ISSN 1880-7143

# 地球環境学

Global Environmental Studies

## 目　次



No. 17　上智地球環境学会

2021年

# Global Environmental Studies

## CONTENTS

### Articles



Sophia University

# 持続可能な開発のための「住み続けられるまちづくりを」：
## 鉄道ネットワークとコチメトロを実例に

プテンカラム ジョンジョセフ

**要旨**

本研究は（基盤研究B・17H04495）“鉄道ネットワークの構築による貧困・教育・環境問題の複合的解決のための方法論の開発”の一部である。この研究はアジア地域におけるインフラ構築に関する情報収集・分析を実地調査に基づいて行なったものである。具体的にインドのケララ州のコチメトロ鉄道建設によって行ったものである。実地調査を通してインドでは経済・環境の観点からインフラ構築のために必要な要素を抽出することを目的とした。インドでは、全世界的に経済の拡大に起因して急激な都市化の傾向がみられた。また、2050年までにインドの人口の70%ほどが都市部に居住するとみられる。加えて、都市部は経済的成長の動力と考えられ、最新の調査によると、インドの国民総生産（Gross Domestic Product GDP）の58%がその経済成長の動力によるもので、2030年までには、70%を占めると予想されている。都市部の発展は従来の都市計画を凌ぐペースで発展しており、現段階での都市計画を見直し、サステイナブルなプランを都市部にもたらす新しい都市計画が必要である。都市の資源としてSustainable Urban Development（SUD）はそのプランを実現させることを楽観的に見通している。したがって、このプランを大切にすることは都市の将来にとって必要なことである。また、SUDの本質として、都市の重要性があげられる。そして、都市の渋滞や混雑を緩和し、都市と人間の居住地を包摂的、安全、強靭かつ持続可能にすることである。メトロ鉄道インフラのある都市では、都市開発にあたり、鉄道インフラのみならず、都市全体としての開発であると認識する必要がある。メトロ交通がもたらした経済、環境、インフラなどへの影響を分析し、持続可能な都市開発は都市の資源を最適条件で利用し、かつ、その需要を満たすということであり、引き続き、それらを包括的に研究、検証していく必要がある。

## Make Cities inclusive, safe, resilient for Sustainable Development:

Case study of Kochi Metro Railway

Puthenkalam John Joseph*

**Abstract**

"Make cities inclusive, safe, resilient for Sustainable development: Case study of Kochi Metro Railway" in Kerala, India, is part of a research grant of the Ministry of Education（基盤研究B・17H04495）.In this research using survey oriented field work, we were able to collect data to analyze the impact of Metro railway development on economy, environment and resilient cities. This article focuses only on the environmental aspects related to Kochi city and the Kochi Metro development. It is said that by 2050 about 70% of the Indian population will be living around cities and they would contribute about 58% of GDP. Sustainable Urban Development (SUD) plan focusses on mobility of the working population and public transportation is key to its success. This research also analyzes the impact of metro systems in the lives of the people from various perspectives so that we can formulate a new design for sustainable urban development based on building resilient cities.

* Graduate School of Global Environment Studies

## 持続可能な開発のための「住み続けられるまちづくりを」：
### 鉄道ネットワークとコチメトロを実例に

本研究は（基盤研究B・17H04495）“鉄道ネットワークの構築による貧困・教育・環境問題の複合的解決のための方法論の開発”の一部である。この研究はアジア地域におけるインフラ構築に関する情報収集・分析を実地調査インドのケララ州のコチメトロ鉄道建設によって行ったものである。平成30年度からの科学研究費助成事業（科学研究費補助金）の目的は、鉄道ネットワークの形成により、貧困、教育、環境問題を複合的に解決する指針を与えることである。そのために、主に発展途上国を中心として、国あるいは地域レベルによる公共交通ネットワークの構築が交通網の国際化により受ける影響を検証するとともに、持続可能な社会づくりのために必要な交通ネットワークの形成理論モデルを産学官連携のもと構築する必要がある。平成30年度は、主として2つの作業を行った。第一に、以前南アフリカで行った調査の結果より、方法論の構築に要する要素を抽出し、数理モデルに具体的な数値を組み込み検討した。第二に、インフラが発展途上地域においてどのように位置付けられ、利用されているか明らかにするため、インドやエチオピアにおいても予備調査を実施し、地域の特性による違いを検討した。関連研究のレビューは継続し、数理モデルにおけるロジスティクス、エネルギーのそれぞれの観点からの分析も行っている。本年度の研究実施計画 1.本研究の目的を達成するため、前年度に続き方法論の構築を目指すとともに、提案する鉄道ネットワークに対する経済効果、雇用の創出などの開発経済の側面や教育環境への影響の側面について検証方法をさらに検討していく。具体的には、簡易的なモデルケースに対して、導入すべき鉄道技術に関する数例を提示した上で、(a) 消費エネルギー (b) 環境負荷の低減効果 (c) 物流促進効果を測定し、(d) 雇用の創出 (e) 経済効果・その他教育・環境への影響を含めた検証・評価過程までを整理、確立することとなる。

モデル構築には、最適化手法の導入を目指し、定量的な検討を可能とすることが重要である。ここでは、地域特性を考慮した鉄道システムにおける最適車種・最適経路導出のための研究を引き続き行う。地域特性の設定において、物流効果やエネルギー消費などは、それぞれ定量測定が可能な項目である。上記過程で構築した方法論に、貧困、教育、環境の側面からどのような評価を行うべきかを検討し、この課題に対する総合的な解決手法の基礎提案を行うこととする。特に、前年度調査より、鉄道をはじめとするインフラが教育上のアクセスに繋がるだけではなく、移動距離が短縮されることによる教育の質の向上へのインパクトがあることも仮説として成り立つことが考えられた。これは、検証可能かつ実際の問題に即した有効な地域をターゲットとした簡易モデルケースに対して、方法論の確立とその検証について一連の手順を提示することとなり、方法論の有効性の根拠材料として提示されるものである。そのため、実地調査に基づいた有効性の検証が必要であり、引き続き調査を実行するとともに、その妥当性について客観的評価を得るよう進める。

実地調査は、インド、南アフリカ、エチオピアを引き続き対象とし、モデル構築の評価軸を検討するためのデータ・情報収集を行う。インドでは経済・環境の観点からインフラ構築のために必要な要素を抽出することを目的とする。また、南アフリカやエチオピアでは、都市交通を中心

とした公共交通が教育とどのように影響し合うか注目する。なお、このプロジェクトは政策的側面を併せ持つため、実地調査においては国際協力機構や国際機関、省庁、海外の研究機関とも連携し、情報収集網をさらに拡大・構築する。本論文では持続可能な開発のための住み続けられる街づくりをインド・ケララ州のコチメトロを実例に分析を行っていく。

## 持続可能な開発目標・SDGsとは？17の国際目標やターゲット

現在も世界では貧困や人権など様々な課題があり[1]、それぞれの課題について対策や取り組みが行われている。それらは各国がそれぞれに行っているわけではなく、世界が一丸となって取り組むSDGs[2]（エスディージーズ）といわれる国際目標がある。SDGsは、現在の世界をより良いものにしていくため、2030年までに挙げられた課題を解決し、目標を達成していくために作られ、それは持続可能な開発目標として定められ、ターゲットを明確化することで、先進国・途上国がそれぞれにやらなければならないことを考え、取り組んでいるのである。

## 目標11：持続可能なまちと地域社会

2030年までに、すべての人が適切で安全かつ安価な住まいや、水・電気などの基本的なサービスにアクセスできるようにするとともに、スラム地区の状況を改善し、特に、子どもや女性、障がい者、高齢者にとって安全で使いやすい公共交通機関を整備し、災害に強く、地域の人々が参画できる持続可能なまちづくりへの取り組みが掲げられている。世界人口の半数以上は都市部に居住しており、このまま行けば2030年には6割の人々が都市部に居住すると推定されている。[3]これは都市部で財やサービス、交通手段を効率よく提供することができ、技術革新や経済成長をもたらすチャンスが拡大するためである。しかし一方で急速に増える都市部での居住者の管理が適切ではなく、生活の安全面や環境面での深刻な問題、さらに貧困層の生活を厳しいものにしているという現状がある。

## 都市と人間の居住地を包摂的、安全、強靭かつ持続可能にする

新型コロナウイルス感染の90%は、都市で起こっている。パンデミックは、10億人にのぼる人口密度の高いスラムなどに住む社会的に弱い立場の人々に、最も影響を与えている。しかし、新型コロナウイルス発生以前から加速する都市化による、大気汚染・不十分なインフラ整備・都市の乱開発などの問題に、40億人もの人々が直面していた。都市部に住む人々の健康と安全を守るために、安全な公共交通・信頼性のある基礎設備・公共スペースの整備が、いま特に重要である。新型コロナウイルス抑制の成功例を見ると、都市にどれだけ回復力があり、新しい「普通」に慣れることができるかが重要であるといえる。都市は間違いなくパンデミックから回復するが、次に来る危機に立ち向かえるかどうかは、データに基づいた包括的で持続的な都市開発をどれだけ進められるかにかかっている。

### スラム居住者を減らす動きは停滞している

スラムや非公式集落に住む人々は、日常的に基礎的なインフラや設備へのアクセスが不可であったが、パンデミックにより状況はさらに悪化している。公衆衛生や経済面など、さまざまな問題によって生活が苦しくなっている状況である。2000年から2014年の間はスラム居住者を減らすことに成功していたが、それ以降は都市化の加速に開発が追いつかず後退している状況である。[4]

### 世界の都市にさらに公共交通機関が必要

信頼性がありアクセスしやすい公共交通機関は、大気汚染を減らし生産性と社会の一体性を促進することが可能となるものである。2019年に610都市で集められたデータによると、都市に住む人の公共交通機関へのアクセスは50%のみであった。公共交通機関を気軽に利用できなければ、非公式な交通機関に頼らざるを得ないが、公共交通機関と比べて規則性や安全性に欠けるものである。また昨今では、新型コロナウイルス感染拡大を防ぐために公共交通機関の安全政策を考え直すことが必要である。そのためには、短期間の投資を募ることが不可欠とされている。新型コロナウイルスは都市のあるべき状態を考え直す機会となっている。都市開発の方法と計画は、その都市の長期的な繁栄度合いの決め手となるものである。多くの都市の物理的な拡大が人口増加を上回っていたものの、それは都市の乱開発を示す可能性でもある。Figure 1に示すように新型コロナウイルスは、都市計画における公衆衛生・医療・危機管理などの重要性を明らかとした。[5]そのため多くの国や都市は、次の危機に備えた都市開発計画を作成する方向に進んでいる。


Source for Figure 1: https://sdgs.media/blog/5348/

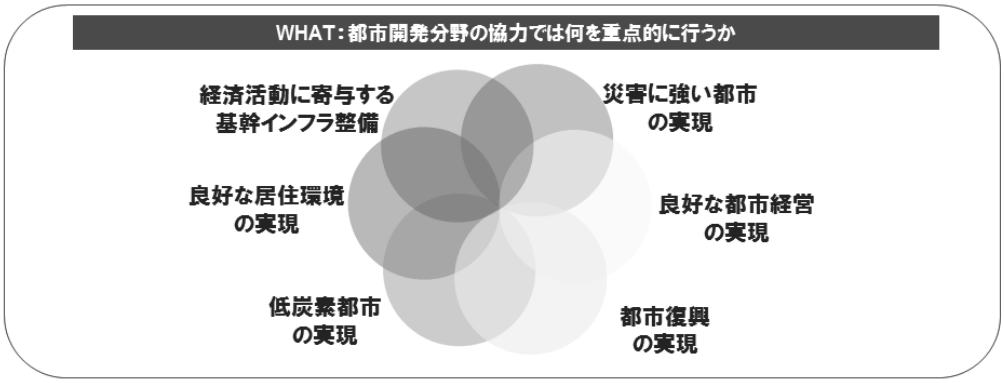
**都市と人間の居住地を包摂的、安全、強靭かつ持続可能にする**

ターゲット

| | |
|---|---|
| 11.1 | 2030年までに、全ての人々の、適切、安全かつ安価な住宅及び基本的サービスへのアクセスを確保し、スラムを改善する。 |
| 11.2 | 2030年までに、脆弱な立場にある人々、女性、子供、障害者及び高齢者のニーズに特に配慮し、公共交通機関の拡大などを通じた交通の安全性改善により、全ての人々に、安全かつ安価で容易に利用できる、持続可能な輸送システムへのアクセスを提供する。 |
| 11.3 | 2030年までに、包摂的かつ持続可能な都市化を促進し、全ての国々の参加型、包摂的かつ持続可能な人間居住計画・管理の能力を強化する。 |
| 11.4 | 世界の文化遺産及び自然遺産の保護・保全の努力を強化する。 |
| 11.5 | 2030年までに、貧困層及び脆弱な立場にある人々の保護に焦点をあてながら、水関連災害などの災害による死者や被災者数を大幅に削減し、世界の国内総生産比で直接的経済損失を大幅に減らす。 |
| 11.6 | 2030年までに、大気の質及び一般並びにその他の廃棄物の管理に特別な注意を払うことによるものを含め、都市の一人当たりの環境上の悪影響を軽減する。 |
| 11.7 | 2030年までに、女性、子供、高齢者及び障害者を含め、人々に安全で包摂的かつ利用が容易な緑地や公共スペースへの普遍的アクセスを提供する。 |
| 11.a | 各国・地域規模の開発計画の強化を通じて、経済、社会、環境面における都市部、都市周辺部及び農村部間の良好なつながりを支援する。 |
| 11.b | 2020年までに、包含、資源効率、気候変動の緩和と適応、災害に対する強靱さ（レジリエンス）を目指す総合的政策及び計画を導入・実施した都市及び人間居住地の件数を大幅に増加させ、仙台防災枠組2015–2030に沿って、あらゆるレベルでの総合的な災害リスク管理の策定と実施を行う。 |
| 11.c | 財政的及び技術的な支援などを通じて、後発開発途上国における現地の資材を用いた、持続可能かつ強靱（レジリエント）な建造物の整備を支援する。 |

Above data is based on: https://unsdgs.jp

SDGs目標11の達成の為に国際協力機構（JICA）は、世界のさまざまな都市開発の支援に取り組んでいる。それは、どのような考え方に基づいて進めているのだろうか。現在、途上国の都市が直面している問題の多くは、過去において日本も直面し、乗り越えてきたものである。そこでJICAは、Figure 2に示すように下の図のように、日本の知見と経験を生かせる6つのターゲットを設定し、都市開発を包括的にサポートしている。[6]



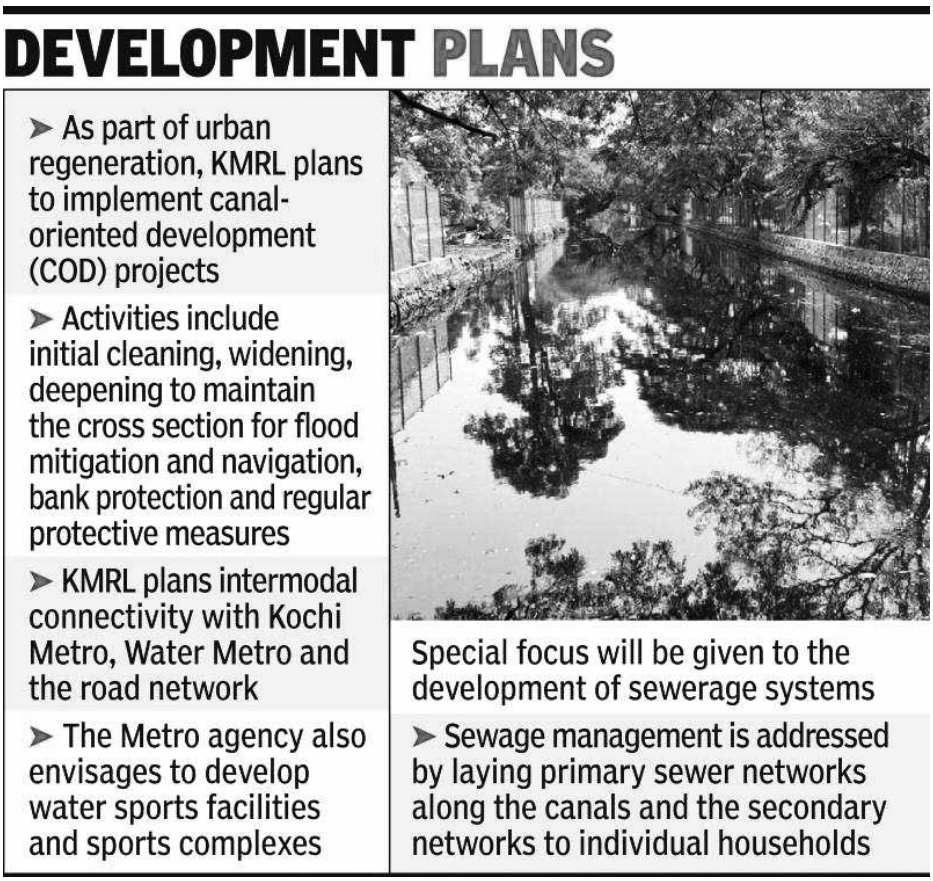

Source for Figure 2:「都市分野の協力」（平成 25 年 2 月）より

JICAの強みはどこにあるのであろう。JICA社会基盤･平和構築部次長の荒仁さんによると､「総合的な都市開発のビジョンづくり、すなわちマスタープランの策定から事業実施、キャパシティディベロップメントまで一貫した協力を行っている」とのことである。都市開発分野の協力は、都市の現状や課題、相手国政府の組織・体制、他の援助供与国の動向を把握しながら、相手国と協議を重ねながら進められるものである。都市の課題を解決するためには、加えて、調和のとれた都市の実現には、短期的な対応を行うとともに、20年先、30年先を見据えた都市開発のビジョンに基づき対応策を検討していくことが重要である。道路整備や河川改修といったインフラ整備はこの主要な「対応策」の一つであるが、都市開発ビジョンや都市全体の開発の方向性に基づき、計画を作成し事業を実施していくことが大切であり、そのためにはマスタープランの策定が重要となる。マスタープランの策定は、まず基礎情報の収集から始まり、国勢調査の人口データや社会・経済指標を参考にしたり、家庭訪問調査で世帯情報を調査し、独自に開発したJICA-STRAD（交通需要予測システム）で将来の交通量を予測することもある。また、都市開発マスタープランでは土地利用計画が重要な要素となるが、この土地利用計画やインフラ整備の基礎となる地図を作成することもある。例えば、ミャンマーのヤンゴンなどでは都市開発のマスタープランの作成を支援するにあたり、5000分の1のデジタル地形図を作成し、計画策定や都市開発管理に活用している。次のステップでは、都市の効率的な発展を目指す開発戦略ビジョンを企画し、都市化を進める開発地区と都市化を抑制する地区等の土地利用計画を作成するとともに、都市の骨格となる基本インフラや人々が快適に暮らすための生活インフラの整備方針を示していくのである。こうして道路や水道、電力など各セクターの具体的な計画をつくり、また、資金協力の計画を検討することもある。マスタープランの実現には、インフラ整備とあわせ都市管理の仕組み、土地区画整理等の都市開発事業を実施するための仕組み、これらの仕組みを運用する行政組織のキャパシティディベロップメントも必要となるものである。都市開発プロジェクトを進めていくときに欠かせないのが合意形成である。相手国政府、地域住民などプロジェクトに関わる人々の合意形成が図られなければ計画はスムーズに進まないからである。[7] Figure 3にて都市再開発法を構成する4つの法的理念を検証することができる。


Source for Figure 3:「都市分野の協力」（平成25年2月）より

### サステイナブルな都市計画

サステイナブルな都市計画（Sustainable Urban Development, SUD）[8]のコンセプトは、過去10年の国連の持続可能な開発目標に沿うものであり、これに沿っての実現と発展を目指しているものである。国連におけるワーキンググループはその開発目標報告書にて2015年以降のSUDの目指すべき指標を以下のように掲げている。“都市開発のプロセスにおいて、環境の基準を整備し、組織の確立を行なうことが大切であり、それに伴い、一般家庭と社会共同体が都市開発からの恩恵を享受できるように、幅広い種類のサービスを最大限に拡充することが必要である。また、都市計画の拡充が現在および将来の人々の生活の向上には欠かせないことであるとしている。”現時点においてこの目指すべき指標の目標は経済における生産性を保ちながら、持続可能であり環境に配慮した都市作りを促進することである。また、SUDの目標のひとつとして、2030年までに交通整備計画と持続可能な都市交通開発計画を実行できる都市を30%以上増やすとしている。持続可能性はその性質上、様々な定義とコンセプトに定義されるため、そのテーマによって、様々な解釈がなされるものである。したがって本論文はSUDの解釈として、より簡単な定義として“都市資源の最適な利用方法が都市の要求と合致すること”を使い考察を行いたい。また、将来の都市構想にも焦点を当ててすすめていくことが、Figure 4にて示されている。




Source for Figure 4: https://kochimetro.org/the-project/

**インドのメトロ交通**

インドに初めてメトロ交通が開設した都市はコルカタであり、1984年であった。それ以降1995年にはDelhi Metro Rail Corporationが2002年までの完成目標にて、デリーにてメトロ交通を開通する計画を発表した。それ以降、メトロ交通はムンバイ、チェンナイ、そしてバンガロール他、インド国内の20の都市において建設中、もしくは建設計画中となっている。先のジャーナルにおいて、インドにおけるメトロ交通システムについて考察しており、参照願いたい。

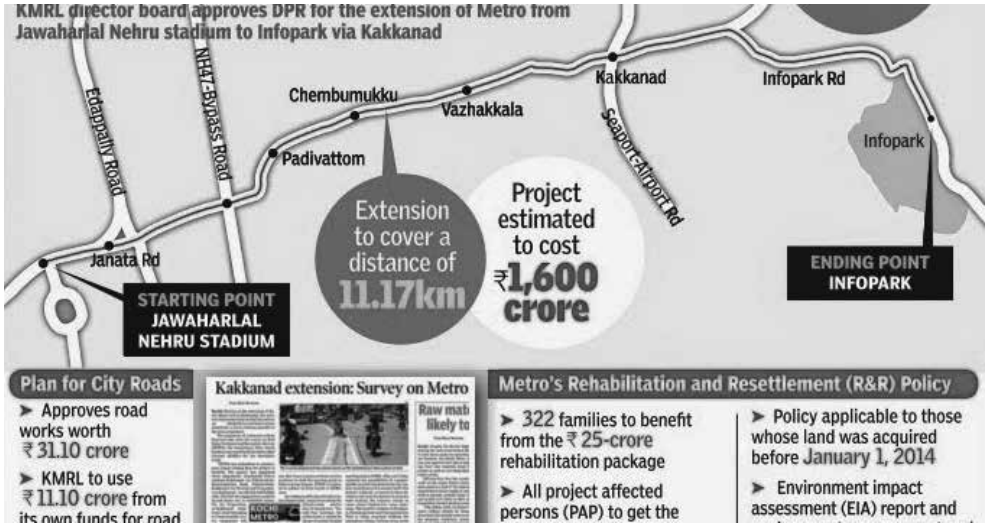
**コチメトロ交通**

本論文においては、主にコチのメトロ交通を環境の側面から考察していきたい。

コチはすべての商業活動の中心都市であり、またケララ州における最大の都市集積地である。そして、コチの中心部は630スクエアーキロメートル内に228万人が居住している。[9]コチは、インドの南西海岸を代表する湾港都市であり、しばしば“アラビア海の女王”と賞されている。また、コチ空港はインド国内で7番目に航空機の発着数の多い空港であり、空港でのエネルギーは

ソーラーパネル発電力で賄われている。そして観光客にとって、主要な観光目的地であり、バックウォーターやビーチ、遺跡などが有名である。[10]

ケララ州のコチメトロ交通は2017年6月に開通した。この開通までに要した時間はインド国内で最も短期間での開通であった。アルバからパラリヴァトムまでの地下鉄路線の13.4km区間は、2017年6月17日にナレンドラ・モディ首相によって一般公開され、パラリヴァットムからマハラジャ大学までの第2の5km区間は2017年8月までに開通に至った。開通までの第1段階は、Rs.518億1000万のコストで設定されており、以下Figure 5にて、プロジェクト全体の概算コストを確認することができる。



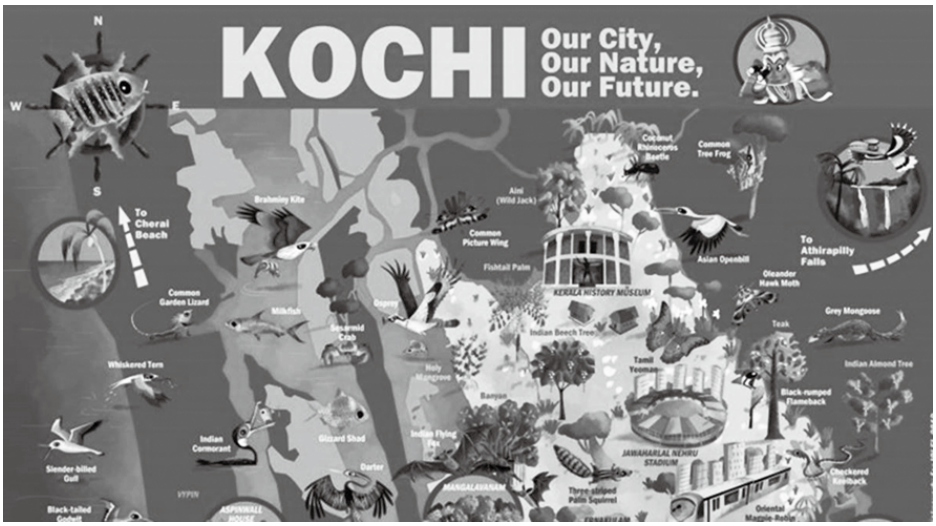

Source for Figure 5: https://kochimetro.org/the-project/

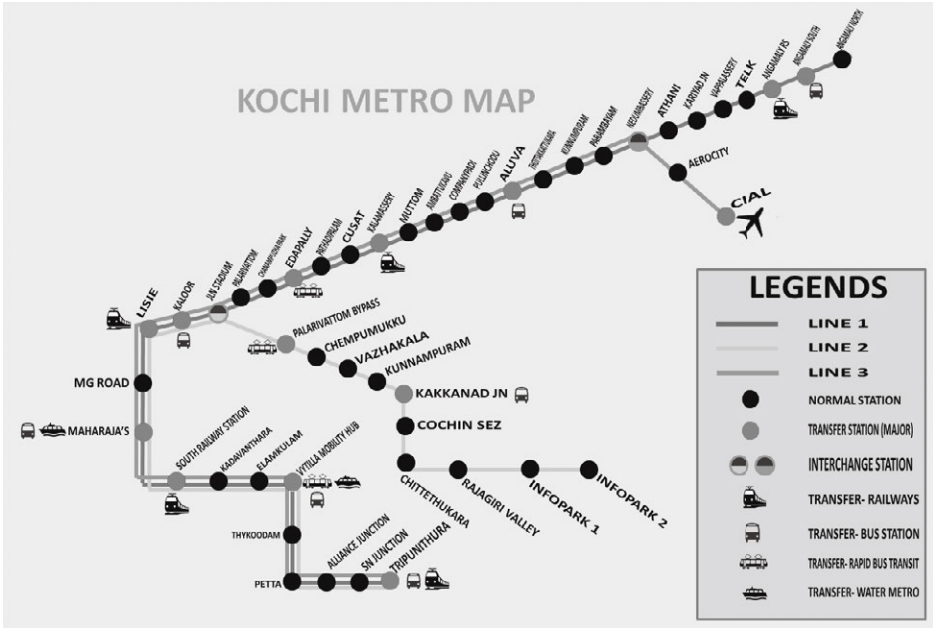
**「環境に配慮したインフラ開発と産業化」**

コチメトロ交通を設計するにあたり、環境影響評価を行い、環境モニタリングを下述の点にて反映させた。

・鉄道の運用における二酸化炭素排出と空気汚染の関連性
・騒音公害
・エネルギー消費量
・建設工事の際に発生する騒音と公害
・都市の景観を損なう公害

以下、Figure 6にて、コチという都市の生態学的な強みを、そして、Figure 7にてコチメトロ交通の路線図をみることができる。




Source for Fig.6 & 7: Executive Summary of EIA Study & Environment Monitoring Plan for Kochi Metro Project

「環境に配慮したインフラ開発と産業化」についても様々な可能性がある。エネルギー効率を向上させるための機械設備を開発する、廃棄物の発生を抑える製品を開発するといった目的の研究開発はこの目標の達成に大きく貢献するものである。過去10年で東アジアや東南アジアは著しい発展を遂げており、その要因はインフラや産業、イノベーションである。そのため「強靭（レジリエント）なインフラ構築、包摂的かつ持続可能な産業化の促進及びイノベーションの推進を図る」ことを目標とすることが、持続的経済成長と持続可能な開発を目指すこととなるであ

ろう。SDGsでは誰一人取り残さないという理念を掲げていることから、2030年までに脆弱な国家への様々な支援を行うなど8項目のターゲットに取り組むことで、この目標の達成を目指している。

### コチメトロ交通プロジェクトの環境影響評価調査と環境モニタリング計画

コチメトロ交通システムは、ケララ州政府によって計画された。コチメトロ交通株式会社（KMRL）と呼ばれる特別目的事業体（SPV）は、メトロプロジェクトの実施、運用、保守のために設立された。ムトムにメンテナンスデポを備え、アルヴァからペッタまでの間に、22の駅、約25kmの長さの地下鉄路線が開発された。2006年のEIA通知とその後の修正、および「事前の環境クリアランスが必要なプロジェクトまたは活動のリスト」を提供するスケジュールには、メトロレールプロジェクトが含まれていないため、メトロレールプロジェクトは環境森林省（MoEF）からの環境クリアランスが不要であった。このEIA調査[11]の主な目的は、メトロレールの開発に関連する環境影響の評価を関連する環境モニタリング計画とともに文書化し、資金提供機関の要件に従ってKMRLEIAレポートを促進することであり、この文書は、上記の調査を通じて提案された環境影響評価および環境モニタリング計画の要約を示すものである。

・植樹：コチメトロ交通は、DMRCの企業方針に従い、伐採される樹木ごとに10本の植樹を行っている。したがって、477本の樹木を伐採するには、約4770本の樹木を植える必要があり、KMRLは、すでに5159本の植樹を行い、加えて、8000本の木を植樹予定である。KMRLは、コチその周辺のさまざまな教育機関で利用できるオープンスペースに植樹を計画している。また、サホダランアイヤパンロードのメトロ線形に沿ってのプランテーションを整備するにあたり、コチメトロ交通の乗客数の更新と汚染物質への影響、伐採に関するKMRLガイドラインが作成され、請負業者は、管轄当局からの事前の承認が必要な伐採が必要な樹木の数、周囲のサイズ、および種類を事前に把握し作業にあたることとしている。

・景観と緑化：プロジェクトのために伐採される樹木のリストに基づくと、ココナツの木が主であり、次いで、ゴールデンフランボヤントとレインツリーが続いている。その地域の在来樹木を維持するために、植林中は、他の既存の樹種と一緒に在来樹木を優先することが推奨される。樹種のリストは、「中央汚染管理委員会によるグリーンベルト開発のガイドライン、2000年3月」に基づいて提案されている。

・ユーティリティ：排水管理を任された業者は、ユーティリティ管理会社とともに緊密に調整を行い、エンジニアによる管理のもと、ユーティリティシフト計画を遂行するものである。

・大気汚染防止対策：建設期間中の大気への影響は、主に道路沿いの浮遊粒子状物質（SPM）の増加と、車両や建設機械からの排出によるものである。提案されている防止対策は、散水、資材輸送車両の制限、高い隆起した金属シートによる掘削現場のフェンシング、建設車両およびその他の機器の定期的なメンテナンスなどである。

・騒音と振動の制御対策：バラストレス軌道は2層のゴムパッドで支えられており、軌道の騒音と地面の振動を低減するものである。以前のメトロプロジェクトのベースライン調査と騒音レベル調査では、プロジェクトの周囲の騒音レベルは、騒音に関する全インド大気品質基準の範

囲内になると想定された。したがって、隔離された場所において、必要な場合は、運用段階で観察された騒音レベルに基づいて防音壁を設置できることが示唆されている。線路の形状による騒音／振動を低減できるように、鉄道の客車と線路を定期的にメンテナンスすることが必要である。

・交通の迂回と管理：交通の迂回計画は、閉鎖された場所やアクセスが制限されたすべての場所へのアクセスに代替ルートが提供されることを保証するために必要である。さまざまな通信手段を通じて、事前に迂回について通知がなされ、交通監視員と交通警察の助けを借りて、交通の流れを維持することとしている。

・土壌侵食防止：請負業者は、適切な予防措置を講じる必要があり、堤防の作成、シルトフェンスの設置などにより、公道や既存の小川沿いの道や敷地内または敷地に隣接する排水路など、敷地周辺に隣接する土地に、いかなる種類の腐敗物やがれきが押し出されたり、流されたり、堆積したりしないようにする必要がある。また、工事開始時に排水システムを構築し、工事現場で水が停滞しないようにすることも求められる。加えて、建設資材の残骸が流出されないように沈降タンクを設置することも必要である。

・建設廃棄物の処分：コンクリートブロックは、交通の危険や歩行者や交通に不便をもたらすような状態を避けなければならない。コンクリートブロックが不便をもたらす状況にある場合は、一時的に廃棄物保管場所に移動し、水を含ませ、小さな砕けやすい材料とならないようにして、汚染の防止措置をすることが必要である。掘削土の保管・処分のための一時保管場所や処分場は、請負業者が特定し、DMRCは、廃棄物の処分に必要なさまざまな政府機関の許可の取得義務が求められる。また、掘削物の輸送は、こぼれを防ぐために水密ダンプカーで行わなければならない。

・建設資材の供給と管理：コチメトロ交通の建設に使用される主な建設資材は、粗骨材、セメント、粗砂、鉄筋、構造用鋼、給水、排水、衛生設備などである。建設資材は管理が必要であり、その保管場所は、定期的に検査される必要がある。

・労働宿泊施設の管理：すべての請負業者は、地域およびKMRLの労働基準に準拠するものである。すべての一時的な宿泊施設は、汚染されていない安全な水が飲用、調理、洗浄に利用できるように建設および維持されなければならない。 適切な洗面、入浴場所が提供され、清潔で排水された状態に保たれなければならない。すべての職場での施設は男性と女性の労働者の使用のために別々に無料で提供されなければならない。適度な規模の調理が可能な食堂施設は、必要な際にはいつでも、労働者のために食事を提供しなくてはならない。 滅菌された包帯材料と器具の適切な供給を含む、すぐに利用できる応急処置ユニットも整備する必要がある。

・給水、衛生、固形廃棄物の管理：建設および施設運営期間中、必要な水は地方自治体から供給されるものとする。コチでは、下水処理システムが建設中であるため、発生した下水は浄化槽とソークピット施設を組み合わせて処理することが可能である。固形廃棄物は駅で発生し、デポは分別して別々に保管し、コチの協力を得て科学的に処分可能である。その他の廃棄物、つまりリサイクル可能物と廃油廃棄物は、それぞれリサイクル業者と認定リサイクル業者を通じて処分される。駅で溜まった雨水は、駅の排水溜めに貯めることができ、緑地、駅やデポでのフラッシングや床掃除に再利用して、淡水を節約することが可能である。

・水管理計画：地表水の汚染を防ぐために、請負業者は必要な処理を行わずにサイトから水を排出することは許可されていない。請負業者は、土、ポリマー、化学薬品、コンクリート攪拌機の洗浄液などが水路に堆積しないようにしたのち、地方自治体が承認した方法で適切に収集し、残留物を処分することとなる。認可されたベンダーの助けを借りて、廃油を収集および処分するために、油除去/インターセプターが必要である。
・有害廃棄物管理：2008年の有害廃棄物（管理、取り扱い、国境を越えた移動）規則およびその後の改正で有害と分類された廃棄物が生成された場合、与えられた手順に従って廃棄するものする。保管場所は不浸透性の床を持ち、四方に束ねられなければならない。このような廃棄物は、認定ベンダーの助けを借りて処分されるものである。
・エネルギー管理：エネルギーステーションの設計は、自然光を最大限に活用し、他の照明への依存を減らすような設計が望ましい。エネルギー効率の高いものとしてLEDとCFLはすべてのステーションで使用される。デポでは、エネルギー効率の高い照明器具も使用することが推奨される。
・デポ管理計画：水供給は、コチの行政、または管轄当局の許可を得て、ボーリングチューブを介して地面に供給されるものである。油の取り扱いエリアは、偶発的な油流出の浸透を防ぐために、固いコンクリート/不浸透性のプラットフォームで構成する必要がある。デポの雨水は、油水分離器を備えた排水管から集まり、収集されたオイル、油性ラグ、コンテナは、汚染防止委員会認定コレクター/ベンダーに廃棄する必要がある。STPを設置することにより、下水や排水を処理することが可能となる。処理された水は、必要に応じて近くの小川や排水路に排出され、園芸目的として、使用することができる。グリーンベルトの開発/プランテーションは、デポの境界に沿って行われ,集められた雨水はグリーンベルトの開発、床掃除、フラッシングに使用される。詳細なプロジェクト固有の災害管理計画は、地区災害管理局と協議してKMRLが作成する必要がある。ケララ州の災害管理局が、最終意思決定機関として機能し、州内のすべての災害管理関連活動を促進、調整、レビュー、および監視するものとする。したがって、すべてのメトロプロジェクトの災害管理の予防と軽減のプロセスは、最終的にはこの機関によって管理されることとなる。緊急行動委員会（EAC）は、駅長、警察官、運輸公社、ホームガード、消防隊、保健局、情報広報局などの代表者で構成される。KMRLは適切なシステムを確立し、維持するものである。熟練した訓練を受け、かつ効率的な通信機器およびその他すべての機器と設備を備えて、いつでも災害管理に迅速に適用できるようにする必要がある。運用担当者は、消防およびメトロの運用に関する広範なトレーニングを受け、災害に対応できることとする。このシステムは、地下鉄/鉄道業界で採用され、法定機関によって承認された基準に基づいて施行される。自動消火システムは、主要なエリアに設置され、必要なサポートについては、地元の消防署に連絡することとする。オフサイト緊急対応計画には、近くの集落が含まれ、これには、訓練と認識、警報、避難手順、消防、緊急通信システム、応急処置などが含まれる。手順と計画は、地区および州当局との主要な緊急事態のために作成および確立される。
KMRLの建設活動と、ある程度のプロジェクト運営は、ベースラインの環境条件に影響を与える可能性があり、その影響は、建設の性質や操作方法/技術に応じて、空気、騒音、水などのさまざまな環境属性に影響を与える可能性がある。さまざまな管理計画の適切な実施と環境に

やさしい技術の使用の助けを借りて、環境汚染物質に対するプロジェクトの貢献を大幅に制御することができるが、主要な環境パラメータの監視はベースラインの確立に役立つものである。Figure 8に示すように建設および運用段階での空気、騒音、およびパラメータの監視スケジュールが必要とされる。環境モニタリングは、MoEF / NABL認定の研究所を通じて実施することができ、環境課／外部機関は、このEIA & EMP調査およびその他の関連規制で提案された条件とパラメーターの実施を監視する責任を負うKMRLによって関与されている。 報告ガイドラインと責任を備えた組織体制が必要である。

・人口増加率：コチの自治体の人口増加率はここ数年安定して推移している。GCDA地域内の自治体と2011年の国勢調査における都市における集積地は、コチ全体の自治体の人口増加率よりも増えていることがみてとれる。このことは、低い密集率を保ちながら、コチの街が拡張していることをあらわしている。この10年間におけるコチの各自治体の人口増加率は隣接する自治体の増加率よりも少ないことから、コチの住民は街の中心よりも郊外を好む傾向にあることが読み取れる。街の人口の自然増加率は、幾年にもわたり、減少しており、そして、それはほぼ一定数を保っている。都会と田舎の境界線が幾年にもわたる国勢調査によって、明確となった。コチ開発計画2031は、コチの居住性を向上させることを目的としているコチは、IT、観光、ヘルスケア、港湾ベースのグローバルな都市へと発展している。開発計画2031は、PIA区域の残りの地域の人口を15,25,734人と予測しているが、現在の人口は8,02,307人となっている。メトロ鉄道の開発によってPIAに引き付けられる可能性のあるこれらのエリアの人口は7,23,428人追加されている。隣接する市区町村の30%の自然成長と、残りのパンチャーヤトの地域の20%の自然成長率を想定して推定した後、分配される可能性のある潜在的な過剰人口は4,02,505人となる。したがって、追加されたPIAの総人口は、133PPHの総密度で11,50,283人となる。[12]

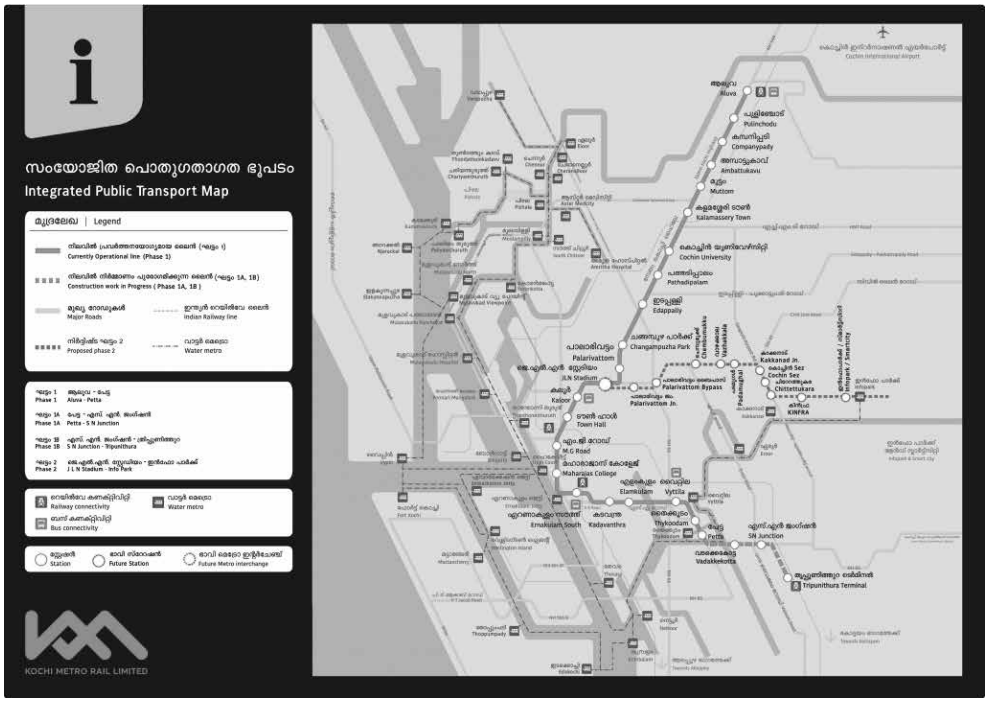
**公共交通機関の生産性**

都市道路の交通状況が改善され、都市におけるバスの平均速度が上がることで、メトロインフラが整った状態で1日に約2回の交通移動が可能になり、追加の利益を得ることが可能となった。年間では、Rs.30クローレ。しかし、メトロ鉄道が登場すると、メトロ鉄道駅への効率的なフィーダーサービスとして機能するようにPTバスルートのルートを変更する必要が生じた。[13]

都市構造については、以下、Figure 8、9にて参照できるように、かつて主要道路のジャンクションや行政区画の本部に集中していた商業センターやビジネス地区は、次の地下鉄駅の近くに集中する傾向がある。[14]したがって、都市の都市構造は、単一中心の多核構造から多中心の多核構造に変換され、各地下鉄駅は商業開発の新しいノードとして機能することとなる。これらの駅へのフィーダー道路の接続は、都市の道路網でも際立っており、駐車スペースの拡大、割り当て、適切な歩行者インフラの提供が求められる。[15]


Source for Fig.8: https://kochimetro.org/the-project/

The following is an integrated transport map and that gives us a glimpse of future mobility in Kochi.[16]
*Source: for Fig.4: Integrated Public Transport Map: https://kochimetro.org/the-project/*




Source for Figure 9: https://kochimetro.org/the-project/

## 結論

本論文で、持続可能な開発のための住み続けられる街づくりをSDGsの目標に照らしながら、コチメトロ鉄道の役割を分析し、環境アセスメントを通して、検証してきた。都市の将来の成長を導く上で、コチメトロ鉄道の役割に関する研究は、都市開発のさまざまなパラメータに基づいて評価される。持続可能性を測定する際の曖昧さを回避するために、本研究では、現地調査によるデータを利用した。また、本論文を通じて、コチメトロ鉄道のインフラストラクチャーは、国連の持続可能な開発目標（SDGs）を達成するための効果的なツールであることが証明された。開発された土地消費量の節約は、どの都市の開発にも不可欠である。この調査は、メトロへの投資が無形の影響を通じてどのように引き起こされ、住民の社会的および経済的幸福に利益をもたらすかを示している。膨大なインフラプロジェクトに恵まれたコチは、国内経済の原動力となる可能性がある。コチメトロ鉄道は移動条件を改善し、コチをケララ州の主要な観光、産業、経済の中心地としての地位を確立するための港湾都市とするための開発に役立つものとなるであろう。

---

**References**


Note: All the materials related to MDGs and SDGs and urban resilient infrastructure are based on the following sources:

1. https://www.un.org/millenniumgoals/2015_MDG_Report/pdf/ 2.https://www.unic.or.jp/sustainable_development/2030agenda/2030agenda/
3. https://www.unido.org/fileadmin/ Resources/ IDR2016_FULLREPORT.pdf.
4. https://www.itdp.org/our-work/sustainable-urban-development/
5. https://sdgs.media/blog/5348/
6. https://www.jica.go.jp/ urban/ku57 /position_paper_urban.pdf
7. Ibid
8. https://www.changing-transport.org/wp-NUMP_India_2014_EN.pdf
9. https://kochimetro.org/the-project/
10. http://www.gcda.kerala.gov.in/
11. *Executive Summary of EIA Study & Environment Monitoring Plan for Kochi Metro*
12. *Ibid*
13. Analysis on Kochi Metro Network is based on discussions with Metro personnel during study visit 2018-2020 and data are based on documents provided by Kochi Metro Development Authority Office. https://kochimetro.org/
14. Ibid
15. https://kochimetro.org/ Development_ProposalsControlRegulations.pdf
16. *Integrated Public Transport Map: https://kochimetro.org/the-project/*



N.B. I take this opportunity to acknowledge the financial support through the research grant and also acknowledge the various data and research based materials used in this study provided by various sources.（本論文の記述は膨大な研究資料と科研費によるサポート及び、編集者に寄与するものである。）


For publication and other details about the author, please refer to: http://pweb.sophia.ac.jp/j-puthen/

## Understanding Social, Economic and Environmental Impacts of Renewable Energy:

A Case Study of the Maldives

Noboru Zama, Masachika Suzuki

**Abstract**

Not only the potential of renewable energy on climate change mitigation, but the social, economic and environmental impacts of renewable energy have gained interest and have been studied. This is relevant for the context of Small Island Developing States (SIDS) such as the Maldives as it may enjoy larger impacts. This article addresses the social, economic and environmental impacts of renewable energy in the Maldives. It illustrates a brief literature review on the impacts in general, the national context of the impacts, and a brief picture of renewable energy projects implemented by major donors and development partners in the Maldives. The main part of this article describes key results from a questionnaire survey conducted to understand the current state of renewable energy deployment and its impacts. It concludes by wrapping up major findings of the research and makes five recommendations for further research and for policymakers to consider in future renewable energy projects to improve the social, economic and environmental impacts in the Maldives.

## 再生可能エネルギーの社会的、経済的、環境的影響：

モルディブを事例として

坐間　昇・鈴木　政史

**要約**

再生可能エネルギーの活用は気候変動の緩和の可能性だけでなく、その社会的、経済的、環境的影響に関しても関心を集め研究が進んでいる。このテーマはその影響をより多く受けるであろうモルディブのような小島嶼開発途上国（Small Island Developing States: SIDS）の文脈においてより大きな意味がある。本論文は、モルディブにおける再生可能エネルギーの社会的、経済的、環境的影響を取り上げる。これらの影響に関する先行研究のレビューを簡潔に行うとともに、モルディブの文脈における影響を検討し、モルディブにおいて主要なドナー及び開発パートナーが援助・実施している再生可能エネルギー事業の概要を示す。本論文の主要部分では、再生可能エネルギーの導入とその影響の理解を目指して実施した質問票調査の主要な結果を提示する。本論文の最後ではモルディブで社会的、経済的、環境的影響を改善する可能性がある将来の再生可能エネルギー事業の検討に向けて政策立案者に向けて5つの提案を提示する。

# Understanding Social, Economic and Environmental Impacts of Renewable Energy:

A Case Study of the Maldives

## 1. Introduction

Renewable energy deployment has been accelerating in the Maldives in the recent years. Ambitious goals[1] to reduce greenhouse gas emissions set by the Government of the Maldives and the goals and targets of the Sustainable Development Goals (SDGs) and the Paris Agreement at the global level are boosting this phenomenon.

There is no doubt pertaining to the contribution of renewable energy to climate change mitigation, although there is a growing interest of the impacts of renewable energy on the society and the economy as well. A number of research related to renewable energy and the potential contribution/impacts to the economic, social and environmental dimensions of countries has been conducted (Jaramillo-Nieves and Del Rio, 2010; Bertheau, 2020; Sheikh et al., 2016; Akella et al., 2009; Kumar, 2020). Particularly, in the context of SIDS, taking into consideration some of the characteristics such as narrow and dispersed land, long distance from international markets and vulnerability to environmental changes such as natural hazards and climate change, the impact of renewable energy could be large.

The aim of this paper is to study the social, economic and environmental impact of renewable energy in the Maldives. Section 2 describes and summarizes results of literature review on relevant studies up to the present. Section 3 briefly introduces the national context of the Maldives with a focus on the energy sector and highlighting relevant national policies. Section 4 summarizes renewable energy projects implemented in the Maldives, particularly by multinational and bilateral donors. A bias in the renewable energy technologies being deployed, particularly on solar PV systems, could be seen from the table. The core of this paper is Section 5 which presents the results from a survey on renewable energy technologies in the Maldives and its impacts. The result presented here is based on a qualitative questionnaire survey which was conducted in August 2021 targeting various actors in the Maldives and in Japan working on renewable energy projects in the Maldives. Section 6 summarizes this study and makes recommendations for future works.

## 2. Literature Review on Social, Economic and Environmental Impacts of Renewable Energy

Up to recent, various studies have attempted to understand the social, economic and environmental impacts of renewable energy in relation to sustainable development. Social impact could be defined as the effect on society and the wellbeing of the community and its members and it also refers to as the

1 By 2023, share of renewable energy in the national energy mix increased by 20% compared to 2018 levels (Strategic Action Plan 2019–2023), 26% reduction of emissions in 2030 (under a BAU) in a conditional manner, in the context of sustainable development, supported and enabled by availability of financial resources, technology transfer and capacity building (Update of Nationally Determined Contribution of Maldives) and to achieve net-zero carbon emissions by 2030 with international support and assistance.

consequences of human populations of any public or private actions that alter the ways in which people live, work and play, relate to one another, organize to meet their needs and generally cope as member of society (Sheikh, et al., 2016).

A few examples of social benefits are improved health, consumer choice, greater self-reliance, work opportunities and technological advances, that of environmental benefits are reduced air pollution, lower greenhouse gas emissions, lower impacts on watersheds, reduced transportation of energy resource and maintaining natural resources for the long term, and that of economic benefit is job creation (Akella et al., 2009).

As socio-economic benefits are gaining prominence as a key driver for renewable energy deployment, to contribute to this field of knowledge, the International Renewable Energy Agency (IRENA) has published a report to present a conceptual framework for analyzing the socio-economic effects of large-scale renewable energy deployment (IRENA, 2014).

Through a literature review conducted in 2010, it was revealed that the dimension predominantly covered was the economic one, whereas the social and especially the environmental aspects have received less attention (Nieves and del Rio, 2010). Geographical coverage was also identified: most of the studies focused on the Mediterranean region, especially Greece and Spain (ibid). To cope with the geographical gap is important because insights from case studies revealed that the capability to benefit from access to electricity strongly depends on the socio-economic and socio-cultural context (Kumar, 2018). From this reason, it is necessary to assess the impact of modern and improved energy access at the local level to derive recommendations for policy makers and technology policy interventions (McCollum, et al., 2018). Taking this into consideration, a case study approach was taken to derive local and regional recommendations (Bertheau, 2020).

During the past decade, a number of case studies in different countries have been carried out including Indonesia, Pakistan, Pacific SIDS, Philippines and the United Kingdom (Van der Waal, 2020; Hong and Abe, 2012; Rachmawatie et al., 2019; Wirawan and Gultom, 2021; Kumar, 2020; Weir and Kumar; 2020). Weir and Kumar (2020) is unique in the sense that they attempted to look into the relationship between the use of renewable energy and reducing vulnerability to hydro-metrological disasters. In the context of the Maldives, an attempt to link the Strategic Action Plan with the SDGs has been conducted and a linkage between the clean energy subsector and SDG 1, SDG 3, SDG 7, SDG 9, SDG 11, SDG 12, SDG 13 and SDG 17 has been shown (UNDP, 2020).

## 3. National Context

The Maldives consists of approximately 1,190 islands and 26 atolls and combines many of the geographical characteristics of SIDS namely diffusivity, narrowness, remoteness, and vulnerability. The main industries are tourism and fishery where tourism accounts for about 26% of the GDP of the nation (Ministry of Economic Development, Government of Maldives, 2020).

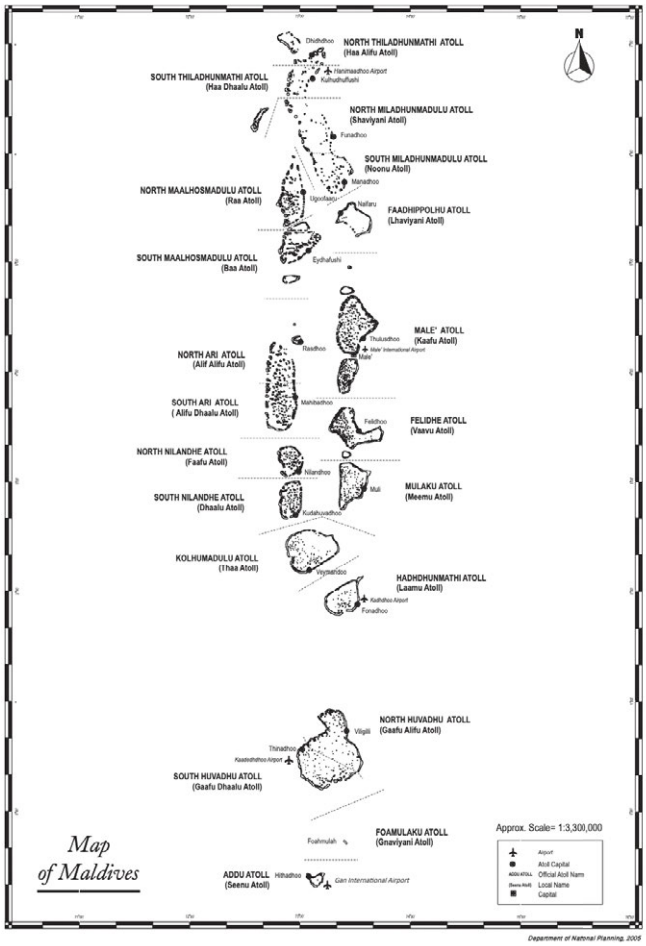



Figure 1: Map of Maldives
Source: Department of National Planning. (2011).
Statistical Yearbook of Maldives.

The Maldives' power system is independent as the country is scattered over a vast sea area due to the above-mentioned diffusivity. The fuel used for power generation is mainly diesel, and there are issues such as reducing the emission of greenhouse gases emitted during power generation and strengthening energy security by eliminating dependence on diesel. Most of the greenhouse gases are emitted from the energy sector which is pushing the Government of Maldives to increase its priority and speed to promote the deployment of renewable energy nation-wide. In the short term, there is a strong political incentive to accelerate the deployment of renewable energy by 2023, where the next presidential election is scheduled to take place.

In the Strategic Action Plan 2019-2023, the Government of Maldives has set a goal to increase the proportion of renewable energy in its energy mix by 20% by 2023 compared to 2018. In addition, the "Nationally Determined Contributions (NDC)" submitted to the United Nations Framework Convention on Climate Change (UNFCCC) Secretariat has set a target to reduce greenhouse gases by 26% by 2030

compared to Business as Usual (BAU) levels. The president has also announced that carbon neutrality is achievable by 2030. Ambitious goals have been set and stronger action is being required.

## 4. Situation of Renewable Energy in the Maldives through Multilateral and Bilateral Support

The current administration has set a goal to achieve carbon neutrality by 2030 and the Maldives is now aiming to reduce 26% of its greenhouse gas emission compared to BAU level by the end of this decade. Both domestically and globally, the Maldives has set a relatively ambitious goal and accelerating actions to achieve them.

Despite relevant policies and knowing what to do, scarcity of resource is one of the major challenges the nation is facing. International support is crucial and multiple donors have been extending their support in the area of renewable energy. Support extended from major donors and development partners could be found in Table 1.

Table 1: List of Renewable Energy Projects Implemented by Major Donors and Development Partners

| Donor[2] | Start | End | Location | Budget | Name of Project | Technology |
|---|---|---|---|---|---|---|
| World Bank | 2021 | 2026 | Malé, Faafu, Fuvahmulah, Addu | USD 12,400,000 | Accelerating Renewable Energy Integration and Sustainable Energy (ARISE) | Solar, storage, grid upgrade |
| World Bank | 2014 | 2021 | Greater Malé (Hulhumale, Malé, Hulhule) | USD 16,000,000 | Accelerating Sustainable Private Investments in Renewable Energy (ASPIRE) | Solar, storage |
| World Bank | 2012 | 2014 | Malé, Thinadhoo | | Maldives Clean Energy for Climate Mitigation | Renewable energy, energy efficiency |
| Asian Development Bank | 2014 | 2021 | 160 islands | USD 38,000,000 | Preparing Outer Islands for Sustainable Energy Development (POISED) | Energy efficiency, renewable energy, capacity enhancement |
| UNDP-GEF | 2004 | 2012 | | USD 2,738,780 | Renewable Energy Technology Development and Application Project (RETDAP)[3] | Advocacy and awareness, resource assessment, policy development and institutional strengthening, technical capacity building, project financing schemes, system project development |
| UNEP-GEF | 2014 | 2018 | | USD 38,340,835 | Strengthening Low-Carbon Energy Island Strategies[4] | Monitoring and assessment, energy efficiency, capacity building, policy and regulation |

2 Donor with a hyfen: former indicates the implementing agency and latter indicates the funding source.

3 https://www.thegef.org/projects-operations/projects/1029. Accessed December 3, 2021.

4 https://www.thegef.org/projects-operations/projects/4629. Accessed December 3, 2021.

| | | | | | | |
|---|---|---|---|---|---|---|
| UNEP-GEF | 2021 | 2024 | | USD 6,234,823 | Integrated, Sustainable and Low Emissions Transport in the Maldives[5] | Low-emissions transport systems |
| Asian Infrastructure Investment Bank | 2021 | 2026 | | USD 20,000,000 | Solar Power Development and Energy Storage Solution[6] | Solar, storage, grid modernization |
| JICA | 2010 | 2014 | Malé, Hulhumale | JPY 1,000,000,000 | The Project for Clean Energy Promotion in Male[7] | Solar, capacity building |
| Joint Crediting Mechanism (JCM)-Japan | 2017 | 2018 | Malé | | Solar Power on Rooftop of School Building Project[8] | Solar |

Source: Various sources.

From Table 1, it could be found that solar PV systems are the technologies mostly deployed in the Maldives. This reflects the high potential of solar PV systems and the reality that technologies other than solar PV systems are not sufficiently studied nor demonstrated due to lack of resources. Another finding is the geographical gap where the projects have been implemented. Many of the projects have been implemented in the capital Malé, its suburbs and major cities, and less in the small-inhabited islands. It is also interesting to note that while major donors have been deploying large scale solar PV systems broadly throughout the country, major development partners have been implementing projects that bring impacts not only to the environment but also on socioeconomic development.

## 5. Results from the Survey on Renewable Energy and its Social, Economic and Environmental Impacts in the Maldives

To study and analyze the current state of renewable energy and its social, economic and environmental impacts, a questionnaire survey was designed and carried out in August 2021. The purpose was to understand the renewable energy deployed in the Maldives and how it is bringing social, economic and environmental impacts to the locals. The questionnaire targeted various renewable energy related actors mainly in the Maldives but included a limited number of actors from Japan. The questionnaire was designed to be qualitative and the respondents were asked to provide their answers freely. The response rate was 67% and the answers were received from government, state-owned utility companies, private sector and consulting firm. The questionnaire was structured with four sections: basic information; current situation; impacts; and going forward.

5 https://www.thegef.org/projects-operations/projects/10301. Accessed December 3, 2021.

6 https://www.aiib.org/en/projects/details/2021/approved/Maldives-Solar-Power-Development-and-Energy-Storage-Solution.html. Accessed December 3, 2021.

7 https://www.jica.go.jp/oda/project/0961960/index.html. Accessed December 3, 2021.

8 http://gec.jp/jcm/projects/14pro_mdv_01/. Accessed December 3, 2021.

The survey clearly revealed the reality of renewable energy in the Maldives: most renewable energy deployed up to date are solar PV systems. All respondents have worked on solar PV systems and they have also put a strong priority towards it. Waste-to-energy and hybrid boat were other renewable energies that were pointed out, however the application was very limited and the priority was still not as high as solar PV systems. The locations where solar PV systems have been deployed were limited to the north, central and south regions of the country and less in north-central and south-central regions. Approximately one-thirds of the total population belong to cities (Kulhudhuffushi, Malé, Fuvahmulah and Addu) which are located in the north, central and south regions and the high energy demand has been one of the reasons why majority of the projects have been implemented in these regions. Other reasons were accessibility from the capital Malé, customer interest and demand for private sector.

The current situation is a little different from the past. Solar PV systems and waste-to-energy remains to be in the top list among the renewable energies being deployed, however electric transport and energy savings are also being looked into. What is important to note is that the respondents except from the private sector are considering 2023 to be the target year for current projects. 2023 is the year for the next presidential election and most of the actors especially from the government sector are scaling and speeding up projects on renewable energy to achieve the commitments made by the current administration. For the target area, specific island and atolls in the central and south regions have been pointed out, although some actors, both public and private, are aiming to cover all islands and atolls. The source of the project is diverse not limiting to external resources but utilizing private investment and taking a business-to-business approach.

Social, economic and environmental impacts from renewable energy have been considered to be important for all respondents. While health, job creation and environment have been pointed out as specific sectors where impacts could be directly expected from renewable energy, it was raised that the reduction of electricity production cost through deploying renewable energy will reduce the amount of government subsidy which will open windows for social development activities. There is a potential that deploying renewable energy itself has a potential to indirectly provide social, economic and environmental impacts. When it comes to common global goals, respondents except the private sector have responded that they consider the Paris Agreement when they develop projects. On the other hand, all respondents answered that they consider the SDGs particularly SDG 5, SDG 7, SDG 11, SDG 13 and SDG 17. When it comes to actual impacts, employment (job creation) was reported from various respondents. Other impacts were given mostly related to environment (energy security, training for employees, technology transfer, awareness on energy efficiency, cheaper and cleaner electricity).

It was agreed unanimously the importance for renewable energy projects to give social, economic and environmental impacts. However, at the same time, respondents stress the criticality of community acceptance of projects and the importance of making communities a partner of projects. Every respondent answered they will consider developing projects which will give social, economic and environmental impacts in the future and sectors such as job creation, training, knowledge, education, better living through reduced cost of living have been specified. When it comes to potential factors which may maximize the impacts, respondents highlighted communication, information sharing and community consultations and selection

of optimal technology. When discussing which renewable energy has the strongest potential of providing impacts in the Maldives, two technologies have been raised: solar PV systems and ocean energy. As solar PV systems have already been widely deployed throughout the country it is natural to consider it to be highly potential. At the same time, it is promising that ocean energy has also been mentioned. Being a SIDS, Maldives faces typical challenges including small physical size and the fact that they are surrounded by large expanses of ocean, limited natural resources, proneness to natural disasters and extreme events, relative isolation, extreme openness of their economies which are highly sensitive to external shocks, poorly developed infrastructure, limited funds, human resources and skills (Nurse et al., 2001). Although, ocean energy is a renewable energy source which has infinite possibilities and high potential not only for power generation, but for social, economic and environmental impacts.

## 6. Conclusions and Recommendations

This study conducted a questionnaire survey to understand the current state of renewable energy and its social, economic and environmental impacts in the context of the Maldives. Solar PV systems were found to be the most deployed renewable energy. It was found that solar PV systems have been deployed in major regions with bigger population in the initial stage and the coverage has improved recently, however geographical gap still remains. The importance of social, economic and environmental impacts from renewable energy have been confirmed by all respondents and the importance of community acceptance and working with communities were raised as potential factors to maximize the impacts. Besides solar PV systems, the potential of ocean energy was pointed out as a renewable energy which has the strongest potential of providing impacts in the Maldives.

The first implication of our findings is the importance to look more into social impacts. The impact of renewable energy on environment and on economy has been seen to some extent, although the impact on social (e.g. health, education, gender, inequality, etc.) is still unclear.

Secondly, coping with geographical gap is needed. Currently, renewable energy is being deployed in various locations throughout the nation, although gap still remains. As renewable energy has the potential to bring broad impacts on social, economic and environment, it would be ideal to cover the most underdeveloped region, especially the south-central region for it to enjoy the benefits.

Thirdly, detailed study in local islands is crucial to understand the true social, economic and environmental impacts of renewable energy. This study has targeted renewable energy related actors at the central level, although further study needs to be conducted at local level involving local stakeholders including atoll councils, island councils, Women's Development Committees, local NGOs, small and medium-sized enterprises, researchers and local islanders. Actors at the central level understand the importance of social, economic and environmental impacts from renewable energy, however the true impacts are unclear and detailed survey targeting local islands will only answer this question. Method of the survey should not be limited to questionnaire surveys, but interviews and/or focus group discussion should be useful tools to incorporate the voices of the locals and to analyze in-depth.

The fourth implication is to look into other renewable energy besides solar PV systems such as ocean energy as it is relevant to the context of the Maldives. Fishery is the major industry together with tourism and social, economic and environmental impacts of ocean energy could be observed in such sector which could be worth exploring.

The final implication is to put stronger effort towards the soft component of renewable energy. Currently most of the effort is put towards deployment of renewable energy equipment and less on capacity building. Focusing more on training engineers to operate, maintain and repair the equipment and promoting research and development of renewable energy sources suitable for the Maldives could bring significant mid-to-long term impacts of renewable energy on social, economic and environment.

---

**References**


Akella, A. K., Saini, R. P., Sharma, M. P. (2009). Social, Economical and Environmental Impacts of Renewable Energy Systems. *Renewable Energy*. (34).

Asian Development Bank. (2021). Preparing Outer Islands for Sustainable Energy Development Project: Updated Project Administration Manual.
https://www.adb.org/projects/documents/mld-46122-003-pam. Accessed November 28, 2021.

Bertheau, P. (2020). Assessing the Impact of Renewable Energy on Local Development and the Sustainable Development Goals: Insights from a Small Philippine Island. *Technological Forecasting & Social Change*. (153).

Casillas, C. E., Kammen, D. M. (2010). The Energy-Poverty-Climate Nexus. *Science*. (330).

Hong, G. W., Abe, N. (2012). Sustainability Assessment of Renewable Energy Projects for Off-grid Rural Electrification: The Pangan-an Island Case in the Philippines. *Renewable and Sustainable Energy Reviews*. (16).

IRENA. (2014). The Socio-economic Benefits of Solar and Wind Energy.

Jain, A. (2020). Project Information Document - Accelerating Renewable Energy Integration and Sustainable Energy-P172788 (English).
http://documents.worldbank.org/curated/en/469831603679455390/Project-Information-Document-Accelerating-Renewable-Energy-Integration-and-Sustainable-Energy-P172788. Accessed November 28, 2021.

Jaramillo-Nieves, L., Del Rio, P. (2010). Contribution of Renewable Energy Sources to the Sustainable Development of Islands: An Overview of the Literature and a Research Agenda. *Sustainability*. (2).

Kumar, M. (2020). Social, Economic, and Environmental Impacts of Renewable Energy Resources. In K. E. Okedu (Ed.), *Wind Solar Hybrid Renewable Energy System*: Intech Open.

Nurse, L. A., Sem, G., Hay, J. E., Suarez, A. G., Wong, P. P., Briguglio, L., & Ragoonaden, S. (2001). Small island states. In J.J McCarthy, O.F. Canziani, N.A. Leary, D.J. Dokken, & K.S. White (Eds.), Climate change 2001: impacts, adaptation, and vulnerability (pp. 843–875). Cambridge: Cambridge University Press

Rachmawatie, D., Rustiadi, E., Fauzi, A., Juanda, B. (2019). Analysis of the Socio-Economic Impact of Renewable Energy Hybrid Electricity Utilization for Rural Community Development (Case Study: Pantai Anyar, Yogyakarta Special Region, Indonesia). IOP Conf. Series: Earth and Environmental Science. (383).

Sheikh, N. J., Kocaoglu, D. F., Lutzenhiser, L. (2016). Social and Political Impacts of Renewable Energy: Literature Review. *Technological Forecasting & Social Change*. (108).

Sovacool, B. K. (2012). Deploying Off-Grid Technology to Eradicate Energy Poverty. *Science*. (338).

The Ministry of Economic Development, Government of Maldives. (2020). Rapid Livelihood Assessment – Impact of the COVID-19 Crisis in the Maldives.

https://www.undp.org/sites/g/files/zskgke326/files/publications/UNDP-MV-Rapid-Livelihood-Assessmentt-Impact-of-COVID-19-Crisis-in-the-Maldives-2020-Part-I.pdf. Accessed November 28, 2021.

The World Bank. (2015). Maldives - Clean Energy for Climate Mitigation Project (English). http://documents.worldbank.org/curated/en/189121468189856068/Maldives-Clean-Energy-for-Climate-Mitigation-Project. Accessed November 28, 2021.

The World Bank. (2020). Maldives - Accelerating Renewable Energy Integration and Sustainable Energy: Project Information Document (PID). https://documents1.worldbank.org/curated/en/469831603679455390/pdf/Project-Information-Document-Accelerating-Renewable-Energy-Integration-and-Sustainable-Energy-P172788.pdf. Accessed December 3, 2021.

The World Bank. (2020). Maldives - Accelerating Sustainable Private Investments in Renewable Energy (ASPIRE) Project: Supplement to the Project Appraisal Document (English). http://documents.worldbank.org/curated/en/939571581994906489/Maldives-Accelerating-Sustainable-Private-Investments-in-Renewable-Energy-ASPIRE-Project-Supplement-to-the-Project-Appraisal-Document. Accessed November 28, 2021.

UNDP. (2020). Mapping of the Strategic Action Plan (2019-2023) of the Maldives with the Sustainable Development Goals. Key Findings Report. United Nations Development Programme in the Maldives.

Van Der Waal, E. C. (2020). Local Impact of Community Renewable Energy: A Case Study of an Orcadian Community-led Wind Scheme. *Energy Policy*. (138).

Weir, T., Kumar, M. (2020). Renewable Energy Can Enhance Resilience of Small Islands. *Natural Hazards*. (104).

Wirawan, H., Gultom, Y. M. L. (2021). The Effects of Renewable Energy-based Village Grid Electrification on Poverty Reduction in Remote Areas: The Case of Indonesia. *Energy for Sustainable Development*. (62).

# "Urban Nature, Urban Culture: Rethinking Water in Japan's Cities"

~ Notes from the Field ~

Ewa Machotka[a], Mikiko Sugiura[b], Takehiro Watanabe[c]

**Abstract**

Urban water has emerged as a major environmental concern in recent years. This article highlights several key issues that address the social and cultural dimensions of urban water. Based on "Urban Nature, Urban Culture: Rethinking Water in Japan's Cities," an international symposium held at Sophia University on Oct 24, 2021, this article is presented as notes on this event by its conveners, who are also the authors of this article. Exploring the ideas and practices that have emerged as a response to the urban water crisis in this age of great environmental challenges, the symposium engaged with newly emerging biophilic sensibilities sprouting through the cracks in the modernist legacies of Japanese cities. Watering these new seeds of innovation — some germinating from the local soil and others drifting in from afar — are academics, community leaders, engineers, artists, designers, and naturalists who are working to improve their urban habitats. These newly emerging sensibilities mark a fundamental shift in the approaches to urban water, one that is rooted in cross-disciplinary, cross-sectoral, and cross-cultural exchange.

**Keywords**: water, cities, sustainability, aesthetics, infrastructure, landscape architecture, art history, water resources management, anthropology, environmental history, Japan, watershed, interdisciplinarity, cross-cultural, biophilic sensibility, paradigm shift

a. Department of Asian and Middle Eastern Studies, Stockholm University, Sweden

b. Center for Global Education and Discovery, Sophia University, Japan

c. Faculty of Liberal Arts, Sophia University, Japan

# ソフィアシンポジウム2021
# 『都市の自然と文化〜水の変遷をたどって』

エヴァ　マホトカ[a]・杉浦　未希子[b]・渡辺　剛弘[c]

**要旨**

「都市の水」は、近年、大きな環境問題として目に見える形で現出している。この論文は「都市の水」の重要な諸問題のうち、社会的・文化的側面に焦点を当て、筆者たちが呼び掛け人として開催した国際シンポジウム「Urban Nature, Urban Culture: Rethinking Water in Japan's Cities」（2021年10月24日・上智大学）の成果をまとめるとともに、新たな思考の試みとその発展プロセスをメモとして発表するものである。そこでは、都市の水の危機に対応するために生まれた考えや実践を探り、バイオフィリックな新しい感性が、日本の都市が抱えるモダニズムの遺産の隙間を突いて芽生えている点に向き合った。新しい基軸による新しい価値の創造は、イノベーションという種（たね）であり、それに水をやる行為は必須である。種には地元の土壌から芽を出したものもあれば、遠くから漂ってきたものもあるが、発芽を育む人々はいずれも都市の生息環境を改善しようと努める者たちで、具体的には住民の他、学者、コミュニティリーダー、エンジニア、芸術家、デザイナー、ナチュラリストなどである。このような最近の動きは、都市の水に対するアプローチの根本的な変化を体現するものであり、学際的、分野横断的、異文化交流に根ざしている。

**キーワード**：水、都市、持続可能性、美学、インフラ、ランドスケープ･アーキテクチャー、美術史、水資源管理、人類学、環境史、日本、流域、学際性、異文化、バイオフィリック・センシビリティ、パラダイムシフト

a. ストックホルム大学　アジア・中東学科
b. 上智大学　グローバル教育センター
c. 上智大学　国際教養学部

## "Urban Nature, Urban Culture: Rethinking Water in Japan's Cities"

~ Notes from the Field ~

### Introduction

Urban water has emerged as a major environmental concern in recent years. This article highlights several key issues that address the social and cultural dimensions of urban water. Based on "Urban Nature, Urban Culture: Rethinking Water in Japan's Cities," an international symposium held at Sophia University on Oct 24, 2021, this article is presented as notes on this event by its conveners, who are also the authors of this article. Exploring the ideas and practices that have emerged as a response to the urban water crisis in this age of great environmental challenges, the symposium engaged with the framework of sustainable development "that meets the needs of the present without compromising the ability of future generations to meet their own needs".[1] Social-ecological systems are increasingly viewed as interlinked and inseparable,[2] and the Sustainable Development Goals (UN 2015) represent a holistic approach to sustainability.[3] Across many disciplines and domains of practice in Japan and elsewhere, we see a fundamental shift in approaches to urban water.

### Urban Water Culture in Japan

Water is the source of all life, but it is also at the base of many socio-ecological problems in cities worldwide, including those in Japan. Cities such as Tokyo, Osaka, and Nagoya, which are some of the largest cities in the world, are faced with many water-related challenges, such as flooding,[4] non-point pollution, groundwater depletion and loss of springs, land subsidence, heat-island effect, and biodiversity loss. Water is also at the heart of human urban life and essential for sanitation and public health. Moreover, accessibility of blue-green spaces is vital for human wellbeing and positive social interactions, as the ongoing pandemics have made apparent,[5] and yet socio-ecological and cultural barriers have highlighted the complexity and conflicted nature of water-related issues in the urban space. The climate crisis is exacerbating this situation,

---

1 UN. Secretary-General, World Commissions on Environment and Development, *Report of the World Commission on Environment: Our Common Future*, United Nations Digital Library. A/42/427, New York: 1987, https://digitallibrary.un.org/record/139811/files/A_42_427-EN.pdf (accessed January 20, 2022).

2 Fikret Berkes and Carl Folke, eds., *Linking Social and Ecological Systems: Management Practices and Social Mechanisms for Building Resilience* (New York: Cambridge University. Press, 1998); Elinor Ostrom "A General Framework for Analyzing Sustainability of Social-Ecological Systems," *Science,* 325, no.5939 (July 2009): 419–422.

3 Albert Norström et al., "Three Necessary Conditions for Establishing Effective Sustainable Development Goals in the Anthropocene," *Ecology and Society,* 19, no.3 (2014). DOI: 10.5751/ES-06602-190308.

4 Cabinet Secretariat of Japan, *Mizujunkan hakusho* (2018), 2–40. Also see Ministry of Land, Infrastructure, Transport and Tourism (hereafter abbreviated as MLIT), *Kasen jigyō gaiyō 2018*, Tokyo: 2018, https://www.mlit.go.jp/river/pamphlet_jirei/kasen/gaiyou/panf/pdf/c1.pdf, (accessed December 4, 2021).

5 Mathew P. White et al., "Spending at Least 120 Minutes a Week in Nature is Associated with Good Health and Wellbeing," *Scientific Report*, 9, no.7730 (June 2019). DOI: 10.1038/s41598-019-44097-3.

as changes in the precipitation pattern are causing the intensification of flood events, some of which have led to property damage, such as, most recently, flooding disasters caused by Typhoon Hagibis in October 2019 and Typhoon Jebi in August 2018. Japan's continuing economic downturn and accelerating depopulation, however, are also presenting difficulties in building and maintaining large-scale infrastructures for protecting cities from floods. These challenges have also stressed the massive network of water-related infrastructure that protects cities in Japan. River engineering, irrigation technologies, extraction of resources such as hydropower and fish, and land reclamation via the drainage of wetlands and estuaries all have a long history that goes back many centuries.[6]

Yet for cities in Japan, it is the legacy of modern urbanism, which prioritized roads and railway tracks over waterways in planning, imported knowledge of engineers and planners over that of local carpenters and water masters, the constancy of dry land over the fluidity of terraqueous spaces, that have contributed to major changes to urban metabolism and slowed an effective response to the current challenges that these cities face.[7] This modernist legacy is based on the instrumentalization of nature as a resource for humanity, as well as the separation of humanity from nature in civilizational discourse.[8] To borrow from Langdon Winner's now classic essay "Do Artifacts Have Politics?," the material manifestations of this legacy, such as the city, its infrastructure, and the physical connection to the hinterland, "embody specific forms of power and authority" within specific arrangements of economic production, social reproduction, and dominant ideologies.[9] Again, the city is at the core of this modernist vision, as humanity's most iconic symbol of triumph over nature. With nature tamed and domesticated, the city is not only a center of commerce, power, science, and the arts, but also designed to be a habitat well-suited to the activities of modern humans.

In cities such as Tokyo, this legacy is expressed in the vast reclaimed lands drained of water, rivers channelized and straightened, and the concrete and asphalt that now cover much of the urban areas. These infrastructural and urban planning projects advanced the goals of the Meiji government, Japanese government in the late 19th and early 20th century, to "Enrich the Country and Strengthen the Military"

---

6 Roderick I. Wilson, *Turbulent Stream: An Environmental History of Japan's Rivers, 1600–1930s* (Leiden, The Netherlands: Brill, 2021). See also Yutaka Takahashi, *Kasen kōgaku* (Tokyo: The University of Tokyo Press, 2008).

7 Christopher Kennedy, John Cuddihy, and Joshua Engel-Yan, "The Changing Metabolism of Cities," *Journal of Industrial Ecology*, 11, no.2 (2007): 43-59. DOI: 10.1162/jie.2007.1107; Matthew Gandy, "Rethinking Urban Metabolism: Water, Space and the Modern City," *City*, 8, no.3, (2007): 363–379. DOI: 10.1080/1360481042000313509. For a similar historical instance of a mismatch between imported science and local environmental processes in Japan, see Gregory Clancy, *Earthquake Nation: The Cultural Politics of Japanese Seismicity, 1868–1930,* (Berkeley: University of California Press, 2006).

8 Martin Heiddeger, *Question Concerning Technology and Other Essays* (New York: Harper Perennial, 2013); Bruno Latour, *We Have Never Been Modern* (Cambridge: Harvard University Press, 1993).

9 Landon Winner, "Do Artifacts Have Politics," in *The Whale and the Reactor: A Search for Limits in an Age of High Technology* (Chicago: The University of Chicago Press, 1986), 19. See also David Harvey, "The Urbanization of Consciousness," in *Consciousness and the Urban Experience* (Baltimore: Johns Hopkins University Press, 1985): 250–276.

(*fukoku kyōkei*), facilitated the rebuilding of urban areas after disasters such as the Great Kantō Earthquake of 1923, and its kyōhei kickstarted Japan's postwar reconstruction that urgently provided security, food, and jobs for a defeated nation, while also laying the foundations for Japan's meteoric rise as one of the largest economies in the world by the 1980s. Cities in Japan are more protected than ever from droughts, floods, and earthquakes, and are models of compactness, efficiency, and what Danish urban planner Jan Gehl calls "the human scale."[10] However, these benefits come with many costs. The current water infrastructure and urban land-use have resulted in the disruption of the natural water cycle, thus hindering aquifer recharge, as well as the severing of river connectivity, thus preventing sediment supply to coastal areas and blocking the movement of species such as fish and plants. These hydrological modifications have, conversely, contributed to the intensification of flood events and further advanced the loss of biodiversity.[11] Moreover, cities have suffered from diminished social-ecological resilience, and its residents have lost access to blue-green spaces, and most importantly, have little opportunity to directly and routinely experience the ecological system that provides important services, such as clean water and air, sanitation, and the mitigation of extreme weather as well as human social and psychological wellbeing.

Yet there are signs of renewal in Japan, as "biophilic" sensibilities[12] are sprouting through the cracks in this modernist legacy. Watering these new seeds of innovation — some germinating from the local soil and others drifting in from afar — are academics, community leaders, engineers, artists, designers, and naturalists who are working to improve their urban habitats. These newly emerging sensibilities mark a fundamental shift in the approaches to urban water, one that is rooted in cross-disciplinary, cross-sectoral, and cross-cultural exchange. To describe this general shift, we will describe the changes in laws, practices, sensibilities, and discussions among four areas that are key in this shift, organized according to the expertise of stakeholders concerning urban water: 1) water infrastructure, 2) city planning, 3) urban ecology, and 4) art discourse and practice.

The first area of exchange is between water resource managers, hydrologists, and river engineers. Since the end of Japan's high growth era in the late 1970s, water specialists have responded to the changing patterns of water use in Japanese society.[13] Due to changes in socio-economic conditions, the overall water demand decreased slightly since 1995.[14] Moreover, due to innovative progress in the recovery and reuse of water used, the amount

---

10 Jan Gehl, *Cities for People* (Washington DC: Island Press, 2010).

11 Keigo Nakamura, Klement Tockner, and Kunihiko Amano, "River and Wetland Restoration: Lessons from Japan," *BioScience*, 56, no.5 (May 2006): 419–429. DOI: 10.1641/0006-3568(2006)056[0419:RAWRLF]2.0.CO;2.

12 Edward O. Wilson, *Biophilia* (Cambridge, MA: Harvard University Press, 1984).

13 Yutaka Takahashi, "Dainijitaisengo-no-nippon-niokeru-mizushigen-to-kasenkankyo-no-hensen," Journal of Geography (Chigaku Zasshi), 91, no.6 (1982): 446–451.

14 For instance, with changes in lifestyles such as the spread of flush toilets and the expansion of economic activities, the amount of water used for domestic use (both for domestic use and for urban activities) tripled between 1965 and 2000. Similarly, industrial water use tripled (for a business with 30 employees). The information above is from MLIT, "Mizushigen no riyō jōkyō ," Tokyo, https://www.mlit.go.jp/mizukokudo/mizsei/mizukokudo_mizsei_tk2_000014.html accessed December 17, 2021.

of water withdrawn from rivers has decreased since 1973.[15] Also, in response to public opposition to dams for multipurpose water resources development projects, the plans shifted from building new dams, irrigation channels, and levees to the maintenance and retrofitting ("rehabilitation") of the ageing infrastructure. At the same time, with the growing public interest in environmental remediation and recreational uses of lakes and rivers, policymakers reviewed the existing laws concerning water, thus resulting in legal changes such as the 1997 amendment to the River Laws (*Kasenhō*) and the 2014 Basic Water Cycle Act (*Mizujunkan kihon hō*). Nature-oriented stream restoration, which had been implemented in the United States and Europe during the same period,[16] had already achieved a status in 1990 through the label *tashizengata kawa zukuri* (nature-oriented river engineering), officially introduced in 1990 in a government notice.[17] "Satoyama Initiative" (2010), which takes the Japanese rural landscape of rice paddies and coppice forests as its model, promotes sustainable and land-use with benefits to the local ecology, attempts to restore the human-nature relationship.[18] One key feature of these recent policies is a shared acknowledgement of the watershed as a unit for governance. In this context, "River Basin Disaster Resilience and Sustainability by All," the English name for the newly announced national policy of *ryūiki chisui* (literally "watershed flood management") that started in 2021,[19] aims to reduce water-related disasters by emphasizing the importance of nature-based solutions (often referred to as "green infrastructure" in Japan). These policy reforms were also in response to calls for further decentralization of water resource management, as new co-management structures with businesses, industry groups, local governments, and community organizations were pursued. While many of these developments have transformed rural areas, cities have also been witness to these effects. These series of moves are positioned as a shift in the view of nature that rethinks the risk of flooding.[20]

---

15 MLIT, "*Mizushigen no riyō jōkyō*," Tokyo: XX, https://www.mlit.go.jp/common/001371909.pdf (accessed December 3, 2021).

16 Ellen Wohl, Stuart N. Lane, Andrew C. Wilcox, "The Science and Practice of River Restoration," *Water Resources Research*, 51, no.8 (2015): 5974–5997 DOI: 10.1002/2014WR016874. For the United States, see Rebecca Lave, *Fields and Streams: Stream Restoration, Neoliberalism, and the Future of Environmental Science* (Athens: University of Georgia Press, 2012).

17 MLIT, "Tashizengata kawa zukuri no suishin in tsuite" (Kensetsukyoku kachi hatsu dai 56 gō, Kensetsukyoku kato hatsu dai 27 gō, Kensetsukyoku kabō hatsu dai 144 gō), Tokyo: November 6, 1990.

18 Takeshi Ito and Mikiko Sugiura, "Satoyama Landscapes as Ecological Mosaics of Biodiversity: Local Knowledge, Environmental Education, and the Future of Japan's Rural Areas," *Environment: Science and Policy for Sustainable Development* 63, no.5 (2021): 14–25. DOI: 10.1080/00139157.2021.1953911. These efforts are having a ripple effect both domestically and internationally, and further cooperation is expanding, which is exemplified by the fact that rice paddies are now included as an example of "wise use" of wetlands in the Ramsar Convention. These can be described as an attempt to understand the multifunctionality of water from a cross-sectoral perspective. The introduction of Payment for Environmental Services (PES) in the Satoyama Initiative is a case in point.

19 MLIT, "River Basin Disaster Resilience and Sustainability by All," (Tokyo: November 2020), https://www.mlit.go.jp/river/kokusai/pdf/pdf21 (accessed December 6, 2021). The Japanese version "*Ryūuiki chisui heno tenkan*" is also available https://www.mlit.go.jp/river/kokusai/pdf/pdf22.pdf (accessed December 6, 2021).

20 Takashi Okuma, *Kōzui to suigai wo toraenaosu: Shizenkan no tenkan to kawa tono kyōsei*. (Tokyo: Nōsanson gyoson bunka kyōkai, 2020).

A second area of exchange has been that of urban planners, architects, and local communities. Japan's low birth-rate has been a major factor in Japan's shrinking population, especially in rural areas. In addition to this demographic change was the reorganization of the Japanese economy, as it shifted from an export-led, heavy-industry and construction-focused economy to one that increasingly looked inward and moved to the service and information sectors. At the government level, the germs of this transformation already appeared in Prime Minister Takana Kakuei's 1972 "A Plan for Rebuilding the Japanese Archipelago" (*Nihon rettō kaizō ron*), which laid the basis for this coming economic shift. Yet the government's slow response to pollution problems (e.g. Minamata mercury poisoning[21]) caused unrest among the public and contributed to anti-pollution grassroots movements in urban communities.[22] These campaigns also coincided with the *machizukuri* movement, a model of grassroots urban planning based on community engagement, which had its roots in the 1960s but flourished in the 1990s.[23] While these community-based movements emerged in part due to relatively weak drive for urban planning found at the city-administration level,[24] they also became an important force in renovating urban areas to accommodate changing labor markets, demographics, and lifestyles of citydwellers. Aside from civil society groups, the local private sector, too, were also regarded as important resources for this vast redesigning of urban areas, as seen in the popularity, among urban planners, of "area management" (*eria manejimento*) — a scheme promoted by the Japanese government to promote civic revitalization through the participation of community groups, businesses, and landowners.[25] One such example is the Nihonbashi Renaissance Association, which incorporates the concept of *machizukuri* with area management elements to revive a central area in Tokyo in which the Kanda River merges with Sumida River. Concomitant with these changes in urban planning is the introduction of nature-oriented urban design and the incorporation of design principles from the field of landscape architecture.

A third area of exchange had been that of ecologists, naturalists, and environmentalists. Until recently, Japanese environmental discourse has focused on the issue of toxic pollution harmful to human physiology, such as the Minamata case or air pollution in Yokkaichi.[26] In response to these industrial pollution disasters, the Japanese government established the Environmental Agency in 1971, the precursor to the Ministry of

---

21 Minamata disease is one of the four major pollution diseases during Japan's high growth era. See Michiko Ishimure, *Kugai jōdo: Waga minamatabyō* (Tokyo: Kodansha, 1969), translated by Livia Monnet as *Paradise in the Sea of Sorrow: Our Minamata Disease* (Ann Arbor: University of Michigan Press, 2003).

22 Such as the "Suginami Disease." Hideyuki Kawana and Shigetaka Itō, *Suginami byō kōgai* (Tokyo: Ryokufū Shuppan, 2002).

23 For example, Jennifer Robertson, *Native and Newcomer: Making and Remaking a Japanese City* (Berkeley: University of California Press, 1991).

24 Shigeru Satoh, *Japanese Machizukuri and Community Engagement: History, Method and Practice* (London: Routledge, 2020).

25 MLIT, *Eria manejimento suishin manyuaru*, Tokyo: MLIT, 2008, https://www.mlit.go.jp/totikensangyo/totikensangyo_tk2_000068.html (accessed Dec 2, 2021).

26 Jun Ui ed., *Industrial Pollution in Japan* (Tokyo: United Nations University Press, 1992). See also Brett Walker, *Toxic Archipelago: A History of Industrial Disease in Japan* (Seattle: University of Washington Press, 2011).

the Environment, and local municipalities enacted anti-pollution measures, such as Tokyo Metropolitan Government's series of measures to reduce air pollution in the late 1960s and 1970s.[27] In recent years, however, biological conservation has been added as a major environmental concern. In field biology, which has for a long time prioritized research on species in their natural habitat, ecosystems with major human intervention (anthropogenic disturbances) were often neglected as a focus of study.[28] However, scientists began to look more closely at the effects of intense human activity — an issue that came into better focus due to the rising status of the field of ecology since the 1950s and, in particular, with the publication of *Silent Spring*, a book written by marine biologist Rachel Carson.[29] These changes in the natural sciences coincided with the rapid transformation of the Japanese landscape in the postwar period, which impeded the natural ecological processes required for the health and propagation of wildlife: species such as the Japanese river otter (*Lutra lutra nippon*), with the last sighting in the 1970s, have become extinct. Public interest in nature conservation and wildlife protection also gained traction at this time, coinciding with anti-pollution activism, city beautification programs, and anti-dam movements. The 2010 Convention on Biological Diversity, held in Nagoya and the resulting Aichi Targets stimulated a variety of movements for biodiversity conservation. However, it has only been in the last decade or so that urban ecologies have also become targets of conservation activities. Local cities in Japan have begun to draft their own "Biodiversity Plans,"[30] which are legally promoted by the Basic Biological Diversity Act of 2008 (*Seibutsu tayōsei kihon hō*).[31] Another important change is the shift in the conservation discourse from the protection of specific species to the conservation of biodiversity and the dynamism of natural ecological processes.

A fourth area of exchange where the environmental issues have been considered is contemporary art discourse and practice. Japan's culture, visual and literary arts, architecture and design have been recognized and celebrated for their extensive and diverse engagements with the natural environment. However, the notion of nature as *shizen* itself emerged in Japan only around the 1880s, thus marking the birth of modernity.[32] Therefore, it is not surprising that modernist and anthropocentric understanding of

---

27 Kenneth E. Wilkening, *Acid Rain Science and Politics in Japan: A History of Knowledge and Action Toward Sustainability* (Cambridge, MA: MIT Press, 2004).

28 Nancy E. McIntyre, Kimberley Knowles-Yánez, and Diane Hope, "Urban Ecology as an Interdisciplinary Field: Differences in the Use of 'Urban' Between the Social and Natural Sciences" in *Urban Ecology: An International Perspective on the Interaction Between Humans and Nature,* eds. John Marzluff et al. (New York: Springer, 2008), 49–66.

29 Rachel Carson, *The Silent Spring* (Boston: Houghton Mifflin, 1962).

30 For example, Tokyo Metropolitan Government, "Midori shisaku no shin tenkai: seibutsu tayōsei no hozen ni muketa kihon senryaku," Tokyo, May 2012, (https://www.kankyo.metro.tokyo.lg.jp/basic/plan/nature/green_biodiversity.files/whole_passage1.pdf (accessed December 6, 2021).

31 Ministry of the Environment, "Seibitsu tayōsei kihon hō," Tokyo: 2012, (https://www.env.go.jp/nature/saisei/network/law/law5_1_2.html (accessed December 5, 2021).

32 Masato Maruyama, *Studies in the Intellectual History of Tokugawa Japan*, trans. Mikiso Hane (Tokyo: The University of Tokyo Press, 1974); Kojin Karatani, *Origins of Modern Japanese Literature* (Durham, N.C: Duke University Press, 1993).

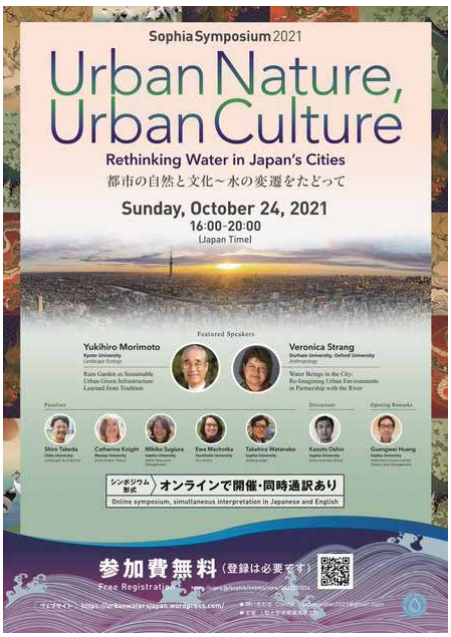
relationships between humans and the environment have shaped contemporary architecture, urban planning as well as literature and arts. Still, the myths of Japan as a primordial paradise unspoiled by modern Western civilization (Reischauer and Jansen 1995) for decades pervaded interpretations of Japan's literature and arts. Only since the 1990 have scholars begun to deconstruct the myth of Japan's "inherent affinity with nature" (Kalland and Asquith 1996; Thomas 2002; Shirane 2012; Cwiertka and Machotka 2018)[33] and reveal complexities of artistic engagements with nature especially in relation to the artifacts created before the birth of the concept of "nature." At the same time also artists have started to critically engage with environmental issues and more specifically with urban waters. For example, in his installation "Reverberation" (2009-10) or three simultaneously screened videos showing three distinctive areas of contemporary Tokyo, Shinoda Tarō (b. 1964) focuses on the invisibility of Tokyo's waterways. One of the films is shot from a boat cruising the underground waterways in central Tokyo. Following Japan's economic success and the capital's growth, these canals were covered over to create space for the city's transportation arteries. The other movie shows deserted lakes near Tokyo that provide drinking water for the capital. The last film explores the artist's neighborhood in the capital's Western suburbs and juxtaposes a parking lot and a garbage disposal plant with images of a tapir in a zoo. Shinoda's tapir brings into focus the artificiality of contemporary concepts of nature, which is likened to a wild animal kept in a cage. Shinoda's work offers a commentary on the artificiality of the concept of nature and the near-total invisibility and virtual irrelevance of "nature" in today's human urban experience. Clearly, new artistic developments, often based on participatory practices and interaction with communities, increasingly challenge the modernist understanding of blue-green spaces and their role in the living tissue of Japanese cities. However, although closely connected, they are rarely discussed in the context of the discourse on water infrastructure, city planning or urban ecology, the flaw that undermines their significance and potential.

Thus, among the stakeholders involved in these four areas of exchange — 1) water infrastructure, 2) city planning, 3) urban ecology, 4) artistic practices — there is an emerging shift in the paradigms, regimes, and discourses surrounding urban waters. While each of these four areas originate from different historical trajectories and the way they frame these issues vary, there are striking similarities: a shift from an anthropocentric to a more ecocentric approach; the inclusion of non-state local actors, such as community groups, artists, and local businesses, in the program design process and implementation; a move away from development priorities and more toward management and participatory engagements; replacing allegedly universal environmentally-engaged artistic paradigms and green urban design principles with site-specific solutions; critical assessment of the socio-ecological effects of beautification projects; working across

33 Arne Kalland and Pamela Asquith, "Japanese Perceptions of Nature: Ideals and Illusions," in *Japanese Images of Nature: Cultural Perspectives*, ed. Arne Kalland and Pamela Asquith (London: Routledge, 1997), 1–35; Julia Adeney Thomas, *Reconfiguring Modernity: Concepts of Nature in Japanese Political Ideology*, (Berkeley: University of California Press, 2002); Haruno Shirane, *Japan and the Culture of the Four Seasons: Nature, Literature, and the Arts* (New York: Columbia University Press, 2013); Ewa Machotka and Katarzyna Cwiertka, eds., *Consuming Life in Post-Bubble Japan: Transdisciplinary Perspective* (Amsterdam: University of Amsterdam Press, 2018).

bureaucratic and disciplinary boundaries for a more holistic solution to problems; acceptance of diverse voices and willingness to review long-term plans; the acceptance of the limits of technical solutions and the inclusion of social, cultural, and artistic approaches; and the awareness of the need to adjust to changing externalities such as demographic shifts, decline in government funding, and climate change. It is these shifts in the four areas of exchange concerning urban water culture[34] that inspired the design of our symposium.

### Urban Nature, Urban Culture: Rethinking Water in Japan's Cities




On October 24, 2021, the Institute for Studies of the Global Environment hosted a Sophia Symposium, titled "Urban Nature, Urban Culture: Rethinking Water in Japan's Cities." The symposium, which brought together scholars and practitioners engaged in urban water issues, was held remotely with simultaneous interpretation in Japanese and English. This symposium was part of an on-going research project that began with MIRAI (2017–2019), a joint project by the governments of Japan and Sweden to promote research collaborations between the two countries. Held at Sophia University, the event was co-convened by Ewa Machotka (Stockholm University), Mikiko Sugiura (Sophia University), and Takehiro Watanabe (Sophia University). The symposium proceeded with a series of presentations that included talks by two featured speakers and four panelists, followed by a discussion session.

The symposium began with an opening remark from Guangwei Huang, the Vice Director of the Institute for the Studies of the Global Environment at Sophia University (Japan). He launched the symposium by highlighting the importance of urban water sustainability as we face environmental challenges due to urbanization and the climate emergency. This remark was followed by a greeting by Takehiro Watanabe, who set the tone for the event by citing how cities in recent years have begun to re-evaluate the culture, institutions, and practices surrounding water in urban ecologies.

34 We have retained the singular from of the term "cuture" to avoid the problem of essentializing the various approaches, practices, and concepts associate with particular communities, including academic disciplines. In deciding to keep the term "culture," we acknowledge that such essentializing can lead to one-dimensional accounts that ignore disagreements and conflicts in, flatten the history of, and freeze the dynamism at work in social groups. In keeping with the singular form, we recognize that there are differences both within and between such communities, and that social ecological interactions can both efface and highlight such pluralities.

*Rain Garden as Sustainable Urban Green Infrastructure Learned from Tradition*

Yukihiro Morimoto, a landscape architect and landscape ecologist as well as the Chairperson of the Kyoto Greenery Association and Professor Emeritus of Kyoto University (Japan), presented on the cultural and ecological history of Kyoto's urban development as offering hints for today's urban water challenges.

He explained that adaptive management and human-induced disturbances are important, especially when managing landscape ecologies in urban settings, because such actions substitute the ecological role played by flooding, storms, and earthquake events. In particular, areas of urban nature in Kyoto, such as the EXPO '70 Commemorative Park, Inochi-no-mori Park, and Heian Shrine grounds, have helped maintain a high level of biodiversity through the existence of fractal patterns that form miniature versions of larger patch dynamics, including ecotones and gap dynamics. He advised that these examples in Kyoto may serve as models for implementing "green infrastructure" — a term to denote the use of nature-based construction and planning methods for reducing the risks associated with urbanization and the climate crisis. Such urban pockets of biodiversity can improve resilience over time and space. Kyoto in particular is a good model for long-term sustainability due to its Feng shui-informed spatial layout and a millennium-long history of what Morimoto calls "a multi-layered structure of repeated disturbances and regeneration." For example, Ogura Pond, which was drained in the modern era, not only served as habitat for a diverse range of fauna and flora but also cultural services such as recreation. Such green infrastructure implementations, which he called "wind and willow style" (yanagi-ni-kaze gata), will most likely be combined with "grey infrastructure," such as steel-and-concrete systems of levees and drains, which he called "fortress style."

Rain gardens are today's answer to the disappearance of areas such as the Ogura Pond, as they mitigate disasters and enhance the habitat for hydrophilic plant communities by allowing for increased absorption of stormwater into the ground. But Morimoto also sees traditional garden cultures, as seen in the ancient temple grounds of Kyoto, as also an "aesthetic" method of stormwater mitigation. Examples are: the dry landscape garden that are typical of many Zen-style gardens, such as the one in Shōkokuji Temple, or the ponds and dry river designs found at Shinnyōji Temple, or the combination of flood-control bamboo groves and raised floors found at the Katsura Imperial Villa and Garden, considered to be a masterpiece of traditional Japanese gardens. Morimoto gave recent examples of green infrastructure implementations, such as the Uzumasa Campus Rain Gardens of Kyoto Gakuen University, the Green-Water Walkway at Kyoto Station, and right-of-way bioswales (rain gardens) at the Shijō Horikawa Intersection, as well as efforts to promote widespread adoption of these measures, such as government certification programs and environmental management systems for the private sector.

*Water Beings in the City: Re-imagining Urban Environments in Partnership with the River*

Veronica Strang, a cultural anthropologist at Durham University and Oxford University (UK), began her talk with the recent critiques of anthropocentric views concerning water, such as efforts to reposition water beyond a utilitarian object to be used as a resource by humans but as an active agent in the co-creation of our world. Characterizing this reframing of human-water relations as a paradigm shift, she highlighted

the "infrastructural violence"[35] that human society has perpetrated on aquatic environments through large-scale projects that are rooted in the dichotomy of nature and culture.

To note the possibilities of moving beyond a utilitarian understanding of water, she gave the example of the Rainbow Serpent, a supernatural entity associated with aboriginal communities in Australia, was brought up as an example of an eco-social entanglement that "continues to generate human and non-human life in a continuous creative hydro-theological cycle [...]." She also mentioned how the Whanganui River in New Zealand, and other rivers around the world, have recently been conferred a legal personhood. She encouraged us to think about how these examples can contribute to discussions of water management in other contexts, such as those in Japan and the Room for Rivers project in the Netherlands.

To further illustrate this hydro-cultural change, she discussed the recent efforts in the Brisbane River watershed to move towards more watershed-wide management while also including the voices of the aboriginal and farmer communities. The Brisbane River Valley experienced a massive land-use change after the arrival of Europeans in the nineteenth century. These modifications, which has resulted in problems of soil erosion, water shortage, and flooding, are now being addressed through new initiatives. Since the 1990s, as the Australian public began to accept the environmentalist agenda, there has been interest in linking local heritage to watershed management. One major cause of this shift in public discourse is the toll that agricultural run-offs and point-source pollution are having on the Great Barrier Reef and the general ecology of the estuary and near-shore areas in the mouth of the Brisbane River. Local citizen groups have sprung up to improve the watershed ecosystem, farmers are starting to understand themselves as stewards of the environment, and indigenous communities are being included as co-managers of the land and water in the valley.

Strang's talk ended with Japanese examples of human-water relationships. She discussed the Japanese history of river channelization and dam construction and applauded the government's recent turn to a more nature-oriented program for river engineering. However, she also suggested that such change in practice would require a more foundational change in ways of relating to water. She discussed a 12th-century painting of cloud dragons at the Kenninji Temple in Kyoto, as an example of water veneration that offers hints as to how to form "more reciprocal and equitable partnerships with the non-human domain." Such examples from our indigenous communities and religious traditions of our past also point us to a way to better incorporate non-human entities into the decision-making process.

### *Monet's Pond in Tokyo: Aestheticizing Waterscapes and the Aura of Cosmopolitan Ecologies*

Ewa Machotka, an art historian at Stockholm University (Sweden) and Takehiro Watanabe, an anthropologist at Sophia University, presented on the role that aesthetics plays in urban water environments. Aesthetic categories such as the beautiful and the picturesque have exerted considerable influence on the development of environmental attitudes and the creation of green spaces such as nature reserves and city

35 Dennis Rodgers and Bruce O'Neill, "Infrastructural violence: Introduction to the special issue," *Ethnography* 13, no.4 (December 2012): 401–412.

parks. But what exactly is that role in urban water conservation practices today? This issue was explored through a case involving two ponds, connected through time and space by a Twitter feed.

This presentation introduced a case in which a social media influencer commented that a pond in Tokyo, which had been the focus of an on-going, community-based conservation project, bears a resemblance to the water lily paintings of the French artist Claude Monet (1840–1926). For this community, "Monet's pond" may be a shorthand for a waterscape that is both exquisite in its beauty and healthy in its ecological balance, thus framing this urban waterscape as both an aesthetic experience and an ecological success story. Yet behind this casual commentary is a long and tangled global history of transcultural exchange between Japan and Europe that involved arts and material culture as well as politics, trade, ecological systems and conservation practices. This presentation also examined the key nodes in the history of this cosmopolitan exchange between Monet's pond and the pond in Tokyo. The presenters located the initial moment of exchange in Japonism or Western fascination with Japanese material culture, the global popularity of Japanese gardens, Japan's modernization processes and the interplay between native aesthetic paradigms and Western design principles in Japanese parks, and contextualize these phenomena in the global horticultural trade and circulation of the cosmopolitan water imaginaries. By attending to the history of this particular interplay between ideas, materialities, and life, they elucidated the dynamic tension between aesthetics and ethics in today's urban ecological conservation initiatives.

### *Nature and Wellbeing in Aotearoa New Zealand*

Catherine Knight, an environmental historian and policy practitioner who holds roles at Victoria University of Wellington and Massey University in New Zealand, based her presentation on her recent book "Nature and Wellbeing in Aotearoa New Zealand,"[36] to explore how interaction with nature is intrinsic to the wellbeing of humans.

Ideas such as Rachel and Stephen Kaplan's attention restoration theory (ART)[37] and practices such as forest therapy (*shinrin'yoku*, or "forest bathing") as practiced in Japan both share the idea that human health and wellbeing is based on a closer physical engagement with the natural world. The presentation also highlighted the author's personal experience in Japan and her own family's project to explore the stream that runs through the gully beside their residence. The reconstruction of shrubland in New Zealand was brought up as an example of the restorative power of nature for human wellbeing. Nature in cities, in particular, plays a major role in keeping human health and wellbeing since a majority of people live in cities. But to take full advantage of nature in cities, people must have the opportunity to incorporate nature into their everyday lives. Rivers can be effective as a corridor that connects mountains to the coasts, and other ecosystems on their paths. Urban stream restoration offers many opportunities to bring ecological benefits to human beings.

---

36 Catherine Knight, *Nature and Wellbeing in Aotearoa New Zealand* (Wellington, NZ: Totara Press, 2020).

37 Rachel Kaplan and Stephen Kaplan, *The Experience of Nature: A Psychological Perspective* (Cambridge: Cambridge University Press, 1989).

### *Urban Landscape Design for Living with Water: Cases in Europe and Possibilities and Challenges in Japan*

Shiro Takeda, a landscape architect who teaches at Chiba University, discussed the Dutch efforts on river management and offered examples from his work in Japan. The talk began with a discussion of how the dichotomy between the terms "space" (*kūkan*) and "place" (*basho*), often used by urban designers, corresponds to two understandings of landscape — landscape as objective materiality (*keikan*) and landscape as subjective imaginary (*fūkei*). He used these ideas to explain that urban planning in Japan is facing a fragmentation that is hampering effective responses to the challenges of the Anthropocene. To solve this problem he suggested that these two understandings of landscape need to be integrated, synthesizing the natural with the anthropogenic. One crucial aspect of this effort to synthesize these two landscape concepts is the need to reframe risk as a resource to be liberated through use by nature and people, rather than contained by standardized design and managed by overly cautious risk assessment scores. He also underscored the importance of "temporal and spatial diversity" (jikanteki kūkanteki na tayōsei), both in terms of the ecological variations created by disturbances and the variegated cultural responses to such challenges.

As an example of this way of thinking, he described the *Ruimte voor de Rivier* (lit. Room for the River) plans initiated in the Netherlands in recent years. In the Noordwaard project, a lowland area was retrofitted to create a riparian area that functions as a flood detention area, an agricultural area, and a recreation area. This multi-functional land-use approach is a new undertaking with an aesthetic appeal. He also commented that the Japanese government's implementation of a new watershed flood management program based on the concept of *ryūiki chisui*[38] has not offered a convincing plan for community revitalization or a new urban lifestyle that would address the needs of the people. He suggests that communities themselves may want to devise plans in anticipation of governments using them. As an example of a planning program, he showed a video of a project in Kameoka, Kyoto, from 2020.

### *The "Next-Generation" Relationship between Humans and Nature Brought about by the Unique Construction Method of Kasumi tei, an Open Levee*

Sugiura's presentation addressed how the next-generation relationship between people and nature, especially with rivers, should be in a future of climate change with high-risk flooding. She emphasized the importance of two kinds of continuity that rivers provide: the one between mountains, rivers, and people, as symbolized by the Japanese Satoyama concept, and the other between the rural area (downstream) and the urban area (upstream). Rather than self-contained metabolism, urban water functions sustaining continuity with rural water, as a watershed, and as a social-ecological system. This continuity has been fostered in a rich and diverse context, mediated by various factors that have shaped the value of water, such as culture, aesthetics, history, and religious beliefs, in addition to the geographical and hydrological characteristics of each watershed unit.

---

38 See footnote 19.

In order to reconsider the importance of these two types of continuity in a contemporary context, Sugiura took up the unique infrastructure and construction method of an open levee (*kasumi tei*) in Kitagawa Town, Miyazaki Prefecture. The idea of open levees, which dates back to the 16th century according to documents, was revived here in the 1950s by modern construction methods for downstream flood control. As a result, the farmers upstream around the overflowing openings are faced with issues that challenge their identity, such as coexisting with the overflowing water, searching for the future of agriculture, and redefining their relationship with the urban area downstream. As one of the modern nature-based solutions (green infrastructure), the *kasumi tei* was included in *ryūiki chisui*,[39] the national watershed management project announced in March 2021. However, there is a lack of the past-nurtured concept of continuity between mountains, rivers, and people. In other words, the emphasis on storing water using "artifacts," such the open levee, rather than the historically available idea of forest management in mountains upstreams, is tricky, she pointed out.

### *Discussion*

Kazuto Oshio, a scholar of U.S. environmental history at Sophia University, commented on the presentations by the two featured speakers. In his comments on Morimoto's talk, he welcomed the ecological concept of disturbance and suggested that its acceptance would require an interdisciplinary approach that crosses the humanities, the social sciences, and the natural sciences. Such an approach, he suggested, was one way to move beyond the choice between protecting nature *qua* nature and nature for human needs. He also applauded Strang in her observation of "infrastructural violence" in the urban context, while also calling for thinking beyond "the dualism of nature and culture." Observing that spirituality is a key concept in both talks, Oshio cautioned us about ascribing the affinity for a spiritual connection to nature only to indigenous communities or to the ancient capital of Kyoto: there are Christian traditions, such as that of St. Francis of Assissi, that are regarded as "environmentally sensitive," while First Nations communities may have been exploitative of nature. To highlight this connection between Catholicism and urban environmental activism, his commentary concluded with a discussion of the Mothers of East Los Angeles, a group of Mexican-American women who in the 1980s fought for environmental justice and helped implement water-saving techniques for their urban community.

## Future Directions: Riffles, Pools, and Runs of an Interdisciplinary Collaboration

The symposium highlighted similarities and exposed differences between the disciplines and practices represented by the participants. The definition and the geographical extent of "urban water," the ontological status of water and other elements of the water ecosystem, the politics and aesthetics of how the past is used in the present, and the global circulation of ideas, practices, and species — are some of the themes that

39 See footnote 19.

provoked lively discussions. Despite the expected diversity of viewpoints, this exchange revealed that an underlying shift is astir in the confluence of the various disciplinary streams. In this conclusion, we describe some of these possibilities for future discussion concerning urban water.

Already at the outset of planning for the symposium, we decided to proactively engage with the concept of interdisciplinary research and set our major goal, beyond that of the actual research itself, to find ways to engage with each other's ideas, interpretations, and priorities. This simple goal, however, was more difficult to achieve than we expected. Many academic disciplines and professionalized practices can be described as "thick cultures" — cultures that have developed over many generations in either an isolated or a dense situation, so that traditions, such as language and custom, show a great degree of particularity due to their embeddedness to their natural, social, and political milieu and hence lose universality and translatability.[40] Thus, we found ourselves playing the role of the ambassador, translating our native language with diplomatic finesse and, at times, delivering critical assessments of the politics and poetics particular to our respective tribes. As with many interdisciplinary collaborations, the exchange of ideas can cause friction at the most basic levels of scholarly engagement.[41] Agreements and disagreements can happen at a number of levels: 1) the availability of terms in their vocabularies, 2) the definition of terms, 3) research priorities and values, 4) epistemological and ontological norms concerning existential status of the studied objects and the justification and quality of data, 5) rules concerning research procedure, including methodology and presentation of data, and 6) the exigencies of professional expectations.[42] While we cannot explore them all here, we would like to address a few.

One major issue had to do with what we mean by "urban water." The term obviously refers to water in cities. But this formulation already causes problems of scope and definition because water defies physical, conceptual, and disciplinary boundaries: in many languages, water is the master metaphor for movement and change. Even just thinking about water in cities, we need to acknowledge that water flows in and out of cities, changing constantly. As part of the larger hydrological cycle that surges through various systems from the interplanetary to the microscopic, urban water can mean many things — in our rivers ponds and swimming pools, but also in the ground in the soil and aquifer, in our sewage and water pipes, in our reservoirs and tanks, in our machines as lubricants and coolants, in our grocery stores and refrigerators (often as fluids in receptacles or frozen as ice cubes), in all organic matter (including human bodies), and

---

40 One classic formulation of this is Clifford Geertz, "Thick Description: Toward an Interpretive Theory of Culture," in *The Interpretation of Cultures: Selected Essays* (New York: Basic Books, 1973), 3–30. See also Edward Hall, *Silent Language* (New York: Anchor, 1973).

41 For a philosophical discussion on disagreements, see Kwame Appiah, *Cosmopolitanism: Ethics in a World of Strangers* (New York: Penguin, 2006).

42 A few representative works on interdisciplinarity: Julie Klein, *Interdisciplinarity. History, Theory, and Practice* (Detroit: Wayne State University Press, 1990); Marilyn Strathern, *Commons and Borderlands: Working Papers on Interdisciplinarity, Accountability, and the Flow of Knowledge* (Oxon, UK: Sean Kingston Publishing, 2004). See also Bent Flyvbjerg, *Making Social Science Matter: Why Social Inquiry Fails and How It Can Succeed Again* (Cambridge: Cambridge University Press, 2001).

even in the air we breathe in vapor form. Of all these different types of water found in urban areas, we mainly focused on large bodies of water, such as rivers and ponds, as well as small patches of land, such as gardens and parks, that serve as temporary receptacles for rain that directly lands on the city, indirectly delivered through the inflow of rivers and groundwater, and transferred across watersheds and oceans by human intervention. Since cities must confront both the dearth and over-abundance of water flowing into them, we extended our scope to the hinterlands of the city that are directly connected to the major bodies of water that flow into our cities. We also highlighted water's importance for fauna and flora, especially of those species that require water habitats.

Likewise, there are many definitions of cities, such as those that rely on population density, on land-use, on the dominant type of buildings, on administrative status, on history, on culture, on ecology, or on metabolic input and output.[43] For our purpose, we suggest that hydrology — the study of how water flows through the various planetary systems — may offer a useful way to define cities.[44] Thus our understanding of the city's boundary also extended to its watershed, also referred to as catchment basin, and beyond the watershed to include the effects of groundwater that feed the springs within city boundaries. Also included in this hydrological definition are the engineered flows of water – the sewershed, for one, but also the trans-watershed movements that are controlled by networks of dams, sluices, waterways and pipes to feed the water needs of our cities.[45] Urbanization also affects surface permeability, thus altering stormwater movement on a vast scale, including shaping ocean currents[46] eroding coasts due to decrease in fluvial sediment transport; and causing eutrophication due to increase in nutrient salts.

Our recognition of the engineered hydrology as part of the urban is largely inspired by Boelens et. al., who define "hydrosocial territories" as "socially, naturally and politically constituted spaces that are (re) created through the interactions amongst human practices, water flows, hydraulic technologies, biophysical

---

43 UN Habitat, "What is a City?" (https://unhabitat.org/sites/default/files/2020/06/city_definition_what_is_a_city.pdf) (accessed December 5, 2021). For a discussion of how urbanism is defined differently by ecologists and social scientists, see also Nancy E. McIntyre, K. Knowles-Yánez, Diane Hope, "Urban Ecology as an Interdisciplinary Field: Differences in the use of "Urban" Between the Social and Natural Sciences," in *Urban Ecology*, eds. John M. Marzluff et al. (Boston, MA.: Springer, 2008): 49–65. DOI: 10.1007/978-0-387-73412-5_4. Yet for a critique of "methodological cityism," see Hillary Angelo and David Wachsmuth, "Urbanizing Urban Political Ecology: A Critique of Methodological Cityism," *International Journal of Urban and Regional Research*, 39, no.1 (2015): 16–27.

44 A work that approach es urban hydrology from a sociological view is: Gandy "Rethinking Urban Metabolism. DOI:10.1080/1360481042000313509. From an urban planning approach, see chapter two of Michael Hough, *Cities and Natural Process* (New York: Routledge, 1995).

45 Mikiko Sugiura, "Ryūiki gainen kara mita tōgō teki ryūiki kanri no dankaiteki tenkaikatei," *Journal of Japanese Society of Irrigation, Drainage and Reclamation Engineering*, 86, no.4 (2018): 33–36.

46 Phillips S. Levin, Emily R. Howe and James C. Robertson, "Impacts of Stormwater on Coastal Ecosystems: The Need to Match the Scales of Management Objectives and Solutions," *Philosophocal Transactions of the Royal Society B,* 375, no.1814 (2020), 20190460. DOI: 10.1098/rstb.2019.0460.

elements, socio-economic structures and cultural-political institutions."[47] Their approach to urbanism resonates with the fact that, archaeologically, the earliest cities appeared along with the earliest technologies of irrigation, water supply, and sanitation.[48] It also begs the question of whether water can be urbanized or whether certain types of water use can be regarded as a criteria for the definition of cities. Furthermore, as water impacts every aspect of human society, cities are by definition a highly concentrated form of human society. In short, cities are capital incarnate: as centers of commerce and power, urban hydrology is also shaped by the economic and political forces at multiple levels and scales. From the local politics of city council meetings or the everyday concerns of the neighborhood grocery, to the global politics of climate talks or the business concerns of the largest corporations, they all affect urban hydrology.

Yet by taking seriously the idea that the hydrological cycle is a biogeochemical cycle, we also recognize the other common metaphor that water is used for — that water is life. Water is the most important solvent on this planet, one that allows for metabolism, or the conversion of matter into energy for the growth and movement of organisms at the cellular level. It is also a key climatological and geomorphological force that shapes the contours of the planetary surface, which in turn impact the way water flows over the landscape. In other words, water creates topological variations through erosion and influences the temperature, humidity, precipitation, and other atmospheric elements, thereby generating a myriad habitat types — mountains, woodlands, grasslands, wetlands, rivers, estuaries, tidal flats — that give rise to biodiversity. Such ecological variation have also made possible the emergence of human settlements.

These meditations on the ecological role of water and its entanglements with human life can offer a few clues as to how to move beyond a monolithic, purely instrumentalist view of water as a resource for human society. The personification of the planet, such as the Gaia hypothesis or the Andean goddess Pachamama, or of local water entities such as the Whanganui River may seem like an insubstantial symbolic gesture or a hoax of legal wizardry with flimsy ecological or scientific basis. However, water makes such metaphoric connections with life metonymic or synecdochic, and therefore, more real: the hydrological cycle is the circulatory system that keeps the planetary metabolism going, servicing ecosystems with supplying nutrients and energy, flushing out toxins, regulating temperature, and responding to disturbances. Acknowledging water's fundamental connection to life has also prompted us to explore the complex and meandering threads between its many socio-ecological functions with its central role in many spiritual and aesthetic traditions.

The anthropomorphism and zoomorphism of water, however, also present important questions. What is, first of all, the definition of life? If such aggregates of ecological relationships on the planet can be construed collectively as alive, can we also ascribe similar ideas to smaller aggregates, such as that of a river ecosystem? Secondly, in our current legal, ethical, and moral systems, not all lives are granted protection. What are the criteria for such granting of rights? Thirdly, is the recognition of life or of rights enough to move us away

47 Rutgerd Boelens, Jaime Hoogesteger, Erik Swyngedouw, Jeroen Vos and Philippus Wester, "Hydrosocial Territories: A Political Ecology Perspective," *Water International*, 41, no.1, (2016): 1–14, DOI: 10.1080/02508060.2016.1134898. The quote is from p.1.

48 Larry Mays, ed., *Ancient Water Technologies* (New York: Springer, 2010). See also Karl Wittfogel, *Oriental Despotism: A Comparative Study of Total Power* (New York: Random House, 1957).

from an instrumentalist view of nature or promote effective, sustainable practices? And finally, what aspects of the ecological system should be under protection or should be given rights? Should native fauna and flora be given more protection because they are native or because they are ecologically suitable? Or does this kind of reasoning smack of a naturalistic fallacy?

This last question is related to another major set of ideas, revolving around the role of infrastructure in the mitigation of risks. From ancient times, the control of water has been essential to the rise of urbanism in human society. Irrigation channels, levees, dams, reservoirs are prehistoric technologies for supplying and stopping water by controlling its flow. While rivers naturally flood, and there are many ecological benefits to flooding such as the deposition of nutrients and silt, in Japanese cities, flooding has become a major problem, especially in the era of climate change.[49] Should rivers be given the right to flood, if we understand flooding to be a natural occurrence for rivers? How many of these propensities of the river should be allowed, even if such concessions for rivers mean human resettlement and loss of usable land? That is, if risk is reconceptualized as natural disturbances that we must accept in the name of ecological health, do we need to come to a public consensus about the types of natural disturbances and the amount of such disturbances that human society can accept? And conversely, should flooding be seen not so much as a river's right that humans need to respect, but as more prosaically an ecological limit of the system, in a way similar to how the carrying capacity of ecosystems are viewed as a limit?

Whether expressed in the prohibitionary language of religious taboos or the economistic language of physical limits, what seems to matter is the way in which these understandings can promote changes in behavior. Many speakers in the symposium recognized that changes in society's dominant ideas, concepts, and practices may be a contributing factor in the overall trajectory of urban water sustainability. Green infrastructure implementations, such as rain gardens and hydrophilic landscape design, not only has the benefit of disaster prevention by retrofitting urban surfaces for better stormwater porosity and absorbency, but it also can offer urbanites a way to connect to nature and experience the risks of ecological disturbances first-hand. In addition to the health benefits of being in nature, such areas can, by bringing such risks closer to the city in a more manageable size, serve to raise awareness among city dwellers of the risks involved and the need for preparation. If the residents are themselves involved in the design, implementation, maintenance, and management of these civic projects, they may also have greater emotional stake in their own surroundings as well as their safety.

Nature-oriented solutions, in principle, integrate the existing ecological dynamism of the local ecosystem into the designed projects, often by using living organisms as construction material. While the benefits of nature-oriented design may seem clear, its use of fauna and flora as construction material is more complicated than it may first appear. Using breathing, growing trees is ecologically, culturally, and ethically different from using dead, sawed-up trees, i.e. lumber. Urban green spaces have many benefits, but if they are populated by ornamental foreign species and over-fed with fertilizer, such spaces can unleash invasive

49 Nobuhito Mori et. al., "Recent Nationwide Climate Change Impact Assessments of Natural Hazards in Japan and East Asia," *Weather and Climate Extremes*, 32 (December 2021). DOI: 10.1016/j.wace.2021.100309.

species and trigger nitrogen eutrophication in local waters, which may debilitate an otherwise healthy urban ecosystem and ultimately be counterproductive to the goal of habitat conservation. This is perhaps why native vegetation is preferred for rain gardens — they are more maintenance-free because they are more evolutionarily adapted to the local ecosystem. However, are such ideas concerning invasive species true for all non-native species?[50] Can such ecological nativism be extended to traditional practices and aesthetics and practices? Does it make sense to read into such older traditions, such as feng shui-informed planned design of Kyoto or the patchwork of controlled burning of the Australian aborigines, as creating ecological mosaics that are beneficial and sustainable?[51]

The symposium provided an arena for exploring these questions through specific cases involving urban water in Japan. Convened in the spirit of a symposium, in the original Greek sense of a philosophical dialogue rather than strictly an academic conference, the event provided an opportunity for discussion, exchange of ideas, and reflection on existing practices and envisioning new pathways for the future approaches to urban water sustainability. Providing the basis for future exploration, the symposium also brought into focus the need for conceptual fluidity characteristic of interdisciplinary and intercultural exchanges that usually facilitate similar paradigm shifts as the one we are witnessing right now. The challenges and the benefits of such an exchange reverberate with Mieke Bal's notion of "traveling concepts," proposed in 2002 and further elaborated in 2009.[52] Bal writes:

> They [concepts] facilitate discussion on the basis of a common language. But concepts are not fixed. They travel — between disciplines, between individual scholars, between historical periods, and between geographically dispersed academic communities. Between disciplines, their meaning, reach, and operational value differ. These processes of differing need to be assessed before, during, and after each 'trip.' All of these forms of travel render concepts flexible. It is this changeability that becomes part of their usefulness for a new methodology that is neither stultifying and rigid nor arbitrary or 'sloppy.'[53]

This traveling nature of concepts is an asset rather than a liability. Neither fixed nor unambiguous, they are "amenable to change and apt to illuminate historical and cultural differences."[54] We agree with Bal that concepts are productive not through "application to the cultural objects being examined" but through confrontation with them. Awareness of and openness to this fluidity and interplay is the *condition sine qua non* for any interdisciplinary and intercultural work, which as we increasingly realize, is the foundation for a holistic approach to urban water.

---

50 Mark A.Davis, et al. "Don't Judge Species on Their Origins," *Nature* 474 (2011): 153–154. DOI: 10.1038/474153a.

51 Richard Forman, *Land Mosaics: The Ecology of Landscapes and Regions* (Cambridge, UK: Cambridge University Press, 1995).

52 Mieke Bal, *Travelling Concepts in the Humanities: A Rough Guide* (Toronto: University. of Toronto Press, 2012); Mieke Bal, "Working with Concepts," *European Journal of English Studies,* 13, no.1 (2009): 13–23. DOI: 10.1080/13825570802708121.

53 Ibid., 13.

54 Ibid., 19.

## Acknowledgements

The authors would like to express their sincere gratitude to the guest speakers, panelists, and discussant who gave the symposium a variety of perspectives and depth, to the students and staff who helped organize it, and above all to Sophia University and the Institute for Studies of the Global Environment for their support of the multi-disciplinary collaboration.

## From the Sea to Inland Pastures:

Adaptation and Construction of Territories and their Multiple Narratives Tailored by the Environment Transformation

Tana[1], Erika Salazar[2], Juan Ricardo Gómez[3], Pablo Ramos Baron[4], Anne McDonald[5]

**Abstract**

Food production is one of the main expressions of human dependency of nature, it represents cultural tradition, human needs and economic means. To its fulfillment, humans have moved and transformed many ecosystems, developing complex systems of biodiversity use across the world. Some of these systems have led to environmental degradation and resulted in displacement of communities or knowledge sets and forced migration. Asia has experienced large displacement related to environmental events decreasing possibilities to produce food in quality and quantity for local increasing demands, including floods, fires, intense droughts, sea level rise and loss of biodiversity. Whether migration is internal (within a nation state's geo-political borders) or transnational, the intersection of environmental degradation, resource depletion – specifically related to resource management and food production – and migration requires innovative, comprehensive contextual solutions to the multidimensional challenges it creates. As a part of the Sixth Biennial Conference of East Asian Environmental History (EAEH 2021), some narratives from sea to land migration in search of food in East Asia were explored and discussed across different case studies by researchers from Sophia University and Javeriana University. From seasonal migration and outward transnational migration of coastal communities in Japan in the early 20th Century, to land-based agricultural communities in Japan who migrated to the Pacific Islands of Micronesia and to Inner Mongolia pastoral communities.

**Keywords:** environmental fragility, food production, biodiversity use, migration, resource management.

---

1. PhD Student. Graduate School of Global Environmental Studies. Sophia University. Tokyo, Japan. t-tana-8g4@eagle.sophia.ac.jp
2. PhD Student. Graduate School of Global Environmental Studies. Sophia University. Tokyo, Japan. Salazar.erika@javeriana.edu.co
3. Professor. Facultad de Estudios Ambientales y Rurales. Pontificia Universidad Javeriana. Colombia, Colombia. jrgomez@javeriana.edu.co
4. Professor, Facultad de Estudios Ambientales y Rurales. Pontificia Universidad Javeriana. Colombia. Bogotá, Colombia. p.ramos@javeriana.edu.co
5. Professor. Graduate School of Global Environmental Studies. Sophia University. Tokyo, Japan. annemcdonald@sophia.ac.jp

# 海から陸へ、そして牧草地へ：
## 環境変容が語る領地への適応と構建及びその物語

タナ・エリカ サラサ・ホアン リカルド ゴメス・パブロ ブラムス バロン・あん まくどなるど

**要旨**

人間の自然への依存を最も表す活動として挙げられるのが食料生産であり、文化的伝統、人間の需要、および経済を表している。最大限のものを求め移動を繰り返す中で、世界各地に渡って多くの生態系を変化をもたらし、生物多様性を利用した複雑で新たな生態系を生み出してきた。この中のいくつかは環境の悪化を引き起こし、それによってコミュニティの強制移住と共に地域の伝統知識の消失したケースもある。アジアはこれまでに、洪水、火災、干ばつ、海面上昇、生物多様性の喪失のような確保できる食糧の量や質の低下をもたらす環境の変化にを理由とする、大規模な移住を経験している。移住が国内間（国家の地政学的境界内）であろうと国境を越えたものであろうと、環境劣化、資源枯渇（特に資源管理と食糧生産に関連する）、そして移住が生み出す多面的な課題に対して、革新的かつ包括的な解決策が必要とされる。東アジア環境史の第6回 Biennial Conference of East Asian Environmental History（EAEH 2021）の中では、食糧を求めて海から内陸への移動に関するいくつか事例が取り上げられ、上智大学とジャベリアナ大学の研究者によって行われたケーススタディについても議論された。扱われた事例としては、季節に伴う移動、日本の20世紀初頭の沿岸を拠点としていたコミュニティが国外への移住、日本の内陸で農業を主に行っていたコミュニティがミクロネシアや内モンゴルの遊牧地域への移住などである。

**キーワード**：環境脆弱性、食料生産、生物多様性利用、移住、資源管理

## From the Sea to Inland Pastures:

Adaptation and Construction of Territories and their Multiple Narratives Tailored by the Environment Transformation

### Introduction

For millennials, humans have crossed social and ecological borders in search of resources, transforming and adapting to new conditions (Berkes et al., 2002). In the search of sustainability, lessons from the past could be examined in understanding the directions in which social, technological, and environmental systems co-evolve over time within different societies (Leach et al., 2007). Through history, communities have made decisions to use their surrounding resources in various ways, primarily for basic needs such as food, in which diverse actors prioritize different goals, based on local realities and linked to historical dependencies and power relations (Bastiaensen et al., 2015; Karpouzoglou et al., 2020). The historical and present context shaped by the feedbacks between sociocultural and ecological features play a fundamental role determining future outcomes in the territories. On this path, communities have developed different resource management strategies adapting practices and technologies and co-evolving with it, but this process has deeply transformed the ecosystems and the ecological services humans rely on to a degradation point.

Indeed, the rise of environmental history as a discipline since its emergence in the 1970s was a consequence of the growing awareness of environmental problems looking for their causes from the interaction between culture and nature. Recently, scholars from environmental history have become more interested in the study of successful cases of natural resources management, furthermore in understanding of the contributor's factors in today's socio-ecological crisis in search of solutions for it (Carey, 2009). During The Sixth Biennial Conference of East Asian Environmental History "Human and Nature in East Asia: Exploring New Directions in Environmental History." held September 7-10, 2021, students, and professors from Sophia University (Japan) and Javeriana University (Colombia) were part of a panel discussion named "Traversing borders in search of food: sea/land nomads, migration and resource management narratives". This conference has been held for more than 10 years, with participants from many disciplines, mainly East Asian environmental historians.

In this panel, three presentations took place: the first one outlined the history of *ama* divers -artisanal fisher women and men- between Korea and Japan, the second one covered some of the impacts of Japan's expansionism in the Pacific Islands and the third one presented two case studies of the pastoral community in Inner Mongolia of China. From the implementation of technology in *ama* diver communities and trade-off discussions, to outer migration to the Pacific islands driven by lack of resources such as land in Japan, to a nomadic system that has been forced to face desertification in Inner Mongolia. In each of these presentations, narratives from different communities allowed the audience to explore notions and evidence of migration, changing environments, and changing technologies that have transformed the natural resources in many territories, lessons from the past to look for a sustainable future and that improve local

management strategies to cope with the increasing evidence of environmental fragility. On that note, this concept is a key element towards understanding the impacts of human activities on the natural resources, determining the state of socio-ecological systems. Environmental fragility is framed as the susceptibility of the natural system to change or degrade under major disruptions (Campos et al., 2019; Ross, 1994). For instance, could be considered an inherent property of an ecosystem that responds to external factors (Nilsson & Grelsson, 1995). The purpose of this paper is to present the narratives discussed in the panel that underline key transversal elements to understand how different communities face and manage environmental fragility.

## Sea narratives: the *ama* communities and the implementation of technologies

The first presentation named "Japanese free diver communities at a crossroads: conflicting narratives from Mie and Ishikawa of technological innovation, trade-off decisions gone good and bad, gender and migration" was developed by Professor Anne McDonald from Sophia University. Starting from framing the importance of the sea being 70% of planet earth and its deep alteration resulting from the interactions between humans and marine life, this case study highlighted the importance of marine environmental history even in its early stages. Free *ama* divers are a unique case that exemplifies narratives from women in fisheries, gender, and resource management, historicizing the ocean under marine environmental history perspective (Bolster, 2006). The central point of these narratives is focused on the adaptation of technologies and community debates towards certain practices that could lead to sustainable or unsustainable use of resources. Historically, technology has been indiscriminately adopted across the world, but it is possible to find narratives to learn from trade-off debates and collective decisions to adopt or reject technologies. With the free diver women, debates were held related to the implementation of technology for their harvesting activities. One of those was the eye gear, which was the first technology introduced and debated. Then the fins, that help them to get to deeper places and the third are wetsuits and scuba tanks.

Introduced in the mid-1880s, eye gears were useful to increase visibility, but their adoption responses differ from community to community as it could be seen in a case from Kuzaki and Funakoshi (Mie Prefecture, Japan). In the first case, Kuzaki *ama* community - mainly female- decided to adopt them after 20 years of first being introduced in Japan and decided to come with counterbalance to avoid overharvesting risk, with resource management rules and restrictions, such as delineating no take zones, limiting diving seasons and time. This led to sustainable resource management in that community. On the other hand, Funakoshi *ama* community -both male and female- indiscriminately adopted this kind of technology, focusing on the benefits with minimal discussions in the 1880s. By the 1920s the exhaustion of resources and the number of divers overusing marine resources led to outwards migration to supplement incomes and food security. Some divers migrated to other parts of Japan, Korea and California seeking new frontiers.

For wetsuit and fins, the *ama* community from Ishikawa prefecture adopted wetsuits in the mid-1960s, taking place trade-off discussions regarding the benefits such as protection against cold and jellyfish and all year harvesting, and the potential negatives like overharvesting and economic cost. Eventually, the *ama* community fully adopted wetsuits, extending their harvest all-year round (Figure 1). Later, fins were

introduced pushing resource limits to tipping points. In order to counterbalance the adoptions, by 2007 restrictions on harvesting times (from 8 hours to 4 hours) were implemented responding to the decrease of resources. Lastly, scuba tanks were never adopted in this community due to the possible overexploitation of the resources which will not allow sustainable use.

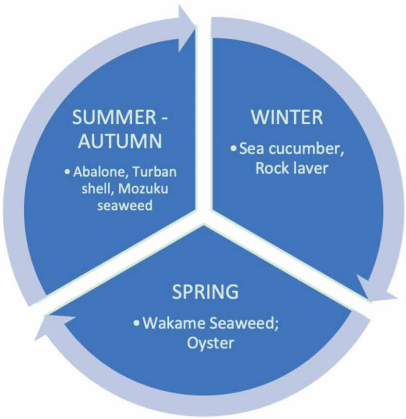



Figure 1. Introduction of the wetsuit in the 1970s allowed all year-round harvesting in the *ama* community at Ishikawa prefecture (Japan).

To ensure sustainable use of resources, the *ama* community in Ishikawa prefecture kept their sea nomadism activities through seasonal migration to balance the stress on resources in traditional harvesting grounds. Currently, additional challenges such as ocean warming have put a race against time as to whether their ecological knowledge, their traditional practices and their understanding of the ocean are sufficient to deal with climate change. Now discussions are around to have a more interdisciplinary approach to not only look at the past but to move forward adaptably into the future and face the challenges of climate change. Indeed, there is a need to integrate several narratives such as the historical to have a more holistic point of view.

## Japan's growing empire: sea to land in the Pacific

Increasing population and exhaustion/depletion of natural resources have placed discussions not only at a community level but also at national level (Myers & Peattie, 1984). During the Meiji Period (1868–1945), Japan entered a process of nation-making and empire-building, under the new economic and political international order established by western imperialism after World War I (WWI), in 1914. Territorialism moved to Asia and the Pacific - the Greater East Asia Co- Prosperity Sphere-, encouraged by a set of reasons such as westernization, self-preservation, economic crisis, lack of land for farming, aid, trade, investment, military ambition, political power, within others (Crocombe, 2007). Japan was able to rule over German Micronesia for 3 decades, from 1914 to 1945, concealed by the League of Nations mandate and many Pacific Islands such Palau, Northern Mariana Islands, Federated States of Micronesia, and Marshall Islands, faced deep transformations to the natural but also social dimensions such as in traditional practices (Ishikawa, 1987; Dickinson, 2013).

This case study evidences, first, the need to migrate in search of resources and two, the impact of colonialism on local people's lives from a cultural and ecological perspective, changing fishing practices, enforcing religion and language (Figure 2) (Micronesia Area Research Center, 1986; Mita, 2009). The installation of Japanese culture impacted food systems, creating preference of rice, which has resulted in food dependency on imported products with limited nutritional value and neglecting local agriculture development. This change also had repercussions associated with local health increasing cases of non-communicative diseases such diabetes (Hu, Pan Malik and Sun, 2012). During that period, many companies such as *Nanyo Kohatsu Gaisha* (South Seas Development Company) settled in many islands in the Pacific to increase resource exploitation for sugar industry, alcohol production, phosphate mining, fisheries, starch production and coconut plantation, where many Japanese immigrants were employed (King, 2017; Blakes, 1922). However, the introduction of commodities (pots, fishing hooks, rubber sandals, kerosene lanterns) and infrastructure gave a sense of livelihood improvement with the Japanese empire.

Diving specifically into narratives from one of the Pacific Islands, Belau or the Republic of Palau, before the influence of Spanish (1885), Germany (1899) and Japan (1914) -with Nanyo-cho (South Seas Government)-, traditional diets were mainly seafood and cultivated carbohydrates such as taro, which altered the landscape of Babeldaob from forest to terraced fields, taro patches and vast savanna (Liston, 2008). With colonization, coconut plantations and mine phosphate were established, deeply transforming the landscape. During 'Japanese time' 1914 – 1945, agriculture, mining and fishing activities peaked to export to Japan impacting land use and land cover change reducing agroforestry and forest by 10 to 15% (Iida et al., 2011; Peattie, 1988). In 1947, these Pacific Islands passed under the control of the United States of America as a United Nations Trust Territories. In 1994, the Compact of Free Association with the USA was established, and Palau was declared as an independent territory, the 'Republic of Palau' (Mita, 2009).

Kamata-sensei and his students in *kogakko* (photo: *Nanyo Gunto Bunka Kyokai* 1938)

Figure 2. Kamata-sensei and his students in kogakko. Photo by Nanyo Gunto Bunka Kyokai, 1938. Taken from Mita (2009).

Food systems were heavily transformed due to colonialism, making them strongly dependent on external inputs. Fishery development in Palau by the Japanese was mainly focused on dried bonito, establishing *Nanyo Suisan Kigyo Kumiai Fisheries Industry Association* in 1931 by Okinawan people, and pearl business (Peattie, 1992). Tuna industry remains an important link with Japan even after their independence, where Japan still accounts for fishery rights in the Pacific Islands using the Exclusive Economic Zone of Palau (Izawa, 2000; Rinaldi, 2009). In relation to agriculture development, sugar cane and coconut are still the main crops in the islands imposed by the history of colonization in Palau. Regardless of this, one of the remaining traditional food production systems found on the Pacific islands are *taro patches* with traditional medicinal and other edible products such as water spinach, within others, which is a very important part of the culture (Figure 3). These places represent the holistic view of the interaction of crop, field, and forest as an ecological whole, that face challenges to its conservation and use through different generations due to the loss of interest of younger generations.

Figure 3. Taro Patch. Photo by Elchung Hideyos (2021).

### Land narrative: Nomadism in the Mongolian Plateau

In the third case study, the narratives from the Inner Mongolia Autonomous Region of China present the struggle to face desertification and keep providing food under traditional practices. Communities from Otog Banner[1] at the southwest of Ordos Plateau, and Ar Horqin Banner at Greater Khingan Mountains,

1 Banner: a county-level administration region in Inner Mongolia, where most residents are Mongolians

are recognized to have nomadic life-maintained after years of conquest and territorial expansion. Major questions framing these cases are: Can we look at some of their strategies at pastoralism, as the way to utilize the land, to combat desertification? Does it contribute to ecological restoration, or can it worsen desertification?

Nomadic pastoralism has been sustained in these areas over centuries and played a vital socio-economic role as a basic means of production and herdsmen have developed ways to utilize the pasture resources while maintaining the balance of ecosystem and biodiversity (Fernandez-Gimenez, 2000). The nomadic ancestors of the historical period avoided the unreasonable utilization of grassland by using animal husbandry, which not only maintained the integrity of grassland resources but also ensured the sustainable use of resources. However, in China, nomadic or semi-nomadic pastoralism was gradually replaced by sedentary pastoralism in response to the increasing population, environmental challenges, and land use policy such as Rangeland Household Contract Policy and the Nomad Settlement Policy. Meanwhile, grassland fencing developed rapidly, undergoing a change from collective management to herding enclosures, and continuously consolidated the production change in pastoral animal husbandry from nomadic to sedentary (Figure 4).

Figure 4. Left photo, Sedentary household; Right photo, Goats' fence at Aerbas Sumu. Photo taken by Tana, July 20, 2021, Otog banner.

Otog banner bordered the Mao Us desert where desertification[2] is increasingly serious. However, the degradation of grasslands has been blamed as a cause of soil erosion and sandstorms, and measures to protect grasslands against nomadic and herding livestock seem logical (Chu & Meng, 2006). In 2000, the central government initiated the ecological resettlement project to relocate the people to new towns. Then seal vulnerable areas to restrain the interference of human activities on nature. Migration is not only a strategy of survival but also a means of livelihood (McDowell & De Haan, 1997). In Otog banner, the ecological migration

2 Desertification has been defined by UNCCD (1999) as the land degradation process due to human activities along with climate variation and occurring in arid, semi-arid, and dry sub-humid areas.

projects neither result in the expected improvements in the ecosystem nor help herders from marginal poverty.

Since sedentary life has been encouraged, there is a current project focused on how to reverse the negative impact of sedentary animal husbandry. Local government developed an "intelligence ranch" on the individual-owned pastures to relieve the heavy manual labor. The Beidou navigation grazing system, along with multiple sets of high-definition cameras were installed that allowed herdsmen to observe the location of the livestock and promote production. High-tech, inevitably embedded into the pastoralists' daily life, cooperated with the traditional approach of "grassland transfer" in the contemporary era of rapid technological innovation. "Intelligence ranch" was introduced to the remote community as a new experimental trade-off solution to face environmental issues from the failure of the previous policy.

In comparison, looking back to Mongolian tradition, Ar Horqin shepherds are still characterized to be nomads by the lifestyle of "settling down along those places with adequate grass". Pastoralists divided grassland into seasonal pastures and transitioned according to vegetation and climate conditions (Fernandez-Gimenez, 2000). It still maintains the traditional resource management, culture, and resource utilization.

The seasonal migration starts from the beginning of summer and through autumn to early winter. It follows different routes to reach the summer camp which has good natural pasture and mowing grassland. The rotational grazing according to seasons and the growth cycle of herbage and climate change is still managed which refers to the orderly transfer of livestock between grasslands in different regions (Figure 5). The integral and holistic approach to resource use is taken into account of the seasonal migration.

Figure 5. Left, Cattle migration at Bayanwenduer; Right, Yurt at Summer Pasture. Photo taken by Tana, September 19, 2021, Ar Horqin Banner.

These two case studies presented how Mongols in the different pastoral areas inherited nomadic traditions and used the ethnic character of flexibility to maintain stable food supplements. No matter the traditional mode or current way, its core lies in the "mobility" of traditional resource management, which still plays an irreplaceable role in relieving grassland pressure, maintaining the self-renewal capacity of grasslands.

**Connecting narratives from sea to land.**

From an environmental history point of view, humans looking for wellness have developed interactions with their environments through strategies shaped by their perception and appropriation of nature. The examples presented here show different expressions of the way humans have tailored ecosystems based on the social and economic trajectories of food production. Particularly, the case studies in this panel displayed how communities across Asia and the Pacific have moved and made decisions related to their biodiversity use system, specially established by their food access and utilization. Food culture is one of the most representative expressions of biodiversity use in a specific territory. From the *ama* divers in Japan to the nomadic communities in Inner Mongolia, various narratives have presented how interventions or changes in technologies, culture or governance directly affects the sustainability of natural resources and the transmission of traditional knowledge and practices derived from human-nature relationship.

Recalling Carol Merchant's Ecological Revolutions, these cases are examples of major transformations in human relations with non-human nature, at three levels - production, reproduction, and consciousness on non-human nature-, arising from "changes, tensions, and contradictions", and addressing one of the fundamental questions of environmental history: What is the process by which change occurs? Ecological transformations occurred at first level -production- which indicates how nature is used for subsistence, second -reproduction- which represents how this use affects complex social dimensions such gender role and family, and third -consciousness- which is how these systems legitimize human behavior towards nature and are translated into practice -values, ethics and taboos- (Merchant, 1987).

What the planet is living now is the result of all the decisions human societies have made in the past, it is the ecological response of the human alteration of their surroundings. Therefore, the human-nature relationship is reciprocal, which is clearly traceable through the three case studies (Table 1). Technological shifts can be subtle, like the goggles in the *ama* divers, or imposed with strength like fishing and agricultural techniques on the small islands in the Pacific or sedentarism in the Mongolian pastures. Whatever the change, it all has impacts and feedbacks on the production or extraction, profit, revenue, culture and of course the landscape and its ecosystems.

Table 1. Key points from the three case studies related to culture, governance, technology, and sustainability.

| Case study | Culture | Governance | Technology implementation | Sustainability |
|---|---|---|---|---|
| *Ama divers* | Resource management in some *ama* communities are culturally tight which have mainly led to sustainable choices, for example the designation of counterbalanced practices to mitigate the risk of overexploitation. Female *ama* communities have strong ties to Ise Jingu (Kuzaki, Mie Prefecture, Japan). | Community trade-off discussions to implement practices and technologies. Gender influence on resource management, where is not always driven by utilitarian benefits. | Communities under similar context making decisions towards the adoption of technologies. Implementation of eye gear in Kuzaki and Funakoshi (Mie Prefecture, Japan). Adoption of wetsuit and fins in ama community in Ishikawa prefecture (Japan). | Counterbalance practices such harvesting time, seasonal migration, partly use of the technology. |
| *Japan territorialism* | Two ways: 1) Japanese imposed culture to transform socio-ecological systems in the islands leading to an intense use of land and sea resources, 2) Pacific traditional cultures for food production that remains on a small scale such as the taro patches but has been marginalized through time by different factors. | Japanese imperialism that implemented a new government system with the establishment of Nanyo-cho (South Seas Government) through the Pacific Islands. | Land use and land cover change prioritizing production to export to Japan over food security and sovereignty in the islands. One of the major technologies implemented in the island by the Japanese was the fishing hooks and development in fisheries specially for tuna and bonito. | Japan's over-exhaustion of resources lead to outer migration in search of fertile land to grow and seas to extract food resources. |
| *Mongolian pasture* | Herdsmen livelihood of "settling down along those places with adequate grass", conduct rotational grazing according to seasons and the growth cycle of herbage. | Nomadic pastoralism was replaced by sedentary pastoralism in response to the increasing population and land use policy such as Rangeland Household Contract Policy and the Nomad Settlement Policy. | Beidou navigation grazing system, automatic water dispensers | Pastoralists divided grassland into seasonal pastures and transitioned according to vegetation and climate conditions keeping these practices over centuries. Desertification as a result of rapid environmental change is forcing communities to implement new practices towards sustainability. |

The *ama* divers case exemplifies the way communities maintain permanent and experienced informed decision processes toward resource management, ones with successful solutions balancing the trade-off between the benefits and impacts of technologies maintaining at some extend resource sustainability; others with tragic tales from less or non-existent debates that drove to implement indiscriminately strategies/technologies that rapidly depleted the resources they relied on being forced to migrate. Following this case study, due to the exhaustion of marine resources and lack of land to grow food within other natural resources, Japan nation needed to move outward migration in search of arable land and primary resources to maintain their population and political-imperial-power in Asia, marginalizing traditional practices of Pacific Islands communities through colonialism. Finally, nomadic systems in Inner Mongolia pastures bring back reflections of ecosystem fragility and governance towards adapting to rapid environmental change that threatens not only livelihoods but the whole ecosystem itself.

On another note, as the discussion of nomadism - especially from the pastureland in Inner Mongolia, or even the *ama* divers in Japan, or the farmers or fisherfolks in small islands- often leads us to the question

whether the resource use and practice tight to traditional knowledge are sustainable or not. Dynamic management strategies are very important over time for the survival of indigenous/traditional local communities. It is proving more critical right now that they are facing challenges and increasing changes of climate, putting stress on their land and their ability to produce food. Looking back to nomadic wisdom and traditional knowledge set in modern-day, is an approach to look not only for ecologically viable solutions, but also looking for socially and culturally viable solutions as well. There is no need to build nostalgic historical narratives, but to draw from the past certain knowledge sets of resource use management and practices that might be integrated with the scientific approach to find sustainable alternatives - in this case to food production. Looking back to history and how traditional knowledge has been shaped as an outcome from trial and error of local solutions to specific environmental fragility can trace future paths towards sustainable development and resource management.

In conclusion, traditional ecological-based food systems have adapted and survived for centuries, although they face accountable threats to their livelihoods such increasing environmental degradation, and changes in climatic conditions. Local and traditional knowledge and ability to adapt provide lessons from which other non-indigenous societies can learn, especially when designing more sustainable food systems that mitigate climate change and environmental degradation. The whole planet is in a race against time with the speed of events accelerating by the day. There is a need to re-evaluate tradition, bringing forth new ideas but learning from the past and cultural legacy. It is crucial to recognize traditional knowledge as key in achieving the 2030 Agenda and to create larger spaces for more inclusive dialogues recognizing the vast lessons to be learned from them. Having an environmental history focus helps to transcend different boundaries of knowledge and disciplines and move away from the side approach, incorporating the necessary from the past to contribute to a working solution for today that will contribute to a sustainable future for all.

---

**References**


- Almerico, G. (2014). Food and identity: Food studies, cultural, and personal identity. Journal of International Business and Cultural Studies, 8, 1.
- Bastiaensen, J., Merlet, P., Craps, M., De Herdt, T., Flores, S., Huybrechs, F., Mendoza, R., Steel, G. & Van Hecken, G. (2015). Making Sense of Territorial Pathways to Rural Development: A Proposal for a Normative and Analytical Framework. IOB Discussion Paper/2015.04. University of Antwerp, Belgium.
- Berkes, F., Colding, J., & Folke, C. (Eds.). (2002). Navigating Social-Ecological Systems: Building Resilience for Complexity and Change. Cambridge: Cambridge University Press. doi:10.1017/CBO9780511541957
- Behrendt, K., Liu, H., Kemp, D., & Takahashi, T. (2020). Sustainability modelling of grassland systems. Sustainable Chinese grasslands. Australian Centre for International Agricultural Research, Monograph, 210, 97-124.
- Bolster, J. (2006). Opportunities in marine environmental history. Environmental History, 11(3), 567–597.
- Carey, M. (2009). Latin American environmental history: current trends, interdisciplinary insights, and future directions. Environ. Hist. 14 (2), 221–252.·
- Campos, J., Aires, U., Da Silva, D. & Calijuri, A. (2019). Environmental fragility and vegetation cover

dynamics in the Lapa Grande State Park, MG, Brazil. Anais da Academia Brasileira de Ciências. 91 (02):16

- Chu, C., & Meng, H. (2006). Ecology migration and sustainable development of economy in Inner Mongolia Autonomous region. Res. Agric. Mod, 2(005).
- Blakes, G. (1922). The Mandates of the Pacific. Foreign Affairs. 1 (1): 103. doi:10.2307/20028201. JSTOR 20028201.
- Crocombe, R. (2007). Asia in the Pacific Islands, Replacing the West. University of the South Pacific. 623 pp.
- Dickinson, F. (2013). World War I and the Triumph of a New Japan, 1919–1930 (Cambridge University Press, 2013)
- Fan, M., Li, W., Wei, G., & Luo, F. (2015). Tourism impacts on indigenous pastoral communities in China. Rangeland Ecology & Management, 68(1), 86–91.
- Fernandez-Gimenez, M. (2000). The Role of Mongolian Nomadic Pastoralists' Ecological Knowledge In Rangeland Management. Ecological applications, 10(5), 1318–1326.
- Geels, F. & Schot, J. (2007). Typology of sociotechnical transition pathways. Res. Policy 36 (3), 399–417. https://doi.org/10.1016/j.respol.2007.01.003.
- Ishikawa, E. (1987). Oseania Sekai no Dento to Henbou (Tradition and Transformation of the World of Oceania). Tokyo: Yamakawa Shuppansha
- Izawa, A. (2000). Condition for Existence of Fresh-Tuna exporting industry. Seikei Kenkyu, 74: 91–108
- Iida, A., Osawa S. & Ishikawa, M. (2011). A study on the past and present conditions of the development sites of the Japanese colony in Micronesia – A case study at the plantations and the bauxite mining lands the Babeldaob Island, the Republic of Palau. Journal of the City Planning Institute of Japan 46(3): 319–324 (In Japanese with English Abstract).
- Karpouzoglou, T., Dewulf, A., Perez, K., Gurung, P., Regmi, S., Isaeva, A., Foggin, M., Bastiaensen, J., Van Hecken, G., Zulkafli, Z., Mao, F., Clark, J., Hannah, D. M., Chapagain, P. S., Buytaert, W., & Cieslik, K. (2020). From present to future development pathways in fragile mountain landscapes. Environmental Science and Policy, 114, 606–613. https://doi.org/10.1016/j.envsci.2020.09.016
- King, T. (2017). The Islands of the Japanese Mandate in 1937. TIGHAR.
- Leach, M., Scoones, I. & Stirling, A. (2007). Pathways to Sustainability: An Overview of the STEPS Centre Approach. Brighton, UK.
- Li, Y., & Li, W. (2015). China's rangeland management policy debates: What have we learned? Rangeland Ecology & Management, 68(4), 305–314.
- Makino, M. (2011). Fisheries Management in Japan. Its institutional features and case studies. Ed. Noakes, D. Fisheries & Wildlife Department, Oregon State University, Corvallis, USA. Volume 34. Doi 10.1007/978-94-007-1777-0
- McDowell, C., & De Haan, A. (1997). Migration and sustainable livelihoods: A critical review of the literature.
- Merchant, C. (1987). The Theoretical Structure of Ecological Revolutions. Environmental Review. 11(4): 265–274
- Merchant, C. (2010). Ecological revolutions: Nature, gender, and science in New England: Univ of North Carolina Press.
- Mita, T. (2001). Japan's development assistance in the Republic of Palau: Community Impacts and Effects. Thesis for the degree of Master of Arts in Pacific Islands Studies. University of Hawai'i. 164p.
- Mita, M. (2009). Palauan Children under Japanese Rule. Senri Ethnological Reports. 87: 1–20.
- Micronesia Area Research Center. (1986). An Oral Historiography of the Japanese Administration in Palau.

Guam: Micronesia Area Research Center, University of Guam.

- Myers, R & Peattie, M. (1984). The Japanese Colonial Empire, 1895–1945. Princeton University Press. ISBN 9780691102221.
- Nilsson, C. & Grelsson, G. (1995). The Fragility of Ecosystems: A Review. Journal of Applied Ecology, 32(4), 677–692.
- Peattie, M. (1988). Nan'yo: The Rise and Fall of the Japanese in Micronesia, 1885–1945. Pacific Islands Monograph Series. Volume 4. University of Hawaii Press. ISBN 0-8248-1480-0.
- Peattie, M. (1992) Nan'yo: The rise and fall of the Japanese in Micronesia, 1885–1945. Tokyo: Iwanami Shoten. Summarized and translated by Masaaiki Gabe. Honolulu: University of Hawaii Press.
- Rinaldi, R. (2009). Painted stories that tell of gods, legends, fishing, wars, hunting etc., found on inside and outside walls and on beams of bai (men-houses) in Palau. Nature picture library. https://www.naturepl.com/stock-photo-palau-nature-image08116324.html
- Ross, J. (1994). Empirical analysis of the fragility of the natural and anthropogenic environments. Revista do Departamento de Geografia FFLCH-USP 8:63–74
- Yan, T. & Qian, W. (2004). Environmental migration and sustainable development in the upper reaches of the Yangtze River. Population and Environment, 25(6), 613–636.
- UNCCD (United Nations Convention to Combat Desertification). (1999). Secretariat for the Convention to Combat Desertification, Bonn.

# 上智地球環境学会

1．設立主旨

持続可能な地球社会システムを形成するために、社会科学、人文科学そして自然科学の成果を総合した地球環境学の創成と発展の必要性が今日誰の目にも明らかになってきています。上智地球環境学会は、これに貢献するために研究者の知的コミュニケーションと人的ネットワークの形成およびそれを基礎にした、研究と人材育成のダイナミックな展開を目的として発足しました。自由でオープンな議論、自立的な研究の相互依存、琢磨によって新しい文明創造的な場を広く提供していきます。

2．学会の活動

(1) 定例研究会の開催
(2) 研究紀要『地球環境学』の発行
(3) ディスカッションペーパーの発行
(4) その他

3．構成メンバー

(1) 地球環境学研究科　専任教員
(2) 地球環境学研究科　大学院生

**地球環境学　No. 17**

2022年3月26日 発行

発　　行　上智地球環境学会
〒102－8554
東京都千代田区紀尾井町 7－1
Tel. 03－3238－4176
上智大学大学院　地球環境学研究科
URL: https://www.genv.sophia.ac.jp
上智大学地球環境研究所
URL: https://dept.sophia.ac.jp/is/risgenv/

印 刷 所　株式会社 白峰社

ISSN　1880 － 7143