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RESEARCH NOTE

Seeing the forest for the trees? An exploration of the Miyawaki forest method in the UK

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ABSTRACT

The "Miyawaki forest" is described as a dense, fast-growing and biodiverse native forest. It is based on afforestation management methods pioneered by Dr Akira Miyawaki in the 1970s. The "Miyawaki Forest method (MFM)" relies on intensive ground preparation and dense tree planting from the onset, a system that claims to enhance tree growth and be biologically richer than other afforestation techniques. Applied in urban environments, it claims to reconnect people with nature and enhances human wellbeing. It has recently been introduced in Western countries culminating in hundreds of recent MFM tree planting projects in the UK dating from 2020 onwards. However, there is very little accompanying research investigating how feasible and applicable MFM is in the UK context. This paper addresses this gap by ascertaining the knowledge of, and attitudes towards, MFM of a small sample of professionals and practitioners ($n = 12$). The results showed how those opinions varied on the potential of applying the method in a temperate climate. Half the interviewees supported using MFM in practice and there was broad support for its application in specific urban landscapes, including school playgrounds and pocket parks. Cost was seen to be an important factor with perceived high initial costs and high tree mortality through competition. Interviewees did not consider MFM to be feasible in rural areas. Interviewees agreed that the MFM could be useful for ecosystem services such as carbon sequestration and storage, flood management and connecting people to nature, but they also called for more, and longitudinal, research into the method to fully understand its suitability in the UK.

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Miyawaki forest method; tree planting; climate change; forestry; native and non-native tree species

Introduction

Forest ecosystems are considered to be one of the most powerful and critical livelihood-supporting systems on the planet, providing enormous benefits (Balderas Torres et al., 2015; R. Wang et al., 2002). They are rich in biodiversity, important in combating climate

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change (European Commission, 2022); globally, forests store 2.4 billion tonnes of carbon per year (Pan et al., 2011). However, forests are rapidly disappearing around the world. Since the last ice age, the world has lost a third of its forest, equal to an area twice the size of the USA (Kump, 2004; Ritchie & Roser, 2021).

Forest restoration is therefore being encouraged to meet carbon sequestration targets (Keenan, 2015; Stanturf et al., 2014). The Miyawaki Forest method is an afforestation method developed in the 1970s by Professor Akira Miyawaki, inspired by the Japanese temple sacred shrine forest (Chinju-no-mori) (Miyawaki, 1993; Rots, 2015). It is based on the principles of successional vegetation ecology and potential natural vegetation generation, where vegetation occurs in a specific area without human interference (Chiarucci et al., 2010; Tüxen, 1956). MFM emphasises and advocates using trees native to an area to replicate natural forest regeneration processes (Miyawaki, 1993, 1998; Webber, 2022). This technique is claimed to create local forests at a fast speed compared to conventional tree planting (Lu et al., 2011; Riyas, 2022). Trees planted using MFM are claimed to require a short establishment time, low costs and easy management, to create a natural ecological environment with a complete community structure, rich forest structure, and species diversity (Lewis, 2022; Miyawaki, 1993).

Before planting a Miyawaki forest, it is necessary to identify the local dominant tree species, the quality of the soil and the range of indigenous tree species (R. Wang et al., 2002). MFM requires high density and mixed planting. The depth of the planting area should be 0.5–1 m, with well-drained topsoil planted with saplings with well-developed root systems, which are 30–50 cm in height, preferably with 5–8 leaves, and planted at a density of 2–7 trees/m^2 (X. Wang & Xu, 1998; R. Wang et al., 2002). This all contributes to considerably shortening the establishment time-period (Cárdenas et al., 2022). The input costs for a Miyawaki forest are claimed to reduce as each successive year passes (Species tree munnar, 2021). MFM maintenance (i.e. watering and weeding) stops three years after planting.

In the last 50 years, MFM has been implemented in over 3,000 projects worldwide, particularly in Japan but also in other Asian and American countries, with apparently overwhelmingly positive results (Miyawaki, 1989, 1999; Webber, 2022). There are approximately 900 projects in Japan cultivating 90 million trees (The Naturals, 2014; Suzuki, 2022). MFM has also been applied in Brazil and Chile for lowland tropical forest restoration, Malaysia to address damage to local tropical rainforests, and India to improve deteriorating air quality and address declining tree cover (Miyawaki, 1989, 1999). It is perhaps unsurprising that the idea has been exported to Europe, with MFM planting found here since 2015. The first Miyawaki forest in the UK was planted in 2020, partly driven by political interest in MFM in England via a Government-funded project (Trees Outside Woodlands) including pilot projects in Kent and North Norfolk.

Proponents of Miyawaki forests, including Earthwatch Europe (which plant the MFM-inspired (and trademarked) "Tiny Forest" in the UK), Afforestt and Boomforest, argue that they offer numerous benefits including carbon sequestration and storage, rainwater interception, noise abatement, habitat for wildlife, as well as a number of soil-related benefits including pollution abatement and preventing erosion and flooding (Lu et al., 2011; Riyas, 2022). There is however a lack of empirical data on how it is currently being applied in the European/UK contexts, and to what extent they achieve the aforementioned benefits. There are claims that MFM is a cost-effective method of establishing forest (Singh & Saini, 2019),

while others describe it as an expensive, manually and labour-intensive effort because MFM establishment generally requires substantial pre-planting soil preparation and dense-placement of new plantings (Taylor & Lovell, 2021; Vashisth, 2019). There are no research data to date comparing the costs of MFM with other tree planting approaches.

The practice of MFM is therefore ahead of research in Europe and the UK, resulting in a number of Miyawaki forests having been planted without underpinning research. This paper aims to address the gap in knowledge through a small-scale study exploring the feasibility and application of the MFM in the UK.

Materials and methods

As an initial exploration into the state of knowledge in the UK, the perceptions of 12 professionals and practitioners working in UK forestry were gauged through semi-structured interviews (Savin-Baden & Major, 2013), as part of a postgraduate research study. Respondents, who did not necessarily have previous knowledge of the MFM, consisted of academics (coded as AC-1, 2 and 3), landscape architects (LA-1 and 2), commercial tree managers (CTM-1 and 2) and non-governmental organisations (NGO-1, 2, 3, 4, and 5; Table 1).

The interview questions were designed to capture participants' perceptions of the MFM and its perceived barriers and catalysts. The professionals interviewed work in forest research, tree planting and management practice with an average of 20–35 years' experience. These in-depth interviews which lasted around 30–60 minutes either online or in person between Sept-Nov 2022, were digitally recorded and transcribed (Jupp, 2006). The interview comprised semi-structured questions within an interview "guide", employed to enable the interviewer to have flexibility in terms of order and wording of questions (Bryman, 2022). Questions were organised around the following topics: I) What tree species should be included in MFM planting in the UK? II) How acceptable and feasible is the MFM in the UK? III) Where would you consider planting the Miyawaki forest (urban or rural or more specific)? IV) What are the potential benefits and constraints of the MFM? Questions were accompanied with a brief introduction to the MFM for interviewees who were not familiar with this method. The majority (9/12) lived and

Table 1. Information on interviewees.

Code	Affiliation	Position	Gender	Already familiar with MFM	Experience of using MFM
AC-1	University	Lecturer	F	Y	N
AC-2	University	Lecturer	M	N	N
AC-3	University	Professor	M	Y	N
LA-1	Landscape company	Landscape Architect	F	N	N
LA-2	Botanic Garden	Director	M	N	N
CTM-1	Conservation charity	Project manager	M	N	N
CTM-2	Community forest charity	GI planning manager	M	Y	N
NGO-1	Environmental charity	Research lead	M	Y	Y
NGO-2	Environmental charity	Senior researcher	F	Y	Y
NGO-3	Plant industry	Director	M	N	N
NGO-4	Horticultural industry	Manager	F	N	N
NGO-5	Conservation sector	Director	M	Y	Y

worked in the urban context, which is where MFM has been largely implemented in the UK. Six interviewees had not heard of MFM before the interview.

Results

We asked respondents about where MFM could be applied in the UK. Half the interviewees considered location as important in the potential acceptance of the MFM for both tree survival and to maximise the benefits they bring. Most (10) interviewees responded that MFM could be implemented fully, or as an experiment, in urban areas (Table 2). Interviewees explained how they had concerns about disruption to the existing ecosystem in the rural environment if new methods of tree planting such as MFM were introduced. This is also reflected in two interviewees only considering the MFM as potentially acceptable in both urban and rural contexts in the UK (AC-2 and NGO-2):

> "So as long as you're choosing species that are right for that area, as long as you are not planting in areas within a certain distance from sites of special scientific interests (SSSI), I don't see why the method would be inappropriate." (NGO-2).

In urban areas, the most recommended locations are those close to educational or health facilities (Table 3):

Table 2. Perception of the acceptability of where Miyawaki forests could be planted.

	Urban	Experiment in Urban	Rural	Don't know
AC-1		✓		
AC-2	✓		✓	
AC-3		✓		
LA-1	✓		✓	
LA-2		✓		
CTM-1	✓			
CTM-2	✓			
NGO-1		✓		
NGO-2	✓		✓	
NGO-3				✓
NGO-4				✓
NGO-5	✓			

Table 3. Perceptions of the potential location of the Miyawaki forests.

	School	Hospital	Park	Residential	Unused farmland
AC-1			✓		
AC-2					✓
AC-3	✓		✓		
LA-1					
LA-2					
CTM-1	✓				
CTM-2					
NGO-1	✓		✓	✓	
NGO-2	✓		✓		✓
NGO-3			✓	✓	
NGO-4					
NGO-5	✓	✓			

> "There can often be a small patch of forest that connects the school or university to the local community or hospital, for example, and I think those are the spaces where potentially there's the opportunity to use the Miyawaki method." (NGO-5)

Other interviewees highlighted its potential for planting along highways:

> "If you think about our highways, with large expanses of grass, it is pretty low maintenance. It doesn't really support a lot. We talk a lot about creating these biodiversity highways where life can sort of travel across the town or a city, or around it. And I think for me, Miyawaki potentially could be that." (NGO-3)

Regarding rural settings, two respondents discussed how the Miyawaki forest could be considered for disused farmland. They attributed this potential to the constraints in urban areas by existing land uses and values: as there is more land in the countryside, there is more potential for afforestation in rural areas.

> "We have an awful lot of agricultural lands in the UK. If [Miyawaki style] forest planted, basically the land will be financially viable again. I think that could work really well." (LA-1).

Perceptions of what tree species should be planted in a Miyawaki Forest in the UK

All interviewees agreed that native tree species (NT) should be dominant in tree planting projects in the UK, stating that many English councils and local ecosystems demand NT species. Seven interviewees said that their organisations currently only plant NT species (NGO-1 -5, LA-1 and CTM-1). Three interviewees (AC-1, AC-2 and CTM-2) referred to a need to consider non-native tree species (NNT) as well as NT species:

> "… There's not a huge range of [tree] species [in England] … the other thing that complicates this now is the impact of climate change. And that means the list of native tree species will change. It's more likely that there is going to develop a balance between native and non-native planting … to give better adaptability to climate change." (AC-2)

In relation to rural environments, respondents were more likely to consider the need for native only tree planting due to the natural ecosystem in rural settings.

> "Our definition of native is quite strict, particularly for the rural setting, it's the Woodland Trust definition of 'native', which is that they were in the UK just after the last Ice Age." (NGO-2).

However, when considering urban environments, most respondents considered that the selection of tree species could be extended to NNTs to create diversity. As interviewees (AC-1, NGO-2 and NGO-4) said:

> "We get more and more ornamental planting in urban areas, such as Magnolia, Liquidambar and Rhododendron trees, which are not native species to the UK." (NGO-4)

All respondents reported seeing the effects of climate change on trees in their current practice and commented on how species selection plays into this.

> "Maybe put 5% to 10% non-native into the planting based on our current understanding of climate change, and tree resilience." (NGO-3)

While all interviewees reported being aware of looking at climate resilient species, such as French or Italian tree species, they did express that knowledge is incomplete:

> "We should not be introducing non-native without more study, because there's a lot we don't understand. We believed that was a correct approach 100 years ago of using fertilisers and chemicals. Now we understand this is not the correct approach. And it's the same for all these up-to-date ideas about tree species." (CTM-1)

Perceptions of the acceptability of MFM in the UK

We applied conceptual definitions of acceptability and feasibility from Johnson et al. (2020). They define acceptability as stakeholder expectations, including perceptions of advantages and disadvantages, stakeholder and public benefits. Results show that participants consider acceptability to be largely related to popularisation and communication, location selection and potential benefits MFM could bring.

Half the interviewees highlighted that for MFM to be accepted by the public, the method would need to be explained and well introduced clearly.

> "If we can make everyone talk about it, it is good because we get more people to talk and then think about planting and nature. It doesn't make the method right or best; it just makes the method spread. So, propaganda is essential." (CTM-1)

Potential benefits of the MFM

Interviewees agreed that the MFM has social and ecosystem benefits. Firstly, it can bring education and mental health benefits through engagement with, and communication of, the Miyawaki tree plantings.

> "… it's a great opportunity for school pupils to learn about the ecosystem service benefits of woodlands." (NGO-5)

Other reported ecosystem benefits include flood mitigation:

> "They [Miyawaki forest] store carbon in the tree itself, but it can also benefit the environment into the flood mitigation, in terms of slowing water flow and that type of thing improve these ecosystem services". (CTM-1)

carbon sequestration and thermal comfort,

> "We know it's never going to solve the climate crisis, but we want to understand how they are cooling and capturing carbon, so we can use that as a tool…" (NGO-1)

and also creating an opportunity for citizen science.

> "It provides the opportunity for citizen science. So, whether that's to engage schoolchildren or local volunteers, it provides the opportunity to connect them to that space, to create a sense of ownership." (NGO-5)

LA-1 thinks a major factor will be the speed of the establishment of the Miyawaki forest.

> "I think the main thing with MFM is the speed at which you'd see change … you're not going to have to wait 15 or 20 years for any kind of meaningful research when the landscape could be completely different. I think that is a unique attribute, particularly in the realms of tree planting." (LA-1)

Other interviewees (AC-3 and LA-2) highlighted the need for evidence that MFM will be ecologically valuable in the UK context.

> "There are claims it's good for biodiversity and carbon capture. I think these would need to be tested and verified in the UK." (AC-3)

NGO-3 mentioned the indirect economic benefit, particularly in an urban environment as greener areas will attract locality investment in premises and businesses, then directly and positively impact house prices, as a knock-on effect.

> "If Miyawaki forests enable the engagement with green spaces in a more productive and more diverse way, then it can be part of that economic enhancement."

Perceptions of the feasibility of MFM in the UK

Assessing feasibility calls on an evaluation of skills and knowledge of people, financial and management resources to determine the viability of a strategy in practice (Johnson et al., 2020). In this research, space, density, safety and costs are the main concerns raised by interviewees which could influence the feasibility of its application in the UK.

AC-1, NGO-1 and NGO-5 referred to a lack of publicly owned space in urban areas with space for tree planting due to competition for land as this comment demonstrates:

> "The number of parks and open spaces available to us to plant on now is diminishing rapidly. So, our first objective really is to try and find any public spaces left that are appropriate and suitable for planting trees and woodlands on. The key thing really is for us to work very closely with the local authority partners." (NGO-1)

AC-3 and CTM–2 said the high density of the Miyawaki forest would make it look chaotic and unmanaged, resulting in low aesthetic value.

> "I think it will look a little scruffy, people think it looks like a muddy pitch with a few weeds in it, which might be the pushback because it's not what people expect to see conventionally." (CTM–2)

NGO-1, NGO-5 and CTM–1 had concerns about anti-social behaviour problems in terms of Miyawaki forest:

> "People could perceive anti-social behaviour. Dense woodland not being managed properly might lead to a perception of an increase to crime, which might make people feel uncomfortable." (NGO-5)

NGO-2 countered this opinion to some degree, stating that anti-social behaviour is not a problem specific to Miyawaki forest:

> "You're going to have anti-social behaviour in a lot of places. It is a common issue for all types of green space, not only specific to Miyawaki forests." (NGO-2)

Almost all (11/12) interviewees considered costs to be an important constraint for applying MFM.

> "I think it's probably more costly, because of the soil preparation and amount of tree whips purchased." (NGO-2)

Statements also focused on it being considered inefficient, with high tree mortality through competition:

> "Trees will compete with each other until finding a happy balance, so you might have five or six out of ten trees die within 10 years. That's quite expensive and you're buying inefficiency." (AC-2)

When discussing the costs with interviewees who have experience of planting Miyawaki forests, they stated that it requires 3–4 times the budget of traditional tree planting, including soil preparation which can be expensive, particularly in urban areas.

> "The urban land could also be in a bad state and compacted commonly, so preparing and digging the soil in the planting area is costly. And the amount of saplings needed are expensive, which could stop us thinking about using this method for tree planting." (NGO-1)

LA-2 thinks Miyawaki forest is a novel and expensive "product" to be sold and bought:

> "Because it starts with a trademark. I don't think you need to trademark a method for planting trees."

However, AC-2 indicates that MFM could save money, in terms of looking at the establishment costs over the long term.

> "You can get very significant discounts when you buy trees in large quantities, and after three to five years, it is basically free from maintenance."

Discussion

Do professionals support the application of MFM in the UK?

MFM is increasingly adopted in urban forestry programmes around the world and it could be potentially a way to fulfil the tree planting targets (Thornton, 2020), but there is no existing data examining MFM in the UK. This preliminary, exploratory interview data show that professionals hold different attitudes towards acceptance, with general support for applying MFM in urban, not rural, settings. The interviewees were relatively positive about the potential public acceptance of MFM, which contrasts with their own, professional, attitudes towards the feasibility of the MFM in the UK which were less positive. Only half the interviewees support using the MFM in practice. As professional perceptions inform decisions made about public spaces (e.g. Nam & Dempsey, 2019), the less supportive perceptions of professionals could constitute a barrier to exploring the application of MFM in the future UK. Forthcoming research by the authors will explore this further.

What tree species should be planted in Miyawaki forests?

The interviews suggest that academic researchers and NGO representatives interviewed seemed more open to the planting of NNT species in urban settings in the UK than commercial tree managers and landscape architects. This empirical data challenges

insights of previous studies which only advocate and use NT species (Miyawaki, 1993; Ottburg et al., 2018) which is how MFM has been approached in the UK to date. One suggestion was that the proportion of NNT species in the MFM could be up to 10% in rural settings and a higher proportion in urban settings.

The results, therefore, suggest that professionals are mindful that NNT species should be considered in tree planting to mitigate climate change. This corresponds with Hoyle et al. (2017) whose research reported widespread public support for planting NNT, "climate-ready" tree species to parks and gardens in the UK. Researchers in the US and the UK are conducting future climate modelling studies to identify "climate-ready" tree species, which are not limited to NT species (McPherson et al., 2018; Watkins et al., 2020). This points to the need for more research to be conducted, into future projections of species distributions and species tolerance, that could better adapt to climate change. There is also a need for research to explore the extent to which climate change may be a major driver of acceptance of NNT planting amongst professionals and the public in the future.

Is MFM an expensive tree planting method?

Almost all the interviewees considered MFM to be more expensive to establish forest than conventional tree planting concurring with some existing research (Crowd Foresting, 2022; Vashisth, 2019), in terms of sapling purchase, soil preparation and maintenance. Interviewees stated that the perceived high costs involved in MFM is the main reason why the professionals, who might initially consider applying this method, would ultimately withdraw. However, it should be noted that interviewees generally only drew comparisons between upfront establishment costs and therefore consider the MFM is expensive. They did not refer to results, in terms of survival rates, one commonly used indicator of early success, and the non-monetary benefits that brings, which are also critical to the economic and environmental success of reforestation (Le et al., 2012; Preece et al., 2023). For instance, the survival rate in a conventionally planted forest is about 65% compared with claims of 90% in a Miyawaki forest after its establishment. Thus, the perceived difference in costs may be differently understood by doing a comprehensive comparison of these factors. As yet, it is unclear if the overall costs of the MFM is more expensive than other planting methods in the UK context and indeed if survival rates of MFM planting is higher than conventionally planted trees. More research is therefore needed to address this issue.

Limitations of the study

This study provides a snapshot from a small sample and does not capture the perceptions of professionals from a wide range of disciplines. Most of the interviewees live and work in urban areas, and most of the MFM planting in the UK are based in urban settings. It is therefore important to balance interviewees from urban and rural forestry in further research to gain a more comprehensive understanding of perceptions of MFM and its feasibility in future tree planting. In addition, the issue of location was not fully explored in the interviews, and a questionnaire survey will be conducted in follow-up research to explore this in more detail.

Conclusion

This small-scale, exploratory study has shown that there is a lack of awareness of the MFM in the UK despite its political support, which reflects the importance of this research in exploring the feasibility of the MFM and obtaining initial data about professionals' perceptions. This is an important starting point for further exploration of Miyawaki forests in the UK. It is currently unclear what the implications of this potentially costly tree planting method might have on widespread uptake, given its political support. There is also a need to explore survival rates and how the public perceive the MFM in the range of settings in which it has already been applied. This requires more research which this team of researchers will be undertaking.

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Author contributions

Hanyu Qi conceived the ideas, designed methodology, collected and analysed the data, wrote, reviewed and edited the manuscript.

Nicola Dempsey conceived the ideas, designed methodology, wrote, reviewed and edited the manuscript and provided supervision.

Ross Cameron conceived the ideas, wrote, reviewed and edited the manuscript and provided supervision.

All authors contributed critically to the drafts and gave final approval for publication.

Data availability statement

A summary of the results will be placed within the University of Sheffield PhD data repository.

Notes on contributors

Hanyu Qi is a PhD candidate in the Department of Landscape Architecture at the University of Sheffield. Hanyu's research interest is about climate change, ecology, forests, and their relationship to human well-being. Specifically, to her project, the topic is: What is the potential trend in forest rewilding? The suitability of the Miyawaki Forest method in the 21st century UK?

Nicola Dempsey is Senior Lecturer in the Department of Landscape Architecture at the University of Sheffield. Nicola is an interdisciplinary social scientist whose research interests are focused on place-keeping: the long-term management of our green and open spaces. This involves examining how relevant policies, strategies and political rhetoric are implemented in urban green and open spaces and experienced by users.

Ross Cameron is Professor in the Department of Landscape Architecture at the University of Sheffield. Ross is a landscape horticulturalist specializing in the use and value of landscape plants. And his current research interests centre around green infrastructure and climate change mitigation, with a strong emphasis on providing recommendations on plant species choice with respect to ecosystem function (city cooling, thermal insulation, flood tolerance, biodiversity enhancement).

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