INTRODUCTION

Maltidhari College, Naubatpur, Patna is an important educational hub for study in faculties of Arts, Science and Humanities. It was founded on 14th July 1956 and soon became a preferred place for higher education. Initially its name was Swamy Vasudevacharya College. Its name was changed to Maltidhari College after land donation by Smt. Maltidhari Singh along with consent of the Governing Body as well as by approval of Swamy Vasudevacharya ('Maltidhari College Naubatpur Patna Bihar' 2023). It became constituent college of Magadh University, Bodh Gaya in 1975 and then in 2018 it came under newly formed Patliputra University, Patna after bifurcation of Magadh University, Bodh Gaya. Its development has taken place from a bare piece of agricultural land to a place of higher educational institution with several buildings for providing educational infrastructure. This is first in a kind of study where satellite data of last 17 years has been obtained from google earth on yearly basis. This work has shown the early sequential changes in development of this institution. Our study clearly shows that from 2007 a speedy development in the college has taken place. Earth observation studies has been made easy by Google Earth Engine (GEE) portal which was established towards the end of 2010 (Kumar and Mutanga 2018) . Its massive computational capabilities can be used for analyzing many aspects related to earth like deforestation, drought, disaster, disease, food security, water management, climate monitoring and environmental protection (Gorelick et al. 2017) . Google earth has been used earlier to study land use change in the Savannah River Basin over time (Zurqani et al. 2018) . It has also been used to map vegetation and land use cover in Fanjingshan National Nature Reserve of China (Tsai et al. 2018) . Space-time analysis over two subregions of Singapore has been done using this technique for Tuas as urban land class and Central Catchment Reserve (CCR) for Wetlands land classes to conclude that forest cover is not affected by anthropogenic factors, but instead is driven by the monsoon cycles affecting Southeast Asia (Sidhu, Pebesma, and Câmara 2018) . Moreover, Land use Map Preparation for Urban Related Applications has been used successfully using this web-based platform (Malarvizhi, Kumar, and Porchelvan 2016).

Google Earth Studies Related to centers of higher education has been done earlier. Data from this software has been used for US college campus to make student commuting safer, more accessible, more eco-friendly, and more convenient even as the student population continues to increase (Schnarre et al. 2022). For photogrammetric mapping of KNUST campus Google Earth has been used as image Source (Agyemang et al. 2020). Similarly for Anna University Satellite Image Of Google Earth has been used to develop the campus monitoring system to be used in planning and future developments (Nasurudeen and Yugesh Kumar 2023). Our study instead of focusing on large land cover has remain pointed on small piece of land where Maltidhari College is situated. The Web-Based Platform of Google Earth has been used to study change over time of the college in last 17 years. We have also reported that these changes have occurred in sequential manner in year-on-year basis. We have mainly observed here the developmental changes in the construction of Buildings, Roads, Gardens and other minor constructions. With annual developmental changes increase in number of students admitted annually has also been observed. Their numbers increased from 62 in 2007-08 to 1434 in 2022-23. These numbers included all students taken Admission in science, arts and humanities. We conclude here that Google Earth Engine can be used to study changes occurring over time in Maltidhari College specially for Buildings, Roads, Gardens and Other Minor Constructions which can be observed by satellite through Google Earth Engine. In future this kind of study will be an added advantage in designing, planning and development of college.

MATERIALS AND METHODS: -

1. Google Earth- Photographs of each year from 2007 to 2023 has been taken from this software. The photos are from the height of 1260 feet.
2. College documents- Some previous documents relating to college campus infrastructure development was accessed.
3. Historical student's data of college- It was obtained from establishment department of the college.
4. Historical teaching data of college- It was obtained from accounts department of college.

RESULTS AND DISCUSSIONS-

1. **Geographical Position and area of college-** Maltidhari college, Naubatpur lies at coordinates 25°28'47.69" N and 84°57'35.15" E. The college is in the state capital of Bihar which is Patna. It lies 16Km south of Danapur which is a subdivision of Patna and about 17Km north of Masaurhi which is a block of Patna. Base map of the college indicates six roads in the college along with all the buildings and parks (Figure 1a).



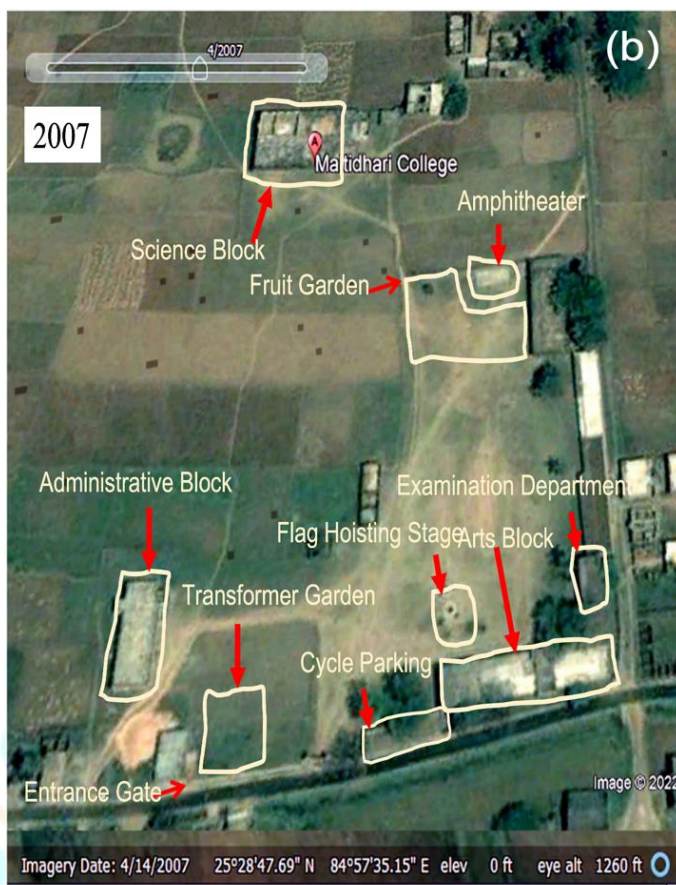
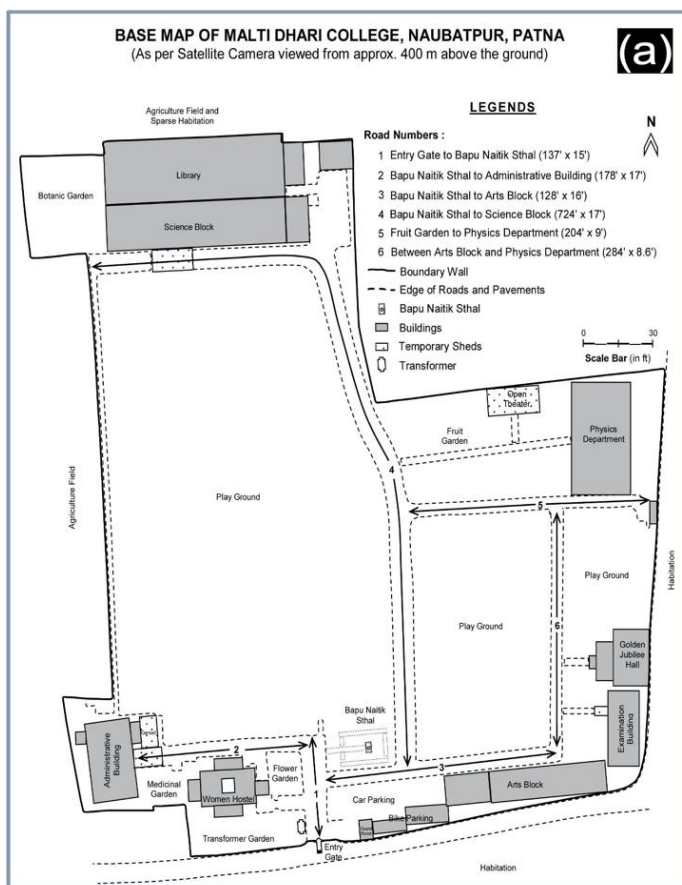


Figure 1- (a) Right upper image showing base map of Maltidhari College, (b) Google Earth Image of year 2007, (c) Right lower image is Google Earth image of year 2010 (d) Left lower image is Google Earth image of year 2011.

2. Developmental changes in college campus on annual Basis- A detailed account of developmental changes occurring from 2007 to 2023 has been done with data available from Google map. Since there is no image of 2008 and 2009 so data analysis for this period has not been done.

2.1. 2007 (Figure 1b)-

- 2.1.1. The boundary wall was with Entry Gate existing only along road from Transformer Garden to Fruit Garden via Physics Department.
- 2.1.2. The existing constructed area of Bicycle parking, Arts Block, Examination Block and Physics Department can be seen.
- 2.1.3. The plinth of Administrative and Science Blocks were constructed.
- 2.1.4. The platform for Flag Hoisting (in front of Arts Block) and an Amphitheatre for organizing events/programme (in front

of Physics Department) were made.

- 2.1.5. Half of the land area was used for agricultural practice by their owners and rest as playground.
- 2.2. 2010** (Figure 1c)-
- 2.2.1. Girls Hostel constructed and construction of Administrative as well as Science Block is in progress.
- 2.2.2. Area of Botanic Garden acquired, enclosed by boundary wall, and planted.
- 2.3. 2011** (Figure 1d)-
- 2.3.1. First floor of administrative block and science block seems to be constructed.
- 2.4. 2012** (Figure 2a)-
- 2.4.1. First floor of Administrative and Science Block seems completed and made operational.
- 2.4.2. Roads (No. 1 and 2) from Entry Gate to Girls Hostel, Administrative Block and from Road No. 1 to Examination Building, another Road No. 3 was surfaced with bricks, rest existing roads remained earthen.
- 2.4.3. The owners of lands were cultivating in their agricultural fields.
- 2.5. 2013** (Figure 2b)-
- 2.5.1. The boundary wall from Fruit Garden to Science Block extended.
- 2.5.2. Construction of foundation of Golden Jubilee Hall started on left hand side of Examination Block.
- 2.5.3. Road No. 4, 5 and 6 been strengthened and are under use possibly due to Agricultural practice.
- 2.5.4. A concrete pavement in between Road No. 6 and Examination Block was constructed with shed at the Entry Gate.
- 2.5.6. The owners of lands ploughed their agricultural fields and/or left barren.
- 2.6. 2014** (Figure 2c)-
- 2.6.1. The agricultural practice had been stopped, and construction of new boundary wall is completed behind and right-hand side of Administrative Block and continuing towards Science Block.
- 2.6.2. The construction work of Golden Jubilee Hall is in progress.
- 2.7. 2015** (Figure 2d)-
- 2.7.1. The new boundary walls from Administrative Block to Science Block and up to girl's hostel via Transformer Garden were completed.
- 2.7.2. Old existing boundary wall was re-strengthened and possibly height was also increased.
- 2.7.3. Foundation and pillaring work of Golden Jubilee Hall is completed.
- 2.7.4. To undertake a greater number of plantations in the premises, approx. 170 pits were made.
- 2.8. 2016** (Figure 3a)-
- 2.8.1. Approx. 170 individuals of plants were planted in developed pits and most of them seems to be Surviving.
- 2.9. 2017** (Figure 3b)-
- 2.9.1. Flower garden was established.
- 2.10. 2018** (Figure 3c)-
- 2.10.1. Generator with shed installed and Roof of Physics Department seems restrengthened.
- 2.10.2. Concrete pavement was made in between boundary wall and big playground.
- 2.10.3. Out of approx. 170 individuals, larger number of plants planted under mass plantation in developed pits were gradually picking up.
- 2.10.4. Trees planted during 2010 have taken shape of juvenile trees.
- 2.10.5. Requisite 40 individuals of medicinal plants were planted in Rishi Vagbhatt Ayurvedic Gardens which was inaugurated on 19.08.2017.
- 2.11. 2019** (Figure 3d)-
- 2.11.1. New concrete footpath and other roads e.g., 4,5 and 6 have been made stronger in front of physics department.
- 2.11.2. Rest of developments are same as they have been mentioned earlier.
- 2.12. 2020** (Figure 4a)-
- 2.12.1. Roads from Entry Gate to Administrative Block which are Road No. 1 and 2 were made by concrete.
- 2.12.2. Sunder Lal Bahuguna Fruit Garden was inaugurated on 31.10.2018.
- 2.12.3. The developmental work of 'Bapu Naitik Sthal' is in progress.
- 2.13. 2021** (Figure 4b)-
- 2.13.1. Road No. 4 starting from Road No. 3 behind 'Bapu Naitik Sthal' to Science Block was widened by raising concrete wall and filling soil.
- 2.13.2. Construction work of 'Bapu Naitik Sthal' seem to be completed and was inaugurated on 02.10.2020.
- 2.13.3. Parking area was also strengthened.
- 2.14. 2022** (Figure 4c)- No developmental Changes Observed.
- 2.15. 2023** (Figure 4d)- No developmental Changes was observed till date of imagery.



Figure 2-(a) Image showing the google earth image of year 2012, (b) google earth image of year 2013, (c) Google earth image of year 2014 and (d) google earth image of year 2015.



Figure 3- (a) Image showing the google earth image of year 2016, (b) google earth image of year 2017, (c) google earth image of year 2018 and (d) google earth image of year 2019.



Figure 4- (a) google earth image of year 2020, (b) google earth image of year 2021, (c) Google earth image of year 2022 and (d) google earth image of year 2023.

3. College Campus development in Last 17 years-

3.1 Boundary Wall- Initially in 2007 boindary wall was present by the side of the road from transformer garden to fruit garden. Later on in 2013 boundary wall from fruit garden to science block has been extended. Further in 2014 it was further extended as new boundary wall

from behind the administrative block going through right side upto half of the distance to science block has been completed. This part of boundary wall was constructed after complete prevention of agricultural work. Later in 2015 construction of new boundary wall was completed from administrative block to science block and from transformer garden to girl's hostel. In addition to that older boundary wall was made stronger and its height was raised.

3.2 Buildings- In 2007 buildings of cycle parking , arts block and examination block were already constructed. Administrative and science block were still being constructed. After 3 years in 2010 construction of administrative block and science block were still in progress while girl's hostel was constructed. In 2011 first floor of administrative block and science block seems to be constructed. In 2012 it is observed that construction of first floor of administrative and science block is completed while construction of second floor is in progress. In 2013 the foundation work of Golden Jubilee Hall located in the left side of examination building has probably started. In 2014 construction of golden jubilee hall is in progress. Next year in 2015 foundation work and pillaring for ground floor of golden jubilee hall was completed. Construction of golden jubilee hall was completely finished in 2022. Students common room.

3.3 Roads- From 2007 we do not recognise any significant changes in road construction of the college. In 2012 we find roads from entry gate to Girl's hostel and road from road no.-1 to examination building i.e. road no. 1, 2 and 3 seems to be constructed by brick. Rest of the roads are likely to be made up of soil. Next year in 2013 we observe that probably due to agricultural works by farmers road no.- 4,5 and 6 is being used more than others. Small footpath was made in between boundary wall and playground in 2018. Then in 2019 we find that new concrete footpath and other roads e.g. 4,5 and 6 have been made stronger in front of physics department. Further in 2020 road no. 1 and 2 have been concreted from entry gate of college to administrative block. Then in following year in 2021 road no. 3 behind Bapu Naitik Sthal to road no.-4 upto science block has been broadened by filling soil and wall was made.

3.4 Gardens- Aesthetic gardens are important element in the sense of teaching as they provide educational experiences in natural areas which are conducive to learning and creativity along with understanding the human- nature relationship. They are an important factor for causing frequent repeat visits by students (Bennett 2014). In 2010 botanical garden was established after land acquisition. In 2017 inauguration of Rishi Bagbhatt Ayurvedic garden was done on 19.08.2017. At that time 40 medicinal plants were planted in the garden. In the same year flower garden also called Malti Pusp Vatika was established which was surrounded on all four sides by fencing with netted iron ward. Development of Bapu Naitik Sthal was in progress in 2020. Back in 2018 SundarLal bahuguna fruit garden was inaugurated where 41 plants of 14 species of fruit bearing plants were present. In 2021 construction of Bapu Naitik Sthal seems to be completed whose inauguration was done on 02.10.2020. In Bapu Naitik Sthal 35 plants of 4 species and herbs , plants/ hedge has been planted in Bapu Naitik Sthal (Table 1). Of all these gardens SundarLal bahuguna fruit garden is largest where many species of fruit yielding plants have been planted.

Serial Number	Name of Garden	Area of Gardens
1.	Rishi Bagbhatt Ayurvedic garden	243.52 m ²
2.	Bapu Naitik Sthal	222.9m ²
3.	SundarLal bahuguna fruit garden	1277.44m ²
4.	Malti Pusp Vatika	339.822m ²

Table 1- Area of different gardens of the college.

3.5 Minor Constructions- Minor constructions for special occasions and functions have also been taken care of. In 2007 flag hoisting stage in front of arts block and amphitheater in front of physics department to organise different programmes were already constructed. In 2013 shade with a broad pavement has been constructed in between road no.-6 and entry gate of examination building. Further in 2018 generator with shade was established along with rendering roof of physics department stronger. In 2021 floor of parking area was strengthened by cemented bricks with proper labelling so that water would drain after rain and formation of mud would also be prevented. Since lighting is very important reason in users' perception of parking garage safety. So light availability was taken care for parking by sun light in daytime and adequate artificial light arrangement in night (Tseng, Duane, and Hadipriono 2004) .

4. Increase in Student's admission and Teacher's Number in Last 16 Years- The number of permanent teachers working here also includes Principal. This college has shown significant increase in admission of students and number of teachers joined in last 15 years. Our data shows that increase in number of students is very well supported by development of campus infrastructure of the college as discussed in previous results. For our convenience we have taken here number of students taking admission in Bachelor of Science, Arts and Humanities in first year only. At present permanent assistant professors belonging to different departments are 2 in economics, 3 in hindi of which one is associate professor, 1 in english, 1 in political science, 1 in Psychology, 1 in physics, 1 in chemistry and 1 in zoology (Table 3). Here permanent teachers are highly qualified as most of 11 teachers are already having their doctoral degree. Diverse assemblage of teachers here gives a good sense of unity as all are from good universities and institutions of national and state importance. Apart from these permanent teachers at present 1 guest faculty in mathematics is also working. We find here that number of students taking admission increased sharply in 2010-11, 2019-20 and 2020-21. Increase in number of students in 2010-11 was not sustained following year as at that time campus infrastructure was not fully developed. It seems construction of boundary wall and roads apart from buildings being constructed had strong effect in increasing the number of students in 2019-20. These campus infrastructural developments also helped in sustaining the increased number of students following year marginal decrease in 2021-22. As latest figure for 2023-24 shows the admission is highest for all time (Table 2).

Year	Number of Teachers	Number of Students
2008-9	7	197

2009-10	9	213
2010-11	7	488
2011-12	5	255
2012-13	5	302
2013-14	5	296
2014-15	8	176
2015-16	6	437
2016-17	3	202
2017-18	11	214
2018-19	11	163
2019-20	11	809
2020-21	15	1241
2021-22	14	1103
2022-23	12	1434
2023-24	11	1638

Table 2- Yearwise numbers of permanent teachers working in the college and number of students admitted every year.

Serial Number	Name of Department	Number of Permanent Teachers
1.	Hindi	3
2.	English	1
3.	Economics	2
4.	Political Science	1
5.	Psychology	1
6.	Physics	1
7.	Chemistry	1
8.	Zoology	1

Table 3- Number of Permanent Teachers present in different departments.

CONCLUSIONS-

Maltidhari college, Naubatpur, Patna of Patliputra University, Patna is an important place of higher education in its locality. In last 17 years its campus has been developed to support education for the students. Boundary walls from all the sides have been constructed to make the campus more secure and prevent any unwanted activities. Except for faculty of Humanities which are located in Arts building, faculty of Arts and Sciences have their own buildings. These faculties are very well connected with concreted roads except for Sciences. As viewed from the google earth construction of Girl's hostel and multi purpose hall started in 2010 and 2014 respectively and within 1-2 years they took their shape. Departments of Botany, Chemistry and Zoology are housed in science building while department of Physics has separate building having ground floor only. In about a decade all old buildings were raised to first floor except for department of physics. The college campus has been developed to provide students an environment friendly condition by constructing four different gardens meant to grow different plant products and also giving the campus a beautiful look. These gardens are Sunderlal Bahuguna Fal Uddyan for growing fruits in front of department of Physics, Botanical Garden in right side of science block, Malti Pusp Vatika for flowers in front of Girl's Hostel, Rishi Baghbhatt Ayurvedic uddyan for medicinal plants in front of administrative block and finally Babu Naitik Sthal for ornamental plants. For comfortability of students shades of steel have been constructed which saves them from rain and sunlight in summer. These shades have also been constructed for the purpose of parking of two wheelers by the side of girl's hostel. Although main parking area near main gate remains unshaded two large trees provide shade for vehicles. MD COLLEGE has been written in the right side of the entry gate in large sized alphabets made of bricks and cements. The campus has free WiFi facility for help in their studies for which a large tower near Administrative block has been established. Providing these infrastructural facilities to students in college campus has resulted in sustained increase in number in their numbers taking admission each year in the college.

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