



Astronomy and Sustainability



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Introduction

As human civilization continues advancing, the concept of **sustainability**—the harmony between economic development, social equity, and the environment—is becoming more and more crucial.

In 2015 the United Nations General Assembly set **17 Sustainable Development Goals (SDGs)** with the aim to create a sustainable future for humanity by 2030.

How can astronomy help meet these goals? We will go over the 17 SDGs and how astronomy has been used and can potentially be used to foster each of them. We will pay special attention to **Africa**, which has been consistently focusing in astronomy for development.

1 NO POVERTY



End poverty in all its forms everywhere

The **Southern African Large Telescope (SALT)** in Sutherland is the largest single optical telescope in the Southern hemisphere and has led to a **large creation of jobs**. SALT has also taken several measures to **make sure this development is felt by all**, like using its political status to source funding for projects that would lead to job creation [2].

2 ZERO HUNGER



End hunger, achieve food security and improved nutrition and promote sustainable agriculture

Satellites are powerful tools astronomy and space science can offer for development, as they can be used to **locate resources** such as food or water. **Ghana** is the first country to have launched a space satellite for this purpose, with Ethiopia expected to launch their own within the next few years [3].

3 GOOD HEALTH AND WELL-BEING



Ensure healthy lives and promote well-being for all at all ages

Interaction with nature is important to human health, as it increases positive emotions and reduces stress levels and daily sedentary time. A recent paper [4] has studied the contribution of **stargazing** to human well-being, and found that participants, among other things, experienced a surge of positive emotions whilst stargazing.

4 QUALITY EDUCATION



Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all

The astronomical sector needs to educate its future workforce. **South Africa**, which has been investing in astronomy to enhance socioeconomic development, created a **national atrophysics programme**, which has led to 149 MSc and 44 PhD students [5], and has also organized activities to spark interest in science in the younger generations.

5 GENDER EQUALITY



Achieve gender equality and empower all women and girls

Astronomy can set a precedent for other STEM branches by striving to **shrink the gap between female and male participation in science**. Steps towards this are already being made, for example with the Girls Astronomy Camp Abuja that took place in Nigeria in 2018 [6].

6 CLEAN WATER AND SANITATION



Ensure availability and sustainable management of water and sanitation for all

As was previously mentioned in SDG 2, **satellites** can be used to locate earth resources such as water. A project focused on creating a completely sustainable observatory, including the acquisition of clean water, will be discussed in SDG 11.

7 AFFORDABLE AND CLEAN ENERGY



Ensure access to affordable, reliable, sustainable and modern energy for all

Observatories that use clean energies can set a great example and be a support for their communities. Examples of how observatories are evolving to clean energies are discussed in SDG 13 and, as mentioned previously, a project focused on a completely sustainable observatory is discussed in SDG 11.

8 DECENT WORK AND ECONOMIC GROWTH



Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all

One of the biggest sectors of astronomy-related economic growth is **astrotourism**. In the first year after the SALT inauguration the number of visitors to the small town of Sutherland jumped up from a few hundred to over **13,000 visitors** per annum [2]. This has resulted in a rapid increase in the number tourism related businesses.

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE



Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation

Astronomy requires **large facilities** that can conduct all sorts of research. The SKA, for example, is now under construction in South Africa; this will be the most sensitive radio telescope on Earth. Astronomy also requires cutting-edge technologies which eventually find their way into **commercial products**, like charge-coupled devices (CCDs) [1].

10 REDUCED INEQUALITIES



Reduce inequality within and among countries

Astronomy generates enthusiasm over all cultures and generations, giving it a key role in reducing inequalities. For example, it can help preserve **Indigenous Knowledge**; a recent paper proposed softwares that would allow Indigenous communities to share their astronomical knowledge (which encompasses a lot of their knowledge) with the world [6].



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11 SUSTAINABLE CITIES AND COMMUNITIES



Make cities and human settlements inclusive, safe, resilient and sustainable

Observatories can be a testing ground for the development of sustainable cities. An example is the **Community Development Around Timor Observatory** project of 2015 [8]. The project entailed giving education to the prospective workforce and fulfilling primary needs (water and energy) for the observatory using STEM knowledge and skill.

12 RESPONSIBLE CONSUMPTION AND PRODUCTION



Ensure sustainable consumption and production patterns

Minimizing food waste and favoring lowest-impact food in conferences has come up as part of more detailed proposals on how astronomy can reduce its impact on the environment, which can set an example for other scientific fields. These proposals are discussed in SDG 13.

13 CLIMATE ACTION



Take urgent action to combat climate change and its impacts

Astronomers have a responsibility regarding climate change as they are **leaders in public outreach**; planetaria alone reach over 146 million people [9]. Furthermore, recent papers have proposed several measures that can be applied to reduce **astronomy's large carbon footprint** like reducing air travel and transitioning its facilities to clean energy [9].

14 LIFE BELOW WATER



Conserve and sustainably use the oceans, seas and marine resources for sustainable development

As was previously mentioned, **satellites** can be used to locate earth resources, which extends to marine life. Furthermore, astronomy benefits from helping investigate and preserve marine life, a new book by NASA astrobiologist Kevin Hand argues the first step to finding **aliens** should be exploring our own planet's oceans [10].

15 LIFE ON LAND



Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification and halt and reverse land degradation and halt biodiversity loss

The article from SDG 3 [4] discusses how individuals who spend more time in nature tend to show pro-environmental behaviors. **Stargazing** can bring awareness to nighttime species, which can encourage concern for their conservation. Astronomy can also help shed light into **light pollution**, a crucial factor in insect population decline [11]

16 PEACE, JUSTICE AND STRONG INSTITUTIONS



Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels

Astronomy can inspire a sense of global citizenship. For example **Columba-Hypatia: Astronomy for Peace** [12] is a project taking place in Cyprus, where its two main communities have been living separated from each other for decades. This project brings together children from both communities to conduct educational astronomy activities.



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17 PARTNERSHIPS FOR THE GOALS



Strengthen the means of implementation and revitalize the global partnership for sustainable development.

Due to the large financial investments and the geographic distribution of observatories, astronomy stimulates the formation of partnerships between countries. The **International Astronomical Union** has more than 10000 astronomers from more than 90 countries [1], and has been funding many development projects across the globe.



Conclusions

In conclusion, Astronomy's universality, inspirational themes and top-notch technology make it an ideal tool for sustainability, being able to contribute significantly to practically all seventeen SDGs.

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Acknowledgements

Thank you to the IAYC for consistently providing me with amazing opportunities such as this. An special thanks to Dr. Dalgleish for her guidance in the making of this article.



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