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# MASTER THESIS

## Biodiversity impact of IKEA supply chains (cotton supply chain) – Tools and methods to measure the biodiversity impact

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# 1 ABSTRACT

In this paper's contents, with collaboration, data provision, and interlinked research, as well as applicational assistance of IKEA, the problem of biodiversity impact measurement and assessment, of business actors and their supply chains, in this case, IKEA's supply chains, and in particular to the testing phase of this project, it's the cotton supply chain, is addressed, analyzed and tested. The paper's contents go through stages of a short introduction upon the topic of biodiversity and its importance for businesses, introduction to current biodiversity impact measurement difficulties, descriptions of the cotton supply chain and its impact, and close interconnectedness upon biodiversity. Subsequently, the potential scale and significance of the impact that IKEA's cotton supply chain poses on biodiversity, as well as their current steps and strive towards measuring of such potential impacts and towards sustainability targets in general, along with the desire for mitigation of such potential impacts and general biodiversity improvements for future's well-being.

Moving further to the review part of the report, the paper reviews and takes an analytical stand upon the current biodiversity impact measurement and assessment tools and contextual applicability and functions, prioritizing those that are most suitable for business purposes, specifically, for the purposes and context of IKEA's cotton supply chain, and analyzes the tools, methods, and platforms, in detail.

In the final analysis part of the report, the paper takes a critical and practical standpoint upon those tools, methods, and platforms, prioritizing some over others, based on their applicability, context, as well as the time scale of the report, and tests upon those tools, using both IKEA's cotton supply chain data as well as global data accessible and available, being necessary for tools' testing phase and thus practical and critical approach, of firstly, deriving to the preliminary, partially factual results at best possible scale of accuracy, dependent upon the date and time available, and secondly, analyzing the deficiencies of those results and methods used, along with their necessary/potential improvements, required to achieve results of a higher degree of precision and factuality; and as of last, describing the potential usability for IKEA's purposes. The results show the risk screening of the locations using IBAT and Global Forest Watch Pro and quantified biodiversity impact by Biodiversity Impact Metric. It must be said part of the results that were created using incomplete data due to which they are not representative of the IKEA cotton supply chain biodiversity impact and serve a function of exemplary and testing results.

## 2 ACKNOWLEDGMENTS

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# 4 INTRODUCTION

Biological diversity, or biodiversity, stands for variability among living organisms and the ecosystems of which they are part, and it underpins our very existence. Biodiversity provides people with essential ecosystem services such as water purification, prevention of soil erosion, nutrient cycling, pollination, regulation of climate, and so on. On top of that, biodiversity provides us with genetic resources, biological materials of actual or potential value containing functional units of heredity, of which derived products represent a crude estimate of 500-800 billion dollars on global markets in the early 2000s. (Kerry Ten Kate, Sarah A.Laird, 2000)

As the biodiversity provides business enterprises directly and/or indirectly with raw materials and other natural assets necessary for their functioning, it can and should be seen as a sphere carrying strategic importance. Whether the businesses acknowledge the fact and subsequently take appropriate steps to improve upon such matters largely depends on the directness of their biodiversity dependency (e.g., ecotourism, agriculture, on the highly dependent end of the scale) and the general company's approach towards sustainability approaches and practices. Yet, at a fundamental level, all economies and businesses depend, directly or indirectly, on biodiversity. (Barna, 2009)

As it is clear, and in regards to the future, essential to not only acknowledge the importance of biodiversity but to take practical and appropriate steps to mitigate the biodiversity loss caused by business activities worldwide, while bridging the gap between the business and the science world and their often opposed stands upon biodiversity, this paper, was produced with intensive cooperation with IKEA corporation and their sustainability department, for the purpose of finding the way of biodiversity impact measurement and assessment, along with potential areas of focus upon the biodiversity loss mitigation from IKEA's supply chains, specifically, IKEA's cotton supply chain.

As IKEA is a multinational corporation, with branches, suppliers, customers, producers, and many other partners and stakeholders across the globe, it avails and uses around 0.69% of cotton produced globally, annually, in its business activities, and thus has a significant potential impact upon biodiversity. (IKEA, 2019, p. 50)

On top of that, in 2014-15, cotton was grown across an estimated 2.5 % of the world's agricultural land, together with the multiple negative effects it poses on the biodiversity; such as water stress from overexploitation and changing weather patterns, biodiversity loss from sub-optimal pesticide application, mono-cropping, conversion of natural habitat, frequent and high rates of agrochemical application, and much more; it stands for an agricultural commodity with significant biodiversity impact. (CISL, 2016, p. 13)

Thus, to measure, assess, and potentially mitigate the biodiversity impact of IKEA's cotton supply chain, this project focuses on and goes through several stages.

**Problem Statement:**

**Which global tools and methods can IKEA use to understand the biodiversity impact in its supply chains (cotton supply chain as testing subject)?**

- What is the best way to approach/angle biodiversity, and how can it be measured?
- What are the global and private tools used to measure biodiversity impact, and how can these tools be used/implemented by IKEA?
- What are the results these tools provide, and what benefits and shortcomings do they offer regarding biodiversity measurements, as well as for IKEA's internal purposes?

As this project uses progressive step-by-step research, going through several stages, firstly, it presents the introduction and understanding of the topic of biodiversity, along with its business-related context and significance. The Paper then discusses the current problems and difficulties related to the measurements of biodiversity impacts deriving from various supply chains. Further, in the initial part of the report, the focus is put on the cotton supply chain and its interconnectedness and close dependency on biodiversity, and subsequently, on its derived negative effects upon biodiversity. Subsequently, the project shifts focus onto IKEA and their cotton supply chain position on the global scale, thus, the potential scale and significance of their impact posed on biodiversity, as well as their current steps and strive towards measuring of such potential impacts, and towards sustainability targets in general, along with the desire for mitigation of such potential impacts and general biodiversity improvements for future's well-being as well as the well-being of the cotton industry.

As a second step, moving to the review part of the report, the focus is put on a review of the contextually chosen biodiversity measurement tools, methods, and platforms, which are analyzed in detail upon their functions in regards to biodiversity measurement and assessment. These tools include Biodiversity Impact Matric (BIM), IBAT, Global Forest Watch, Product Biodiversity Footprint (PBF), STAR Metric, and TRASE. These tools have a different degree of review, dependent on their contextual usefulness, where their functions differ greatly, thus offering different information and data provisions, thus deriving to different results with various applicability.

With each tool having individual specifications and system of functioning (where some of these tools, due to their working system and required expert knowledge, were not reviewed and subsequently could not be tested), as a next step, testing of the tools will is performed, where paper takes critical and practical standpoint upon those tools, methods, and platforms, prioritizing some over others, based on their applicability and context, as well as the time scale of the report. Paper then tests upon those tools, using both IKEA's cotton supply chain data on various geographies and usage of the accessible and available global data that is necessary for the tools' testing phase and thus practical and critical approach. In this section, the paper firstly derives to the preliminary, partially factual results at best possible scale of accuracy (which was refined and refocused several times along the project), depending upon the date and time available, and secondly, analyzes the deficiencies of those results and methods used, along with their necessary/potential improvements, that are required in order to achieve results of the higher degree of factual and contextual precision. As of last, each tested section also contains the tools' usefulness regarding IKEA's supply chains.

# 5 METHODOLOGY

Prior to the start of the project, visits in IKEA facility; specifically, visits to Älmhult in Sweden, Headquarters of IKEA of Sweden, with their own sustainability department; were underdone. Those served as complete basis of the endeavor for finding necessary starting point and appropriate angle; to be used upon the biodiversity measurement and assessment problem; provided by appropriate discussion with numerous representatives of the IKEA and UN-WCMC and others, from IKEA's sustainability department representatives and cotton supply chain representatives to UN scientists and many others. On top of that, research trip to UK was organized by IKEA, to meet the various tool, metric and platform designers and developers; as well as representatives from various organizations, such as Better Cotton Initiative and others; that further provided essential angle and information for appropriate subsequent angle of the research ,subsequently performed by paper writers/students. Once the angle upon biodiversity measurement approach was known, desk research of various scientific data sources; (from web pages to scientific articles to business reports and others) upon numerous tools, methods, metrices, platforms, biodiversity databases and others; was performed, from which few were selected as the best contextual ones, and are found in the hearth of this report; upon which consequently testing was performed, following various scientific methodologies.

In the chapters; 'Introduction to biodiversity, it's business related significance and current measurement deficiencies,' 'Cotton supply chain and significance of its impact on biodiversity,' and 'IKEA and its potential impact on biodiversity through their cotton supply chain,' use of desk research by studying relevant literature was performed, among which were - research articles from Harvard university upon the topic of biodiversity , scientific and review articles from University of Cambridge Institute for sustainable leadership upon the topic of cotton supply chains and its related aspects, as well as usage of IKEA's sustainability report FY19.

In following review part 'Review of the primary biodiversity measurements tools,' and its subsequent subchapters, together with second part of analysis 'Review of the secondary biodiversity measurement tools,' desk research was used, using relevant web pages of the tools, metrices, methods and platforms mentioned, as well as other various scientific literature, e.g. from University of Cambridge Institute for sustainable leadership, regarding the tools descriptions and pre-performed analysis.

When it comes to the ‘Analysis’ part of the paper and its related contents, methodology, as per request of the IKEA (for having methodology along with every tested tool in its separate section, in the hearth of the report), the methodology, for purposes of clarity, is offered in each separate section.

# 6 INTRODUCTION TO BIODIVERSITY, IT'S BUSINESS-RELATED SIGNIFICANCE AND CURRENT MEASUREMENT DEFICIENCIES

Nature, as we understand it, is comprised of living (fungi, plants, animals, etc.) and non-living (climate and atmosphere, water, etc.) components. These together provide us with the 'services' which are fundamental to human survival, from productive soils which enable humans to grow food, to clean water we drink, to the very air we breathe. Nature also provides us with survival resilience, a shelter where to live, so to say, to emerging threats caused by climate change. The resilience of nature is not only causally related to humans' well-being on this planet but also directly related to health and status of biodiversity. (CISL, 2019, p. 6)

Biodiversity is the living component of nature and can be understood as variety of life – its species, ecosystems, populations, and genetic information it carries. Human actions present at every level of nature, from land, freshwater, oceans to the atmosphere, have already caused biodiversity to decline, as well as they will continue to do so. Present and ever-rising unsustainable use of natural resources will create even greater losses upon biodiversity in the future if changes are not made. Any biodiversity losses that occur, whether its losses of entire ecosystems, extinctions of populations and genes, are irreversible, thus lost forever. Even partial losses of biodiversity, such as losses of individual organisms or local populations, mean a decline in genetic diversity, which consequently has various negative effects, e.g., shrinking of populations, sometimes even whole ecosystems, causing a decline in their environmental functions as well as their potential survivability. Such losses, whether on small or larger scales, from ecosystems to genes, all have implications for human health and well-being. (Center for Health and the Global Environment, 2003)

Concerning businesses, biodiversity provides a wealth of essential goods, from food, fuel, fibers, and others, that we rely on. It also provides essential services for society, from birds, insects, or other animals that pollinate our crops, to worms that are essential for soil fertility and forests that have many environmental functions, among it, preventing the spread of diseases. (CISL, 2019, p. 6)

At the present time, biodiversity and nature are in crisis. Living Planet Index records an overall decline of 60% in species 'population sizes between 1970 and 2014, with the effect of 1 million species being now threatened with extinction. (CISL, 2019, p. 6)

Since recent research shows that $44 trillion of economic value generation, standing for more than half the world's total gross domestic product (GDP), is highly or moderately dependent on nature and its services, it is clear to assume that all businesses depend on natural systems either directly, or through their supply chains. (CISL, 2019, p. 6)

Nature's resilience for providing these services is being undermined by growing consumption and damaging production processes, which are increasing pollution and driving land-use changes, having, as a consequence, negative effect for businesses, trade, and economies. Agriculture stands as the key driver, with having most significant impacts on biodiversity and nature, using a third of the world's land for livestock and crop production, at the expense of grasslands and natural forests. (CISL, 2019, p. 6)

This continuous trend of the ecological crisis and biodiversity destruction, interlinked and worsened by climate change, sends a clear signal that business cannot continue as usual. Loss of biodiversity does and will affect businesses, whether indirectly; through supply chains and their business interrelations and interactions with the outside environment (stakeholders), as well as affecting their predictability and resilience; or directly those dependent on nature for raw materials, waste assimilation or indirect support for production processes and continuity of their operations. (CISL, 2019, p. 6)

A successful business can see the risks and opportunities and react to them in a fast and effective manner, seeing the value in recognizing that tomorrow is not going to be identical to today. Thus, companies that understand and recognize their dependency and interconnectedness to nature take the necessary steps towards its long-term resilience and thus position themselves for success in a risky future. Biodiversity focus from the side of businesses thus is not only relevant for branding purposes any longer, but for addressing business' impacts and acting towards them proactively, while mitigating the risks and using the opportunities that inevitable changes in biodiversity, together with their business-related impacts, pose and will continue to do so. Such an approach places the business in a position to succeed in the challenging context of climate and ecological crises, offering competitive advantage and a higher market share. On top of that, businesses that account for and actively seek to enhance biodiversity will as well enhance the resilience of their supply chains, while maintaining a license to operate as well as create additional benefits for the society, and much more. (CISL, 2019, p. 7)

Many business sectors, especially those providing consumer goods, are already realizing that a significant part of their biodiversity impact lies in their supply chains, especially due to their raw material sourcing. Thus, businesses' need to have a comprehensive understanding of the contexts of their raw material sourcing and related impacts upon nature and biodiversity throughout their whole value chain is rising. However, most businesses are not vertically integrated and face the additional serious problem of increased complexity. Consequently, they fail to identify their impacts down to the farm-level, resulting in seeking an approach of proper identification and accounting for such impacts in complex business structures. In an ideal scenario, these impacts, that are significantly location and commodity type-dependent, would be measured at the production site directly, in real-time and iteratively. However, complex field-based biodiversity impact assessments are skill, time, and resource-intensive, as well as expensive, thus making them difficult to integrate across all business operations. That is especially true for multinational businesses, sourcing thousands of various raw materials and/or other commodities from across the globe. (CISL, 2019, pp. 8-9)

Thus, several possible pathways, consisting of tools, metrics, platforms, and other methods, upon the problem of how to measure the biodiversity impact of businesses, will be described, analyzed, and tested in the core content (analysis part) of this project.

# 7 COTTON SUPPLY CHAIN AND SIGNIFICANCE OF ITS IMPACT ON BIODIVERSITY

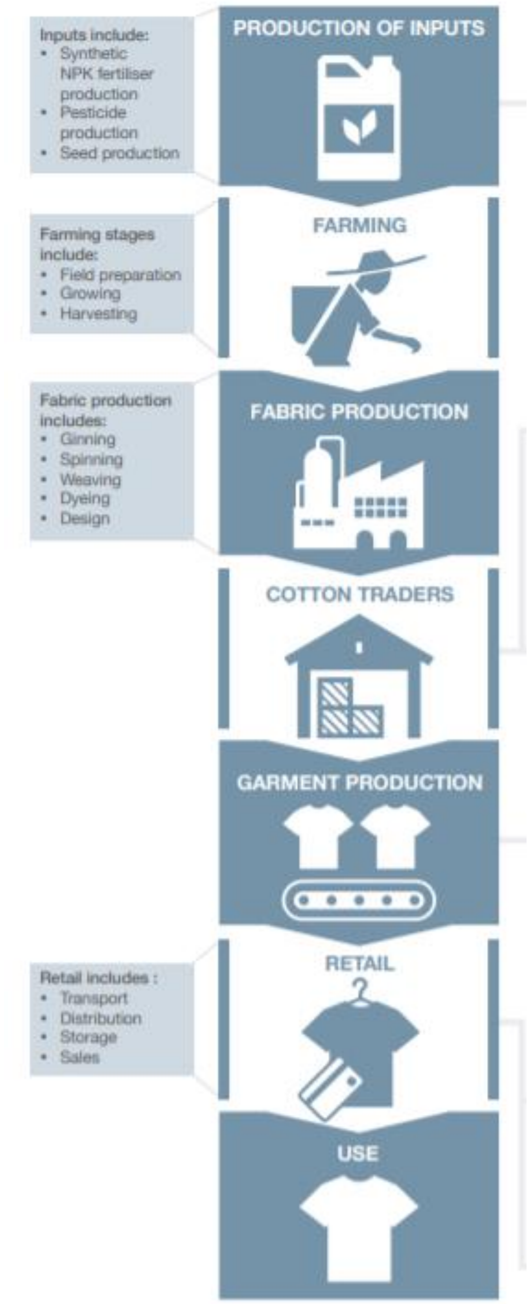



*Figure 1 – Cotton supply chain (CISL, 2016, p. 10)*

Cotton, being a natural fiber used throughout the world for multiple purposes, is one of the most important crops in current society. In 2014-2015, it was grown across 2.5% of the world's agricultural land (size of an area comparable to Finland). (CISL, 2016, p. 5)

Representing one-third of the world's textile demand, production from growing to cotton fiber processing employs approximately 250 million people in more than 80 countries. Even though there is continuance in corrosion of the cotton's share on the market in favor of synthetic textiles, absolute demand for cotton continues to grow. With growing concern about cotton farming practices and the subsequent dramatic increase in cotton production meeting enhanced social and environmental standards, a different number of schemes setting standards for sustainable cotton growing arose. As an example, the initiative used and mentioned in the contents of this project, due to its usage by and connectedness to IKEA's cotton supply chain, BCI (Better Cotton Initiative – certified cotton) already constitutes for almost 10 % of the world's cotton supply and steadily increases. (CISL, 2016, p. 7)

Even though substantial attention has been paid to the negative impacts surrounding cotton production, specifically upon unsustainable water use and poor labor conditions, much has been overlooked in other spheres. Sustainability in cotton-growing should put the closer focus on farming systems that as a main objective for improvement, have maintaining and improvement of natural resources required for cotton farming, as well as meeting social expectations, having adequate and stable yields, safe products, while providing producers with the quality standard of living. (CISL, 2016, p. 7)

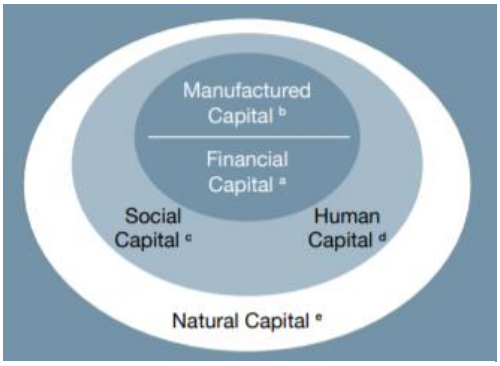



*Figure 2 - Forum for the Future's Five Capital model of the Economy (CISL, 2016, p. 7)*

The cotton industry, as well as its future, is dependent upon natural capital. 'Natural capital' can be understood as an economic characterization of the limited stocks of biological and physical resources that are found on Earth. Its core stands for the limited capacity of ecosystems and their ability to provide services (direct and indirect contributions of ecosystems to humans). When it comes to the production of cotton in a sustainable manner, it requires healthy soils, biodiversity, as well as access to water of sufficient quality and quantity to provide for the plant's needs. All these factors significantly influence the quality and quantity of cotton yields, together with the plant's resistance to various environmental stressors, such as pest infestations, droughts, and similar. Suppose the management and level of attention to these factors provide to be insufficient, especially in an ever-worsening environmental crisis, combined. In that case, they could pose a threat to cotton supply chains, thus influencing the prices and farmer's livelihoods and more. (CISL, 2016, p. 5)

As seen from figure 2, natural capital underlines human, social, manufactured, and financial capital, whereas the, is undeniably significant dependence of cotton production on natural capital, meaning nature's goods and services, that relate and consists particularly of water, biodiversity, and soil. (CISL, 2016, p. 7)

Among the benefits that biodiversity brings are: acting as a biocontrol for pests and assisting the nutrient cycling, helping to avert soil erosion, enhancing water retention and filtering in soil by soil microbes, biological control of plant diseases, nutrient availability for plants, increased resistance to climate changes, pollination, and much more. All these and more goods and services that biodiversity offers underpin cotton production and are essential for a successful harvest. (CISL, 2016, p. 13)

Among the negative effects/impacts and factors playing a role in the degradation of biodiversity could be shortly mentioned:

- **Misuse of pesticides** - where pesticides and other crop protection products commonly used in cotton growing (due to the fact of cotton's long growing season and thus higher vulnerability to weeds, pests, and diseases) can also affect non-targeted organisms, among which belong the beneficial soil microorganisms, beneficial insects and so on. However, even the use of organic pesticides (whether naturally occurring substances or locally made recipes) can similarly be toxic and unsafe to the local, as well as global, environment, yet the local environment can more easily decompose them.
  - Understanding the local ecological context, along with pests and other factors involved, is crucial for identifying the most appropriate application and use of synthetic or organic pesticides.
- **Conversion of natural habitat –** where a large portion of original biodiversity, and its interrelated/dependent biodiversity, is lost.
- **Pollution and Depletion of water resources –** runoffs from cotton fields into water systems, which consequently negatively affect local biodiversity and water catchments.
- **And more**

  (CISL, 2016, p. 13)

Thus, for businesses to secure and safeguard these natural capital elements in their cotton supply chains, firstly, they need to create an understanding upon which agricultural practices and intervention should be considered, while ensuring they are the appropriate ones, in the manner of context and scale at which they should be applied. These dependencies and impacts that the production can be felt throughout the whole cotton supply chain, as illustrated in Figure 1. (CISL, 2016, p. 9)

It is thus understood that a much stronger evidence base is required upon the cotton supply chains in order to ensure informed decisions, especially regarding the actions at the growing stage of the cotton supply chain, where challenges posed by natural capital, thus as well strongly and interrelatedly by the biodiversity component, are the most prevalent. (CISL, 2016, p. 9)

All of the reasons as mentioned above focused around the biodiversity aspect of cotton production show that natural capital, and in particular it's the biodiversity component that is the focus of this report, should be maintained, preserved, improved, and restored in order to safeguard the cotton supply chains with all their related aspects from bottom up. (CISL, 2016, p. 7)

In order to do so, first of all, having in mind the need for stronger evidence base upon this issue for informed decisions, the biodiversity needs to be measured, quantified, and assessed, where finding the appropriate method stands as a core of this report.

## 7.1 IKEA AND ITS POTENTIAL IMPACT ON BIODIVERSITY THROUGH THEIR COTTON SUPPLY CHAIN

To further underline and understand the significance and aim of this report, thus its practical, study case approach, through the interlinking to and collaboration with the multinational corporation of IKEA, should be understood. In context of its role in the cotton sphere and thus its deriving impact upon the biodiversity, the corporation is deeply interested in finding out.

IKEA stands as committed to regenerating resources, improving biodiversity, and protecting ecosystems. It actively works for continuance in developing responsible sourcing standards that include social, environmental, and animal welfare criteria. Even though the main resource, remains forestry and forest derived products and their sustainable procurement and management, cotton belong to one of the main priorities as well as they continue their quest for sustainability on their other raw material sourcing fronts and commodities. (IKEA, 2019, p. 31)

As IKEA is constantly working on improving their responsible and sustainable sourcing agenda in their supply chains, at the moment, all of the cotton they use comes from more sustainable sources, such as cotton grown to the Better Cotton Initiative Standard by farmers working towards Better Cotton, or recycled cotton and other more sustainable cotton sources from USA (e3 Cotton Programme). (IKEA, 2019, p. 46)

This continuous trend of IKEA exists since FY16, where IKEA already used all the cotton derived from sources defined as more sustainable or recycled, which as a consequence, contributed to improving farmer’s livelihoods, yields, and incomes, as well as recurring the negative environmental impact related to production. IKEA’s sense of responsibility derived the position of the cotton as one of their most important commodities and recognition of the impacts of the cotton growing, whereas the total volume of cotton lint consumed in IKEA products across all product categories in FY19 was 142 600 tons, which accounts for approximately 0.69% of the global cotton production that year. (IKEA, 2019, p. 50)

The corporation stands as a founding member of the Better Cotton Initiative (BCI), whose mission is making global cotton production better for both environment in which it grows, the people that produce it, and for the sector's future, with the aim of making 30% of the world's cotton production Better Cotton by 2020. Yet, IKEA continues to strive even beyond their baseline requirements. During FY19 they promoted large-scale changes within the industry, training suppliers and sub-suppliers on requirements for sustainable cotton, methods to meet them, and audits throughout the cotton value chain. (IKEA, 2019, p. 50)

Among the FY19 IKEA cotton project belong Weather-resistant cotton production system in Jalna, Maharashtra, India in cooperation with WWF; Agroforestry project in Warangal, Telangana, India; Climate-resilient crop production (CRPC) project in Pakistan; Agroforestry project in Pakistan; Improving employment practices in the Turkish cotton sector; Supplier review database (SRDB); and more. (IKEA, 2019, p. 50)

Thus, this project, on the topic of finding out how IKEA's cotton supply chain impacts the biodiversity, how this impact can be understood, and thus subsequently allowing for mitigation of negative impacts, or improvement upon related aspects on various levels, is yet another initiative, and subsequently prove, of IKEA's investment and involvement, in sustainable cotton practices and future, throughout their supply chains.

# 8 REVIEW OF THE PRIMARY BIODIVERSITY MEASUREMENT TOOLS

## 8.1 BIM - BIODIVERSITY IMPACT METRIC; BRISC – BIODIVERSITY RISK IN SUPPLY CHAINS; BECS – BIODIVERSITY EXTENT CONDITION AND SIGNIFICANCE FRAMEWORK

From the research of the three above mentioned metrics, it was found there is no real or significant difference between them. All three matrices use slightly different wording phrases for their descriptions, together with their differently worded input units. Still, taking a deeper look into the data required for the calculations, the conclusion is that there is no difference in the underlying calculations and, thus, results. Besides, the BRISC matric presents the possibility of application to more complex supply chains by calculating BRISC for each material in/constructing the product and combining the value to get the whole product's impact, thus not calculating the sourcing material exclusively. The same can be achieved using BIM or BECS, and it is more of the extension of the basic biodiversity metric, based on the simple suggestion of using the same technique everywhere present, at multiple levels of products' components and subsequent result combination.

Therefore, the use, testing, and **sole focus on Biodiversity Impact Metric (BIM)** from CISL (Cambridge Institute for Sustainability Leadership) is the only one required, as the same results can be achieved by any of the presented metrics, as they use the same input data for calculations, deriving to technically-wise, identical results.

### 8.1.1 Description of the Tool and Key features

The purpose of BIM (Biodiversity Impact Metric) is to track and assess how business's sourcing affects the biodiversity, specifically how much biodiversity loss occurs, as the result of habitat or land transformation for purposes of agricultural production, taking into account three factors of the intensity of land use, area of production as well as biodiversity importance at the conversion's/production site. On top of that, the metric enables the comparison of potential impacts (per unit or overall) among different sourcing locations and compares between various commodities. (CISL, 2019, p. 9)

The metric is considered to be a suitable entry-level approach tool, enabling businesses to undertake rapid risk-screening of its sourcing for purposes of identifying where the most significant impacts on biodiversity occur/or are likely to occur, and therefore assisting with prioritization, further in-depth investigation, and possible interventions. (CISL, 2019, p. 9)

### 8.1.2 Methodology and data used/required

$$\text{Biodiversity Impact Metric} = \text{Land area} \times \text{Proportion of biodiversity lost} \times \text{Biodiversity importance}$$

*Figure 3 - Biodiversity Impact Metric Equation (CISL, 2019, p. 11)*

Assessing the impact of agricultural commodity sourced from a specific location, the metric uses an equation based on three main factors; whereas the business needs, at minimum, three pieces of data for calculation, namely, commodity type, sourcing country, quantity purchased (the higher the accuracy of the data, the more accurate result and visibility of sourcing practices; subsequently explained in depth (CISL, 2019, s. 9):

- **The land area needed for production**

With the underlying question of "how many hectares are under production," metric seeks to calculate (to numerically input) the total land footprint that business requires to meet its sourcing requirements, having the relative underlying assumption of that the greater area that is required for production, the greater potential for biodiversity impact. Therefore, the data are required regarding the number of hectares of land use for the production of a specific commodity in a specific country/ more granular location; possibly the hectares required to produce the amount of commodity purchased, or total volume purchased, whereas the actual yields would improve the calculation and thus accuracy of the results the metric offers. (CISL, 2019, pp. 9-10)

Thus, in case of businesses do not have desired visibility in their supply chain, estimation of the land area required to produce a commodity can be calculated by using quantity (tons) of the commodity that the business purchased, in combination with the yield data(whether globally FAO(the United Nations Food and Agriculture Organization) or preferably own/ business' acquired). (CISL, 2019, pp. 9-10)

- **The proportion of biodiversity lost**

In this part of the equation, it is considered how production and production practices used to produce the specific commodity impact the biodiversity at the land of production. Meaning that when natural habitat is transformed into the land of commodity production, some proportion of the original biodiversity may be lost, and there may be various changes in species abundance. (CISL, 2019, p. 10)

The very extent of such changes is closely dependent on the type of land use, specifically mentioned in the methodology if the metric – natural forest, plantation forest, cropland, pasture, and its subsequent intensity of management of such land use – minimal, light, intense, numerically expressed on value range from 0 (no impact) to 1(all original biodiversity lost). In contrast, its value is primarily based on latest Mean Species Abundance coefficients (how many species you can expect to find in an area under production compared with the pristine state of the area). Metric suggests filling the gaps in existing coefficients by using expert judgment and by collaboration and negotiation with metric designers. To properly judge the intensity of the production, metric suggests a questionnaire that would help identify the intensity level of the commodity production. (CISL, 2019, pp. 9-11)

- **Biodiversity importance**

Even though there are several ways to measure the biodiversity's importance, two attributes that are most commonly used are species richness (the number of different species) and uniqueness (rarity of species). Rarity is assessed by the size of species 'range', meaning the area where species resides during its lifetime. The term that is widely used and is a key factor in this equation, Range Rarity, combines the species richness and range size, thus providing an indication of the relative importance of a specific place for biodiversity, in comparison to other regions, and can be expressed numerically, in order to be used in the BIM equation. Locations with a high value of range rarity hold many species and/or they hold those with small global ranges. Taking into account that all of the biodiversity is important, land use and land conversion in areas with higher range rarity carry a greater impact on global biodiversity in comparison with other places, taking into account also important factors such as the condition of the species and it's the likeliness of extinction. (CISL, 2019, p. 10)

In order to quantify and obtain a score of range rarity, data on commodity's sourcing location is necessary. In contrast, the more precise/granular the geographical location is, the more accurately it can impact on biodiversity be assessed. On the other hand, if the business cannot obtain sufficiently granular data, ideally, on the farm level of the production (e.g., only know the location of the supplier on country/state or another level), conclusions about the more precise production location in the assumed unknown, can be derived at using external data sources, regarding production locations (assumptions based on some relevancy of the production data locations, e.g., taking into account only the cotton-producing areas/agricultural areas in given state). (CISL, 2019, pp. 10-11)

### 8.1.3 Scalability

As explained above, due to the very nature of the metric and its underlying equation, BIM can be used at any scale. The geographic area considered within and for the calculation is solely dependent on the availability and accessibility (traceability down the supply chain) of underlying data, thus can be scaled to farm, sub-region, or country level. A possible limitation of the scale can be found in the range rarity layer (biodiversity importance), which is commonly available, and recommended to use, at a minimum scale of one square kilometer. In contrast, the finer resolution than that could provide troublesome, as some species could potentially be incorrectly considered. Another helpful tool to be used that CISL has piloted into the metric, to solve some of the resolution issues and to increase the precision, while reducing the uncertainty around the 'biodiversity importance' variable (mainly the issues connected to insufficient location data), are **'eco-regions,'** which are large areas of land containing geographically distinct collections of species and other biodiversity relevant factors. (CISL, 2019, p. 11)

### 8.1.4 Comparability

BIM can be used for all the agricultural commodities that can be fitted into one of the categories of the 'land use and land-use intensity' supplementary material.

### 8.1.5 Results

The numeric outputs gained from the metric and its underlying equation are interpretable in relative terms, for example, by comparing whether the one sourcing commodity has a higher or lower impact per ton compared to other sourcing locations or global average. By further analyzes and examination of, for example, as shown in Table 1, impact-weighted hectares, the business can see where their greatest impact and of which sourcing location can lie. Another thing to read from the example is that company's total impact per ton is lower than the global average regarding cocoa production. In contrast, in two of their sourcing locations, namely Nigeria and Liberia, the business has a much higher impact than at other location or compared to the global average. Thus the business can already derive to the preliminary conclusion that they possibly could put their focus on those specific sourcing locations. On the other hand, taking into account that the amounts of the commodity being sourced from these locations are at such small amounts, they might consider prioritizing their efforts elsewhere, in locations such as Ghana and/or Côte d'Ivoire, where their total impact is the highest. (CISL, 2019, p. 13)

| Country | Tonnes sourced | Yield (kg/ha) | Land area (ha) | Proportion of biodiversity lost (with 1 representing 100% loss) | Biodiversity importance (range rarity) | Metric results | |
|---|---|---|---|---|---|---|---|
| | | | | | | Impact/ tonne (weighted hectares) | Impact-weighted hectares |
| Côte d'Ivoire | 5,000 | 522 | 9,579 | 0.90 | 1.33 | 2.29 | 11,431 |
| Ghana | 5,000 | 510 | 9,804 | 0.90 | 1.37 | 2.42 | 12,107 |
| Dominican Republic | 100 | 461 | 217 | 0.90 | 1.53 | 2.98 | 298 |
| Nigeria | 100 | 180 | 556 | 0.90 | 0.96 | 4.80 | 480 |
| Cameroon | 50 | 403 | 124 | 0.90 | 1.31 | 2.92 | 146 |
| Liberia | 50 | 142 | 352 | 0.90 | 1.40 | 8.87 | 443 |
| Sierra Leone | 50 | 361 | 139 | 0.90 | 1.29 | 3.22 | 161 |
| **Company total** | **10,350** | | **20,770** | | | **2.42**[a] | **25,066** |
| Global average | | 436 | | 0.90 | 1.35 | 2.79 | |

[a] Weighted average across all source countries

**Data sources**
Tonnes sourced: Business data.
Yield (kg/ha): From credible sources including a business's own data, otherwise FAO country-level yield estimates used.
Land area (ha): Estimated using the volume of raw material purchased (tonnes)/agricultural yield (tonnes per hectare).
Proportion of biodiversity lost: Global Mean Species Abundance values for different land use types and intensities.
Intense (0.90) used for the global average as detailed intensity and land use information is unknown.
Biodiversity importance: Range rarity for cocoa-producing regions (an average that is weighted according to the land area used for production in each region).

*Table 1 – Worked example of the Biodiversity Impact Metric for cocoa supply chains using fictional data values (CISL, 2019, p. 13)*

Yet, in order to appropriately inform the company's decision making, performing in depth-examination and analysis, many more conclusions, assumptions, and subsequent potential actions can be made from the underlying numbers that construct the calculation.

Examining three main components of the equation, several steps can be taken, for example as follows:

- **Land area**
  - Impact reduction could be achieved by reducing the area used for sourcing the commodity, for example, by reducing the quantity of raw material required or possibly

switching to alternative commodity, or perhaps by increasing the yields on already used agricultural land

- **Land-use intensity**
  - Impact reduction could be achieved by reducing the intensity/various aspects of the land use or perhaps changing the land use type where possible
- **Sourcing location – biodiversity importance**
  - Impact reduction could be achieved by sourcing raw materials from other locations that are less important (with lower range rarity values) for biodiversity and/or have higher yields, possibly to location/country or similar, where it requires less land area to produce the same quantity (or possibly make trade-offs) of required commodity (CISL, 2019, p. 15)

It is essential to notice that meddling with various aspects could result in trade-offs; for example, lower production intensity could result in lower yields or similar, affecting the total impact and land footprint. As another example, switching sourcing locations would have numerous social, political, or potentially even environmental consequences, where one should also take into consideration that switching sourcing location to another one would not potentially help the biodiversity as the assumed 'unsustainable production' could potentially continue at the original location, just by switching to another buyer. Therefore, even though the calculations derive at specific numbers/values, it is essential to consider all the values figuring in the equation and subsequently prioritize the further investigation of these values, as the decision making and subsequent actions should be derived at after carefully thought out strategy based on all the figures and values that the very process of the calculation, along with its results, provides. (CISL, 2019, p. 15)

## 8.2 IBAT

"Our common vision is that decision affecting critical biodiversity should be informed by the best and most up to date scientific information and the decision-makers who use that information should help support its generation and maintenance." (IBAT, 2020)

### 8.2.1 Description of the Tool, Key features, and Data used

IBAT is a biodiversity assessment tool that provides up to date scientific data about the current biodiversity state globally and locally. One of the most significant and key features that IBAT provides is rapid visual screening for critical biodiversity. This feature enables the user to visualize geographic information about global biodiversity, on various scales, using three of the world's most authoritative datasets (Protected Areas, IUCN Red List Species, Key Biodiversity Areas), thus enabling users to make informed decisions. (IBAT, 2020)

### 8.2.2 Data required

Data that are necessary as a source of input for both IBAT's rapid visual screening and after mentioned reports are the geographical data of the sourcing locations (pinpoint locations, consisting of longitude and latitude), that are subsequently uploaded in excel format to enable IBAT's functions. (IBAT, 2020)

### 8.2.3 Scalability

Due to its nature and structure, where IBAT builds upon the three worlds largest global databases gathering the data from all around the world about the current state of biodiversity, IBAT allows user to work on various scales/at different resolutions, from the local level to districts, to states, up to a global scale, depending on the granularity of the input data. (IBAT, 2020)

### 8.2.4 Comparability

As the IBAT serves as a tool for biodiversity risk screening and rapid visualization, and does not focus on any commodities in specific, but instead focuses on the instances (such as Protected Areas, IUCN Red List species, Key Biodiversity Areas) around the specified geographical location, IBAT can thus be used on practically any commodity. This allows users to, for example, compare various sourcing locations of various commodities of various suppliers. (IBAT, 2020)

### 8.2.5 Results

Except for the before mentioned rapid visual screening feature that IBAT offers, it also can generate a variety of reports suiting various reporting needs. All reports can be accessed via Pay as You Go or as part of one of their subscriptions.

Reports that IBAT offers are: Proximity Report, Multi-site Report, PS6 & ESS6 Report, Freshwater Report.

**Proximity Report**:

- suitable for high-level early-stage biodiversity risk screening,

- contains and uses databases of Protected Areas, Key Biodiversity Areas & IUCN Red List Species
- limited to a single location
- buffers are user-specified (possibility to select up to three buffers between 1km and 50km for your geometry)
  (IBAT, 2020)

Proximity Report comes as a downloadable file and contains; in PDF (summary of protected areas and Key Biodiversity Areas overlapped for each buffer and IUCN Red List of Threatened Species for a 50km buffer), PNG(two png files showing the outline of the project and chosen buffers concerning protected areas and Key Biodiversity Areas), CSV( full attribute lists of protected areas and Key Biodiversity Areas for each buffer selected and IUCN Red List Species for a 50km buffer) or README(a README file containing an overview of the IBAT platform, limitations, a disclaimer and recommended citations) format. (IBAT, 2020)

**Multi-site Report**:

- suitable for screening against the KBA (Key Biodiversity Areas) and Protected Areas, IUCN Red List Species and their overlap with targeted chosen multiple locations/suitable for incorporating biodiversity into annual sustainability reporting (e.g., reporting against GRI or SASB standards)
- contains and uses databases of Protected Areas, Key Biodiversity Areas & IUCN Red List Species
- possible usage for multiple locations
- user-specified single buffer to be applied to all sites/locations
  (IBAT, 2020)

The multi-site report comes as a downloadable file and contains; in PDF (Protected areas, Key Biodiversity Areas and IUCN Red List Species visualized and compared across a portfolio of sites), CVS (four files detailing the protected areas and Key Biodiversity Areas overlapped by each chosen site, IUCN Red List category counts for each site and a summary overlaps table) and README (a README file containing an overview of the IBAT platform, limitations, a disclaimer and recommended citations) formats. (IBAT, 2020)

**PS6 & ESS6 Report**:

- suitable for high-level early-stage biodiversity risk screening against IFC and World Bank performance standards/ additional screening of single location at 10/50km buffer with emphasis on the likelihood of Critical Habitat flagged
- contains and uses databases of Protected Areas, Key Biodiversity Areas & IUCN Red List Species
- limited to a single location
- buffer defaulted to 10km and 50km
  (IBAT, 2020)

PS6 & ESS6 report comes as a downloadable file and contains; in PDF (Summary of protected areas and Key Biodiversity Areas overlapped for 10km and 50km buffers) and their likelihood to trigger critical habitat. IUCN Red List Species for a 50km buffer and highlights restricted-range species), PGN (two .png files showing the outline of the project and buffers concerning protected areas and Key Biodiversity Areas), CSV (full attribute lists of protected areas and Key Biodiversity Areas for each buffer and IUCN Red List Species for a 50km buffer) ad README(a README file containing an overview of the IBAT platform, limitations, a disclaimer and recommended citations) formats. (IBAT, 2020)

**Freshwater Report**:

- suitable for high-level early-stage biodiversity risk screening of projects with potential to impact on freshwater ecosystems
- contains and uses a database of freshwater species upstream and downstream of a specified location
- limited to a single location
- the user-selected four buffer ranges to be assessed both upstream and downstream of the given location
  (IBAT, 2020)

The freshwater report comes as a downloadable file and contains; in PDF (summarizes freshwater species in hydro-basins upstream and downstream of a specified location within the specified buffers), CSV (one file for each of the buffers specified (as well as the exact site basin) containing IUCN Red List species for a 50km buffer) and a README (a README file containing an overview of the IBAT platform, limitations, a disclaimer and recommended citations) formats. (IBAT, 2020)

### 8.2.6 Subscriptions

IBAT considers itself to be an important cost recovery mechanism, where IBAT subscription directly supports the update and maintenance of three of the world's most authoritative global datasets it uses. IBAT has several subscriptions plans to choose from (IBAT, 2020):

- **FREE subscriptions:**
  - Access to Country profiles
  - Visual Data Map displaying, with Site saving possibility
    - Protected Areas
    - Key Biodiversity Areas
    - IUCN Red List Species
  - Possibility to download reports solely in Pay as you go manner
    (IBAT, 2020)

- **BASIC subscription (5 000 dollars):**
  - All the features of the FREE subscription
  - Access to Site Catalogue
  - Possibility of Uploading & saving multiple locations to Visual Data Map
  - Maximum of 10 proximity reports, with the possibility to download
    (IBAT, 2020)

- **PRO subscription (15 000 dollars):**
  - All the features of the FREE and BASIC subscription
  - Up to 1 million square kilometers of GIS download
  - Up to 30 WBG risk reports, proximity and freshwater reports
  - Up to 3 Multi-site reports
    (IBAT, 2020)

- **ENTERPRISE subscription (price according to an agreement with IBAT):**
    - All the features of FREE and BASIC and PRO subscription
    - Unlimited GIS download
    - Unlimited reports
    - Access to web services

    (IBAT, 2020)

## 8.3 GLOBAL FOREST WATCH

### 8.3.1 Description of the Tool and Key features

Global Forest Watch (GFW) is a free online interactive platform that provides data and tools for monitoring forests. Using cutting-edge technology, GFW allows users to access near real-time information about where and how forests are changing worldwide. As it focused mainly on deforestation risk management in commodity supply chains, it is designed for the possibility of fast action deriving from the real-time forest monitoring. Thus, it is used especially in more action-oriented goals, such as stopping illegal deforestation and fires, calling out unsustainable activities, defending user's land and resources, sourcing sustainable commodities, and others. (Global Forest Watch, 2020)

GFW enables companies to manage geospatial data through analysis and dashboards specifically made for commodity companies and banks' daily operations. As it is free to use, it gathers various users from complex commodity supply chains around a common approach of quantifying and managing progress towards meeting deforestation commitments, its adherence to such commitments, and demonstrating regulatory compliance. (Trade, Development and the Enviroment Hub, 2020)

### 8.3.2 Data used

GFW, bringing together the most current, robust, and reliable timely global data (from the Global Forest Watch Partnerships and World Resources Institute's scientific research) in order to monitor forest changes around the world, incorporates and integrates a wide range of data sets that are being compared and overlayed, such as (Global Forest Watch, 2020):

- University of Maryland/Google – forest change data, global tree cover loss and gain, near real-time FORMA alerts for humid tropics, SAD alerts for Brazilian Amazon, quarterly vegetation change from NASA, and similar
- NASA's Modis satellite for forest fire data
- Global tree cover data, intact forest landscapes, forest cover data, pantropical carbon density data
- Forest use data along with its contextual information, for example, concession areas for natural resource extraction or agricultural production
- Conservation data, for example, global boundaries for protected areas and biodiversity hotspots
- Social data, community land boundaries, and land tenure rights

  (Global Forest Watch, 2020)

### 8.3.3 Scalability

As GFW's nature consists of the usage of the interactive map for near lifetime monitoring of primarily - forest. Yet, also biodiversity and commodity monitoring with other additional functions detailly described below in the "Results" section, the scalability of such monitoring efforts on an interactive map ranges from global to local levels, according to user's usage intentions and granularity of user's input data (location's area sizes). (Global Forest Watch, 2020)

### 8.3.4 Comparability

As GFW focuses primarily on forest monitoring and deforestation monitoring activities and does not work with specific commodities per se, instead works with sourcing locations for those commodities to screen for deforestation or primary forest "risks," this allows user to work with practically any commodities and their subsequent geographical allocations, additionally allowing the user to compare risks and other functions from such commodities 'sourcing locations. (Global Forest Watch, 2020)

### 8.3.5 Results

Global Forest Watch, as well as Global Forest Watch PRO, (which enables commercial use and larger data handling and saving packages), have several features (described together with their frequency of update information, area resolution as well as a source of data used), all belonging under an interactive near the real-time map, which has five main categories and several subcategories, enabling multiple functions, that are as follows:

- **Forest Change**
  - ***Deforestation alerts***
    - ***Deforestation alerts*** (weekly, 30m, tropics, UMD/GLAD) – identification of areas of likely tree cover loss in near-life time
    - ***Deforestation alerts*** (monthly, 250m, tropics, CIAT) – display of the areas where tree cover loss recently occurred
      (Global Forest Watch, Map, 2020)

  - ***Fire Alerts*** (daily, 375 m, global, NASA) – displays up to three months of fire alert data (Global Forest Watch, Map, 2020)

  - ***Tree Cover Change***
    - ***Tree cover gain*** (12 years, 30m, global, Hansen/UMD/Google/USGS/NASA) – identification of areas of tree cover gain
    - ***Tree cover loss*** (annual, 30m, global, Hansen/UMD/Google/USGS/NASA) – identification of the areas of gross cover tree lost, with the possibility to pick according to canopy density
    - ***Emerging hotspots*** (2002-2019, tropics, Harris et al.) – identification of significant clusters of primary cover lost on a country level bases
    - ***Tree cover loss by the dominant driver*** (2001-2018, 10km, global, Hansen/UMD/Google/USGS/NASA) – shows the dominant driver (commodity-driven deforestation, shifting agriculture, forestry, wildfire, urbanization) of tree cover loss within each 10km grid cell and the intensity of that loss for the time period 2001-2018, with the possibility to pick according to canopy density
      (Global Forest Watch, Map, 2020)

- **Land Cover**
  - ***Tree cover*** (2000/2010, Hansen/UMD/Google/USGS/NASA) – identification of the areas with tree cover, with the possibility to pick according to cover density

- ***Primary forests*** (2001, 30m, Pan-Tropical, UMD) – it mapped the extent of primary forests in the global pan-tropical regions in 2001
- ***Intact forest landscapes*** (2000/2013/2016) – Identifying the world's last remaining unfragmented forest landscapes as of the year 2016. Additionally, showing the reduction in the extent of Intact Forest Landscapes from 2000 to 2016
- ***Mangrove forests*** (Global Mangrove Watch) – shows the global coverage of mangroves for select years from 1996 to 2016
- ***Land cover*** (ESA/UCLouvain, 2015) – layer shows the global distribution of land cover in 2015, consisting of subcategories of agriculture, forest, grassland, shrubland, sparse vegetation, wetland, settlements, bare, water, permanent snow, and ice
- ***Tree plantations*** (2015, select countries) - identifies planted forests and tree crops for select countries

  (Global Forest Watch, Map, 2020)

- **Land Use**
  - ***Commodities***
    - ***Logging concessions*** (select countries) – provision of the boundaries of logging concessions for the selective logging of natural forests.
    - ***Mining concessions*** (select countries) – displaying boundaries of the areas which were allocated by governments, in order to compare for extraction of minerals
    - ***Oil palm concessions*** (select countries) – displaying boundaries of the areas which were allocated by governments to companies, regarding oil palm plantations
    - ***Wood fiber concessions*** (select countries) – displaying boundaries of the areas which were allocated by governments to private companies, regarding tree plantations for the production of timber and wood pulp for paper and other paper products
    - ***Palm oil mills*** **–** displaying the locations of palm oil mills
    - ***RTRS Guides for Responsible Soy Expansion*** **–** guiding the expansion of responsible soy production and it evaluates in situ HCVAs according to the RTRS Standard

- ***RSPO oil palm concessions* –** displaying the boundaries of the areas which were allocated by governments to companies, regarding oil palm plantations
- ***Oil and gas concessions*** (select countries) – referring to the areas which were allocated by the government to companies that produce and explore for natural gas, oil, and other hydrocarbons
  (Global Forest Watch, Map, 2020)

- ***Conservation***
  - ***Protected areas* –** displaying the areas which are legally protected, following specific designations, for example, state reserves, wildlife reserves, national parks, and areas that are managed to achieve conservation objectives
    (Global Forest Watch, Map, 2020)

- ***Infrastructure***
  - ***Major dams*** – identification of dam locations for the world's fifty major river basins
  - ***Congo Basin logging roads*** – showing the spread of logging roads in the location of Congo Basin
    (Global Forest Watch, Map, 2020)

- ***People***
  - ***Indigenous and Community Lands*** (LandMark) – displaying the boundaries of the lands that are collectively used or held by Indigenous People or local communities
  - ***Resource rights*** (select countries) – displaying the boundaries of such areas, where indigenous people or local communities have certain rights to various resources and restricted rights to access the land
  - ***Population Density – 2015*** – displays the global estimate from the year 2015, in regard to human population density and distribution
    (Global Forest Watch, Map, 2020)

- **Climate**

- ***Carbon Emissions***
    - ***Carbon dioxide emissions from tree cover loss*** (annual, 30m, tropics, Hansen/UMD/Zarin/WHRC/Google/USGS/NASA) – displaying carbon emissions, which are related to clearing of aboveground live woody biomass across the tropics
    - ***Carbon dioxide emissions from tree cover loss in drained peat*** (Indonesia and Malaysia, 2013/2014) – displaying carbon emissions, which are related to peat drainage in Malaysia and Indonesia from plantation establishment
    (Global Forest Watch, Map, 2020)

- ***Carbon Density***
    - ***Tree Biomass density*** (30m, global, Zarin/WHRC) – displaying carbon density values in regard to aboveground live woody biomass, globally
    - ***Soil carbon density*** (Sanderman (2019), ISRIC SoilGrids (2017)) – identification of organic carbon density in the topsoil (0-30 cm depth)
    - ***Mangrove biomass density*** (30m, global-tropics, Simard et al. (2019)) – dataset containing information about aboveground biomass density of mangroves in global tropical regions
    (Global Forest Watch, Map, 2020)

- ***Carbon Gains***
    - ***Projected carbon storage from forest regrowth*** (40 years, 500m, Latin American tropics, Chazdon et al.) – this function for purposes of guiding national-level forest-based carbon mitigation plans, displays the potential of carbon accumulation in aboveground biomass resulting from natural regeneration of secondary forests
    (Global Forest Watch, Map, 2020)

- **Biodiversity**
    - ***Global biodiversity intactness*** (UNEP-WCMC/NHM) – displaying the impacts of forest change on local biodiversity intactness

- ***Global biodiversity significance*** (IUCN/BirdLife International/UNEP-WCMC) – displaying the relative importance, pixel-wise, regarding its aggregate contribution to the distribution of forest-dependent species of conifers, amphibians, birds, mammals
- ***Alliance for zero extinction sites*** (World Database of Key Biodiversity Areas) – identification of critical sites for conservation, which include both, populations found nowhere else on the planet and endangered species with limited ranges
- ***Biodiversity hotspots*** (Conservation International) – displaying hotspots of Conservation International's biodiversity – which are regions around the world, where biodiversity conservation is most urgent because of the high level of human threat and endemism
- ***Endemic Bird Areas*** (BirdLife International) – identification of areas with the geographic range of two or more endemic bird species overlap
- ***Tiger Conversation Landscapes*** (WWF and Resolve) – displaying three layers, showing the location of current tiger habitats, critical tiger corridors, areas of habitat expansion

  (Global Forest Watch, Map, 2020)

#### 8.3.6 Subscriptions

Even though the GFW comes as free to use, there is an option to purchase and use the Global Forest Watch PRO version, which, most importantly, allows for commercial use and adds several features for the user or the company that made such purchase. Those are:

- ***Upload & Save*** – where the user has a possibility to create various portfolios (e.g., investment locations, production areas, etc.) from/in collaboration with suppliers
- ***Analyze & Monitor*** – better analyzing and identification capabilities, with the possibility of monitoring progress on commitments or goals' pursuit in real-time
- ***Collaborate*** – possibility to share the findings (e.g., risks/ risk assessments/progress assessments, etc.) and prioritize various aspects with colleagues or partner companies within the PRO version
- ***Manage*** – identifying aspects for prioritization, management of goal/mitigation commitments, etc.

  (GFW PRO, 2020)

# 9 REVIEW OF THE SECONDARY BIODIVERSITY MEASUREMENT TOOLS

## 9.1 PBF - PRODUCT BIODIVERSITY FOOTPRINT

### 9.1.1 Description of the Tool

Product biodiversity footprint (PBF) is currently under development and in the testing phase. PDF project aims to answer the lack of specific tools that assess the impact of various products on biodiversity. Its unique baseline principle is to co-develop a method and a tool crossing companies' data with biodiversity studies to quantify the impacts of a product on biodiversity all along the product's life cycle stages to provide the correct recommendations for effective changes. It also brings together all existing available data. It provides quantitative results for the decision making process, while also taking into account product strategy (eco-design, purchasing strategy, risk analysis, and more). (PBF, 2020)

In order to improve the environmental performance of the product, PBF identifies environmental hotspots that can be improved, and it supports eco-design approaches. To have such capabilities, PBF aims to have a strong discriminating capacity – a method that aims to distinguish between the variants of a product and ones with lower impacts on biodiversity. Thus, the LCA framework is used upon the product to assess the relative differences between the variants. PBF aims, in the long term, to be able to compare different products among different sectors at larger spatial scales. (PBF, 2020)

### 9.1.2 Data required

PBF uses various global, publicly available data ad biodiversity databases, whereas the input data that is required is company data in regard to LCA, production processes, localization data, existing local biodiversity studies, and related lists of actions. (Trade, development & environment hub, 2019)

### 9.1.3 Scalability

The tool can be used on any spatial scale, from global to national to site/local level, but the usage of the tool is dependent on data available. (Trade, development & environment hub, 2019)

### 9.1.4 Comparability

The PBF can be used on any products, with preference to work with agricultural commodities and without focusing on/taking into account environmental services. (Trade, development & environment hub, 2019)

### 9.1.5 Results

The tool focuses on covering the five pressures on biodiversity, identified in the Millennium Ecosystem Assessment(2005) (PBF, 2020):

- Land use (habitat change)
- Pollutions
- Climate change
- Invasive species
- Overexploitation of species
  (PBF, 2020)

The knowledge upon biodiversity included in the LCA framework is based upon ecological publications that are specific for each individual pressure, as well as on available global biodiversity database, which assesses the state of biodiversity. Several scientific challenges are being addressed at the moment, such as defining the relevant indicators for each pressure as well as relevant spatial scales and use of heterogeneous data; testing on three case studies (food, textile, cosmetic industries) is being done in order to come up with the most suitable solutions. In order to use the tool, it requires expert knowledge upon LCA methods and user's knowledge upon the biodiversity topic. (PBF, 2020)

Among the strengths of the tool belong:

- Full product approach (e.g., agriculture production)
- Ability to reveal the impact of positive biodiversity actions of a company along the whole product's lifecycle
- Capacity to combine both real company data and database modeled information for reduction of the need for input data from the side of the company while also positioning and comparing specific product performance with average product performance
- Providing coverage of all significant pressures on biodiversity
- Providing quantitative (while scientifically robust) link between impacts and pressures

- Ability to cover all countries and all industry sectors
- Usage of biodiversity and LCA databases that are based on an extensive meta-analysis that continuously allows for adding new scientific material and studies

  (Trade, development & environment hub, 2019)

Among the weaknesses/limitations of the PBF tool belong:

- The methodology needs to include or complete cause-effect pathways (e.g., adding ecotoxicity in pollution)
- Lack of marine biodiversity factor
- Semi-quantitative pressures (such as invasive species, overexploitation, etc.) should be better calibrated to other pressures
- Maps/graphic interface should be improved to facilitate the vision of impact geographically better

  (Trade, development & environment hub, 2019)

### 9.1.6 Subscriptions

PBF aims to be available for, mainly, corporate uses, but subscription/usage conditions are currently unknown because of on-going development/testing.

## 9.2 STAR METRIC

### 9.2.1 Description of the Tool

STAR metric is currently finishing the development and implementation/piloting phase. The STAR metric concerns itself with the measurement of contributions that investments can make to reduce species extension risk. It can possibly be used by the finance industry, investors, businesses, national and subnational governments, cities, and civic societies in order to help them to target their investments for achieving conservation outcomes as well as it can measure the contributions these investments make in fulfilling the global targets and global policy aims, such as Sustainable Development Goals. (IUCN, 2020)

STAR metric focuses on two complementary site-based actions to ensure species conservation. First, it focuses on the abatement of threats to prevent larger deterioration in species survival probability. Secondly, it focuses on the restoration of the habitat itself to contribute to the improvement of species survival probability. (IUCN, 2019, p. 1)

### 9.2.2 Data required, scalability and comparability

STAR metric allows calculations of such contribution that could be made over any spatial scale (from global, national, to small-scale business contributions). Such calculations can be made for any species or group of species for which the adequate data are available. On top of that, STAR stands as a scalable and additive metric, allowing, for example, nations to measure their global contribution or businesses to measure their national contribution. The current focus of the metric and its calculations is global and momentarily focused mostly on amphibians, mammals, and birds due to these taxonomic groups' good data availability. Yet, plant groups and more animal taxa are being considered and implemented. (IUCN, 2019, p. 1)

### 9.2.3 Calculation and Results

The calculations of the metric itself consist of required data on species conservation status (IUCN Red List category), Area of Habitat (AOH, both historical and current, calculated using species distribution polygons, habitat associations from IUCN Red List, and land cover maps) and lastly, the threats they face (IUCN Red List threat classification hierarchy). The metric calculation for a site is: $\sum$ ( PSP x WSp x RSpT) (IUCN, 2019, p. 1)

As to results that the STAR metric brings, it can be used to assess ex-ante(potential) and ex-post(achieved) impacts of investments at a range of scales and over a range of timeframes. The results that the equation brings can be used variously, for example (IUCN, 2019, p. 2):

- Portfolio screening, selecting the projects with maximum potential conservation impact
- Assessment of potential and achieved impact regarding species extinction risk across the chosen portfolio
- Identification and monitoring activities regarding conservation interventions at chosen sites
- Tracking sectoral impacts on extinction risk, across commodity value chains
- Measurement the progress in reduction of extinction risk on the province, state, or national level
- Adhering to global targets on slowing extinction risk and tracking the progress, for example, 2020 global Aichi targets
  (IUCN, 2019, p. 2)

### 9.2.4 Subscriptions

The commercial or other uses of the STAR Metric are currently unknown, as it is currently in the finishing stage of its development and testing/implementation phase.

## 9.3 TRASE

### 9.3.1 Description of the Tool, Data used, and Results

TRASE platform is currently under development, and its vision is to provide, by 2021, the go-to public supply chain information system for investors, companies, governments, and other actors that seeks to transition towards more sustainable trade, consumption, and production for the world's major forest-risk agricultural commodities. TRASE's main goal is to increase transparency in agricultural commodity supply chains, revealing the links to environmental and social risks in tropical forest regions, while also creating opportunities in the improvement of sustainability in regard to production, trading, and consumption of these commodities. (TRASE, 2020)

It aims is to cover over 70% of the total traded volume of major forest risk commodities, such as pulp and paper, timber, coffee, palm oil, beef, soy, cocoa, and aquaculture. When it comes to cover geographies, the initial focus is on Latin American soy, followed by beef in Argentina, Paraguay, and Brazil; palm oil in Indonesia and Colombia, followed by coffee in Colombia. It also intends to add additional countries and commodities in further platform development over time. (TRASE, 2020)

The platform addresses the commodity transparency problems by using publicly available data for mapping the links between consumer countries via trading companies to the places of production in detail. It displays how commodity exports are linked to agricultural conditions – including specific social and environmental risks – at the source - where they are produced, thus allowing governments, companies, and others to comprehend the risks and subsequently identify more sustainable production opportunities. The provision of this data at various scales is intended to be free-of-charge, thus comprehensively mapping supply chains for key commodities on the scale of entire countries and regions. (TRASE, 2020)

By identifying the internationally traded agricultural commodities and key supply chain companies along the way (from the countries where the commodities are produced to the countries that import them), TRASE information/results upon those can be used at every stage of the supply chain for mapping against environmental and social indicators; by, for example, commodity traders (striving to meet sustainability commitments), producer country governments (promoting sustainable production or reducing poverty), consumer country governments (who want to understand and manage their countries' socio-environmental impacts abroad), concerned consumers or others; in order to support improved decision making for improvements in responsible production, as well as sourcing and investments and subsequent monitoring and enforcement. The subscription pathway is currently unknown. (TRASE, 2020)

# 10 ANALYSIS

## 10.1 BIODIVERSITY IMPACT METRIC

### 10.1.1 Methodology

Biodiversity Impact Metric was calculated based on the guidelines published in (University of Cambridge Institute for Sustainability Leadership (CISL), 2020) and supplementary material published in (University of Cambridge Institute for Sustainability Leadership (CISL), 2020). As based on the guidance from CISL, Biodiversity Impact Metric has three main input variables. Area of production, Biodiversity Loss Coefficient, and Range Rarity value. Below we will describe the methodology or the approach we took to get the values for the different input variables.

The global average of BIM for cotton production was also calculated to create a benchmark for comparing different biodiversity impact metric values. Data for the global average can be found here (OECD/FAO, 2016).

**Area of Production/Yield**

As of area of production and yield, the approach was to collect the information/data most representative with the IKEA cotton production. Information on the IKEA sourcing countries and the amount of cotton sourced comes directly from their sustainability report, cited here (Inter IKEA, 2019). As IKEA does not have data for the area of production (yield) for cotton production in their sourcing countries, we have used the information about cotton production area from Better Cotton Initiative as most of the IKEA cotton is sourced through Better Cotton Initiative and it can be found here (BCI, 2020). From this information, we were able to calculate how much area is used by IKEA to grow the sourced amount of cotton. This data is still not directly representative of the IKEA cotton supply chain as the values represent all the cotton grown through the Better Cotton Initiative. Biodiversity Impact Metric is also calculated on the national and state/province region level, where national-level data for IKEA are more precise as we know IKEA sourcing countries. In the case of the lower level of calculation, state/province/region, we have used all the sourcing regions for different countries provided by Better Cotton Imitative, so we do not know from which of them the IKEA grown cotton is coming from. As well, Better Cotton Initiative could not provide the information of yield/area of production in different regions under the Data Communication Policy

(BCI, 2020), which means the national yield was used for all the regions in the country, which makes the results even less precise on a regional level. They serve more of the exemplary/testing purpose.

**Biodiversity Loss Coefficient**

Biodiversity Loss Coefficient comes directly from the methodology of the CISL and its supplementary material (University of Cambridge Institute for Sustainability Leadership (CISL), 2020) (University of Cambridge Institute for Sustainability Leadership (CISL), 2020). The detailed description of the Biodiversity Loss Coefficients can be found in the table below.

*Table 2 Description of different land-use types and intensities and the resulting coefficient used to determine the proportion of biodiversity lost (University of Cambridge Institute for Sustainability Leadership (CISL), 2020)*

| Land Use | Intensity | Description | Coefficient |
|---|---|---|---|
| **Natural Forest** | **Minimal** | Any human disturbances identified are minor (ego a trail or path) or very limited in the scope of their effect (e.g., hunting of a particular species of limited ecological importance). | **0.15** |
| | **Light** | One or more human disturbances of moderate-intensity (ego selective logging) or breadth of impact (ego bushmeat extraction), which are not severe enough to markedly change the nature of the ecosystem. Primary sites in suburban settings are at least Light use. | **0.3** |
| | **Intense** | One or more human disturbances that are severe enough to markedly change the nature of the ecosystem; this includes clear-felling. Primary sites in fully urban settings should be classed as Intense use. | **0.5** |
| **Plantation Forest** | **Minimal** | They are extensively managed or mixed timber, fruit/coffee, oil-palm, or rubber plantations in which native understory and/or other native tree species are tolerated, which are not treated with pesticide or fertilizer, and which have not been recently (< 20 years) clear-felled. | **0.7** |
| | **Light** | Monoculture fruit/coffee/rubber plantations with limited pesticide input, or mixed species plantations with significant inputs. Monoculture timber plantations of mixed age with no recent (< 20 years) clear-felling. Monoculture oil-palm plantations with no recent (< 20 years) clear-felling. | **0.75** |
| | **Intense** | Monoculture fruit/coffee/rubber plantations with significant pesticide input. Monoculture timber plantations with similarly aged trees or timber/oil-palm plantations with extensive recent (< 20 years) clear-felling. | **0.8** |
| **Cropland** | **Minimal** | Low-intensity farms, with small fields, mixed crops, crop rotation, little or no inorganic fertilizer use, little or no pesticide use, little or no plowing, little or no irrigation, little or no mechanization. | **0.6** |

| | | | |
|---|---|---|---|
| | **Light** | Medium-intensity farming typically showing some but not many of the following: large fields, annual plowing, inorganic fertilizer application, pesticide application, irrigation, no crop rotation, mechanization, monoculture crop. Organic farms in developed countries often fall within this category, as may high-intensity farming in developing countries. | **0.7** |
| | **Intense** | High-intensity monoculture farming typically showing many of the following features: large fields, annual plowing, inorganic fertilizer application, pesticide application, irrigation, mechanization, no crop rotation. | **0.9** |
| **Pasture** | **Minimal** | Pasture with minimal input of fertilizer and pesticide, and with low stock density (not high enough to cause significant disturbance or to stop the regeneration of vegetation). | **0.2** |
| | **Light** | Pasture either with significant input of fertilizer or pesticide or with high stock density (high enough to cause significant disturbance or to stop the regeneration of vegetation). | **0.4** |
| | **Intense** | Pasture with significant input of fertilizer or pesticide, and with high stock density (high enough to cause significant disturbance or to stop the regeneration of vegetation). | **0.7** |

Currently, due to the unknown conditions of the farming in the different sourcing locations, we have used the precautionary principle and used 90% biodiversity loss in the cropland, which represents cotton. Based on the table above, a questionnaire should be formed to approach producers of cotton to get a description of the farming conditions and assign a biodiversity loss coefficient based on the situation in the fields. There is a notion in IKEA that some, if not all, sourcing of cotton should have a lower biodiversity loss coefficient because of their use of the Better Cotton Initiative as a certification scheme, but after a discussion with a representative of Cambridge Institute for Sustainability Leadership that was not approved and precautionary principle was used. Due to this interest in IKEA, we have calculated the national level of Biodiversity Impact Metric for two intensities, 70%, and 90%, just as an exemplary result. Further talks between CISL and IKEA are needed to find a solution that would be more applicable in this situation. (University of Cambridge Institute for Sustainability Leadership (CISL), 2020)

To reflect on the supplementary material, the conditions and approach taken to achieve a lower coefficient are not so clear. This creates difficulties in the analysis. It would be very helpful for the future if the conditions and approaches required would be made more clear as it would make it also easier for other organizations to implement this tool's usage.

**Range Rarity Value**

Range Rarity was used to determine the importance of biodiversity in the area of production. There are several approaches to how that can be determined. The raw data come of range rarity come from (IUCN Red List, 2020). These need to be processed for different scenarios, and in the case of CISL, they have used the ecoregion approach using the Food and Agriculture Organization of the United Nations data (University of Cambridge Institute for Sustainability Leadership (CISL), 2020). Due to the unavailability of the methodology for this approach, as it was not published yet, we have had to take a different approach to make our Range Rarity more precise. The main issue was if we take the average of the range rarity value for a whole country/region can provide very distorted value due to the inclusion of regions where cotton is not grown at all. Therefore, we have used the information from (BCI, 2020) in combination with FAO data on where the cotton is grown globally on administrative unit level 2 (Food and Agriculture Organization of the United States, 2020). As we have the availability of data only for countries and administrative units level 1 (states/provinces/regions), we were able to get range rarity value for states/regions/provinces from only cotton-growing areas to make results more representative of the cotton growing. The disadvantage of this approach was that FAO data are not available for all countries globally, and in some cases, we had to use the are of whole state/province/region. Below you can see in which states/province/regions the FAO data where used and in which they were not due to unavailability.

**Ranger rarity value of states/province/regions using FAO data:**

- Queensland, Australia
- New South Wales, Australia
- Andhra Pradesh State, India
- Madhya Pradesh State, India
- Rajasthan State, India
- Punjab State, India
- Odisha State, India
- Karnataka State, India
- Tamil Nadu State, India
- Telangana State, India
- Maranhao State, Brazil
- Piaui State, Brazil

- Bahia State, Brazil
- Goias State, Brazil
- Mato Grosso State, Brazil
- Mato Grosso do Sul State, Brazil
- Alabama State, USA
- Arizona State, USA
- Arkansas State, USA
- California State, USA
- Florida State, USA
- Georgia State, USA
- Kansas State, USA
- Louisiana State, USA
- Mississippi State, USA
- Missouri State, USA
- New Mexico State, USA
- North Carolina State, USA
- Oklahoma State, USA
- South Carolina State, USA
- Tennessee State, USA
- Texas State, USA
- Virginia State, USA

**Ranger rarity value of states/province/regions NOT using FAO data:**

- Hubei Province, China
- Shaanxi Province, China
- Shandong Province, China
- Hebei Province, China
- Maharastra State, India
- Gujarat State, India
- Sanliurfa Province, Turkey
- Kahramanmaras Province, Turkey

- Adana Province, Turkey
- Antalya Province, Turkey
- Aidin Province, Turkey
- Izmir Province, Turkey
- Punjab Province, Pakistan
- Sindh Province, Pakistan
- Andalusia Region, Spain
- South Kazakhstan Region, Kazakhstan
- Kyrgyzstan
- Ivory Coast
- Cameroon
- Zambia

Further along, following the (University of Cambridge Institute for Sustainability Leadership (CISL), 2020) supplementary material, the raw range rarity data were log-transformed to produce an approximately normal distribution and after that, divided by the range rarity scores mean so the average range rarity will have a score of 1. This was done due to the fact that raw range rarity scores are highly left-skewed, with a low number of very high scores and a very high number of very low scores (University of Cambridge Institute for Sustainability Leadership (CISL), 2020).

### 10.1.2 Biodiversity Impact Metric Results

#### *10.1.2.1 Biodiversity Impact Metric Country Level*

In this section, we present our results for the calculation of the Biodiversity Impact Metric of IKEA cotton production. All IKEA sourcing countries are represented, and calculations were done for the 70% biodiversity loss and 90% biodiversity loss to see how the much the BIM scores would be affected if the biodiversity loss coefficient is assessed on the 70% in some sourcing countries.

## Biodiversity Impact Metric for IKEA sourcing countries (Biodiversity Loss Coefficient 0.9)

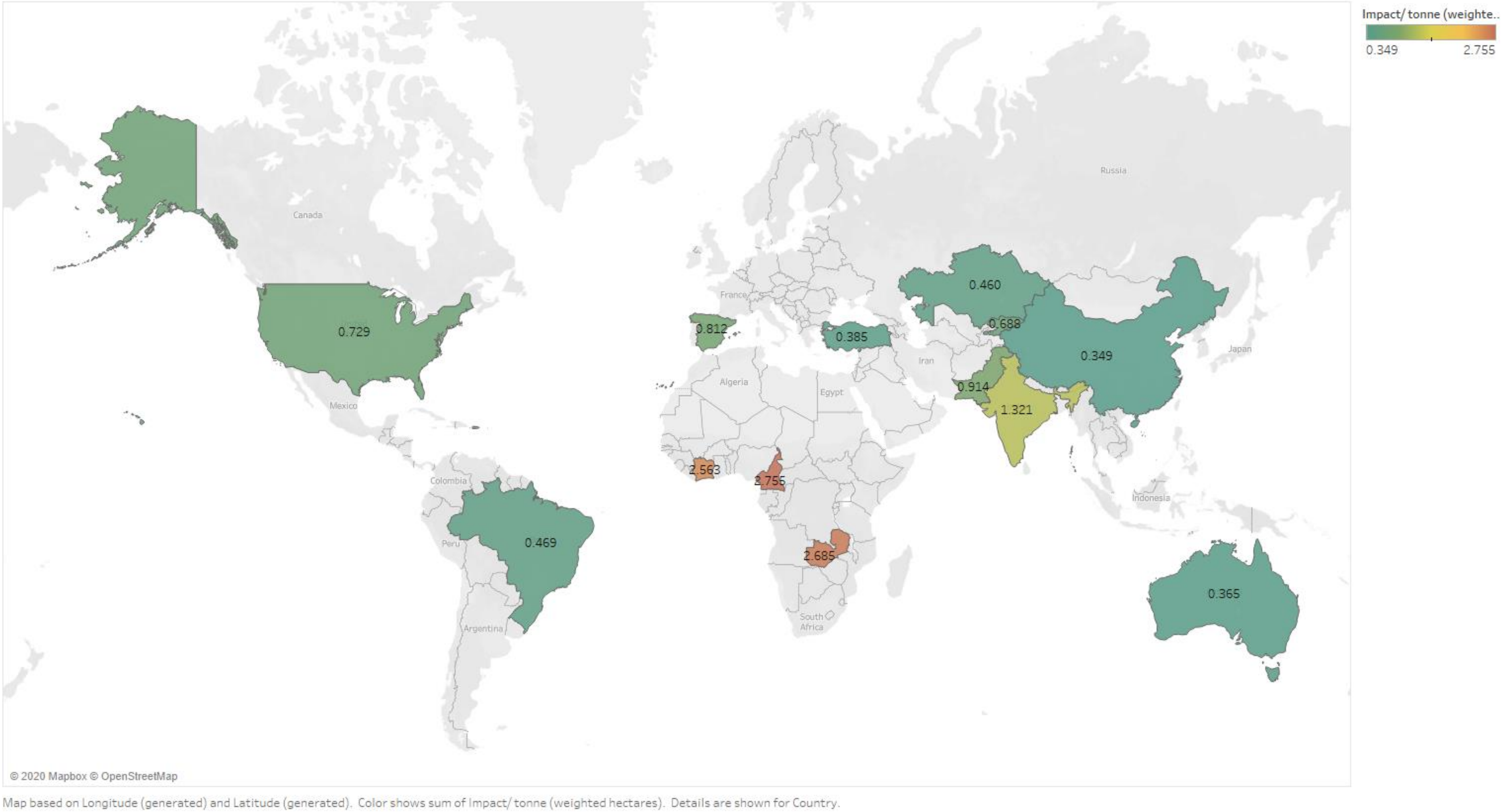
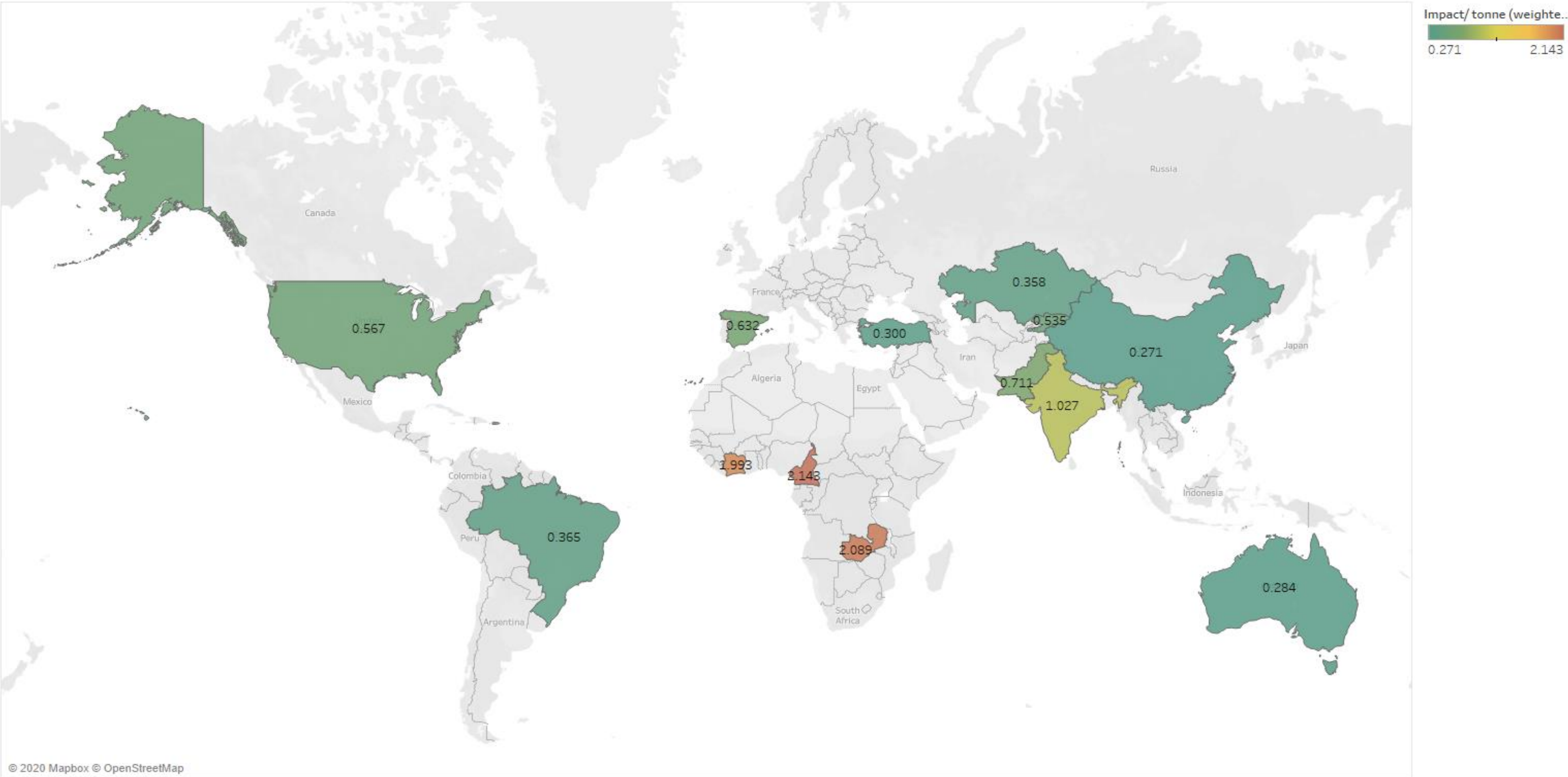



*Figure 4 Map of IKEA cotton sourcing countries biodiversity impact metric with a biodiversity loss coefficient of 90%*

**Biodiversity Impact Metric for IKEA sourcing countries (Biodiversity Loss Coefficient 0.7)**




Map based on Longitude (generated) and Latitude (generated). Color shows sum of Impact/ tonne (weighted hectares). Details are shown for Country.

*Figure 5 Map of IKEA cotton sourcing countries biodiversity impact metric with a biodiversity loss coefficient of 70%*

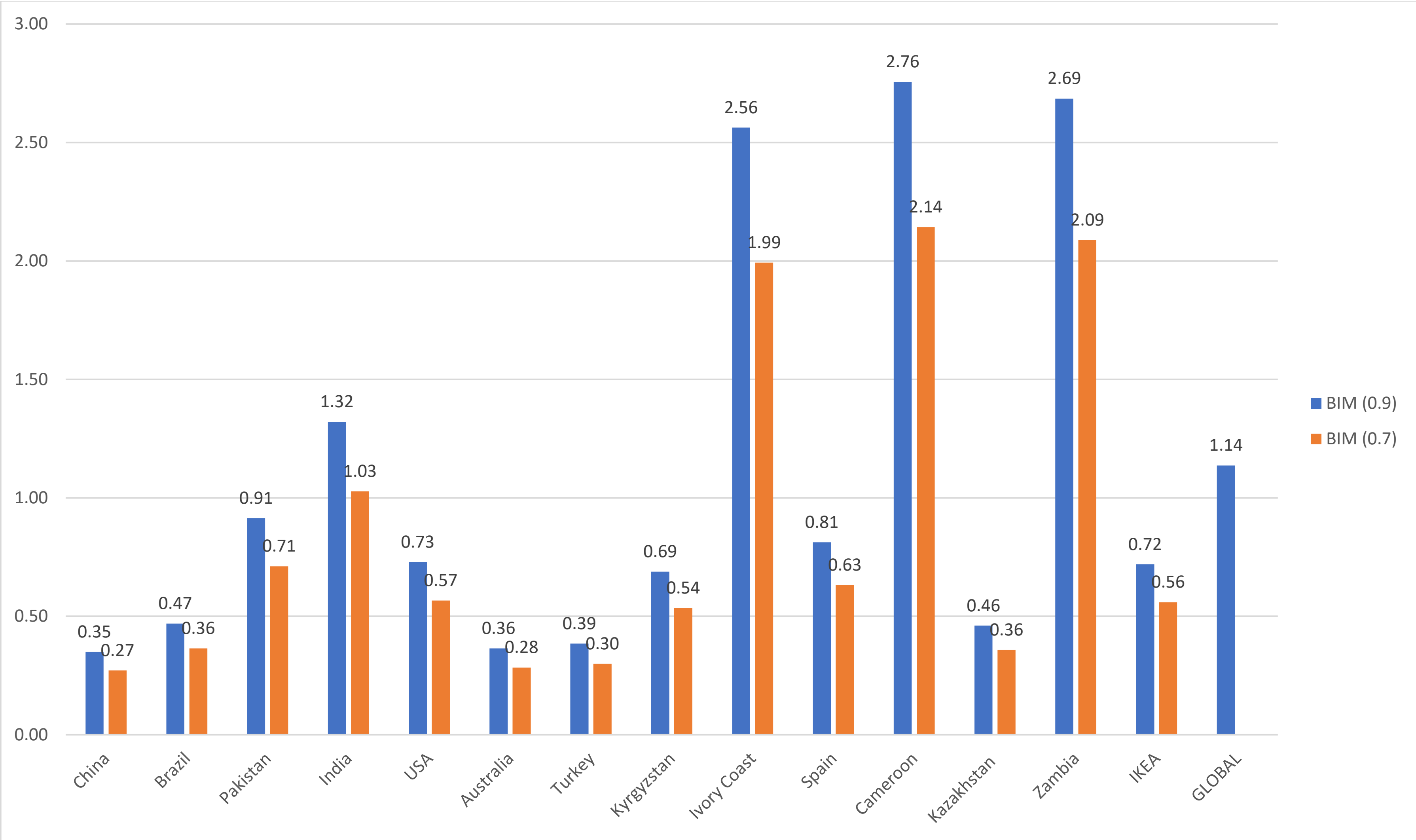



*Figure 6 Graph comparing the 0.9 and 0.7 Biodiversity Impact Metric with an average of IKEA BIM and Global BIM for cotton production*

Figures 4, 5, and 6 show us the results of the calculation of Biodiversity Impact Metric for IKEA cotton sourcing countries. Figures 4 and 5 show us the global map with countries having BIM values based on the Biodiversity Loss Coefficient, with either 70% or 90%. The global average shows us the baseline for what the biodiversity impact is in general for global cotton production, which can also help IKEA support their decision making on where to focus their actions to lower the biodiversity impact of their cotton production. The comparison between the 70% and 90% biodiversity loss in Figure 6 shows us quite a significant lowering of the biodiversity impact with the 70% biodiversity loss. That puts emphasis on the agricultural practices of cotton growing and supports the notion of using more sustainable practices in cotton-growing to lower the impact on the biodiversity.

#### *10.1.2.2 Biodiversity Impact Metric State/Province Level*

In this part, the BIM was calculated on the state/province level. These results work mainly as an example of what you can calculate in BIM and that you can go below the country level. Results are not credible mainly because of the lack of data on yield/are of production, so only the country level was used, and all the locations are calculated with a 90% biodiversity loss coefficient. Therefore, the only factor influencing the results is the range of rarity value. As well as these regions are not directly the sourcing regions of IKEA but the sourcing regions of BCI for the selected countries. As a result, these results are not representative of the biodiversity impact of IKEA cotton production but serve the purpose of understanding of how BIM works, and it could provide in the future for IKEA.

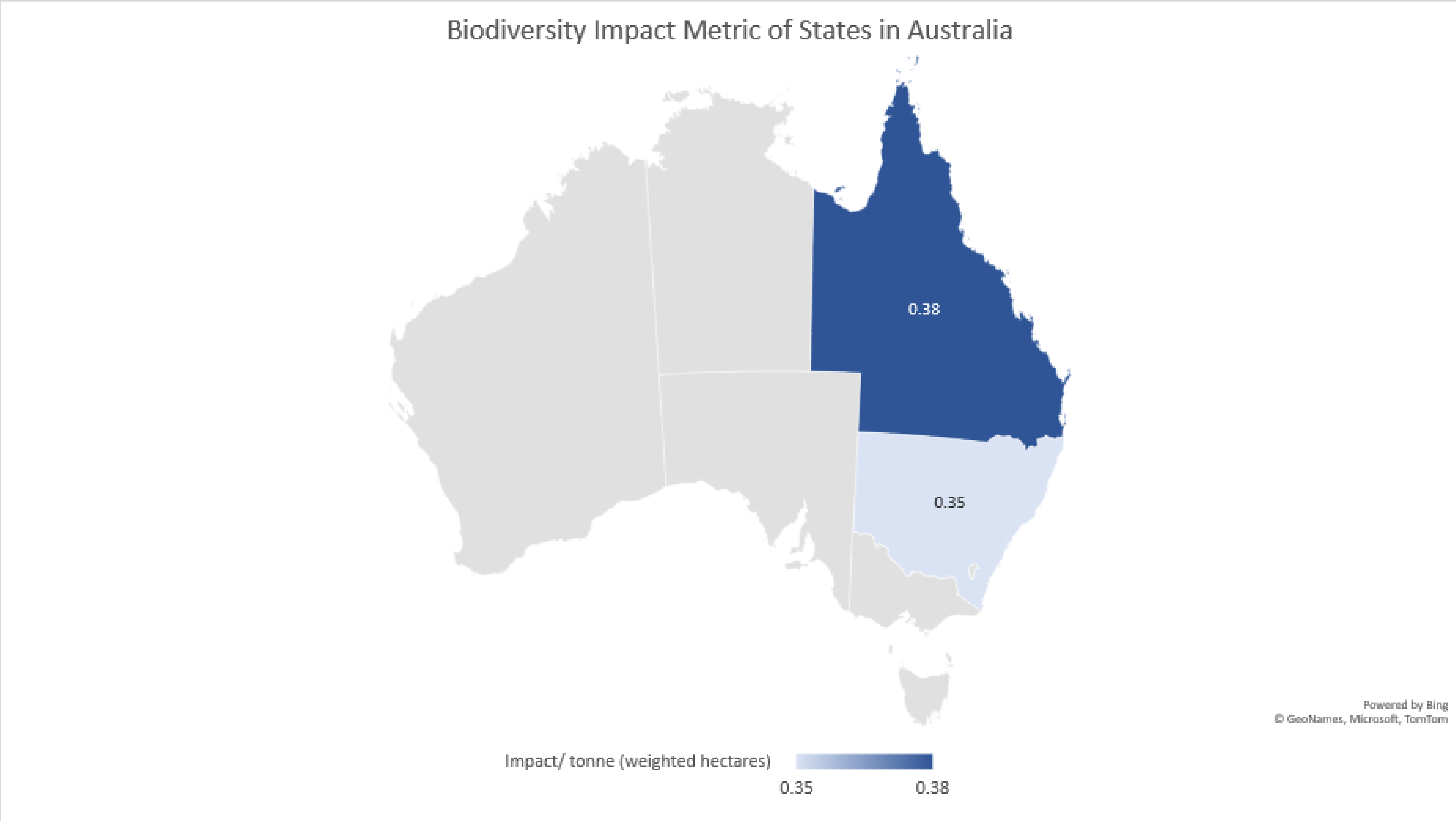



*Figure 7 Map of biodiversity impact of states in Australia*

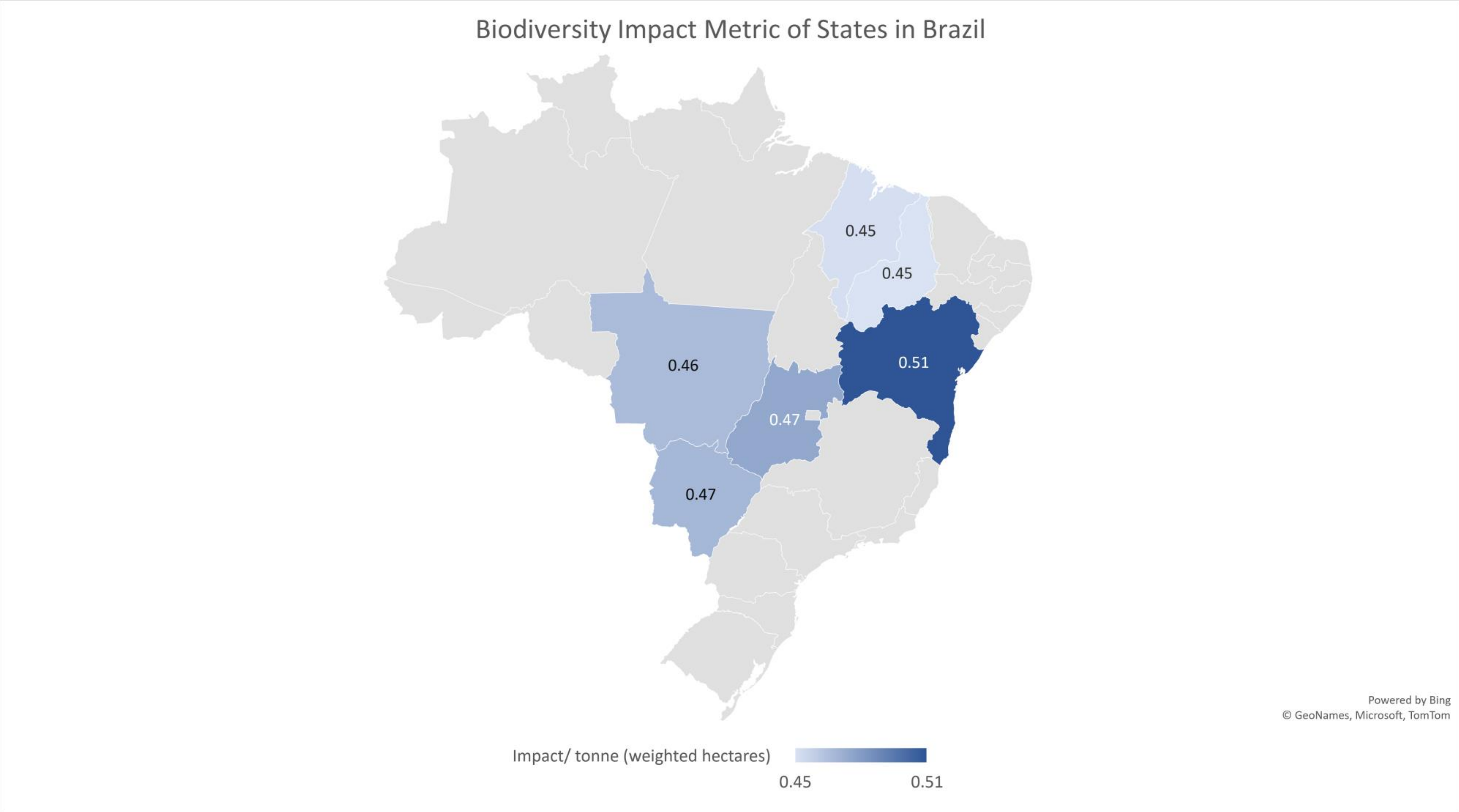



*Figure 8 Map of biodiversity impact of states in Brazil*

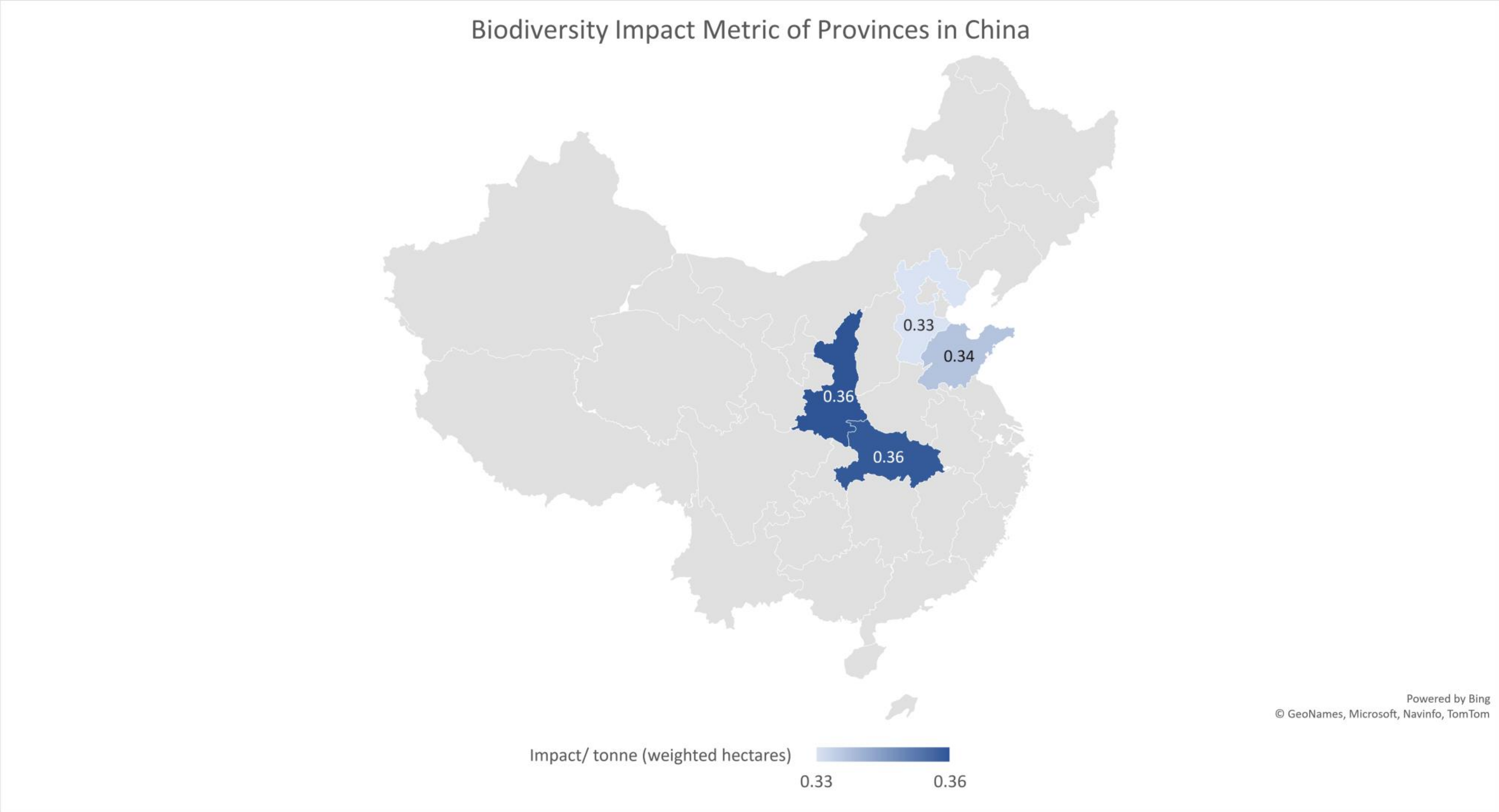



*Figure 9 Map of biodiversity impact of provinces in China*

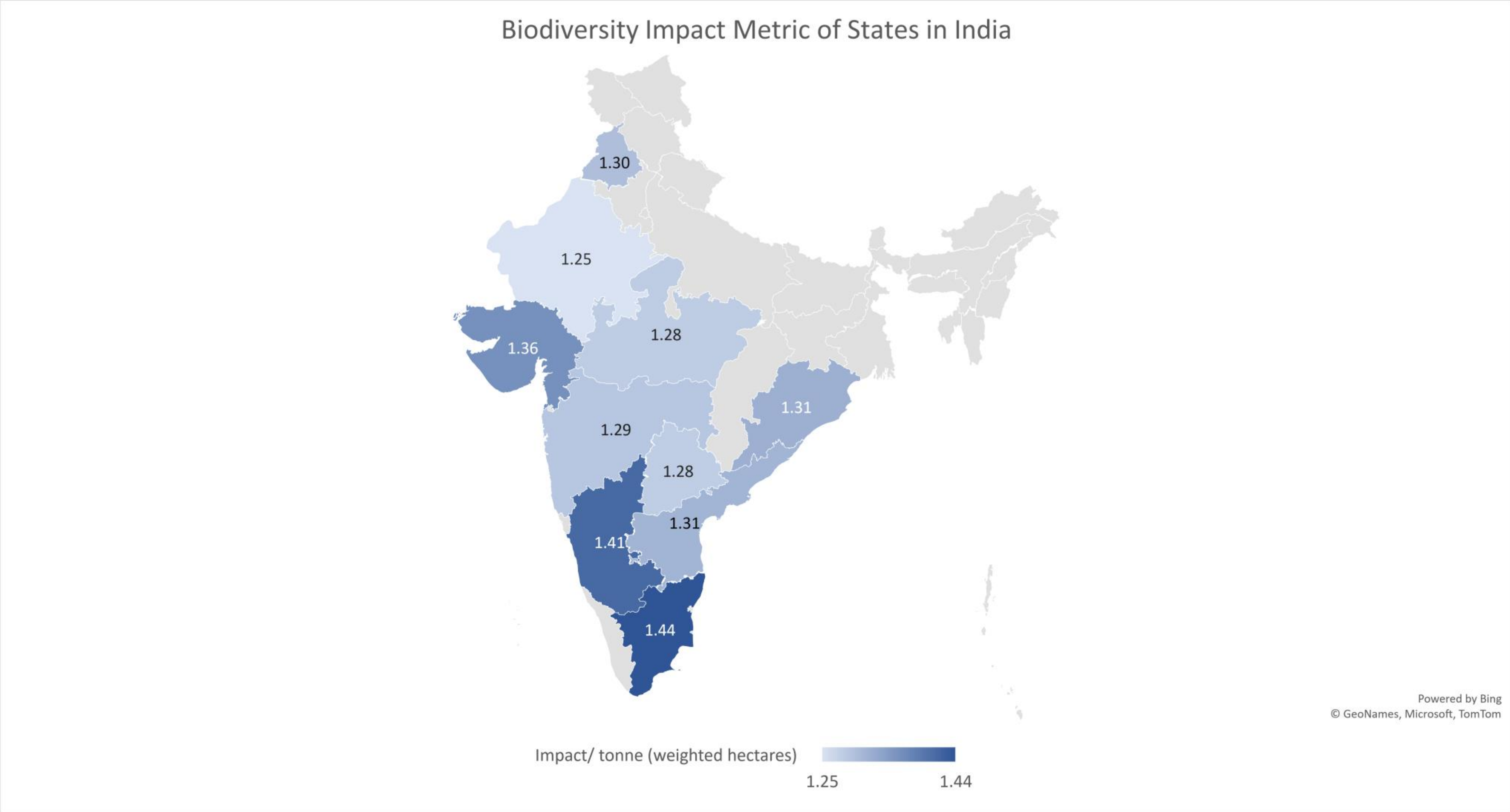



*Figure 10 Map of biodiversity impact of states in India*

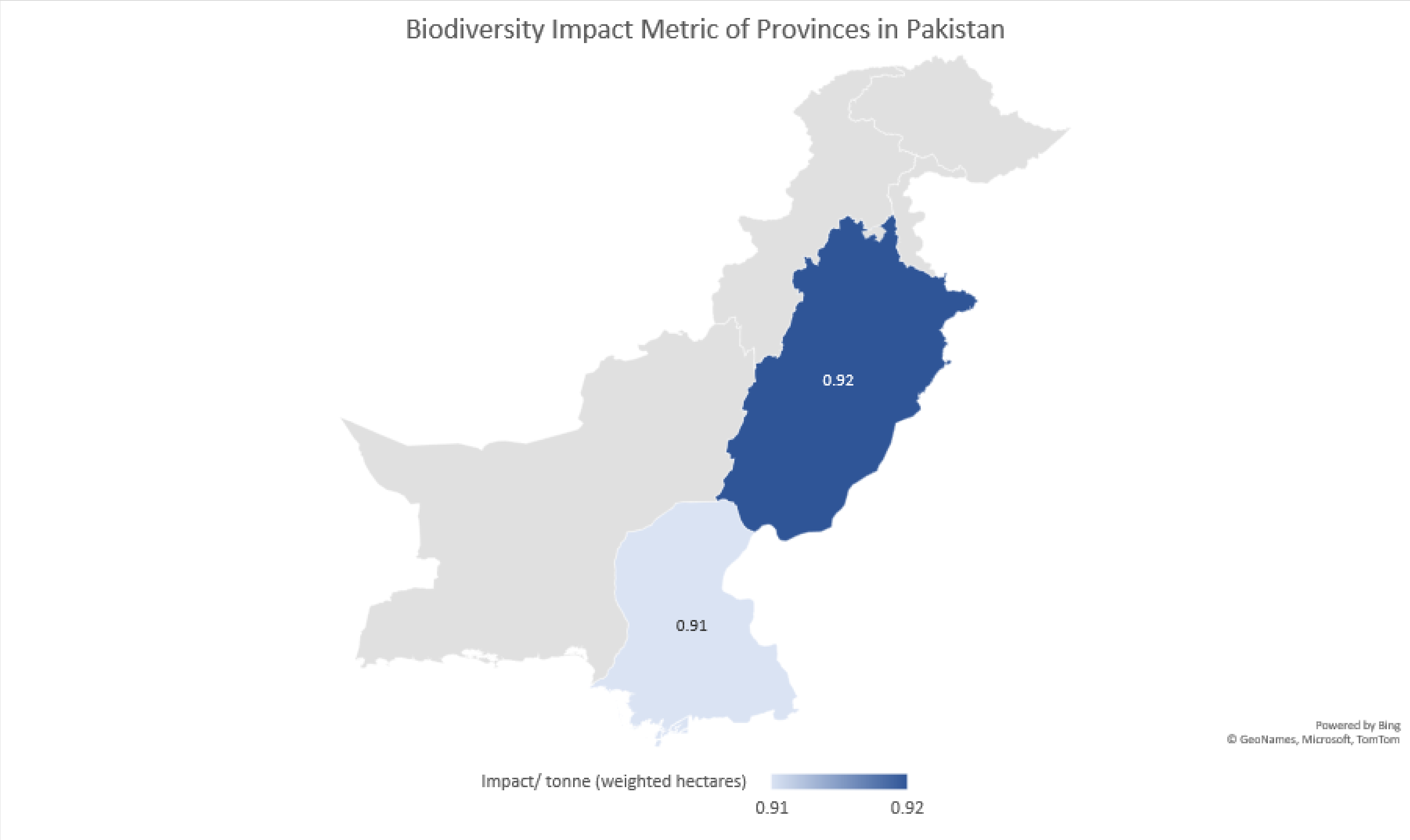



*Figure 11 Map of biodiversity impact of provinces in Pakistan*

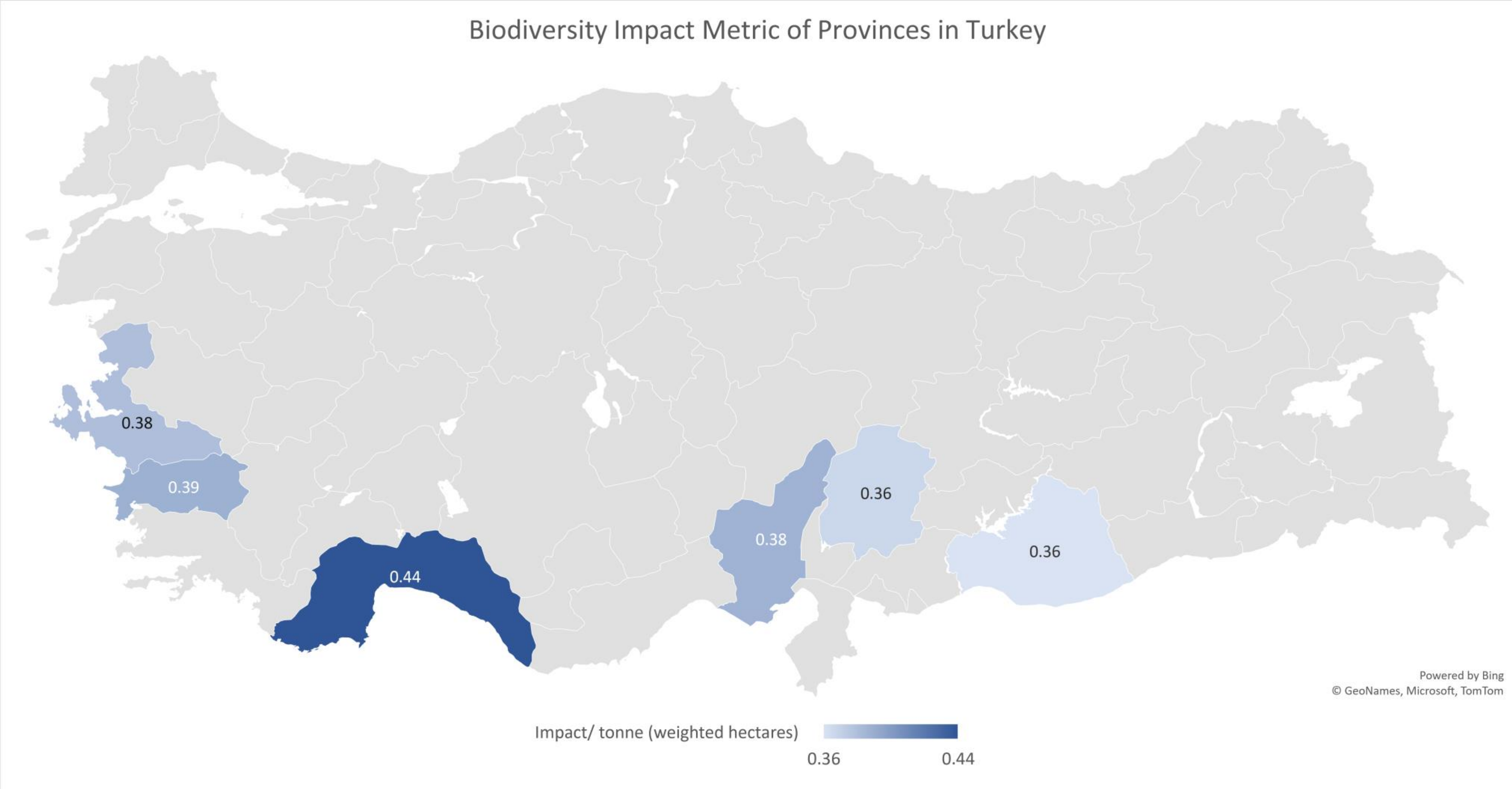



*Figure 12 Map of biodiversity impact of provinces in Turkey*

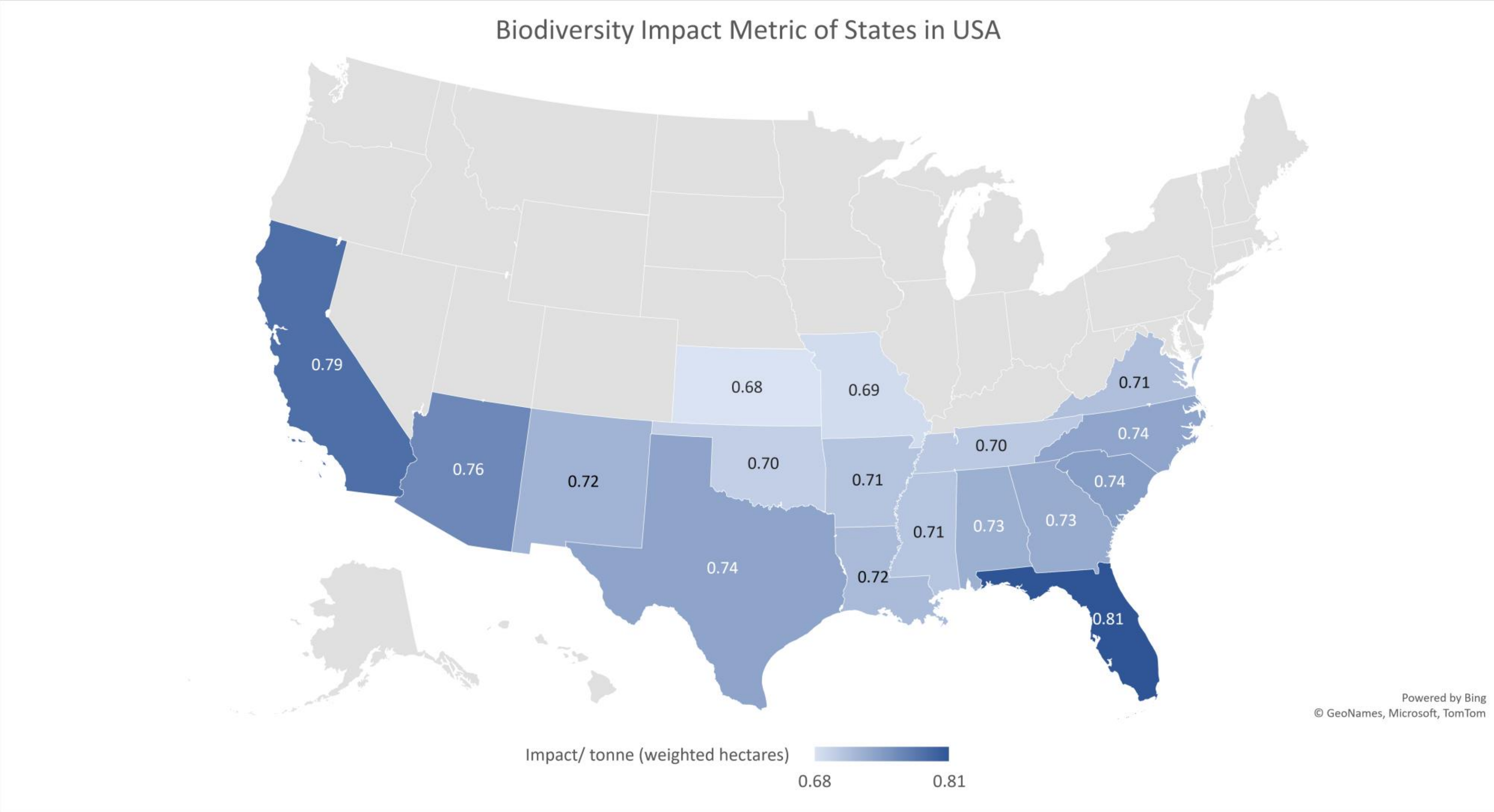



*Figure 13 Map of biodiversity impact of states in the USA*

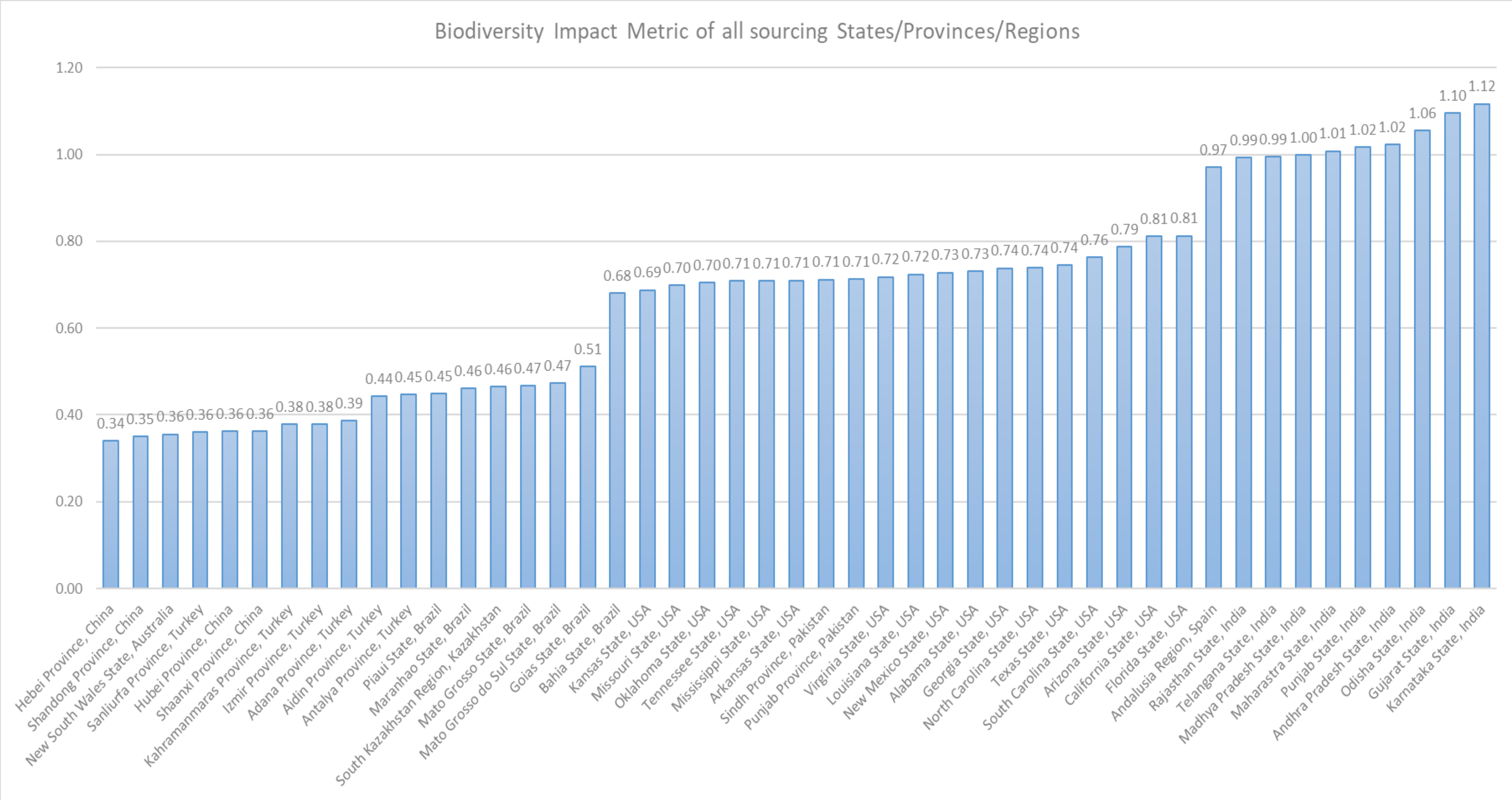



*Figure 14 Graph comparing all the sourcing states/province/regions*

The state/region/province level shows the possibility of understanding biodiversity on a more localized level, even though in our case, results are not very useful due to lack of data, they show us the possibilities of BIM in the future. Further along, if data and information become available, the calculation could move on even to a more precise level than just states/provinces/regions but to the district/municipality levels. This kind of calculation could create a comparison like seen in Figure 15, which could support the decision-making and focus action on a very local level. That could result in more immediate protection or restoration of biodiversity in the most vulnerable areas.

Criticism of these results could be placed on the metric itself; it focuses on three main input values that affect the results. But that also provides the opportunity to understand which of the factors influences the impact the most, either low yield, high biodiversity loss, or high biodiversity importance in the area. That can again support more precise decision making and focus on actions. The results are also not fully representative of the IKEA cotton production due to lack of data or low resolution of the data.

Therefore, the future focus should be mainly on the IKEA side to gain access to better data of their cotton cultivation, which would help to classify the agricultural production of cotton in their areas. Other steps would also be to cooperate with CISL to understand how to best approach the issue of biodiversity loss coefficient if the approach of questionaries is not the most viable and clear option. That could lead to the development of clearer and precise methods to assess the biodiversity loss coefficient. Further along, the advantage of BIM is that it could be applied to other IKEA commodities and, therefore, help create a basic quantifiable biodiversity impact assessment. This would support the inclusion of biodiversity in the general sustainability strategy of IKEA and would help to assess the general needs of biodiversity in its supply chains.

## 10.2 Integrated Biodiversity Assessment Tool

### 10.2.1 Proximity report for cotton sourcing areas of IKEA using IBAT

#### *10.2.1.1 Methodology*

In the proximity report, we did an analysis based on two factors. Firstly, we have run a proximity report on the two districts of Pakistan. We were informed that locations of farms/farming villages are not possible to be shared due to Pakistani legislation for the protection of the farmers.

Therefore, the approach was taken to analyze the districts instead and approach the suppliers/local contacts in Pakistan with the available information from IBAT to confirm that farming is not located in vulnerable areas. Information on the 2 districts come from the cooperation between the WWF Pakistan, WWF India and IKEA on sustainability initiative projects. These districts are Bahawalpur district, Pakistan and Khanewal district, Pakistan.

We have also used IBAT to input all the sourcing states/regions/provinces of IKEA's cotton sourcing (BCI, 2020). As previously stated, the data represent all BCI sourcing regions that IKEA is part of but do not represent all the sourcing regions of IKEA. As these reports are too big in volume and there is a limit on proximity reports in IBAT, we have generated only one example report for one state. The rest are only part of the IBAT database and can be used by IKEA in the future for analysis. The list of states/regions/provinces inserted into IBAT is as follows:

- Adana Province, Turkey
- Aydin Province, Turkey
- Alabama State, USA
- Andalusia Region, Spain
- Andhra Pradesh State, India
- Antalya Province, Turkey
- Arizona State, USA
- Arkansas State, USA
- Bahia State, Brazil
- California State, USA
- Florida State, USA
- Georgia State, USA
- Goias State, Brazil
- Gujarat State, India
- Hebei Province, China
- Hubei Province, China
- Izmir Province, Turkey
- Kahramanmaras Province, Turkey
- Kansas State, USA
- Karnataka State, India

- Louisiana State, USA
- Madhya Pradesh State, India
- Maharastra State, India
- Maranhao State, Brazil
- Mato Grosso do Sul State, Brazil
- Mato Grosso State, Brazil
- Mississippi State, USA
- Missouri State, USA
- New Mexico State, USA
- New South Wales State, Australia
- North Carolina State, USA
- Odisha State, India
- Oklahoma State, USA
- Piaui State, Brazil
- Punjab Province, Pakistan
- Punjab State, India
- Queensland State, Australia
- Rajasthan State, India
- Sanliurfa Province, Turkey
- Shaanxi Province, China
- Shandong Province, China
- Sindh Province, Pakistan
- South Carolina State, USA
- South Kazakhstan Region, Kazakhstan
- Tamil Nadu State, India
- Telangana State, India
- Tennessee State, USA
- Texas State, USA
- Virginia State, USA
-

### *10.2.1.2 Results for districts of Pakistan*

## Bahawalpur district, Pakistan

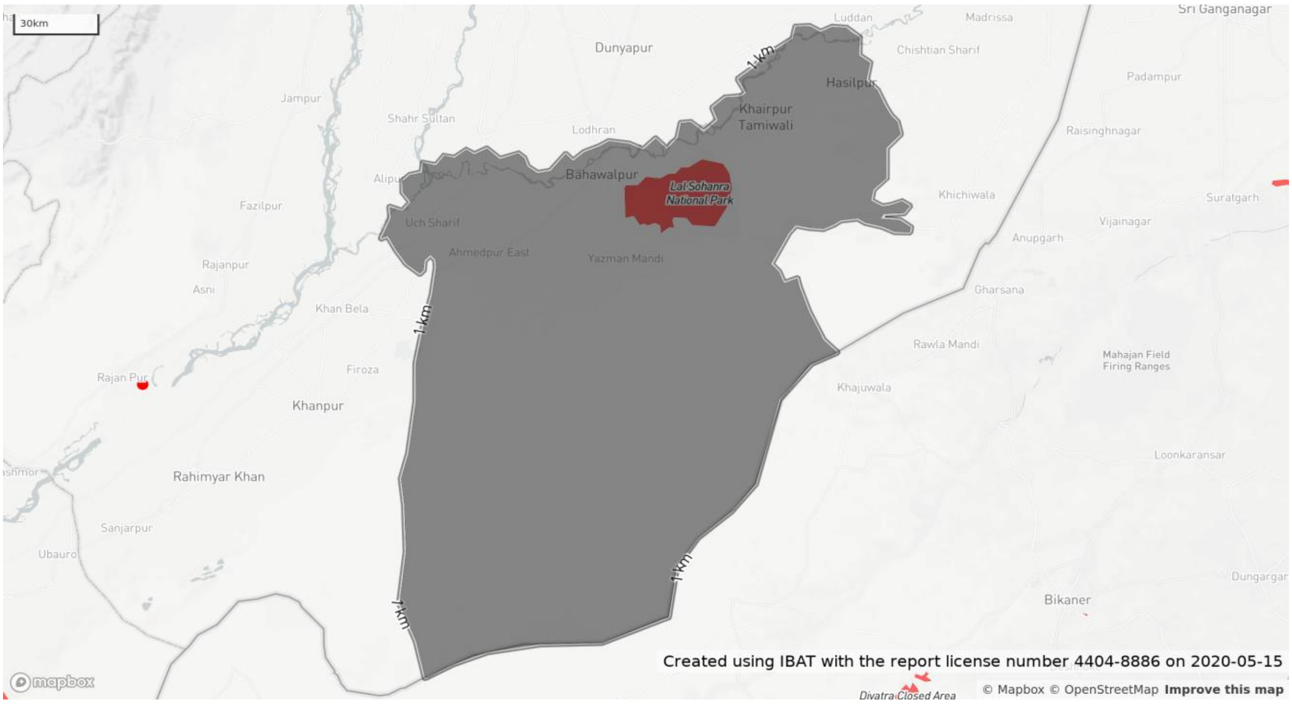



*Figure 15 Map of Key Biodiversity Areas of Bahawalpur district, Pakistan (IBAT, 2020)*

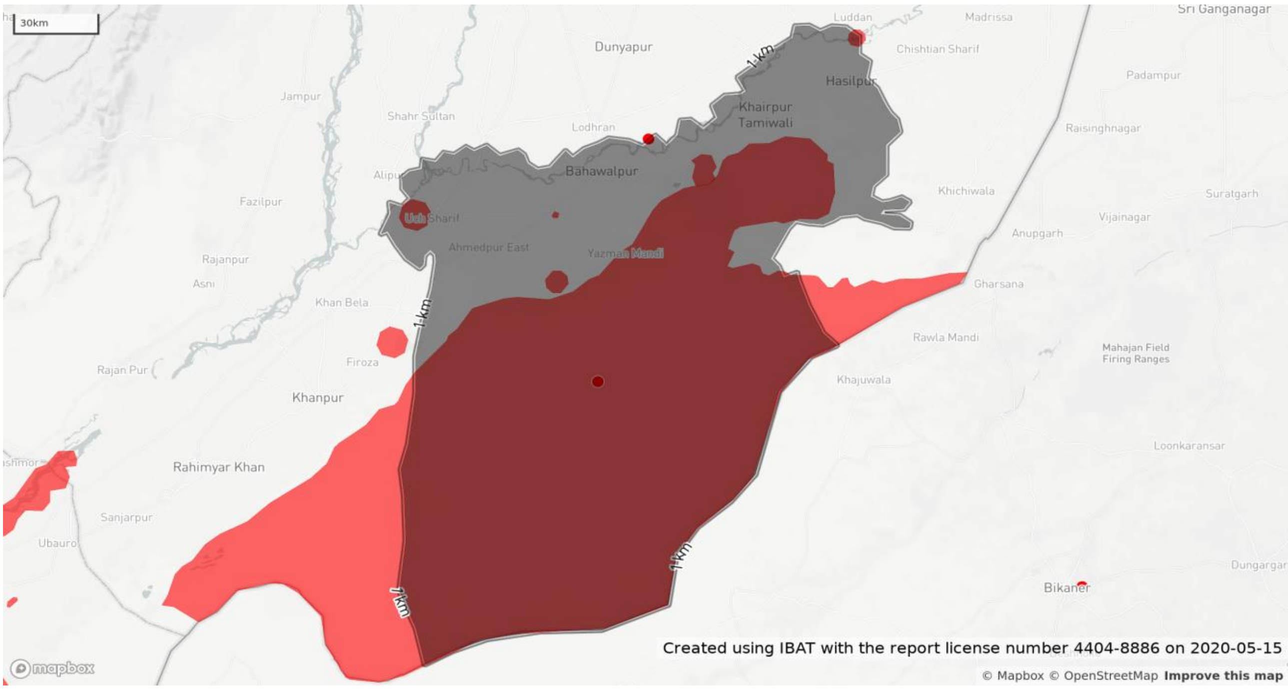



*Figure 16 Map of Protected Areas of Bahawalpur district, Pakistan (IBAT, 2020)*

## Khanewal District, Pakistan

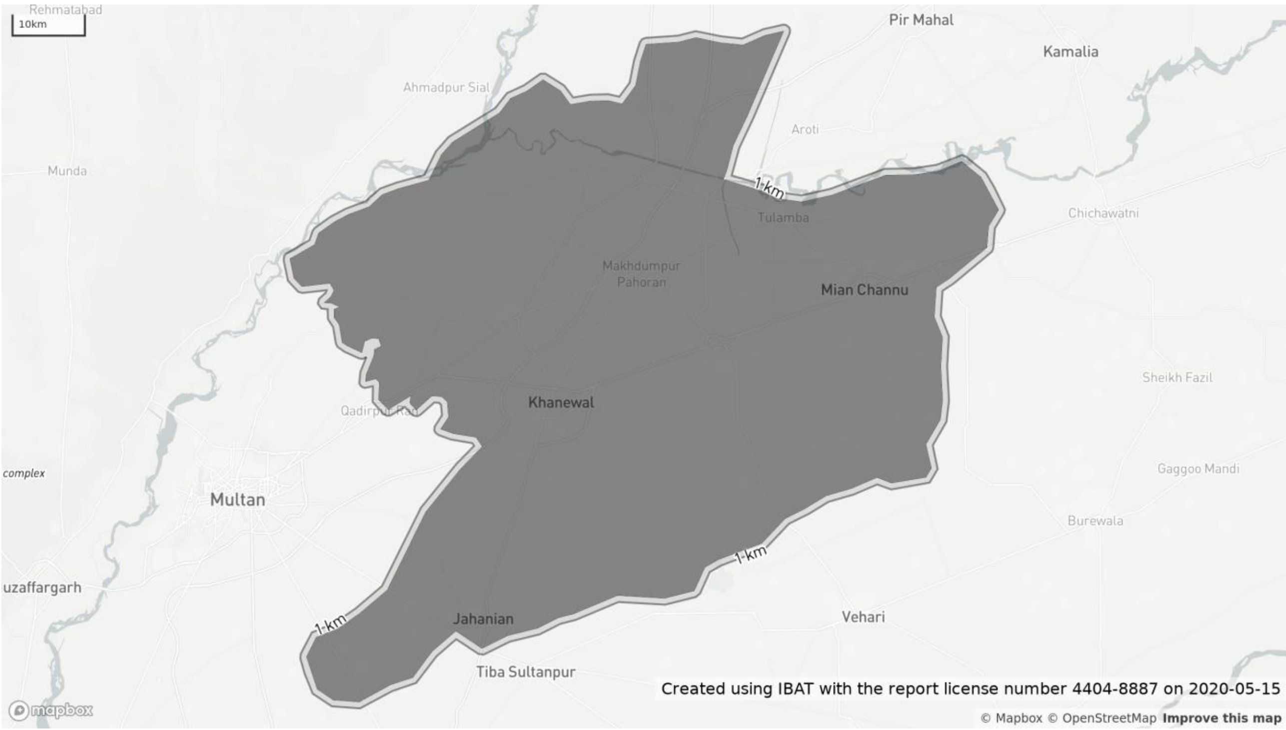



*Figure 17 Map of the Key Biodiversity Areas in Khanewal district, Pakistan (IBAT, 2020)*

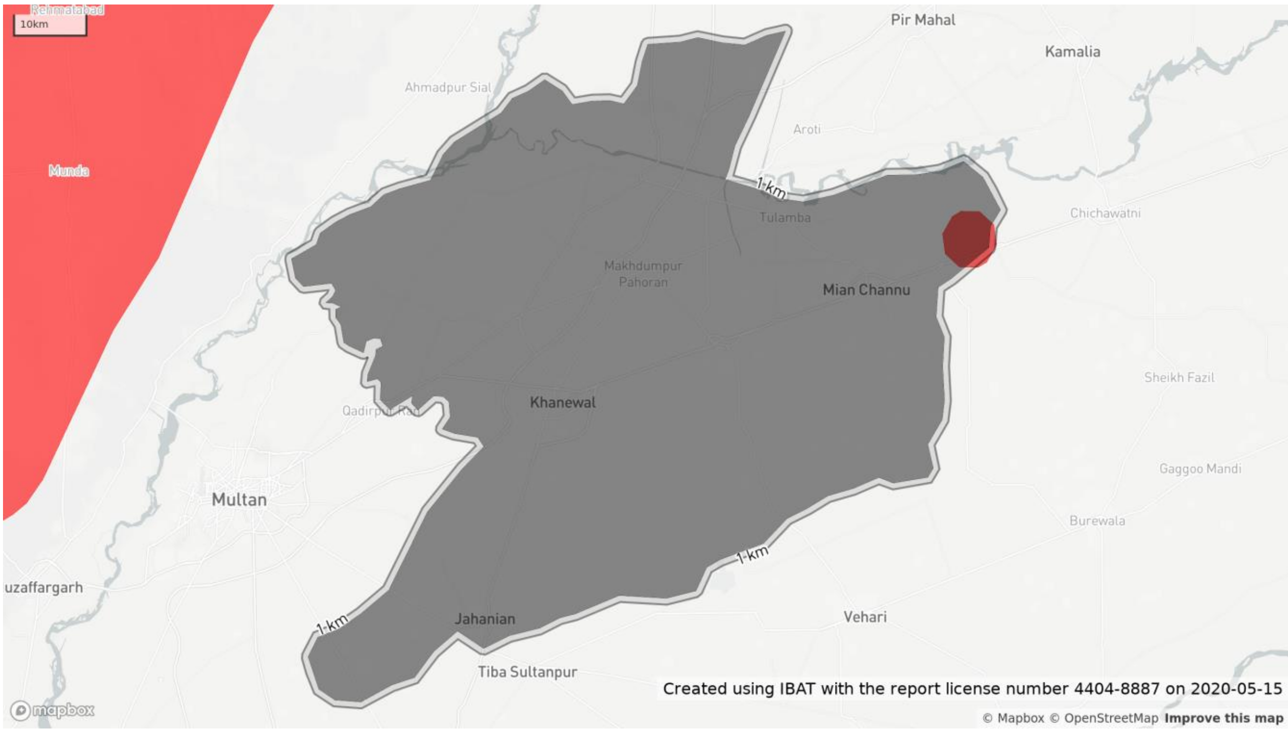



*Figure 18 Map of the Protected Areas in Khanewal district, (IBAT, 2020) Pakistan*

Using the maps and full proximity reports which can be found in Appendix 2 and 3 using IBAT for Bahawalpur and Khanewal districts of Pakistan, we have approached the local contact in Pakistan, third party person from WWF Pakistan, who, after receiving the information, got back to us and confirmed that **NONE** of the farms included in this study were located within the areas of interest.

### Punjab province, Pakistan – State/Province/Regional level example

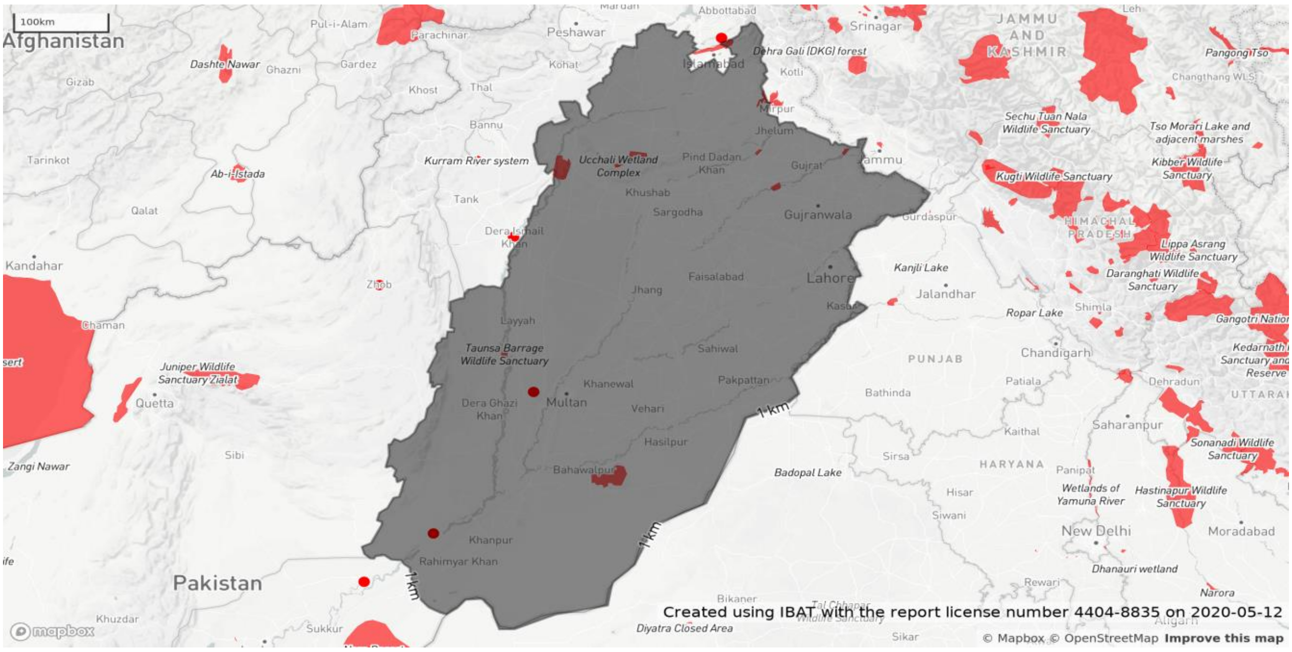



*Figure 19 Map of Protected Areas in Punjab Province, Pakistan (IBAT, 2020)*

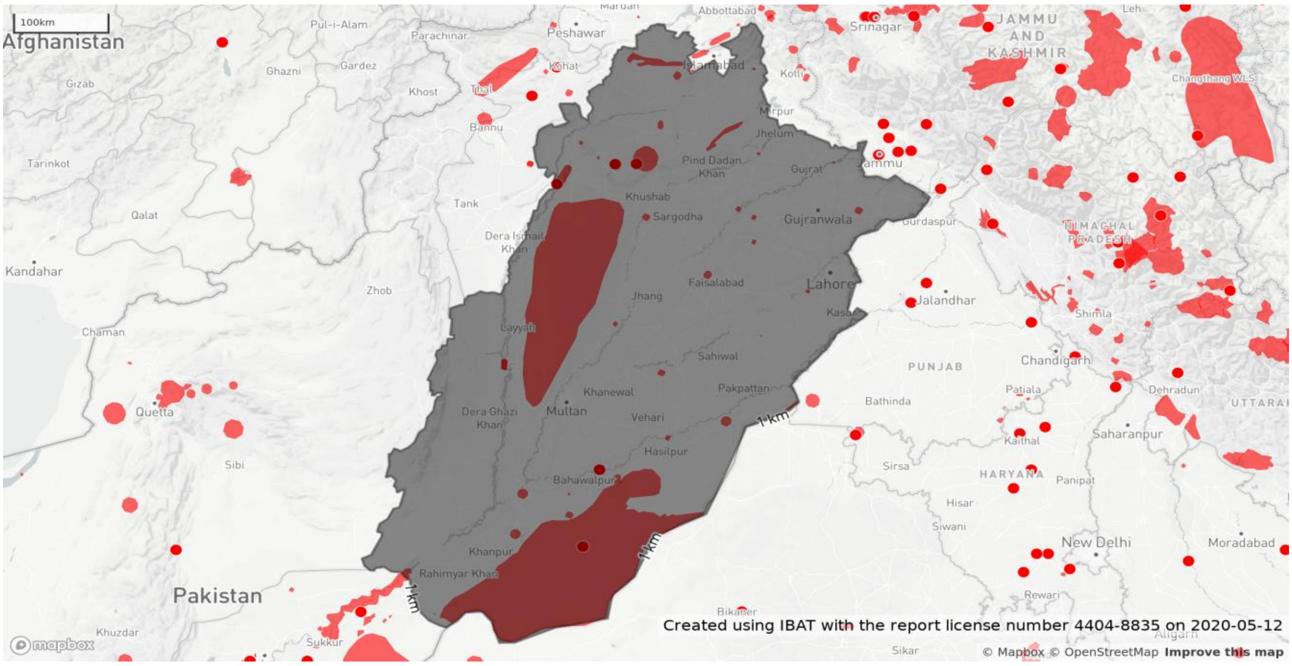



*Figure 20 Map of Key Biodiversity Areas in Punjab Province, Pakistan (IBAT, 2020)*

The above maps of Key Biodiversity Areas and Protected Areas of the Punjab Province in Pakistan and Proximity report of Punjab Province in Pakistan from Appendix 4 can be used to approach suppliers/local contacts in the said locations to get the confirmation if any sourcing location is in the areas of interest. The Punjab Province was used as one example as the volume of all the sourcing states/provinces/regions was too big for this report. The locations are in the IKEA IBAT database and can be used in the future analysis by IKEA.

Proximity Reports of IBAT can be this way used for two purposes. The preferred one would be to know the exact location/shape of the sourcing location to create a proximity report of the highest precision. That could trigger immediate action as the results would provide information if the sourcing is overlapping with the vulnerable or areas of interest. Challenge for this approach is the availability of the information on the sourcing location, which can lead to the use of IBAT to approach the suppliers/producers. As seen in Bahawalpur and Khanewal districts in Pakistan, the approximate location can be analyzed if the precise location is not available or known. Data from the proximity report can be used to approach the suppliers/local contacts. This gives the company an opportunity to have a certain level of information beforehand and opens a way for confirmation. Of course, this approach also has many challenges, mainly from the trust point of view, where in this case, the whole risk screening is based on the word of the external third party. In the best case, it can be combined with companies' own field screening efforts to ensure that the location is out of the areas of interest.

In general, IBAT proximity reports present an opportunity for the early risk screening of the sourcing locations, either directly or indirectly. It also provides the opportunity to risk future screen investments and ensure that new sourcing locations are not in vulnerable areas. Part of the reports is also the information on the IUCN Red List species in the area, which provides the company with knowledge of the species present in the area and the level of threat they are facing. As IBAT keeps on developing, future steps, like the inclusion of STAR metric in IBAT, will provide additional knowledge for the company, of not only understanding what species are present but what are the specific threats and opportunities of those species, which will highly improve the decision making of the company on the future actions taking.

### 10.2.2 Multi-site report for cotton production villages in India using IBAT

#### *10.2.2.1 Methodology*

This report focuses on the cotton production villages in India, which were assessed using the Multi-site report option of IBAT. The data on the locations of the villages in India was provided through the cooperation of the IKEA and WWF India on sustainable initiatives. The multi-site report was generated for a total of 328 villages in India, using a buffer of 1,079 km, which was based on the production area of the largest village as a Multi-Site report can use only a single buffer. Therefore, we have decided to use buffer based on the largest village to ensure the coverage of all the areas. This can lead to a situation where a location can be flagged as being in overlap with Key Biodiversity Area or Protected Area, but because of the larger buffer, the precision of data and maps it does **NOT** have to be the reality. Therefore, the multisite report is used to approach the local contacts at the location to confirm the situation on the field. This report focuses only on the locations where the overlap is indicated by the tool with the Key Biodiversity Areas and Protected Areas. List of Red List Species per location is available in Appendix 1 with the description of the IUCN categories.

Due to the Non-disclosure agreement signed between all parties of this project, the exact names and location of the villages cannot be published. Therefore, villages are referred to only by their numbers, and the maps of the overlaps show only the overlap Key Biodiversity Areas and Protected Areas but not the exact locations of the villages. As well, the multi-site report below is an adjusted version of the original version of the report sent to the local contacts of IKEA in India.

### 10.2.2.2 Overlap locations

*Village 1, India and Village 2, India*

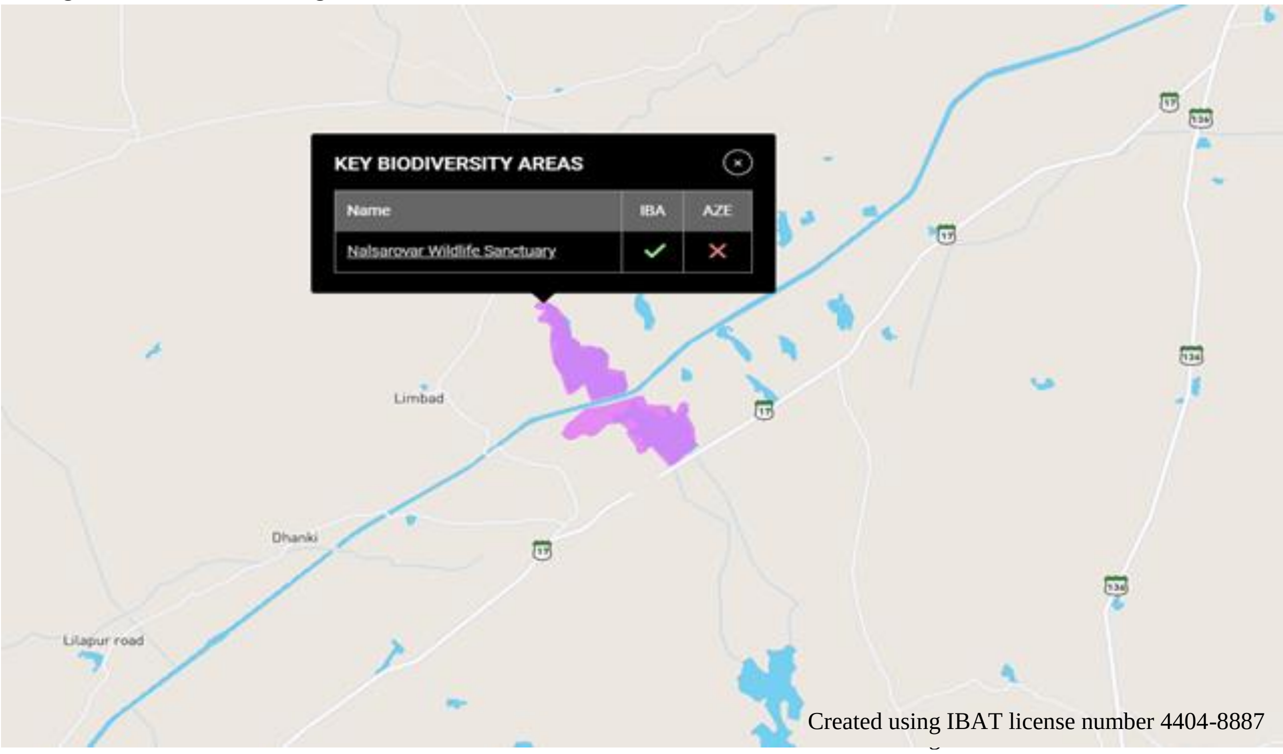



*Figure 21 Map of overlap area of Village 1 India overlap*

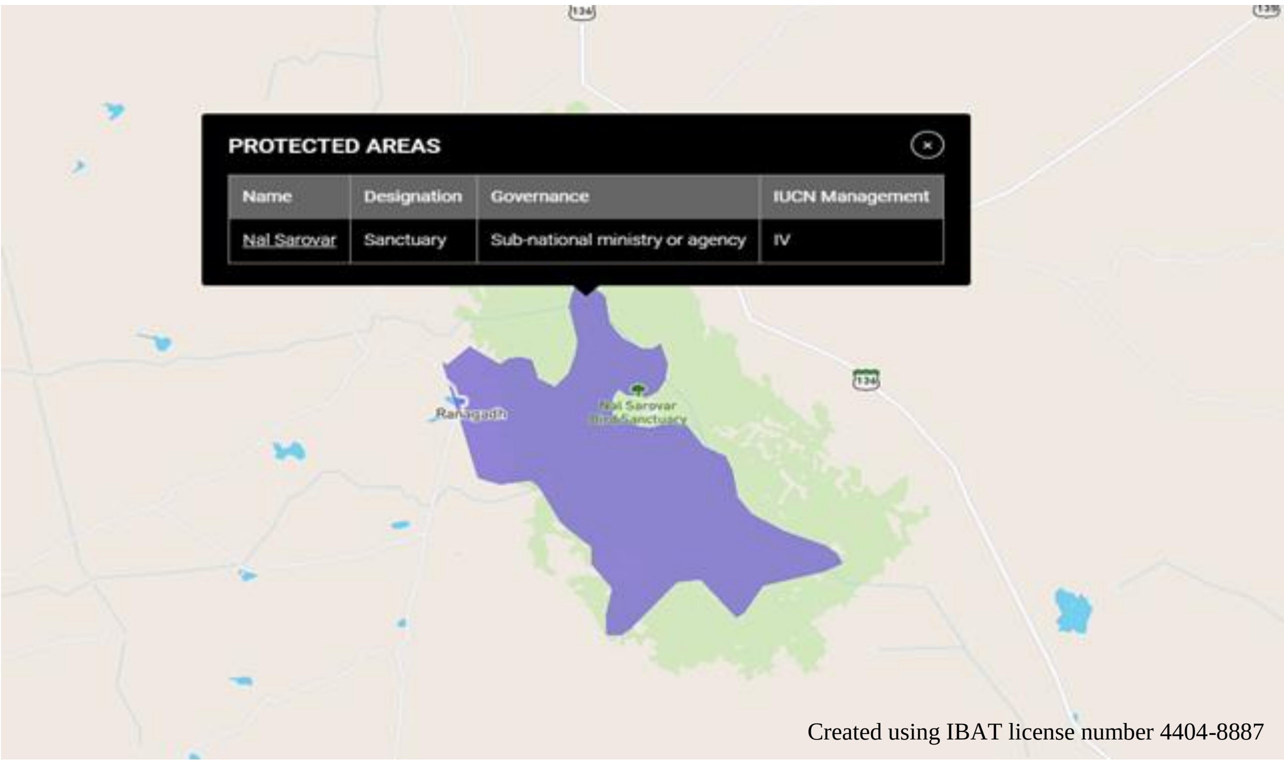



*Figure 22 Map of the overlap area of Village 2 India overlap*

The buffer zone of the village 1 overlaps with the Key Biodiversity Area, specifically Nalsarovar Wildlife Sanctuary, as seen in Figure 22. The village two buffer zone overlaps with the same sanctuary, just the different location of it, as it can be seen in Figure 23.

**Nalsarovar Wildlife Sanctuary**

The area of the Nalsarovar Wildlife Sanctuary is 12 082 ha, and it mainly represents a shallow-water lake. There are about 250 species of birds recorded in the sanctuary with 158 species of waterbirds species. The location presents a migratory route; therefore, the site is visited by hundreds of thousands of birds every year. Sanctuary supports other important fauna species as Wolfs, Hyenas, Golden Jackals, Indian Foxes, Jungle Cats, and around 20 species of fish (BirdLife International, 2020).

*Village 3, India*

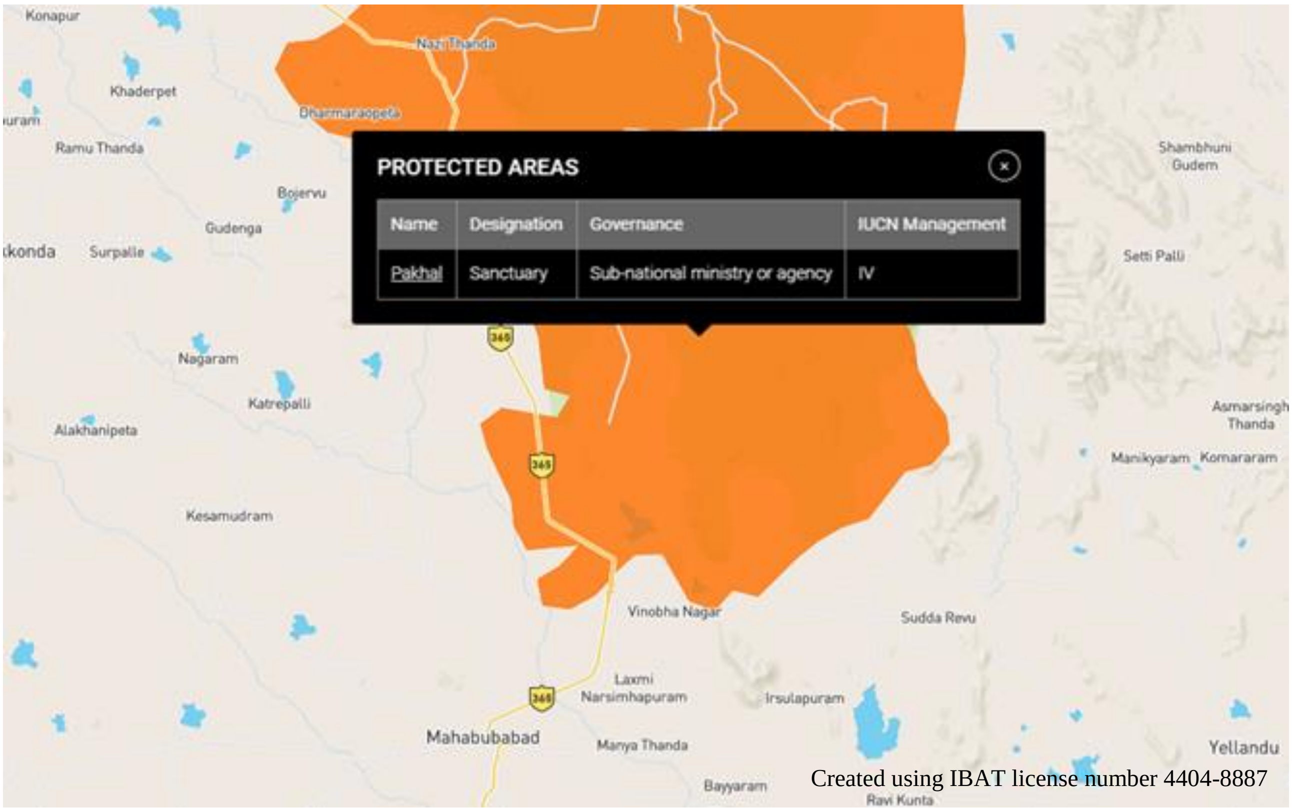



*Figure 23 Map of the overlap area Village 3 India overlap*

The village's buffer zone overlaps with the Protected Area, specifically Pakhal Protected Area designated as Sanctuary.

**Pakhal Protected Area**

There is not much information available about the protected area. The area itself covers 860 $km^2$ and is designated as a Sanctuary and under the IUCN management category IV (ProtectedPlanet, 2020).

*Village 4, India*


*Figure 24 Map of overlap area Village 4 India overlap*

The village's buffer zone overlaps with the Protected Area, specifically the Great Indian Bustard (extension) Protected Area designated as Sanctuary.

**Great Indian Bustard (extension) Protected Area**

There is not much information available about the protected area. The area itself covers 400 $km^2$ and is designated as a sanctuary. It is not designated under the IUCN management category (ProtectedPlanet, 2020).

*Village 5 India*

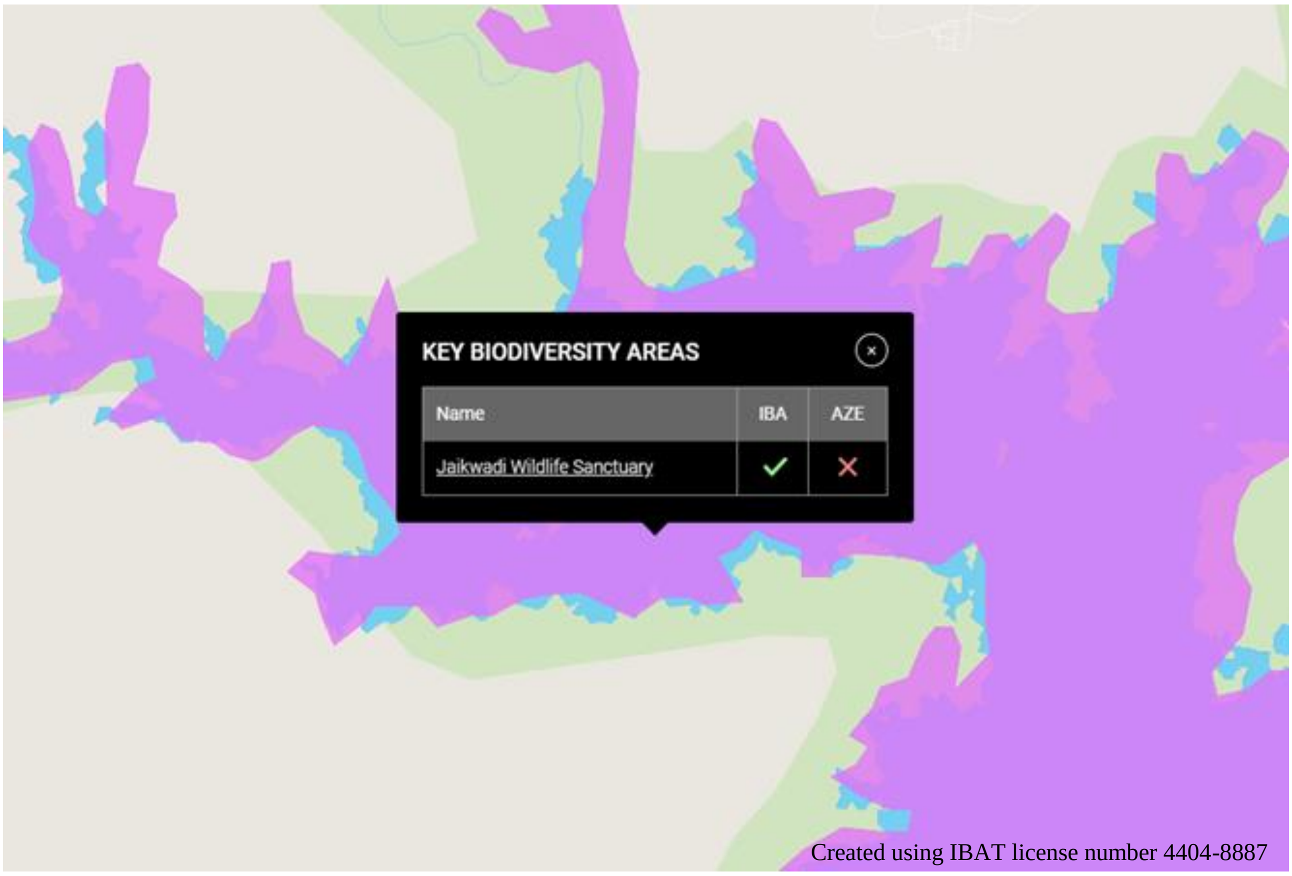



*Figure 25 Map of overlap area Village 5 India overlap*

The location and the buffer zone of the village 5 overlaps with the Key Biodiversity Area, specifically Jaikwadi Wildlife Sanctuary.

**Jaikwadi Wildlife Sanctuary**

The Jaikwadi Sanctuary was declared as a bird sanctuary in 1986. It is a human-made reservoir that was created after the construction of the dam in 1975. Due to the absence of the hilly terrain, the dam has created a large, spread water body which is 27km wide and 55km long. Such a water body has become very attractive to all kinds of waterbirds species and species connected to such an ecosystem. There are records of 264 different bird species in the areas, and during the survey in 2000, the number of birds in the location reached 50 000. Many species located in the area are classified as near-threatened species. (BirdLife International, 2020)

*Village 6 India*

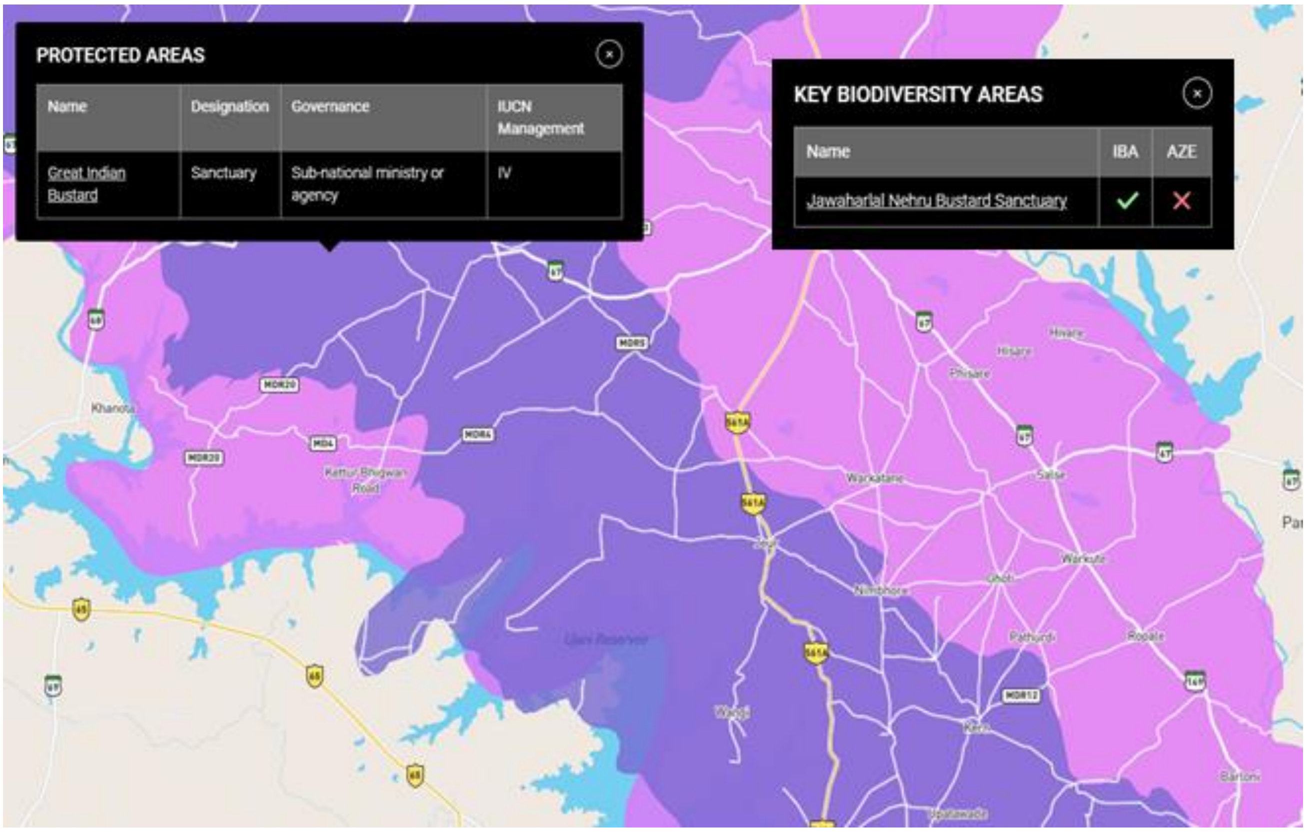



*Figure 26 Map of overlap area Village 6, India*

As seen in Figure 27 above, Village 6 is directly located in the Great Indian Bustard Protected Area, which is designated as a sanctuary. It is also located in the Key Biodiversity Area, specifically Jawaharlal Nehru Bustard Sanctuary.

**Great Indian Bustard Sanctuary**

The sanctuary has an area of 8496,44 $km^{2,}$ and it is under the IUCN management category IV. There is not much more information available on the location. As it is solely focused on Great Indian Bustard, there is an opportunity to take action to support the conservation of the species in the area. (Protected Planet, 2020)

**Jawaharlal Nehru Bustard Sanctuary**

The sanctuary area is 849,644 hectares, and it was assessed in 2013. Most of the area has been under human habitat and land cultivation. The area is home to two important species, Great

Indian Bustard as the previous sanctuary, which is critically endangered, and Lesser Florican, which is endangered. Due to land cultivation and human habitation, the populations of both species have declined rapidly. Besides the bird species, the area is home to a pack of Indian or Grey Wolf. (BirdLife International, 2020)

As we can see, both sanctuaries are mainly focused on Great Indian Bustard, which is critically endangered; there, the support of the conservation actions of the species should be the priority.

*Village 7, India*

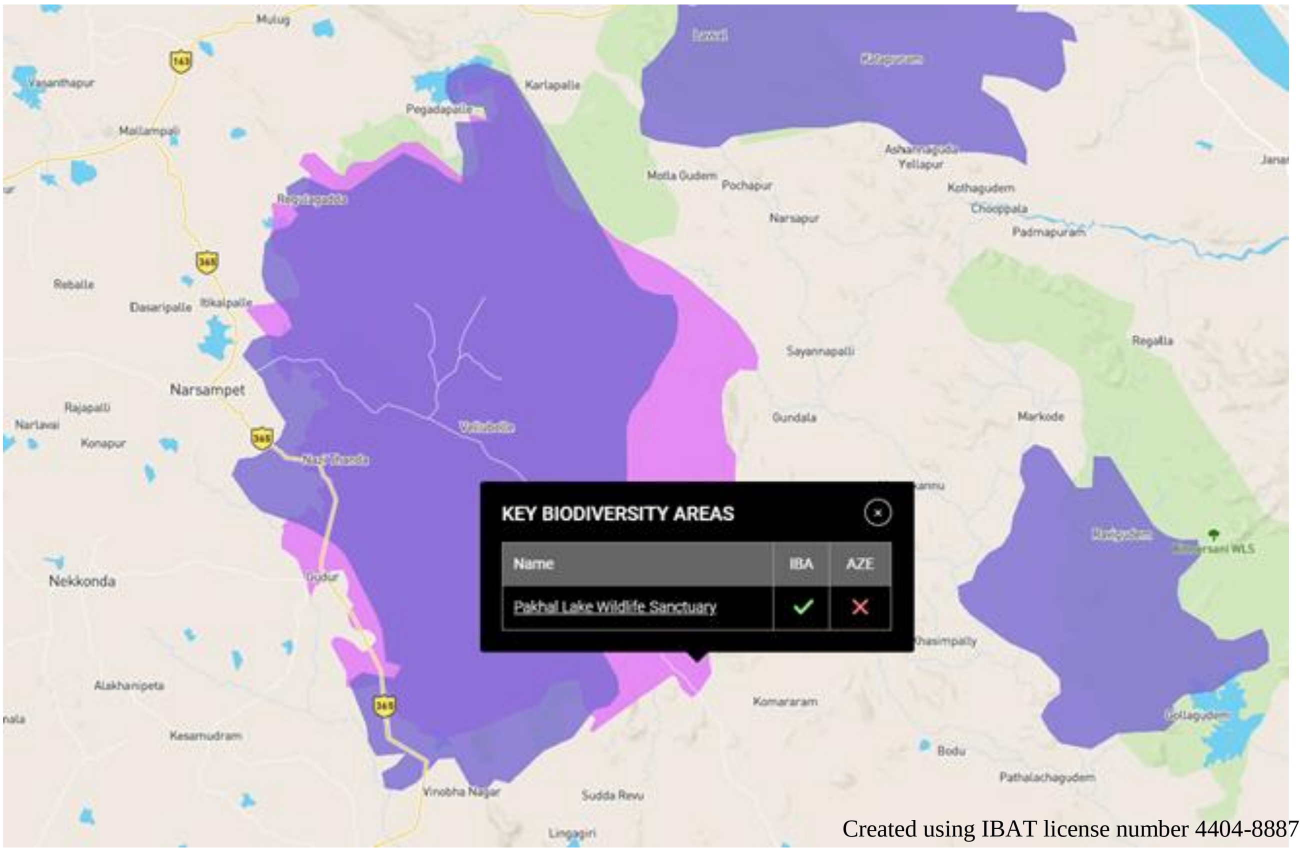



*Figure 27Map of overlap area Village, India*

As seen in Figure 28 above, Village 7 is directly located in the Pakhal Lake Wildlife Sanctuary, which is defined as Key biodiversity area and Protected Area.

**Pakhal Lake Wildlife Sanctuary/Pakhal Sanctuary (Protected Area)**

There is not much information available about Pakhal Sanctuary defined as a protected area except that it is 860 km$^2$ in size and was established in 1952. (Protected Planet, 2020)

More information is available about Pakhal Lake Wildlife Sanctuary, which has an area of 87 930 ha, and the latest year of assessment was 2003. The sanctuary itself consists mainly of the small freshwater lake and surrounding dry deciduous teak forest. The lake is the source of water was surrounding farming areas, and it contains an undisturbed avifauna, which is a core of the Pakhal Wildlife Sanctuary. Lake itself also supports the existence of many marsh and aquatic plants and surrounding grasslands and forests. It also supports a considerate amount of migratory birds, but the avifauna was never researched; therefore, the site is classified as data deficient. The area itself also supports large mammal as tigers, leopards, spotted deer, and others. (BirdLife International, 2020)

#### *10.2.2.3 Follow-up on the multi-site report from local contacts in India*

The multisite report was sent to third-party contact from WWF India and IKEA cotton developer for India. After the checkup directly on the location, third party contact from WWF India got back to us with the results confirms **NO** overlap with the key biodiversity areas and protected area. Villages 3-7 have no overlap with the key biodiversity areas or protected areas. Villages 1-2 have overlap with the 5 km buffer zone of the Nalsarovar Bird Sanctuary, **NOT** with the location of the sanctuary. Therefore, Villages 1 and 2 are in the proximity of the sanctuary (not within the area but close to the area), and there are cautionary efforts taken to make cotton production more sustainable in the buffer area of sanctuary to negate the impact of conventional production of cotton on fragile ecoregion like Nalsarovar Bird Sanctuary.

This case shows the usefulness of the multi-site report, which supports quite an efficient checkup of the huge bulk of the location and, after that, gives the possibility to approach local suppliers/producers or contact to check the reality of the areas of interest. Based on that, it can reduce the resources required to check-up on all the location, which in many cases is impossible and provides the opportunity to risk screen the production area. That will support the decision making of IKEA and provides the opportunity to support the specific types of ecosystems or species. In the future, it can be used not just in the agricultural production areas but also in processing facilities along the supply chain.

The disadvantage is that it requires high precision data, best the polygons of the farm fields, which, in many cases, is very difficult to acquire.

## 10.3 GLOBAL FOREST WATCH PRO

### 10.3.1 Methodology

In the case of the global forest watch, we have used the same locations of the cotton farming villages in India. IKEA already uses the Global Forest Watch Pro for the timber production analysis and risk screening; therefore, we have decided to use it for the cotton location and risk screen for the primary forest and deforestation in the locations. The villages' buffer zone was used based on the farming area of the largest village and equaled to.1, 079 km. Villages areas do **NOT** represent the real sourcing areas of IKEA cotton farms as we only know the pin-point location where some farms are located. Therefore, based on the risk screening by GFW must be confirmed on the field. Maps from the GFW could not be published as the location of the villages are under the non-disclosure agreement. The locations are divided based on the states they are located in, specifically Maharastra state (199 villages), Gujarat state (44 villages), and Telangana state (85 villages).

### 10.3.2 Results

#### *10.3.2.1 Locations in Maharastra state, India*

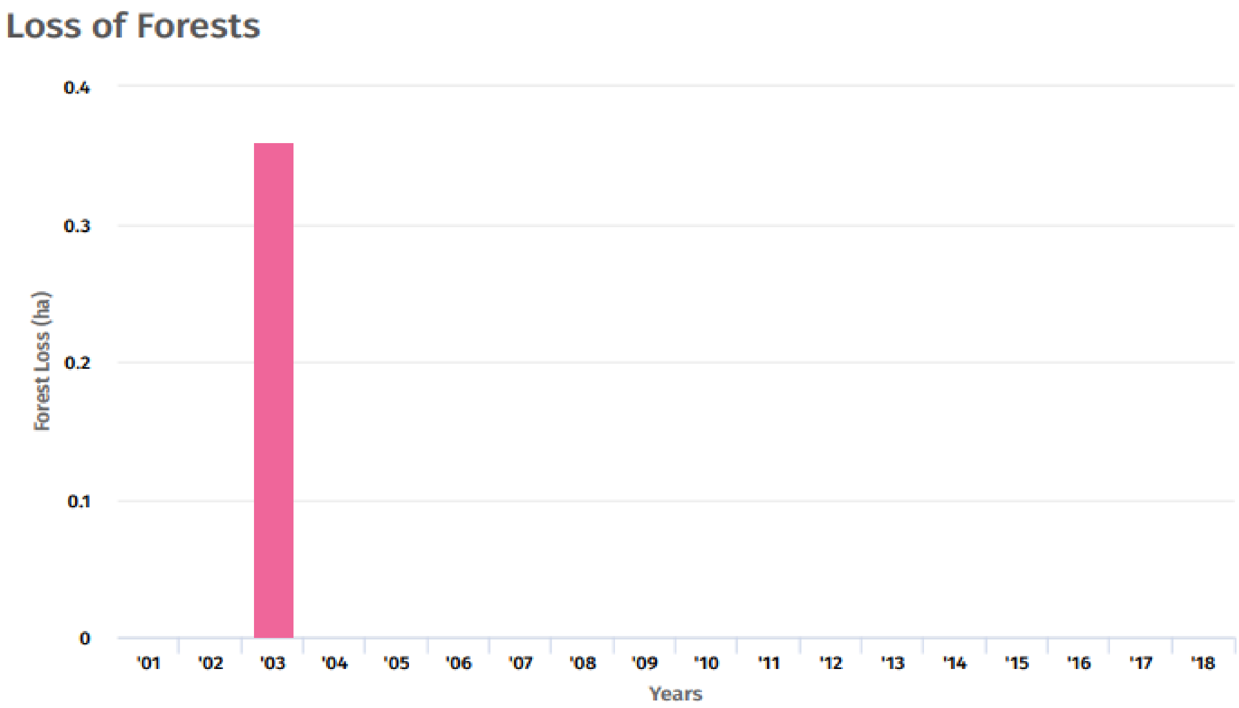



*Figure 29 Graph of Loss of Forest in the buffer zones of the cotton farming villages in Maharastra state, India (Generated by GFWPro License)*

**Percentage of Historic Area Lost**

| | | LOSS (all years) ha | TREE COVER EXTENT (2000)ha |
|---|---|---|---|
| Tree Cover Loss | 0.67% | 0.36 | 53 |
| Primary Forest | 0.00% | 0 | 0.51 |
| Protected Areas | 0.00% | 0 | 6.81 |
| Peat | 0.00% | 0 | 0.36 |
| Intact Forest Landscape | 0.00% | 0 | 0 |

*Figure 28 Graph of the Historic Area Lost in the buffer zones of the cotton farming villages in Maharastra state, India (Generated by GFWPro License)*

### *10.3.2.2 Locations in Telangana state, India*

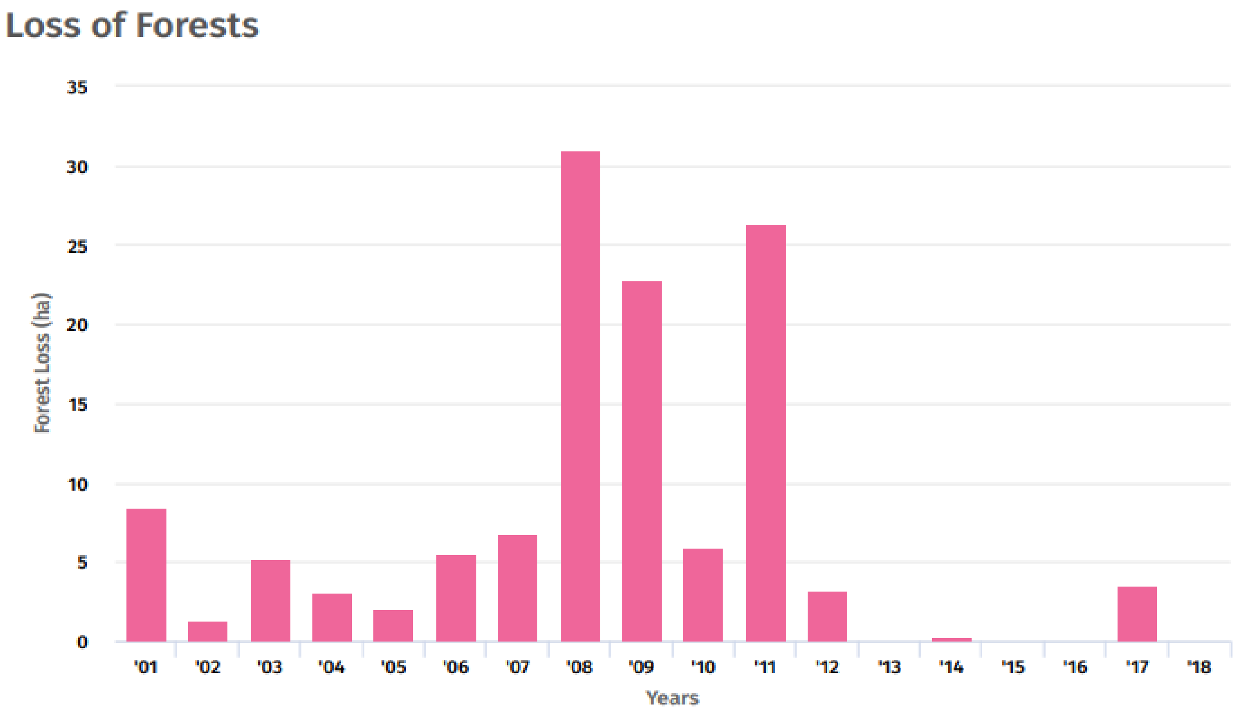



*Figure 30 Graph of Loss of Forest in the buffer zones of the cotton farming villages in Telangana state, India (Generated by GFWPro License)*

**Percentage of Historic Area Lost**

| | | LOSS (all years) ha | EXTENT (2000)ha |
|---|---|---|---|
| Tree Cover Loss | 14.96% | 126 | 844 |
| Primary Forest | 0.00% | 0 | 0 |
| Protected Areas | 2.80% | 0.22 | 7.85 |
| Peat | 25.42% | 0.15 | 0.59 |
| Intact Forest Landscape | 0.00% | 0 | 0 |

*Figure 31 Figure 26 Graph of the Historic Area Lost in the buffer zones of the cotton farming villages in Telangana state, India (Generated by GFWPro License)*

*10.3.2.3 Locations in Gujarat state, India*

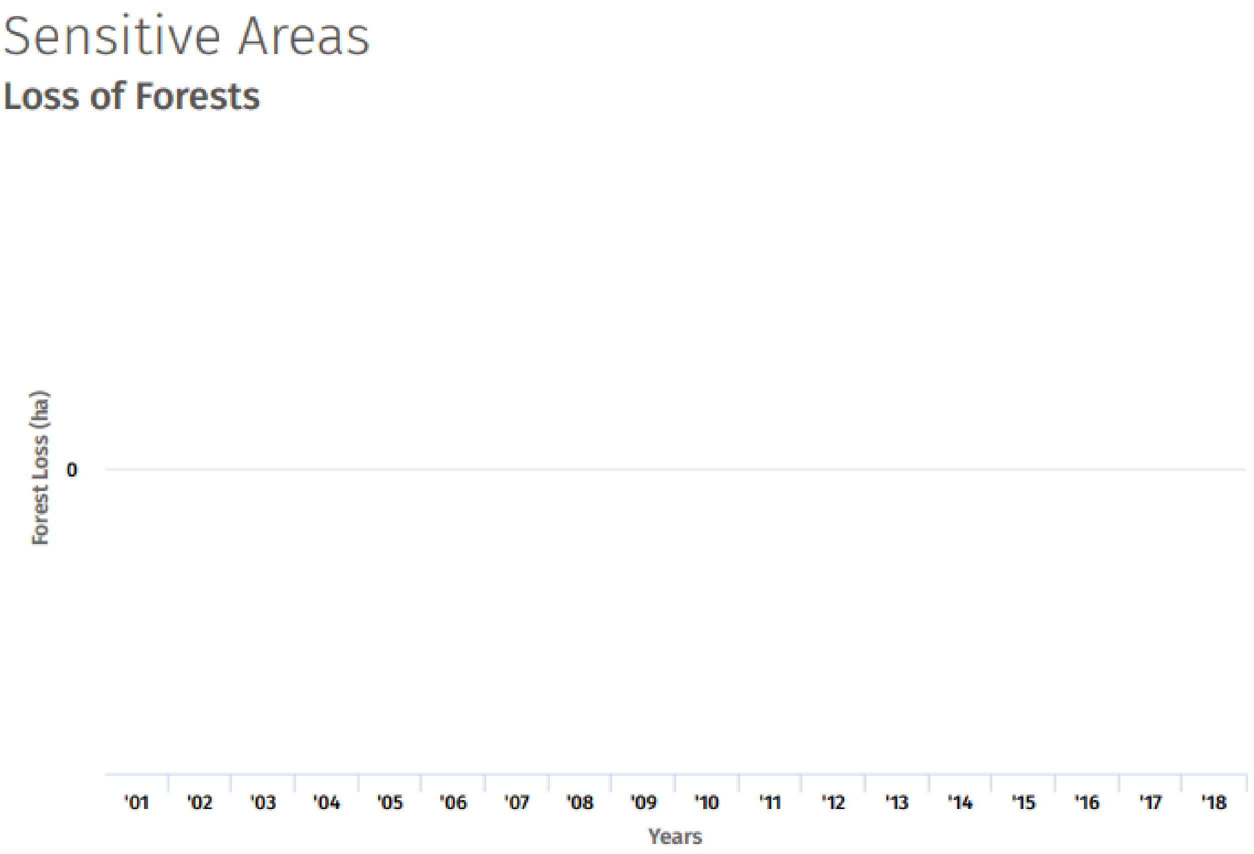



*Figure 32 Graph of Loss of Forest in the buffer zones of the cotton farming villages in Gujarat state, India (Generated by GFWPro License)*

| | | | |
|---|---|---|---|
| Tree Cover Loss | 0.00% | 0 | 24 |
| Primary Forest | 0.00% | 0 | 0 |
| Protected Areas | 0.00% | 0 | 16 |
| Peat | 0.00% | 0 | 8.96 |
| Intact Forest Landscape | 0.00% | 0 | 0 |

*Figure 33 Figure 26 Graph of the Historic Area Lost in the buffer zones of the cotton farming villages in Gujarat state, India (Generated by GFWPro License)*

The screening results using GFWPro show some forest loss in the areas of interest, mainly in the Telangana state. Looking at the Historic Area Lost graphs, we can see that the Primary Forest loss in all the locations is at 0%. That presents for us really good results as it means that not primary forest was lost in the areas of cotton production, recently or in recent history (which in our case dates to 2001). The reason for the forest loss is most probably related to the cutting down of the plantation's forests, which are used for commercial production.

Using GFWPro, we have the possibility to risk screen the already existing sourcing locations or the potential future investment to ensure that the sourcing locations are not located in the areas which would cause the deforestation of the primary forests. Challenge is the quality and precision of the data on the location and the use of global datasets. Therefore, on-field follow-up is needed to ensure the reality of the situation in the locations. GFWPro information helps to direct the focus to the vulnerable locations, which then improves the decision-making of companies like IKEA and supports future actions.

# 11 DISCUSSION

To begin with, the focus of this project was to research the possible methods and tools to analyze the biodiversity impact of the IKEA supply chains. In this specific case, the decision was made by IKEA that the supply chain we would apply this analysis to would be the cotton supply chain. That decision was mainly based on IKEA's confidence that it is a supply chain with the best quality of data and traceability. Even though the cotton was the chosen commodity for this project, the best scenario for IKEA would be that the used or tested tools would be applicable across different sourcing commodities of IKEA. In these terms, it could be argued if the results or the chosen tools would be the same if the different commodity were selected as a starting point and focus point. As the tools we used for testing, IBAT, BIM, and GFWPro are not specified for a particular commodity, it could be argued that it did not affect the results.

The authors must take into consideration the influence of the current COVID-19 pandemic. As the epidemic broke out globally during, we were in the middle of our project already. That had two aspects of influence. Firstly, it had a direct practical impact on our thesis. As borders were closed and people worldwide were asked to work from home, IKEA offices among them, all our regular travels to IKEA offices, were canceled. That made it a bit more challenging to communicate things and change our way of working rapidly. Simultaneously, a huge amount of people was influenced by different levels of restrictions as well, depending on the country they were located at. That influenced our data gathering from India. For example, many offices were fully closed, and the movement of people was minimal. Secondly, we tried to stay confined to our own places, as the working options outside were limited for some time, which we believe had a direct influence on us and our work as it was not something we were used to. It can be definitely argued that the current COVID-19 pandemic had direct and indirect influences on this project and the results of this project.

Looking into our methodology of the reviewed tools and tools used for testing, we could argue at what level we were influenced by our field trip to the United Kingdom, where we met with the developers of some tools. In our review, we have used tools based on the combination of the literature review and the field trip to the United Kingdom. Those tools were selected with the focus of applicability in the business setting. This resulted in the review presentation of the bigger bulk of the tools for IKEA supervisors and also Niels Burgess from UNEP-WCMC, where the decision was made which of the tools would be the best option for IKEA and us to test, based on the availability of the tools and their potential results. We could argue here that these factors could be influential in selecting the tools, but on the other hand, this project was also created for the needs of IKEA; therefore, the review and testing had to be based inevitably on their needs.

In the first part of our project, we mainly focus on the role and the importance of the biodiversity, impact of the cotton supply chain on biodiversity, and review how IKEA is already involved in the cotton supply chain. This part's main purpose was to create an understanding and connection between biodiversity and cotton, why it is essential to understand the biodiversity impacts of cotton, and how much does cotton influence the biodiversity. In relation to that, IKEA’s work on cotton was also described to understand what they already did towards the sustainable development of cotton. We believe that this part of the project created and understanding and highlighted the need to understand the biodiversity impact of the cotton supply chain and in the bigger picture of supply chains in general, yet, opinionated focus and angle upon the biodiversity subject, along with IKEA’s pre-existing efforts towards sustainability focus and improvements, could serve as the base of pre-existing knowledge, that could shape the approach and angle towards the subject itself.

As we moved to the tools review, they have been divided into two main categories of primary and secondary tools. The only reason for this division was the later testing part. Primary tools were the ones that were going to be tested, and secondary tools were the ones that were only reviewed. The main reasons for not testing the secondary tools was their current state of development or availability. In the case of Product Biodiversity Footprint and TRASE, we had no means of testing them as they are still in the early stage of development. Star metric is already developed, but manual calculation would be above our technical expertise and time frame, while the tool is also being developed directly in IBAT, which had the direct possibility for usage in IKEA. Further, PBF and TRASE are also tools that were seen as something that would be very useful in the future in IKEA. The possibilities of partnerships and participation in development were a few of the reasons behind the review of these tools. As of selection of the reviewed tools, it was based on the literature review and discussions with the IKEA stakeholders and members of the development teams of the tools, which in combination, provided a solid base for the objective, yet also subjective, selection of the tools. One could still argue that there are other tools that could be used, and these results should not close the options of the testing and using other tools in IKEA if they become available.

One of the main aspects of this project was the testing and application of the tools in the real setting of the IKEA's cotton supply chain. The main influence of this testing was the availability of the data. As the project began, the main focus was on India and Pakistan's location, as it was believed that farm-level data were available. Later, it was revealed that data at the farm-level are not possible to be acquired due to the legal restrictions on sharing such information in Pakistan. Combining the data unavailability and the need to test the tool's capabilities, it was decided to apply testing to all sourcing countries of cotton in IKEA. The approach was to test on the highest possible resolution, in all available locations. Therefore, some countries like India, have the level of testing on the farm level, but in some cases, testing was done only on region/state/province level or country level. This approach generated the best possible results with the currently available data. It has also tested the tools themselves, along with their capability for providing the results, in instances, where the best data are simply not available. It highlighted the importance of the data quality, if the biodiversity impact of commodities is to be assessed. It also highlighted, that some of the results are not representative of the IKEA cotton supply chain's reality and are more of the testing example to show the tools' potential and provide potential results based on current best data availability. Even though the results are not a direct reflection of the biodiversity impact of IKEA cotton supply chain in many cases, it can be still argued they have a tremendous impact on the future of biodiversity measurement in IKEA, as based on this result; they can understand where do they need to put their focus to collect better data. These results can also support the future development of the tools and thus to support the companies in their usage. It can be argued that they were several shortcomings of the tools, either from their functionality point of view or in the tools' methodology. The same could be said about the availability of information in IKEA and their knowledge of the cotton supply chain. Results were also influenced by the authors' technical capabilities, which lacked several technical skills, like technical knowledge of the GIS.

To discuss the results themselves, IBAT and GFWPro showed us, that they could provide a great basis for the risk screening of the IKEA's current sourcing locations and the future investment locations. In the case of IBAT, we were able to risk screen the location for potential overlap with the vulnerable locations (Key Biodiversity Areas, Protected Areas) and in case of the GFWPro overlap with the deforestation of the primary forests. IBAT also can show the list of species in the overlap locations based on the IUCN Red List, which could be useful for specific actions to be taken. On the other hand, IBAT thus serves only for the analyzed and tested purposes , yet misses the other functionalities, and thus is very limited in its functionality. In further case, the introduction of the STAR metric will ease up this process and deficiencies and provide a better understanding of actions that need to be taken to support biodiversity. These results do not directly measure the impact on biodiversity, but on the other hand, they tell us if the production takes place in the biodiversity important areas, which in return can be used to protect the biodiversity itself. Biodiversity Impact Metric itself gave the results of quantification of biodiversity impact. These results quantify the biodiversity impact on different resolutions, from country to regional level. The results in this project showed different biodiversity impacts of different sourcing countries and regions of IKEA. That can be used to support the decision making and actions to improve the biodiversity itself. Results were highly influenced by the availability of the data, and for example, results of the regional/state/province level are not usable at all as the only input which was making the difference in the calculation was the range rarity value due to missing data. It can also be argued that BIM is still based only on three different input values: area of production, biodiversity loss coefficient, and range rarity value, which in itself very much limits the results as they are representative of only these three values. It can be challenged if these three values are the proper representation of the biodiversity impact itself. Further along, these results do not represent the understanding of the biodiversity impact of IKEA supply chain, rather than a basic knowledge of tools that are out there and create a certain basic understanding of IKEA's cotton biodiversity impact. These results can then be used to create a foundation for future work to understand and measure the biodiversity impact of the commodity supply chain and help understand the shortcomings and potential improvements, and where the focus in development should be put.

# 12 CONCLUSION

As this project uses progressive step-by-step research, going through several stages, firstly, it presents the introduction and understanding of the topic of biodiversity, along with its business-related context and significance. The Paper then discusses the current problems and difficulties related to the measurements of biodiversity impacts deriving from various supply chains. Further, in the initial part of the report, the focus is put on the cotton supply chain and its interconnectedness and close dependency on biodiversity, and subsequently, on its derived negative effects upon biodiversity. Subsequently, the project shifts focus onto IKEA and their cotton supply chain position on the global scale, thus, the potential scale and significance of their impact posed on biodiversity, as well as their current steps and strive towards measuring of such potential impacts, and towards sustainability targets in general, along with the desire for mitigation of such potential impacts and general biodiversity improvements for future's well-being as well as the well-being of the cotton industry.

As a second step, moving to the review part of the report, the focus is put on a review of the contextually chosen biodiversity measurement tools, methods, and platforms, which are analyzed in detail upon their functions in regards to biodiversity measurement and assessment. These tools include Biodiversity Impact Matric (BIM), IBAT, Global Forest Watch, Product Biodiversity Footprint (PBF), STAR Metric, and TRASE.  These tools have a different degree of review, dependent on their contextual usefulness, where their functions differ greatly, thus offering different information and data provisions, thus deriving to different results with various applicability.

With each tool having individual specifications and system of functioning (where some of these tools, due to their working system and required expert knowledge, were not reviewed and subsequently could not be tested), as a next step, testing of the tools will is performed, where paper takes critical and practical standpoint upon those tools, methods, and platforms, prioritizing some over others, based on their applicability and context, as well as the time scale of the report. Paper then tests upon those tools, using both IKEA's cotton supply chain data on various geographies and usage of the accessible and available global data that is necessary for the tools' testing phase and thus practical and critical approach. In this section, the paper firstly derives to the preliminary, partially factual results at best possible scale of accuracy (which was refined and refocused several times along the project), depending upon the date and time available, and secondly, analyzes the deficiencies of those results and methods used, along with their necessary/potential improvements, that are required in order to achieve results of the higher degree of factual and contextual precision. As of last, each tested section also contains the tools' usefulness regarding IKEA's supply chains.

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# 14 Appendix

## 14.1 Appendix 1 – List of IUCN species in buffer of farming villages

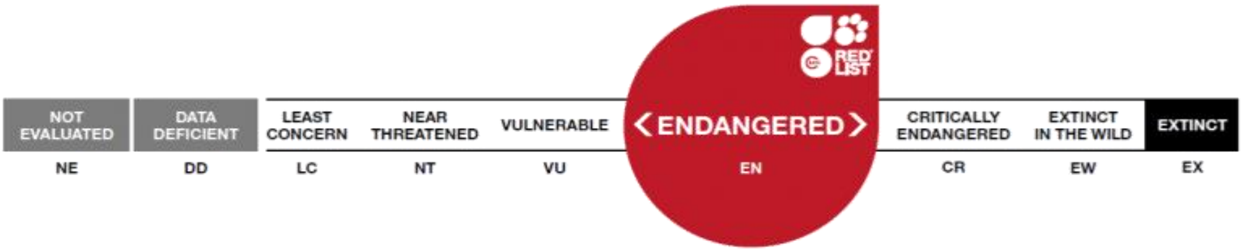


*Figure 34 Description of IUCN categories (The IUCN Red List of Threatened Species™, 2020)*

| SITE_NAME | CR | EN | VU | NT OR LR/NT | LC OR LR/LC | LR/CD | DD | EW | EX | NA | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| VILLAGE 1 | 6 | 6 | 15 | 19 | 740 | 0 | 7 | 0 | 0 | 0 | 793 |
| VILLAGE 2 | 5 | 6 | 17 | 18 | 739 | 0 | 7 | 0 | 0 | 0 | 792 |
| VILLAGE 3 | 12 | 21 | 55 | 77 | 1135 | 0 | 45 | 0 | 0 | 0 | 1345 |
| VILLAGE 4 | 12 | 21 | 57 | 77 | 1161 | 0 | 45 | 0 | 0 | 0 | 1373 |
| VILLAGE 5 | 5 | 6 | 15 | 19 | 739 | 0 | 7 | 0 | 0 | 0 | 791 |
| VILLAGE 6 | 12 | 21 | 57 | 77 | 1162 | 0 | 45 | 0 | 0 | 0 | 1374 |
| VILLAGE 7 | 5 | 6 | 15 | 19 | 737 | 0 | 6 | 0 | 0 | 0 | 788 |
| VILLAGE 8 | 8 | 16 | 40 | 43 | 1224 | 0 | 39 | 0 | 0 | 0 | 1370 |
| VILLAGE 9 | 22 | 27 | 51 | 61 | 1402 | 0 | 62 | 0 | 0 | 0 | 1625 |
| VILLAGE 10 | 5 | 5 | 16 | 19 | 741 | 0 | 7 | 0 | 0 | 0 | 793 |
| VILLAGE 11 | 12 | 21 | 56 | 77 | 1137 | 0 | 45 | 0 | 0 | 0 | 1348 |
| VILLAGE 12 | 6 | 6 | 16 | 19 | 741 | 0 | 7 | 0 | 0 | 0 | 795 |
| VILLAGE 13 | 4 | 6 | 17 | 18 | 726 | 0 | 9 | 0 | 0 | 0 | 780 |
| VILLAGE 14 | 4 | 8 | 24 | 29 | 612 | 0 | 10 | 0 | 0 | 0 | 687 |
| VILLAGE 15 | 6 | 5 | 16 | 19 | 748 | 0 | 7 | 0 | 0 | 0 | 801 |
| VILLAGE 16 | 12 | 21 | 55 | 77 | 1136 | 0 | 45 | 0 | 0 | 0 | 1346 |
| VILLAGE 17 | 6 | 6 | 16 | 19 | 742 | 0 | 7 | 0 | 0 | 0 | 796 |
| VILLAGE 18 | 6 | 6 | 14 | 19 | 740 | 0 | 7 | 0 | 0 | 0 | 792 |
| VILLAGE 19 | 5 | 6 | 15 | 19 | 736 | 0 | 6 | 0 | 0 | 0 | 787 |
| VILLAGE 20 | 5 | 6 | 15 | 19 | 736 | 0 | 6 | 0 | 0 | 0 | 787 |
| VILLAGE 21 | 5 | 6 | 15 | 19 | 740 | 0 | 7 | 0 | 0 | 0 | 792 |
| VILLAGE 22 | 3 | 7 | 18 | 21 | 786 | 0 | 13 | 0 | 0 | 0 | 848 |
| VILLAGE 23 | 6 | 6 | 15 | 19 | 740 | 0 | 7 | 0 | 0 | 0 | 793 |
| VILLAGE 24 | 3 | 7 | 19 | 22 | 790 | 0 | 14 | 0 | 0 | 0 | 855 |
| VILLAGE 25 | 4 | 7 | 18 | 20 | 744 | 0 | 11 | 0 | 0 | 0 | 804 |
| VILLAGE 26 | 10 | 17 | 51 | 69 | 992 | 0 | 23 | 0 | 0 | 0 | 1162 |
| VILLAGE 27 | 12 | 21 | 57 | 77 | 1162 | 0 | 45 | 0 | 0 | 0 | 1374 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **VILLAGE 28** | 5 | 7 | 18 | 15 | 707 | 0 | 8 | 0 | 0 | 0 | 760 |
| **VILLAGE 29** | 5 | 7 | 14 | 20 | 723 | 0 | 9 | 0 | 0 | 0 | 778 |
| **VILLAGE 30** | 6 | 6 | 14 | 18 | 744 | 0 | 7 | 0 | 0 | 0 | 795 |
| **VILLAGE 31** | 3 | 7 | 18 | 21 | 785 | 0 | 13 | 0 | 0 | 0 | 847 |
| **VILLAGE 32** | 6 | 6 | 16 | 19 | 741 | 0 | 7 | 0 | 0 | 0 | 795 |
| **VILLAGE 33** | 5 | 6 | 15 | 19 | 737 | 0 | 6 | 0 | 0 | 0 | 788 |
| **VILLAGE 34** | 3 | 7 | 18 | 22 | 788 | 0 | 13 | 0 | 0 | 0 | 851 |
| **VILLAGE 35** | 6 | 6 | 16 | 19 | 741 | 0 | 7 | 0 | 0 | 0 | 795 |
| **VILLAGE 36** | 5 | 6 | 14 | 19 | 740 | 0 | 7 | 0 | 0 | 0 | 791 |
| **VILLAGE 37** | 16 | 21 | 56 | 77 | 1133 | 0 | 45 | 0 | 0 | 0 | 1348 |
| **VILLAGE 38** | 12 | 21 | 57 | 77 | 1157 | 0 | 45 | 0 | 0 | 0 | 1369 |
| **VILLAGE 39** | 3 | 7 | 18 | 21 | 788 | 0 | 13 | 0 | 0 | 0 | 850 |
| **VILLAGE 40** | 4 | 6 | 18 | 19 | 726 | 0 | 9 | 0 | 0 | 0 | 782 |
| **VILLAGE 41** | 3 | 6 | 18 | 19 | 735 | 0 | 10 | 0 | 0 | 0 | 791 |
| **VILLAGE 42** | 16 | 20 | 56 | 77 | 1133 | 0 | 45 | 0 | 0 | 0 | 1347 |
| **VILLAGE 43** | 4 | 6 | 18 | 19 | 714 | 0 | 9 | 0 | 0 | 0 | 770 |
| **VILLAGE 44** | 5 | 6 | 15 | 19 | 736 | 0 | 6 | 0 | 0 | 0 | 787 |
| **VILLAGE 45** | 5 | 6 | 15 | 19 | 737 | 0 | 6 | 0 | 0 | 0 | 788 |
| **VILLAGE 46** | 4 | 6 | 15 | 19 | 700 | 0 | 10 | 0 | 0 | 0 | 754 |
| **VILLAGE 47** | 5 | 6 | 15 | 19 | 739 | 0 | 7 | 0 | 0 | 0 | 791 |
| **VILLAGE 48** | 8 | 15 | 33 | 30 | 899 | 0 | 27 | 0 | 0 | 0 | 1012 |
| **VILLAGE 49** | 4 | 7 | 20 | 19 | 711 | 0 | 11 | 0 | 0 | 0 | 772 |
| **VILLAGE 50** | 12 | 21 | 57 | 77 | 1164 | 0 | 45 | 0 | 0 | 0 | 1376 |
| **VILLAGE 51** | 5 | 6 | 14 | 19 | 739 | 0 | 6 | 0 | 0 | 0 | 789 |
| **VILLAGE 52** | 5 | 6 | 14 | 19 | 739 | 0 | 7 | 0 | 0 | 0 | 790 |
| **VILLAGE 53** | 6 | 6 | 16 | 19 | 744 | 0 | 7 | 0 | 0 | 0 | 798 |
| **VILLAGE 54** | 8 | 17 | 39 | 44 | 1225 | 0 | 40 | 0 | 0 | 0 | 1373 |
| **VILLAGE 55** | 3 | 7 | 18 | 22 | 785 | 0 | 13 | 0 | 0 | 0 | 848 |
| **VILLAGE 56** | 5 | 6 | 15 | 19 | 739 | 0 | 7 | 0 | 0 | 0 | 791 |
| **VILLAGE 57** | 5 | 6 | 14 | 19 | 737 | 0 | 6 | 0 | 0 | 0 | 787 |
| **VILLAGE 58** | 12 | 21 | 57 | 77 | 1161 | 0 | 45 | 0 | 0 | 0 | 1373 |
| **VILLAGE 59** | 5 | 7 | 17 | 16 | 715 | 0 | 7 | 0 | 0 | 0 | 767 |
| **VILLAGE 60** | 3 | 7 | 18 | 21 | 785 | 0 | 13 | 0 | 0 | 0 | 847 |
| **VILLAGE 61** | 3 | 7 | 18 | 21 | 784 | 0 | 13 | 0 | 0 | 0 | 846 |
| **VILLAGE 62** | 5 | 6 | 15 | 19 | 739 | 0 | 6 | 0 | 0 | 0 | 790 |
| **VILLAGE 63** | 5 | 7 | 19 | 21 | 746 | 0 | 9 | 0 | 0 | 0 | 807 |
| **VILLAGE 64** | 5 | 6 | 16 | 19 | 740 | 0 | 7 | 0 | 0 | 0 | 793 |
| **VILLAGE 65** | 4 | 6 | 18 | 20 | 740 | 0 | 10 | 0 | 0 | 0 | 798 |
| **VILLAGE 66** | 5 | 6 | 14 | 19 | 739 | 0 | 7 | 0 | 0 | 0 | 790 |
| **VILLAGE 67** | 5 | 6 | 15 | 19 | 737 | 0 | 6 | 0 | 0 | 0 | 788 |
| **VILLAGE 68** | 6 | 6 | 16 | 19 | 740 | 0 | 7 | 0 | 0 | 0 | 794 |
| **VILLAGE 69** | 3 | 7 | 18 | 21 | 786 | 0 | 13 | 0 | 0 | 0 | 848 |
| **VILLAGE 70** | 5 | 6 | 15 | 19 | 737 | 0 | 6 | 0 | 0 | 0 | 788 |
| **VILLAGE 71** | 4 | 6 | 17 | 19 | 719 | 0 | 9 | 0 | 0 | 0 | 774 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **VILLAGE 72** | 3 | 7 | 18 | 21 | 786 | 0 | 13 | 0 | 0 | 0 | 848 |
| **VILLAGE 73** | 5 | 6 | 15 | 19 | 739 | 0 | 6 | 0 | 0 | 0 | 790 |
| **VILLAGE 74** | 5 | 6 | 15 | 19 | 737 | 0 | 6 | 0 | 0 | 0 | 788 |
| **VILLAGE 75** | 4 | 6 | 18 | 19 | 736 | 0 | 10 | 0 | 0 | 0 | 793 |
| **VILLAGE 76** | 4 | 7 | 18 | 21 | 787 | 0 | 14 | 0 | 0 | 0 | 851 |
| **VILLAGE 77** | 5 | 6 | 15 | 19 | 736 | 0 | 6 | 0 | 0 | 0 | 787 |
| **VILLAGE 78** | 4 | 6 | 18 | 20 | 739 | 0 | 10 | 0 | 0 | 0 | 797 |
| **VILLAGE 79** | 5 | 6 | 15 | 19 | 736 | 0 | 6 | 0 | 0 | 0 | 787 |
| **VILLAGE 80** | 6 | 6 | 14 | 19 | 741 | 0 | 7 | 0 | 0 | 0 | 793 |
| **VILLAGE 81** | 5 | 7 | 17 | 16 | 716 | 0 | 7 | 0 | 0 | 0 | 768 |
| **VILLAGE 82** | 6 | 6 | 16 | 19 | 742 | 0 | 7 | 0 | 0 | 0 | 796 |
| **VILLAGE 83** | 6 | 5 | 16 | 19 | 745 | 0 | 7 | 0 | 0 | 0 | 798 |
| **VILLAGE 84** | 6 | 5 | 16 | 19 | 742 | 0 | 7 | 0 | 0 | 0 | 795 |
| **VILLAGE 85** | 5 | 6 | 15 | 19 | 735 | 0 | 6 | 0 | 0 | 0 | 786 |
| **VILLAGE 86** | 4 | 6 | 17 | 18 | 720 | 0 | 9 | 0 | 0 | 0 | 774 |
| **VILLAGE 87** | 5 | 7 | 14 | 19 | 745 | 0 | 7 | 0 | 0 | 0 | 797 |
| **VILLAGE 88** | 5 | 7 | 14 | 19 | 740 | 0 | 7 | 0 | 0 | 0 | 792 |
| **VILLAGE 89** | 4 | 8 | 20 | 19 | 720 | 0 | 11 | 0 | 0 | 0 | 782 |
| **VILLAGE 90** | 5 | 5 | 16 | 19 | 742 | 0 | 7 | 0 | 0 | 0 | 794 |
| **VILLAGE 91** | 5 | 6 | 15 | 19 | 739 | 0 | 7 | 0 | 0 | 0 | 791 |
| **VILLAGE 92** | 6 | 6 | 14 | 19 | 740 | 0 | 7 | 0 | 0 | 0 | 792 |
| **VILLAGE 93** | 6 | 6 | 16 | 19 | 740 | 0 | 7 | 0 | 0 | 0 | 794 |
| **VILLAGE 94** | 4 | 6 | 18 | 19 | 726 | 0 | 9 | 0 | 0 | 0 | 782 |
| **VILLAGE 95** | 4 | 6 | 16 | 19 | 714 | 0 | 10 | 0 | 0 | 0 | 769 |
| **VILLAGE 96** | 23 | 34 | 71 | 94 | 1582 | 0 | 86 | 0 | 0 | 0 | 1890 |
| **VILLAGE 97** | 5 | 6 | 16 | 19 | 742 | 0 | 7 | 0 | 0 | 0 | 795 |
| **VILLAGE 98** | 5 | 6 | 14 | 19 | 739 | 0 | 6 | 0 | 0 | 0 | 789 |
| **VILLAGE 99** | 5 | 6 | 14 | 19 | 737 | 0 | 6 | 0 | 0 | 0 | 787 |
| **VILLAGE 100** | 4 | 6 | 17 | 18 | 705 | 0 | 9 | 0 | 0 | 0 | 759 |
| **VILLAGE 101** | 12 | 21 | 56 | 77 | 1136 | 0 | 45 | 0 | 0 | 0 | 1347 |
| **VILLAGE 102** | 6 | 6 | 16 | 19 | 746 | 0 | 7 | 0 | 0 | 0 | 800 |
| **VILLAGE 103** | 12 | 21 | 57 | 77 | 1160 | 0 | 45 | 0 | 0 | 0 | 1372 |
| **VILLAGE 104** | 4 | 7 | 18 | 20 | 787 | 0 | 14 | 0 | 0 | 0 | 850 |
| **VILLAGE 105** | 4 | 6 | 18 | 19 | 736 | 0 | 10 | 0 | 0 | 0 | 793 |
| **VILLAGE 106** | 5 | 6 | 16 | 19 | 738 | 0 | 6 | 0 | 0 | 0 | 790 |
| **VILLAGE 107** | 5 | 6 | 15 | 19 | 736 | 0 | 6 | 0 | 0 | 0 | 787 |
| **VILLAGE 108** | 3 | 7 | 19 | 22 | 795 | 0 | 14 | 0 | 0 | 0 | 860 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **VILLAGE 109** | 5 | 7 | 14 | 19 | 750 | 0 | 7 | 0 | 0 | 0 | 802 |
| **VILLAGE 110** | 4 | 7 | 18 | 20 | 746 | 0 | 11 | 0 | 0 | 0 | 806 |
| **VILLAGE 111** | 3 | 7 | 19 | 21 | 796 | 0 | 15 | 0 | 0 | 0 | 861 |
| **VILLAGE 112** | 5 | 6 | 16 | 19 | 740 | 0 | 6 | 0 | 0 | 0 | 792 |
| **VILLAGE 113** | 4 | 6 | 17 | 18 | 726 | 0 | 9 | 0 | 0 | 0 | 780 |
| **VILLAGE 114** | 5 | 5 | 16 | 19 | 743 | 0 | 7 | 0 | 0 | 0 | 795 |
| **VILLAGE 115** | 4 | 7 | 18 | 19 | 744 | 0 | 11 | 0 | 0 | 0 | 803 |
| **VILLAGE 116** | 12 | 21 | 57 | 77 | 1166 | 0 | 45 | 0 | 0 | 0 | 1378 |
| **VILLAGE 117** | 5 | 6 | 14 | 19 | 739 | 0 | 7 | 0 | 0 | 0 | 790 |
| **VILLAGE 118** | 6 | 6 | 16 | 19 | 741 | 0 | 7 | 0 | 0 | 0 | 795 |
| **VILLAGE 119** | 5 | 6 | 14 | 19 | 739 | 0 | 7 | 0 | 0 | 0 | 790 |
| **VILLAGE 120** | 5 | 6 | 16 | 19 | 739 | 0 | 7 | 0 | 0 | 0 | 792 |
| **VILLAGE 121** | 4 | 7 | 17 | 19 | 743 | 0 | 11 | 0 | 0 | 0 | 801 |
| **VILLAGE 122** | 5 | 6 | 16 | 19 | 742 | 0 | 7 | 0 | 0 | 0 | 795 |
| **VILLAGE 123** | 6 | 6 | 14 | 19 | 740 | 0 | 7 | 0 | 0 | 0 | 792 |
| **VILLAGE 124** | 3 | 6 | 19 | 22 | 759 | 0 | 13 | 0 | 0 | 0 | 822 |
| **VILLAGE 125** | 5 | 6 | 14 | 19 | 740 | 0 | 7 | 0 | 0 | 0 | 791 |
| **VILLAGE 126** | 5 | 6 | 15 | 19 | 735 | 0 | 6 | 0 | 0 | 0 | 786 |
| **VILLAGE 127** | 5 | 6 | 15 | 19 | 735 | 0 | 6 | 0 | 0 | 0 | 786 |
| **VILLAGE 128** | 5 | 6 | 15 | 19 | 735 | 0 | 6 | 0 | 0 | 0 | 786 |
| **VILLAGE 129** | 3 | 7 | 18 | 21 | 785 | 0 | 13 | 0 | 0 | 0 | 847 |
| **VILLAGE 130** | 7 | 7 | 21 | 25 | 818 | 0 | 11 | 0 | 0 | 0 | 889 |
| **VILLAGE 131** | 12 | 21 | 55 | 77 | 1136 | 0 | 45 | 0 | 0 | 0 | 1346 |
| **VILLAGE 132** | 5 | 6 | 14 | 19 | 740 | 0 | 7 | 0 | 0 | 0 | 791 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **VILLAGE 133** | 3 | 7 | 18 | 22 | 785 | 0 | 13 | 0 | 0 | 0 | 848 |
| **VILLAGE 134** | 5 | 6 | 15 | 19 | 737 | 0 | 6 | 0 | 0 | 0 | 788 |
| **VILLAGE 135** | 5 | 6 | 15 | 19 | 735 | 0 | 6 | 0 | 0 | 0 | 786 |
| **VILLAGE 136** | 3 | 7 | 19 | 22 | 791 | 0 | 14 | 0 | 0 | 0 | 856 |
| **VILLAGE 137** | 6 | 6 | 14 | 18 | 742 | 0 | 7 | 0 | 0 | 0 | 793 |
| **VILLAGE 138** | 4 | 6 | 17 | 18 | 708 | 0 | 9 | 0 | 0 | 0 | 762 |
| **VILLAGE 139** | 5 | 6 | 14 | 19 | 740 | 0 | 7 | 0 | 0 | 0 | 791 |
| **VILLAGE 140** | 5 | 6 | 15 | 19 | 743 | 0 | 7 | 0 | 0 | 0 | 795 |
| **VILLAGE 141** | 3 | 7 | 18 | 21 | 784 | 0 | 13 | 0 | 0 | 0 | 846 |
| **VILLAGE 142** | 5 | 6 | 15 | 19 | 735 | 0 | 6 | 0 | 0 | 0 | 786 |
| **VILLAGE 143** | 4 | 6 | 18 | 19 | 736 | 0 | 10 | 0 | 0 | 0 | 793 |
| **VILLAGE 144** | 4 | 6 | 17 | 18 | 722 | 0 | 9 | 0 | 0 | 0 | 776 |
| **VILLAGE 145** | 12 | 25 | 53 | 79 | 1390 | 0 | 40 | 0 | 0 | 0 | 1599 |
| **VILLAGE 146** | 6 | 6 | 16 | 19 | 746 | 0 | 7 | 0 | 0 | 0 | 800 |
| **VILLAGE 147** | 6 | 6 | 14 | 19 | 739 | 0 | 7 | 0 | 0 | 0 | 791 |
| **VILLAGE 148** | 5 | 6 | 14 | 19 | 737 | 0 | 6 | 0 | 0 | 0 | 787 |
| **VILLAGE 149** | 3 | 7 | 18 | 22 | 785 | 0 | 13 | 0 | 0 | 0 | 848 |
| **VILLAGE 150** | 5 | 6 | 15 | 19 | 739 | 0 | 6 | 0 | 0 | 0 | 790 |
| **VILLAGE 151** | 12 | 28 | 57 | 81 | 1344 | 0 | 44 | 0 | 0 | 0 | 1566 |
| **VILLAGE 152** | 6 | 6 | 16 | 19 | 741 | 0 | 7 | 0 | 0 | 0 | 795 |
| **VILLAGE 153** | 12 | 21 | 55 | 77 | 1136 | 0 | 45 | 0 | 0 | 0 | 1346 |
| **VILLAGE 154** | 5 | 6 | 15 | 19 | 738 | 0 | 6 | 0 | 0 | 0 | 789 |
| **VILLAGE 155** | 6 | 6 | 15 | 18 | 746 | 0 | 7 | 0 | 0 | 0 | 798 |
| **VILLAGE 156** | 3 | 7 | 18 | 21 | 787 | 0 | 13 | 0 | 0 | 0 | 849 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **VILLAGE 157** | 5 | 6 | 14 | 19 | 740 | 0 | 7 | 0 | 0 | 0 | 791 |
| **VILLAGE 158** | 12 | 21 | 57 | 77 | 1164 | 0 | 45 | 0 | 0 | 0 | 1376 |
| **VILLAGE 159** | 7 | 7 | 21 | 25 | 818 | 0 | 11 | 0 | 0 | 0 | 889 |
| **VILLAGE 160** | 4 | 7 | 17 | 19 | 743 | 0 | 11 | 0 | 0 | 0 | 801 |
| **VILLAGE 161** | 6 | 6 | 16 | 18 | 746 | 0 | 7 | 0 | 0 | 0 | 799 |
| **VILLAGE 162** | 6 | 6 | 16 | 19 | 742 | 0 | 7 | 0 | 0 | 0 | 796 |
| **VILLAGE 163** | 3 | 7 | 19 | 22 | 790 | 0 | 14 | 0 | 0 | 0 | 855 |
| **VILLAGE 164** | 10 | 17 | 51 | 69 | 992 | 0 | 23 | 0 | 0 | 0 | 1162 |
| **VILLAGE 165** | 6 | 6 | 14 | 19 | 740 | 0 | 7 | 0 | 0 | 0 | 792 |
| **VILLAGE 166** | 3 | 6 | 18 | 19 | 736 | 0 | 10 | 0 | 0 | 0 | 792 |
| **VILLAGE 167** | 5 | 6 | 15 | 19 | 740 | 0 | 7 | 0 | 0 | 0 | 792 |
| **VILLAGE 168** | 3 | 7 | 18 | 22 | 785 | 0 | 13 | 0 | 0 | 0 | 848 |
| **VILLAGE 169** | 6 | 6 | 14 | 19 | 740 | 0 | 7 | 0 | 0 | 0 | 792 |
| **VILLAGE 170** | 4 | 7 | 18 | 20 | 789 | 0 | 14 | 0 | 0 | 0 | 852 |
| **VILLAGE 171** | 4 | 6 | 18 | 19 | 736 | 0 | 10 | 0 | 0 | 0 | 793 |
| **VILLAGE 172** | 6 | 5 | 16 | 19 | 743 | 0 | 7 | 0 | 0 | 0 | 796 |
| **VILLAGE 173** | 5 | 6 | 15 | 19 | 736 | 0 | 6 | 0 | 0 | 0 | 787 |
| **VILLAGE 174** | 4 | 7 | 18 | 19 | 726 | 0 | 11 | 0 | 0 | 0 | 785 |
| **VILLAGE 175** | 10 | 17 | 52 | 69 | 994 | 0 | 23 | 0 | 0 | 0 | 1165 |
| **VILLAGE 176** | 6 | 6 | 14 | 19 | 740 | 0 | 7 | 0 | 0 | 0 | 792 |
| **VILLAGE 177** | 5 | 6 | 14 | 19 | 740 | 0 | 7 | 0 | 0 | 0 | 791 |
| **VILLAGE 178** | 10 | 17 | 52 | 66 | 960 | 0 | 22 | 0 | 0 | 0 | 1127 |
| **VILLAGE 179** | 5 | 7 | 15 | 19 | 735 | 0 | 7 | 0 | 0 | 0 | 788 |
| **VILLAGE 180** | 5 | 6 | 14 | 19 | 739 | 0 | 7 | 0 | 0 | 0 | 790 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **VILLAGE 181** | 5 | 6 | 15 | 18 | 718 | 0 | 7 | 0 | 0 | 0 | 769 |
| **VILLAGE 182** | 5 | 9 | 19 | 24 | 745 | 0 | 18 | 0 | 0 | 0 | 820 |
| **VILLAGE 183** | 6 | 6 | 16 | 19 | 740 | 0 | 7 | 0 | 0 | 0 | 794 |
| **VILLAGE 184** | 4 | 7 | 18 | 21 | 787 | 0 | 14 | 0 | 0 | 0 | 851 |
| **VILLAGE 185** | 6 | 6 | 16 | 19 | 742 | 0 | 7 | 0 | 0 | 0 | 796 |
| **VILLAGE 186** | 6 | 6 | 15 | 19 | 740 | 0 | 7 | 0 | 0 | 0 | 793 |
| **VILLAGE 187** | 16 | 21 | 56 | 77 | 1133 | 0 | 45 | 0 | 0 | 0 | 1348 |
| **VILLAGE 188** | 6 | 6 | 14 | 19 | 739 | 0 | 7 | 0 | 0 | 0 | 791 |
| **VILLAGE 189** | 5 | 6 | 16 | 18 | 732 | 0 | 7 | 0 | 0 | 0 | 784 |
| **VILLAGE 190** | 5 | 6 | 14 | 19 | 739 | 0 | 7 | 0 | 0 | 0 | 790 |
| **VILLAGE 191** | 3 | 7 | 18 | 21 | 785 | 0 | 13 | 0 | 0 | 0 | 847 |
| **VILLAGE 192** | 6 | 6 | 14 | 18 | 742 | 0 | 7 | 0 | 0 | 0 | 793 |
| **VILLAGE 193** | 5 | 6 | 15 | 19 | 738 | 0 | 6 | 0 | 0 | 0 | 789 |
| **VILLAGE 194** | 4 | 7 | 18 | 20 | 786 | 0 | 13 | 0 | 0 | 0 | 848 |
| **VILLAGE 195** | 4 | 7 | 18 | 21 | 787 | 0 | 14 | 0 | 0 | 0 | 851 |
| **VILLAGE 196** | 5 | 6 | 14 | 19 | 740 | 0 | 7 | 0 | 0 | 0 | 791 |
| **VILLAGE 197** | 4 | 6 | 18 | 19 | 736 | 0 | 10 | 0 | 0 | 0 | 793 |
| **VILLAGE 198** | 6 | 5 | 16 | 19 | 743 | 0 | 7 | 0 | 0 | 0 | 796 |
| **VILLAGE 199** | 5 | 7 | 16 | 19 | 712 | 0 | 10 | 0 | 0 | 0 | 769 |
| **VILLAGE 200** | 6 | 8 | 21 | 25 | 826 | 0 | 12 | 0 | 0 | 0 | 898 |
| **VILLAGE 201** | 5 | 6 | 15 | 19 | 740 | 0 | 7 | 0 | 0 | 0 | 792 |
| **VILLAGE 202** | 5 | 6 | 16 | 19 | 742 | 0 | 7 | 0 | 0 | 0 | 795 |
| **VILLAGE 203** | 3 | 7 | 19 | 22 | 766 | 0 | 12 | 0 | 0 | 0 | 829 |
| **VILLAGE 204** | 6 | 6 | 16 | 19 | 740 | 0 | 7 | 0 | 0 | 0 | 794 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **VILLAGE 205** | 5 | 8 | 14 | 19 | 741 | 0 | 9 | 0 | 0 | 0 | 796 |
| **VILLAGE 206** | 5 | 5 | 16 | 19 | 741 | 0 | 7 | 0 | 0 | 0 | 793 |
| **VILLAGE 207** | 6 | 6 | 16 | 19 | 741 | 0 | 7 | 0 | 0 | 0 | 795 |
| **VILLAGE 208** | 5 | 6 | 14 | 19 | 740 | 0 | 7 | 0 | 0 | 0 | 791 |
| **VILLAGE 209** | 6 | 6 | 14 | 19 | 740 | 0 | 7 | 0 | 0 | 0 | 792 |
| **VILLAGE 210** | 5 | 6 | 14 | 19 | 739 | 0 | 7 | 0 | 0 | 0 | 790 |
| **VILLAGE 211** | 24 | 36 | 66 | 68 | 1505 | 0 | 83 | 0 | 0 | 0 | 1782 |
| **VILLAGE 212** | 6 | 5 | 16 | 19 | 748 | 0 | 7 | 0 | 0 | 0 | 801 |
| **VILLAGE 213** | 5 | 6 | 15 | 19 | 739 | 0 | 6 | 0 | 0 | 0 | 790 |
| **VILLAGE 214** | 5 | 8 | 17 | 19 | 710 | 0 | 11 | 0 | 0 | 0 | 770 |
| **VILLAGE 215** | 5 | 6 | 15 | 19 | 740 | 0 | 7 | 0 | 0 | 0 | 792 |
| **VILLAGE 216** | 5 | 7 | 15 | 18 | 741 | 0 | 7 | 0 | 0 | 0 | 793 |
| **VILLAGE 217** | 5 | 5 | 16 | 19 | 744 | 0 | 7 | 0 | 0 | 0 | 796 |
| **VILLAGE 218** | 3 | 7 | 19 | 22 | 790 | 0 | 14 | 0 | 0 | 0 | 855 |
| **VILLAGE 219** | 10 | 17 | 53 | 66 | 984 | 0 | 22 | 0 | 0 | 0 | 1152 |
| **VILLAGE 220** | 5 | 6 | 14 | 19 | 740 | 0 | 7 | 0 | 0 | 0 | 791 |
| **VILLAGE 221** | 4 | 6 | 18 | 18 | 715 | 0 | 10 | 0 | 0 | 0 | 771 |
| **VILLAGE 222** | 5 | 8 | 17 | 19 | 718 | 0 | 11 | 0 | 0 | 0 | 778 |
| **VILLAGE 223** | 4 | 7 | 18 | 21 | 786 | 0 | 14 | 0 | 0 | 0 | 850 |
| **VILLAGE 224** | 5 | 6 | 14 | 19 | 739 | 0 | 7 | 0 | 0 | 0 | 790 |
| **VILLAGE 225** | 5 | 8 | 18 | 18 | 719 | 0 | 10 | 0 | 0 | 0 | 778 |
| **VILLAGE 226** | 5 | 6 | 14 | 19 | 739 | 0 | 7 | 0 | 0 | 0 | 790 |
| **VILLAGE 227** | 4 | 6 | 17 | 19 | 720 | 0 | 9 | 0 | 0 | 0 | 775 |
| **VILLAGE 228** | 12 | 21 | 57 | 77 | 1164 | 0 | 45 | 0 | 0 | 0 | 1376 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **VILLAGE 229** | 6 | 7 | 15 | 18 | 752 | 0 | 7 | 0 | 0 | 0 | 805 |
| **VILLAGE 230** | 5 | 6 | 14 | 19 | 739 | 0 | 6 | 0 | 0 | 0 | 789 |
| **VILLAGE 231** | 5 | 5 | 16 | 19 | 744 | 0 | 7 | 0 | 0 | 0 | 796 |
| **VILLAGE 232** | 6 | 6 | 16 | 19 | 742 | 0 | 7 | 0 | 0 | 0 | 796 |
| **VILLAGE 233** | 5 | 6 | 14 | 19 | 737 | 0 | 6 | 0 | 0 | 0 | 787 |
| **VILLAGE 234** | 16 | 20 | 56 | 77 | 1133 | 0 | 45 | 0 | 0 | 0 | 1347 |
| **VILLAGE 235** | 16 | 21 | 56 | 77 | 1133 | 0 | 45 | 0 | 0 | 0 | 1348 |
| **VILLAGE 236** | 6 | 5 | 16 | 19 | 744 | 0 | 7 | 0 | 0 | 0 | 797 |
| **VILLAGE 237** | 10 | 17 | 53 | 66 | 984 | 0 | 22 | 0 | 0 | 0 | 1152 |
| **VILLAGE 238** | 16 | 21 | 57 | 77 | 1133 | 0 | 45 | 0 | 0 | 0 | 1349 |
| **VILLAGE 239** | 5 | 6 | 16 | 19 | 740 | 0 | 6 | 0 | 0 | 0 | 792 |
| **VILLAGE 240** | 6 | 6 | 14 | 19 | 740 | 0 | 7 | 0 | 0 | 0 | 792 |
| **VILLAGE 241** | 4 | 7 | 18 | 19 | 746 | 0 | 11 | 0 | 0 | 0 | 805 |
| **VILLAGE 242** | 5 | 6 | 15 | 19 | 737 | 0 | 6 | 0 | 0 | 0 | 788 |
| **VILLAGE 243** | 6 | 6 | 16 | 19 | 740 | 0 | 7 | 0 | 0 | 0 | 794 |
| **VILLAGE 244** | 4 | 6 | 16 | 19 | 705 | 0 | 10 | 0 | 0 | 0 | 760 |
| **VILLAGE 245** | 5 | 8 | 15 | 19 | 765 | 0 | 8 | 0 | 0 | 0 | 820 |
| **VILLAGE 246** | 5 | 8 | 17 | 18 | 716 | 0 | 10 | 0 | 0 | 0 | 774 |
| **VILLAGE 247** | 5 | 6 | 15 | 19 | 741 | 0 | 7 | 0 | 0 | 0 | 793 |
| **VILLAGE 248** | 5 | 9 | 19 | 24 | 733 | 0 | 18 | 0 | 0 | 0 | 808 |
| **VILLAGE 249** | 12 | 21 | 57 | 77 | 1162 | 0 | 45 | 0 | 0 | 0 | 1374 |
| **VILLAGE 250** | 5 | 6 | 16 | 19 | 737 | 0 | 7 | 0 | 0 | 0 | 790 |
| **VILLAGE 251** | 4 | 6 | 17 | 18 | 719 | 0 | 9 | 0 | 0 | 0 | 773 |
| **VILLAGE 252** | 5 | 6 | 16 | 19 | 742 | 0 | 7 | 0 | 0 | 0 | 795 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **VILLAGE 253** | 5 | 9 | 14 | 19 | 737 | 0 | 9 | 0 | 0 | 0 | 793 |
| **VILLAGE 254** | 5 | 6 | 16 | 19 | 739 | 0 | 7 | 0 | 0 | 0 | 792 |
| **VILLAGE 255** | 6 | 6 | 16 | 19 | 742 | 0 | 7 | 0 | 0 | 0 | 796 |
| **VILLAGE 256** | 4 | 7 | 16 | 19 | 700 | 0 | 10 | 0 | 0 | 0 | 756 |
| **VILLAGE 257** | 7 | 9 | 16 | 19 | 770 | 0 | 9 | 0 | 0 | 0 | 830 |
| **VILLAGE 258** | 5 | 6 | 15 | 19 | 735 | 0 | 6 | 0 | 0 | 0 | 786 |
| **VILLAGE 259** | 6 | 6 | 16 | 19 | 742 | 0 | 7 | 0 | 0 | 0 | 796 |
| **VILLAGE 260** | 5 | 9 | 14 | 19 | 739 | 0 | 9 | 0 | 0 | 0 | 795 |
| **VILLAGE 261** | 5 | 6 | 15 | 19 | 738 | 0 | 6 | 0 | 0 | 0 | 789 |
| **VILLAGE 262** | 5 | 6 | 14 | 19 | 738 | 0 | 6 | 0 | 0 | 0 | 788 |
| **VILLAGE 263** | 6 | 5 | 16 | 19 | 744 | 0 | 7 | 0 | 0 | 0 | 797 |
| **VILLAGE 264** | 6 | 6 | 14 | 19 | 740 | 0 | 7 | 0 | 0 | 0 | 792 |
| **VILLAGE 265** | 5 | 6 | 15 | 19 | 738 | 0 | 6 | 0 | 0 | 0 | 789 |
| **VILLAGE 266** | 5 | 6 | 15 | 19 | 736 | 0 | 6 | 0 | 0 | 0 | 787 |
| **VILLAGE 267** | 3 | 7 | 18 | 22 | 784 | 0 | 13 | 0 | 0 | 0 | 847 |
| **VILLAGE 268** | 13 | 28 | 61 | 82 | 1314 | 0 | 43 | 0 | 0 | 0 | 1541 |
| **VILLAGE 269** | 5 | 6 | 15 | 19 | 739 | 0 | 6 | 0 | 0 | 0 | 790 |
| **VILLAGE 270** | 6 | 6 | 14 | 19 | 740 | 0 | 7 | 0 | 0 | 0 | 792 |
| **VILLAGE 271** | 7 | 12 | 17 | 21 | 768 | 0 | 14 | 0 | 0 | 0 | 839 |
| **VILLAGE 272** | 6 | 5 | 16 | 19 | 743 | 0 | 7 | 0 | 0 | 0 | 796 |
| **VILLAGE 273** | 16 | 20 | 56 | 77 | 1133 | 0 | 45 | 0 | 0 | 0 | 1347 |
| **VILLAGE 274** | 5 | 6 | 15 | 19 | 737 | 0 | 6 | 0 | 0 | 0 | 788 |
| **VILLAGE 275** | 6 | 6 | 14 | 19 | 740 | 0 | 7 | 0 | 0 | 0 | 792 |
| **VILLAGE 276** | 6 | 5 | 16 | 19 | 748 | 0 | 7 | 0 | 0 | 0 | 801 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **VILLAGE 277** | 5 | 6 | 17 | 15 | 706 | 0 | 7 | 0 | 0 | 0 | 756 |
| **VILLAGE 278** | 5 | 6 | 15 | 19 | 736 | 0 | 6 | 0 | 0 | 0 | 787 |
| **VILLAGE 279** | 6 | 5 | 17 | 20 | 768 | 0 | 7 | 0 | 0 | 0 | 823 |
| **VILLAGE 280** | 12 | 21 | 58 | 77 | 1167 | 0 | 45 | 0 | 0 | 0 | 1380 |
| **VILLAGE 281** | 5 | 6 | 15 | 19 | 737 | 0 | 6 | 0 | 0 | 0 | 788 |
| **VILLAGE 282** | 3 | 7 | 18 | 22 | 796 | 0 | 14 | 0 | 0 | 0 | 860 |
| **VILLAGE 283** | 5 | 6 | 15 | 19 | 739 | 0 | 6 | 0 | 0 | 0 | 790 |
| **VILLAGE 284** | 5 | 6 | 14 | 19 | 737 | 0 | 6 | 0 | 0 | 0 | 787 |
| **VILLAGE 285** | 5 | 6 | 16 | 19 | 742 | 0 | 7 | 0 | 0 | 0 | 795 |
| **VILLAGE 286** | 6 | 6 | 14 | 19 | 740 | 0 | 7 | 0 | 0 | 0 | 792 |
| **VILLAGE 287** | 5 | 6 | 16 | 18 | 725 | 0 | 7 | 0 | 0 | 0 | 777 |
| **VILLAGE 288** | 5 | 6 | 16 | 19 | 744 | 0 | 7 | 0 | 0 | 0 | 797 |
| **VILLAGE 289** | 12 | 21 | 57 | 77 | 1167 | 0 | 45 | 0 | 0 | 0 | 1379 |
| **VILLAGE 290** | 4 | 7 | 15 | 17 | 707 | 0 | 11 | 0 | 0 | 0 | 761 |
| **VILLAGE 291** | 10 | 17 | 53 | 66 | 980 | 0 | 22 | 0 | 0 | 0 | 1148 |
| **VILLAGE 292** | 16 | 21 | 57 | 77 | 1163 | 0 | 45 | 0 | 0 | 0 | 1379 |
| **VILLAGE 293** | 5 | 6 | 15 | 19 | 737 | 0 | 6 | 0 | 0 | 0 | 788 |
| **VILLAGE 294** | 6 | 6 | 14 | 19 | 740 | 0 | 7 | 0 | 0 | 0 | 792 |
| **VILLAGE 295** | 5 | 5 | 16 | 19 | 744 | 0 | 7 | 0 | 0 | 0 | 796 |
| **VILLAGE 296** | 6 | 6 | 16 | 19 | 740 | 0 | 7 | 0 | 0 | 0 | 794 |
| **VILLAGE 297** | 5 | 6 | 15 | 19 | 735 | 0 | 6 | 0 | 0 | 0 | 786 |
| **VILLAGE 298** | 17 | 35 | 67 | 89 | 1493 | 0 | 68 | 0 | 0 | 0 | 1769 |
| **VILLAGE 299** | 6 | 6 | 16 | 19 | 740 | 0 | 7 | 0 | 0 | 0 | 794 |
| **VILLAGE 300** | 21 | 27 | 62 | 79 | 1221 | 0 | 57 | 0 | 0 | 0 | 1467 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **VILLAGE 301** | 5 | 6 | 15 | 19 | 739 | 0 | 6 | 0 | 0 | 0 | 790 |
| **VILLAGE 302** | 16 | 21 | 57 | 77 | 1166 | 0 | 45 | 0 | 0 | 0 | 1382 |
| **VILLAGE 303** | 3 | 6 | 18 | 21 | 753 | 0 | 12 | 0 | 0 | 0 | 813 |
| **VILLAGE 304** | 5 | 6 | 15 | 19 | 738 | 0 | 7 | 0 | 0 | 0 | 790 |
| **VILLAGE 305** | 16 | 21 | 57 | 77 | 1133 | 0 | 45 | 0 | 0 | 0 | 1349 |
| **VILLAGE 306** | 10 | 17 | 53 | 66 | 982 | 0 | 22 | 0 | 0 | 0 | 1150 |
| **VILLAGE 307** | 4 | 7 | 18 | 19 | 746 | 0 | 11 | 0 | 0 | 0 | 805 |
| **VILLAGE 308** | 5 | 6 | 15 | 19 | 739 | 0 | 6 | 0 | 0 | 0 | 790 |
| **VILLAGE 309** | 12 | 21 | 56 | 77 | 1131 | 0 | 45 | 0 | 0 | 0 | 1342 |
| **VILLAGE 310** | 7 | 10 | 19 | 24 | 821 | 0 | 13 | 0 | 0 | 0 | 894 |
| **VILLAGE 311** | 5 | 6 | 15 | 19 | 738 | 0 | 6 | 0 | 0 | 0 | 789 |
| **VILLAGE 312** | 6 | 5 | 16 | 19 | 744 | 0 | 7 | 0 | 0 | 0 | 797 |
| **VILLAGE 313** | 5 | 7 | 13 | 17 | 724 | 0 | 9 | 0 | 0 | 0 | 775 |
| **VILLAGE 314** | 5 | 8 | 24 | 29 | 615 | 0 | 10 | 0 | 0 | 0 | 691 |
| **VILLAGE 315** | 9 | 18 | 39 | 45 | 1224 | 0 | 42 | 0 | 0 | 0 | 1377 |
| **VILLAGE 316** | 6 | 5 | 16 | 19 | 744 | 0 | 7 | 0 | 0 | 0 | 797 |

*Figure 35 List of villages and category IUCN Red List Species in their buffer zone*

## 14.2 Appendix 2 – IBAT Proximity Report on Bahawalpur District, Pakistan

# Proximity Report

BAHAWALPUR DISTRICT, PUNJAB PROVINCE, PAKISTAN

Country: Pakistan

Location: [ 29.2, 71.9 ]

Date of analysis: 15 May

2020 Size of site: 24371

km$^2$ Buffers applied: 1.0

km Generated by: Jozef

Koval

Company/Subscriber:

IKEA

## Overlaps with:

| | |
|---|---|
| Protected Areas | 8 |
| Key Biodiversity Areas | 1 |
| IUCN Red List | 33 |


50km
Khan
Vehari
Bahawalnagar
Hasilpur
Bahawalpur
Khanpur
Rahimyar Khan
1 km
1 km
Bikaner
mapbox
© Mapbox © OpenStreetMap

Displaying project location and buffers: 1.0 km

## About this report

This report presents the results of [4404-8886] proximity analysis to identify the biodiversity features and species which are located within the following buffers: 1.0 km.

This report is one part of a package generated by IBAT on 15 May 2020 that includes full list of all species, protected areas, Key Biodiversity Areas in CSV format, maps showing the area of interest in relation to these features, and a 'How to read IBAT reports' document.

## Data used to generate this report

- UNEP-WCMC and IUCN, 2020. Protected Planet: The World Database on Protected Areas (WDPA)[On-line], Cambridge, UK: UNEP-WCMC and IUCN. Available at: www.protectedplanet.net - May 2020.
- BirdLife International (on behalf of the KBA Partnership), 2019. Key Biodiversity Areas - October 2019. IUCN, 2020. IUCN Red List of Threatened Species - January 2020.
-

## Protected Areas

The following protected areas are found within 1.0 km of the area of interest. For further details please refer to the associated csv file in the report folder.

| Area name | Within buffer of |
|---|---|
| Bahwaalpur Plantation | 1.0 km |
| Cholistan | 1.0 km |
| Cholistan | 1.0 km |
| Head Islam/Chak Kotora | 1.0 km |
| Kot Zabzai | 1.0 km |
| Lal Suhanra | 1.0 km |
| Lal Suhanra National Park | 1.0 km |
| Rahri Bungalow | 1.0 km |

## Key Biodiversity Areas

The following key biodiversity areas are found within 1.0 km of the area of interest. For further details please refer to the associated csv file in the report folder.

| Area name | Distance |
|---|---|
| Lal Sohanra National Park | 1.0 km |

# IUCN Red List of Threatened Species

The following threatened species are potentially found within 50km of the area of interest. For the full IUCN Red List please refer to the associated csv in the report folder.

| Species name | Common name | IUCN Category | Taxonomic Class |
|---|---|---|---|
| Anacyclus pyrethrum | Atlas daisy | VU | Magnoliopsida |
| Aquila heliaca | Eastern imperial eagle | VU | Aves |
| Aquila nipalensis | Steppe eagle | EN | Aves |
| Aquila rapax | Tawny eagle | VU | Aves |
| Ardeotis nigriceps | Great indian bustard | CR | Aves |
| Axis porcinus | Hog deer | EN | Mammalia |
| Aythya ferina | Common pochard | VU | Aves |
| Chlamydotis macqueenii | Asian houbara | VU | Aves |
| Chrysomma altirostre | Jerdon's babbler | VU | Aves |
| Ciconia episcopus | Asian woollyneck | VU | Aves |
| Clanga clanga | Greater spotted eagle | VU | Aves |
| Columba eversmanni | Yellow-eyed pigeon | VU | Aves |
| Crocodylus palustris | Mugger | VU | Reptilia |
| Falco cherrug | Saker falcon | EN | Aves |
| Geoclemys hamiltonii | Spotted pond turtle | EN | Reptilia |
| Gyps bengalensis | White-rumped vulture | CR | Aves |
| Gyps indicus | Indian vulture | CR | Aves |

| Species name | Common name | IUCN Category | Taxonomic Class |
|---|---|---|---|
| Haliaeetus leucoryphus | Pallas's fish-eagle | EN | Aves |
| Leptoptilos dubius | Greater adjutant | EN | Aves |
| Machlolophus nuchalis | White-naped tit | VU | Aves |
| Manis crassicaudata | Indian pangolin | EN | Mammalia |
| Marmaronetta angustirostris | Marbled teal | VU | Aves |
| Neophron percnopterus | Egyptian vulture | EN | Aves |
| Oryza malampuzhaensis | | VU | Liliopsida |
| Oxyura leucocephala | White-headed duck | EN | Aves |
| Panthera pardus | Leopard | VU | Mammalia |
| Platanista gangetica | South asian river dolphin | EN | Mammalia |
| Rynchops albicollis | Indian skimmer | VU | Aves |
| Saxicola macrorhynchus | White-browed bushchat | VU | Aves |
| Sterna acuticauda | Black-bellied tern | EN | Aves |
| Tor putitora | | EN | Actinopterygii |
| Vanellus gregarius | Sociable lapwing | CR | Aves |
| Wallago attu | | VU | Actinopterygii |

## Recommended citation

IBAT Proximity Report, 2018. Generated under licence 4404-8886 from the Integrated Biodiversity Assessment Tool on 15/05/2020. http://www.ibat-alliance.org

## How to use this report

This report provides an indication of the potential biodiversity-related features - protected areas, key biodiversity areas and species - close to the specified location. It provides an early indication of potential biodiversity concerns, and can provide valuable guidance in making decisions. For example, this information can be helpful when assessing the potential environmental risk and impact of a site, categorising investments/projects, preparing the terms of reference for an impact assessment, focusing attention on key species of conservation concern and sites of known conservation value, and reviewing the results of an impact assessment.

The report does not provide details of potential indirect, downstream or cumulative impacts. Furthermore, the report should be regarded as a "first-step", providing a set of conservation values sourced from global data sets, and is not a substitute for further investigation and due diligence, especially concerning national and/or local conservation priorities.

### 14.3 Appendix 3 – IBAT Proximity Report on Khanewal District, Pakistan

# Proximity Report

KHANEWAL DISTRICT, PUNJAB PROVINCE, PAKISTAN

Country: Pakistan

Location: [ 30.4, 71.9 ]

Date of analysis: 15 May

2020 Size of site: 4694

$km^2$ Buffers applied: 1.0

km Generated by: Jozef

Koval

Company/Subscriber:

IKEA

## Overlaps with:

| | |
|---|---|
| Protected Areas | 1 |
| Key Biodiversity Areas | 0 |
| IUCN Red List | 27 |


Displaying project location and buffers: 1.0 km

## About this report

This report presents the results of [4404-8887] proximity analysis to identify the biodiversity features and species which are located within the following buffers: 1.0 km.

This report is one part of a package generated by IBAT on 15 May 2020 that includes full list of all species, protected areas, Key Biodiversity Areas in CSV format, maps showing the area of interest in relation to these features, and a ‘How to read IBAT reports’ document.

## Data used to generate this report

- UNEP-WCMC and IUCN, 2020. Protected Planet: The World Database on Protected Areas (WDPA)[On-line], Cambridge, UK: UNEP-WCMC and IUCN. Available at: www.protectedplanet.net - May 2020.
- BirdLife International (on behalf of the KBA Partnership), 2019. Key Biodiversity Areas - October 2019. IUCN, 2020. IUCN Red List of Threatened Species - January 2020.

## Protected Areas

The following protected areas are found within 1.0 km of the area of interest. For further details please refer to the associated csv file in the report folder.

| Area name | Within buffer of |
| --- | --- |
| Chichawatni Plantation | 1.0 km |

## Key Biodiversity Areas

The following key biodiversity areas are found within 1.0 km of the area of interest. For further details please refer to the associated csv file in the report folder.

No KBAs within buffer distance

## IUCN Red List of Threatened Species

The following threatened species are potentially found within 50km of the area of interest. For the full IUCN Red List please refer to the associated csv in the report folder.

| Species name | Common name | IUCN Category | Taxonomic Class |
| --- | --- | --- | --- |
| Anacyclus pyrethrum | Atlas daisy | VU | Magnoliopsida |
| Aquila heliaca | Eastern imperial eagle | VU | Aves |
| Aquila nipalensis | Steppe eagle | EN | Aves |

| | | | |
|---|---|---|---|
| Aquila rapax | Tawny eagle | VU | Aves |
| Axis porcinus | Hog deer | EN | Mammalia |
| Aythya ferina | Common pochard | VU | Aves |
| Chlamydotis macqueenii | Asian houbara | VU | Aves |

| Species name | Common name | IUCN Category | Taxonomic Class |
|---|---|---|---|
| Chrysomma altirostre | Jerdon's babbler | VU | Aves |
| Ciconia episcopus | Asian woollyneck | VU | Aves |
| Clanga clanga | Greater spotted eagle | VU | Aves |
| Columba eversmanni | Yellow-eyed pigeon | VU | Aves |
| Crocodylus palustris | Mugger | VU | Reptilia |
| Falco cherrug | Saker falcon | EN | Aves |
| Geoclemys hamiltonii | Spotted pond turtle | EN | Reptilia |
| Gyps bengalensis | White-rumped vulture | CR | Aves |
| Haliaeetus leucoryphus | Pallas's fish-eagle | EN | Aves |
| Leptoptilos dubius | Greater adjutant | EN | Aves |
| Marmaronetta angustirostris | Marbled teal | VU | Aves |
| Neophron percnopterus | Egyptian vulture | EN | Aves |
| Oxyura leucocephala | White-headed duck | EN | Aves |
| Panthera pardus | Leopard | VU | Mammalia |
| Rynchops albicollis | Indian skimmer | VU | Aves |
| Saxicola macrorhynchus | White-browed bushchat | VU | Aves |
| Sterna acuticauda | Black-bellied tern | EN | Aves |

| Species name | Common name | IUCN Category | Taxonomic Class |
|---|---|---|---|
| Tor putitora | | EN | Actinopterygii |
| Vanellus gregarius | Sociable lapwing | CR | Aves |
| Wallago attu | | VU | Actinopterygii |

## Recommended citation

IBAT Proximity Report, 2018. Generated under licence 4404-8887 from the Integrated Biodiversity Assessment Tool on 15/05/2020. http://www.ibat-alliance.org

## How to use this report

This report provides an indication of the potential biodiversity-related features - protected areas, key biodiversity areas and species - close to the specified location. It provides an early indication of potential biodiversity concerns, and can provide valuable guidance in making decisions. For example, this information can be helpful when assessing the potential environmental risk and impact of a site, categorising investments/projects, preparing the terms of reference for an impact assessment, focusing attention on key species of conservation concern and sites of known conservation value, and reviewing the results of an impact assessment.

The report does not provide details of potential indirect, downstream or cumulative impacts. Furthermore, the report should be regarded as a “first-step”, providing a set of conservation values sourced from global data sets, and is not a substitute for further investigation and due diligence, especially concerning national and/or local conservation priorities.

## 14.4 Appendix 4 – IBAT proximity Report on Punjab Province, Pakistan (State/Province/Region level example)

# Proximity Report

PUNJAB PROVINCE, PAKISTAN

Country: Pakistan

Location: [ 31.8, 72 ]

Date of analysis: 12 May 2020

Size of site: 206044 $km^2$

Buffers applied: 1.0 km

Generated by: Jozef Koval

Company/Subscriber: IKEA

## Overlaps with:

| | |
|---|---|
| Protected Areas | 43 |
| Key Biodiversity Areas | 13 |


Displaying project location and buffers: 1.0 km

# About this report

This report presents the results of [4404-8835] proximity analysis to identify the biodiversity features and species which are located within the following buffers: 1.0 km.

This report is one part of a package generated by IBAT on 12 May 2020 that includes full list of all species, protected areas, Key Biodiversity Areas in CSV format, maps showing the area of interest in relation to these features, and a 'How to read IBAT reports' document.

# Data used to generate this report

- UNEP-WCMC and IUCN, 2020. Protected Planet: The World Database on Protected Areas (WDPA)[On-line],

  Cambridge, UK: UNEP-WCMC and IUCN. Available at: www.protectedplanet.net - April 2020.

- BirdLife International (on behalf of the KBA Partnership), 2019. Key Biodiversity Areas - October 2019.

- IUCN, 2020. IUCN Red List of Threatened Species - January 2020.

## Protected Areas

The following protected areas are found within 1.0 km of the area of interest.

| Area name | Within buffer of |
|---|---|
| Abbasia | 1.0 km |
| Ayub | 1.0 km |
| Ayub 'National Park' | 1.0 km |
| Bahwaalpur Plantation | 1.0 km |
| Bajwat | 1.0 km |
| Bhon Fazil | 1.0 km |
| Bhono | 1.0 km |
| Chashma Barrage | 1.0 km |
| Chashma Lake | 1.0 km |
| Chaupalia | 1.0 km |

| | |
|---|---|
| Chichawatni Plantation | 1.0 km |
| Chinji | 1.0 km |
| Cholistan | 1.0 km |
| Cholistan | 1.0 km |
| Chumbi Surla | 1.0 km |

| Area name | Within buffer of |
|---|---|
| Daphar | 1.0 km |
| Daulana | 1.0 km |
| Diljabba-Domeli | 1.0 km |
| Gat Wala | 1.0 km |
| Head Islam/Chak Kotora | 1.0 km |
| Head Qadirabad | 1.0 km |
| Indo-Pak Border | 1.0 km |
| Indus River#1 | 1.0 km |
| Islamabad | 1.0 km |
| Kala Chitta | 1.0 km |
| Kalabagh Game Reserve | 1.0 km |
| Kamalia Plantation | 1.0 km |

| | |
|---|---|
| Khabbeke Lake | 1.0 km |
| Kharar Lake | 1.0 km |
| Khari Murat | 1.0 km |
| Kot Zabzai | 1.0 km |
| Lal Suhanra | 1.0 km |

| Area name | Within buffer of |
| --- | --- |
| Lal Suhanra National Park | 1.0 km |
| Nemal Lake | 1.0 km |
| Phala/Kuthnar | 1.0 km |
| Rahri Bungalow | 1.0 km |
| Rasool Barrage | 1.0 km |
| Sodhi | 1.0 km |
| Taunsa Barrage | 1.0 km |
| Taunsa Barrage | 1.0 km |
| Thal | 1.0 km |
| Uchhali Complex | 1.0 km |
| Vatala | 1.0 km |

## Key Biodiversity Areas

The following key biodiversity areas are found within 1.0 km of the area of interest.

| Area name | Distance |
|---|---|
| Bijnote Bustard Game Reserve (proposed) | 1.0 km |
| Chashma Barrage Wildlife Sanctuary | 1.0 km |

| Area name | Distance |
|---|---|
| Chumbi Surla Wildlife Sanctuary | 1.0 km |
| Gharana Wetland Reserve | 1.0 km |
| Head Qadirabad Game Reserve | 1.0 km |
| Lal Sohanra National Park | 1.0 km |
| Mangla Lake | 1.0 km |
| Marala Game Reserve | 1.0 km |
| Margalla Hills National Park | 1.0 km |
| Rangla wetland complex | 1.0 km |
| Rasool Barrage Wildlife Sanctuary | 1.0 km |
| Taunsa Barrage Wildlife Sanctuary | 1.0 km |
| Ucchali Wetland Complex | 1.0 km |

# IUCN Red List of Threatened Species

The following threatened species are potentially found within 50km of the area of interest.

For the full IUCN Red List please refer to the associated csv in the report folder.

| Species name | Common name | IUCN Category | Taxonomic Class |
|---|---|---|---|
| Anacyclus pyrethrum | Atlas daisy | VU | Magnoliopsida |
| Antigone antigone | Sarus crane | VU | Aves |

| Species name | Common name | IUCN Category | Taxonomic Class |
| --- | --- | --- | --- |
| Aquila heliaca | Eastern imperial eagle | VU | Aves |
| Aquila nipalensis | Steppe eagle | EN | Aves |
| Aquila rapax | Tawny eagle | VU | Aves |
| Ardeotis nigriceps | Great indian bustard | CR | Aves |
| Axis porcinus | Hog deer | EN | Mammalia |
| Aythya ferina | Common pochard | VU | Aves |
| Bovista paludosa | Fen puffball | VU | Agaricomycetes |
| Catreus wallichii | Cheer pheasant | VU | Aves |
| Chaetornis striata | Bristled grassbird | VU | Aves |
| Chlamydotis macqueenii | Asian houbara | VU | Aves |
| Chrysomma altirostre | Jerdon's babbler | VU | Aves |

| | | | |
|---|---|---|---|
| Ciconia episcopus | Asian woollyneck | VU | Aves |
| Clanga clanga | Greater spotted eagle | VU | Aves |
| Clanga hastata | Indian spotted eagle | VU | Aves |
| Columba eversmanni | Yellow-eyed pigeon | VU | Aves |
| Crocodylus palustris | Mugger | VU | Reptilia |
| Emberiza aureola | Yellow-breasted bunting | CR | Aves |

| Species name | Common name | IUCN Category | Taxonomic Class |
|---|---|---|---|
| Falco cherrug | Saker falcon | EN | Aves |
| Ficedula subrubra | Kashmir  ycatcher | VU | Aves |
| Geoclemys hamiltonii | Spotted pond turtle | EN | Reptilia |
| Glyptothorax kashmirensis | | CR | Actinopterygii |
| Gyps bengalensis | White-rumped vulture | CR | Aves |
| Gyps indicus | Indian vulture | CR | Aves |
| Gyps tenuirostris | Slender-billed vulture | CR | Aves |
| Haliaeetus leucoryphus | Pallas's  sh-eagle | EN | Aves |
| Leptoptilos dubius | Greater adjutant | EN | Aves |
| Leptoptilos javanicus | Lesser adjutant | VU | Aves |
| Machlolophus nuchalis | White-naped tit | VU | Aves |

| | | | |
|---|---|---|---|
| Manis crassicaudata | Indian pangolin | EN | Mammalia |
| Marmaronetta angustirostris | Marbled teal | VU | Aves |
| Neophron percnopterus | Egyptian vulture | EN | Aves |
| Oryza malampuzhaensis | | VU | Liliopsida |
| Ovis orientalis | Mou on | VU | Mammalia |
| Oxyura leucocephala | White-headed duck | EN | Aves |

environment

| Species name | Common name | IUCN Category | Taxonomic Class |
|---|---|---|---|
| Panthera pardus | Leopard | VU | Mammalia |
| Panthera uncia | Snow leopard | VU | Mammalia |
| Platanista gangetica | South asian river dolphin | EN | Mammalia |
| Rynchops albicollis | Indian skimmer | VU | Aves |
| Sarcogyps calvus | Red-headed vulture | CR | Aves |
| Saxicola macrorhynchus | White-browed bushchat | VU | Aves |
| Sterna acuticauda | Black-bellied tern | EN | Aves |
| Sypheotides indicus | Lesser oricans | EN | Aves |
| Tor putitora | | EN | Actinopterygii |
| Tragopan melanocephalus | Western tragopan | VU | Aves |
| Ursus thibetanus | Asiatic black bear | VU | Mammalia |

| | | | |
|---|---|---|---|
| Vanellus gregarius | Sociable lapwing | CR | Aves |
| Wallago attu | | VU | Actinopterygii |

## Recommended citation

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## How to use this report

This report provides an indication of the potential biodiversity-related features - protected areas, key biodiversity areas and species - close to the speci ed location. It provides an early indication of potential biodiversity concerns, and can provide valuable guidance in making decisions. For example, this information can be helpful when assessing the potential environmental risk and impact of a site, categorising investments/projects, preparing the terms of reference for an impact assessment, focusing attention on key species of conservation concern and sites of known conservation value, and reviewing the results of an impact assessment.

The report does not provide details of potential indirect, downstream or cumulative impacts. Furthermore, the report should be regarded as a “ rst-step”, providing a set of conservation values sourced from global data sets, and is not a substitute for further investigation and due diligence, especially concerning national and/or local conservation priorities.