Agroforestry as nexus of sustainable development goals

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Abstract. Agroforestry, as platform for harmonizing agriculture and forestry in their interactions with landscapes and rural and peri(urban) livelihoods, offers opportunities to benefit from synergies across sustainable development goals (SDGs), and deal with the unavoidable trade-offs. Such synergy, however, may only emerge if site-specific analysis of the multiple functions of landscapes leads to a shared understanding among stakeholders, clear commitment to common goals, effective means of implementation and a system that remains open to innovation by monitoring functions rather than form, and regularly re-evaluates effectiveness of policy instruments.

1. Introduction

If agriculture is primarily associated with Sustainable Development Goal (SDG) 2 'Zero hunger', and forests with SDG 13 'Climate action' and 15 'Life on land', where does 'agroforestry' belong? It is best seen as nexus (point of confluence of relations) of all sustainable development goals that deal with the rural and peri-urban landscapes that have come to dominate the world in the Anthropocene (Figure 1). As argued elsewhere [1], in its fifth decade agroforestry can be a drive to greater policy synergy between technologies, landscapes, rights and markets to achieve restoration of multifunctionality in a Sustainable Development Goals (SDG) context [2]. This agroforestry concept builds on and coexists with earlier ones that focus at plot, farm and landscape-level interactions between trees, crops, livestock, and farmer management, knowledge, values, incentives and intentions.

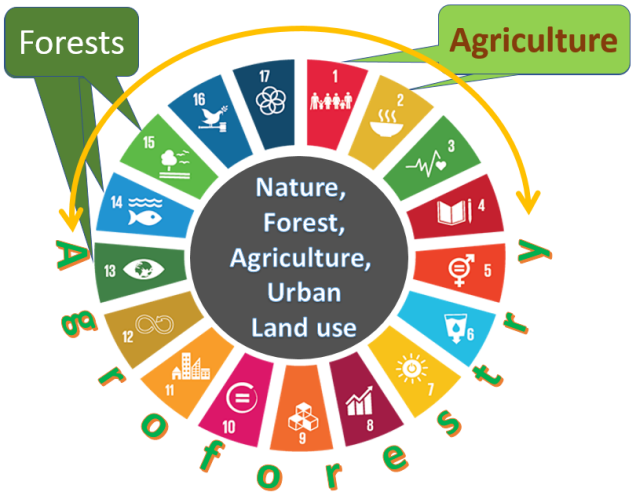

Figure 1. Agroforestry as interface of specific concerns of 'Agriculture' and 'Forestry' with wider perspectives on rural and peri-urban livelihoods and landscapes as reflected in the 17 Sustainable Development Goals (SDGs)

Sustainable development pathways need to provide for the basic ***securities*** (reliable clean water, adequate amounts of healthy food, a healthy environment, reliable energy supply, protection from 'natural' disasters; SDGs 6, 2, 3, 7, 9), provide ***job*** opportunities to escape poverty through education (SDGs 8,1,4), but also allow human ***identities*** to be expressed, by reducing inequalities, supporting a fairer balance between responsible production and consumption, securing rights and increasing the transparency and accountability of governance (SDG 5, 10, 12, 16), while re-investing in the worlds' ecological infrastructure (SDGs 13, 14, 15), within an international framework of shared responsibility and means of implementation (SDG 17). A tall order, but overcoming the traditional gap between agriculture and forestry can smoothen the emergence on a realistic perspective on the continuum of tree cover in multifunctional landscapes. With more than 40% of the worlds' agricultural lands having at least 10% tree cover [4], there is a substantial geographical variation in the types of intermediate tree-cover that fall between agricultural and forestry concepts of 'segregated' land use [5, 6].

In this contribution to the public debate, we will start from the high-level ambitions to reconcile development and environmental sustainability in the Anthropocene, consider the way bottom-up and top-down perspectives on value chains and restoration need to be reconciled, before exploring water as an important part of the SDG nexus. The final section will discuss four dimensions of linking knowledge and action in AF research, education and capacity development.

2. Sustainable development in the Anthropocene

The SDG framework builds on the earlier Millennium Development Goals, in which environmental issues were largely an 'add-on' (to which agroforestry was actively contributing [7]). The challenges of reconciling human ambition for resource appropriation with what the earth system can support, within 'planetary boundaries' [8], calls for an updating of the IPAT (Impact = Population * Affluence * Technology) equation incorporating life-style choices, waste reduction and contributions of Nature to quality of human life based on a range of ecosystem services (Figure 2).

Agroforestry discussions can no longer be restricted to the land use box without connecting to the chains of value (or waste), consumption and wellbeing that link 'Nature' to 'People'. With global trade in products of agriculture and forestry an important driver of land use change [9], governance needs to understand the multiple 'tele-couplings' of local decisions to consequences elsewhere [10], and an SDG-

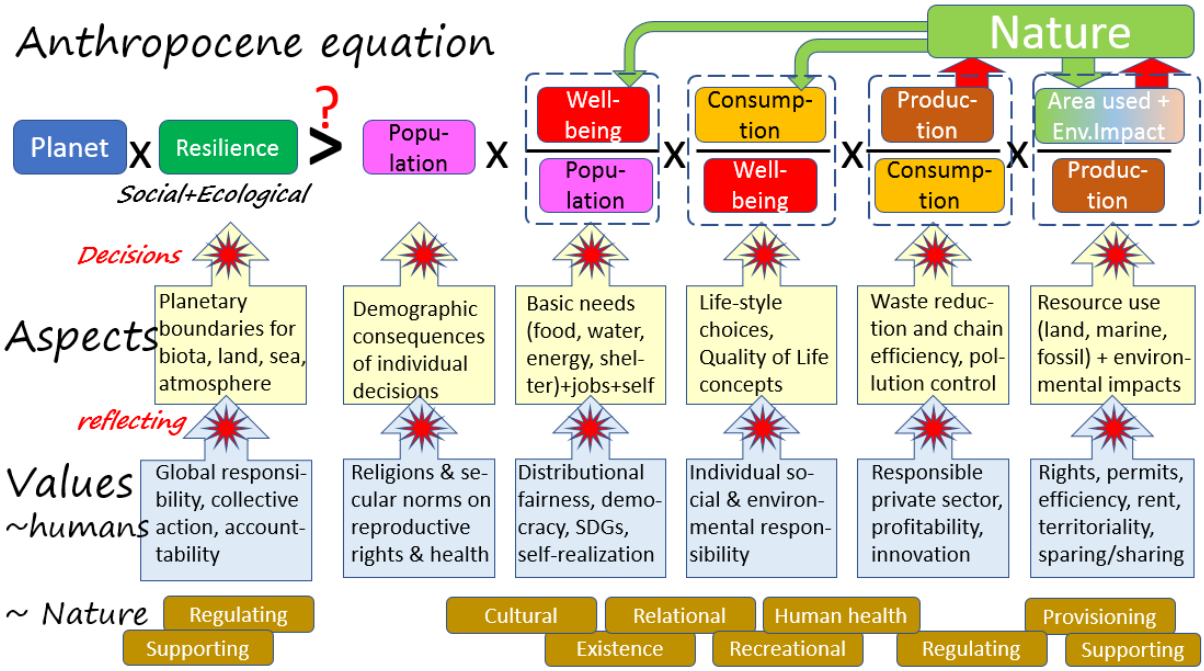

Figure 2. Balancing act between the planetary boundaries and human ambitions for resource appropriation [3]

relevant agroforestry agenda cannot restrict itself to the 'supply' side of land use practices [11], but needs to include the wider aspects of quality of life (human wellbeing), expressions of consumer responsibility [12], life-styles and abolishment of the concept of 'waste'. Resilience in the face of increased climatic variability requires more 'buffered' systems at all scales – and as such forms a new reason for interest in what agroforestry land uses have to offer.

However, although the Anthropocene Equation may summarize some of the most pressing issues of this time, decisions are made every second by millions of individuals that add up to the overall effects, but that are not explicitly considering all consequences (if they would have to do that, no decision might ever be made, which might be worse…). We may only hope that the more aggregated public policy decisions will be stimulated by the SDG agenda to become more coherent. Public/policy decisions follow their own dynamic, however, and have been analysed as 'public issue attention cycles' [12, 13]. They involve five recognisable stages: A) Agenda setting, B) Better and widely shared understanding of what is at stake, C) Commitment to principles, D) Differentiated responsibility in practice, devils in the detail derailing operations, devolved to (newly created or existing) formal institutions that handle implementation and associated budgets, and E) Efforts to monitor and evaluate effects. Progress markers for the various dimensions of this cycle have been proposed but remain to be tested and refined on issues related to agroforestry [13].

While there is growing recognition of the relevance of forms of agrofor4stry for global agendas on biodiversity (SDG15) [14,15] and climate change (SDG13) [16], the real challenge still is connecting the bottom-up aspects on how land use decisions are made (tree by tree, plot by plot, landscape by landscape) with the top-down perspective of national policy instruments and global negotiations and agreements.

3. Connecting bottom-up and top-down perspectives on sustainable development

Sustainable development hinges on production per unit consumption (reducing waste across all stages of value chains and ensuring that all waste returns to biological cycles at desirable locations, rather than in dumps), and on the area used + environmental impacts per unit production. There is a long-standing debate on what type of intensification of land use is the most desirable, in terms of reducing the area used and/or reducing the environmental impacts per unit land [17]. The debate has received new global attention under the heading 'agro-ecology' [18, 19]. With Land Equivalent Ratio's (LER) of up to 1.8 as found to be feasible for smallholder teak-maize systems [20], agroforestry has an important role to play in a 'sustainable intensification' debate, once not only the farmer but also the policymakers realize that this should not be addressed for one commodity at a time, but in a more holistic way, including all

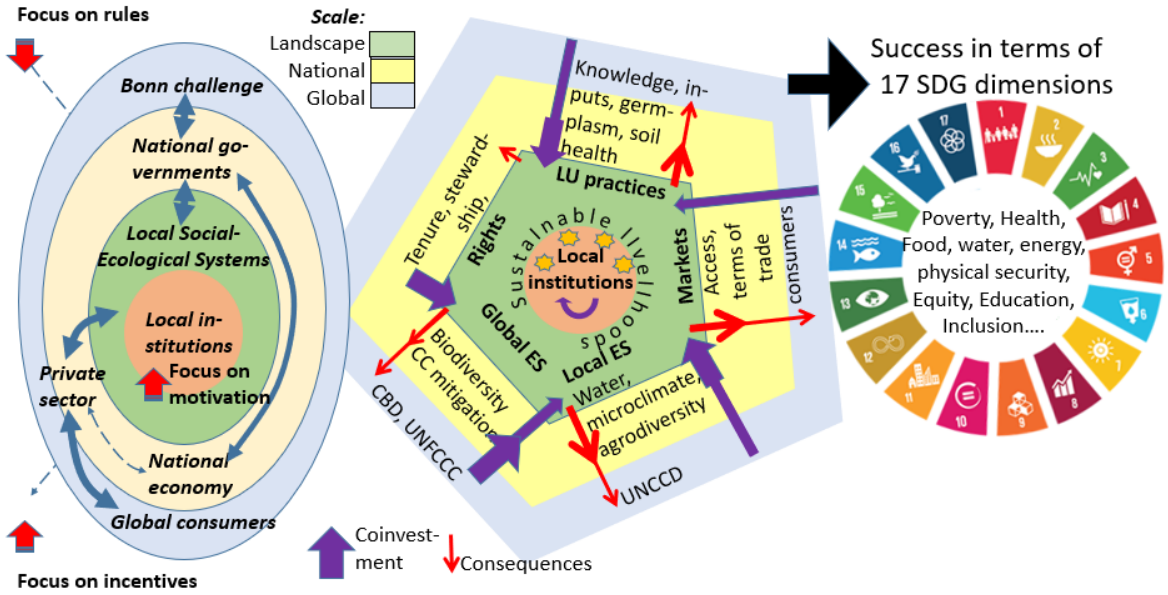

Figure 3. Linkage of global concerns to local change in land use can start from rules, incentives or motivation (left panel), but to be effective it will need to address all sides of the pentagon (middle panel) and be directed towards the totality of 17 SDGs [3]

products and services demanded by society at large. Top-down views tend to focus on rules, while bottom-up ones seek economic incentives. The two can be combined by 'rules on incentives' or 'incentive-based rules', also known as 'Payments for Ecosystem Services (PES) (Figure 3). Rather than being a one-size-fits-all solution for internalizing environmental impacts of land use decisions for 'downstream' (both literally and used as metaphor) stakeholders, PES has in practice evolved to a more sophisticated concept of 'coinvestment' [20,21]. In coinvestment (Figure 3) rights (tenure, stewardship), technical know-ledge and inputs for improved land use practices, markets for inputs and outputs interact with the environmental services within a landscape (often focused on water), and those with global relevance (climate and biodiversity). There are good reasons why the majority of current PES-style application focus on water [22].

PES in its original definition and form has often been seen as a 'commodification' of ecosystem services (putting a price tag on them and letting markets balance supply and demand). The closest approximation to this has been achieved in the idea of a 'carbon market', but even there existing commodity markets (including those for palm oil) see more relevance in a 'branding' of their products as 'deforestation free' (whatever that means in reality, [23]) than in paying a price for carbon emissions. Global consumers have responded to the slow emergence of global governance solutions to the pressing problems of out time by seeking a direct influence in the countries that produce the commodities that are the start of global value chains. By threatening with, and partially implementing, boycotts, active consumer groups have induced private sector companies to take their own responsibility (or at least try to be seen to be doing so). Given the physical, cultural and emotional distances involved, the interactions are driven by perceptions that actors on all sides try to influence (Figure 4). Five issues have emerged from this interaction: 1. Optimal intensification (from an integral SDG perspective), 2. Chain responsibility that drives towards vertical integration and excludes smallholder producers, 3. The concept of indirect land use change (ILUC) on top of the responsibility on the producer side to meet emerging standards, 4. A trend from a product-based to a territorial 'juris-dictional' approach, looking for integrated solutions. 5. Ongoing tension between the norms, values and procedures of the World Trade Organization (WTO) and the 'responsible production and consumption' intent of Sustainable

Development Goals 12, leading to a drive for public responsibility and government involvement in ensuring that there is Free and Prior Informed Consent (FPIC) on the producer as well as consumer side.

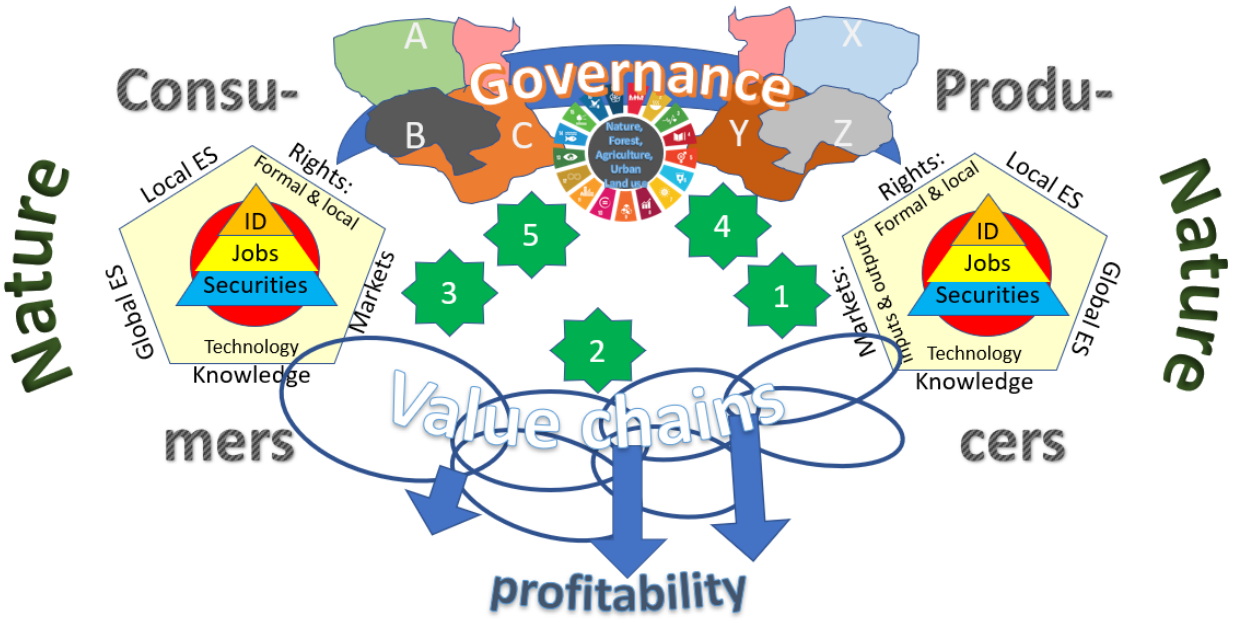

Figure 4. Four-component system view (governance, private sector value chains, producers and consumers) on global trade, with 5 emerging issues discussed in the text [3]

4. Water as nexus

Some of the most direct impacts of global climate change will be through the water cycle (less reliable rainfall, increased frequency of extreme events) that come top of already strong human appropriation of water flows (with irrigated agriculture as the primary consumer). Water (SDG 6) interacts directly with food (SDG2), health (SDG3), energy (SDG7), climate change (SDG13) and life on land (SDG15 and under water (SDG14). The need for protective cover in upper watersheds has been ascertained many centuries ago, but the 'paradise lost' perspective that all problems with water originate in deforestation and can be solved by tree planting, has for the last two decades been competing with concerns about additional water use where fast-growing trees such as Eucalypts are planted in dry environments. New scientific synthesis [24], however, has found a middle ground in a 'full hydrological cycle' perspective where additional water use by trees and forests implies that forests are 'cool' [25], and supports rainfall 'downwind' [26, 27]. The forest-climate discourse, that currently is centred on carbon and greenhouse gasses may well have to be re-interpreted as primarily about water [25, 28]. The meaning of 'forest' in this discourse depends on context, and agroforest and tree cover in agricultural landscapes is likely to be more important than the tree cover as such would indicate (Figure 5). The many functions that the interaction of atmospheric, terrestrial and river sub-systems imply for human wellbeing, lead to a large number of interacting 'ecosystem services', metrics [29] and prototypes for 'coinvestment in environmental stewardship' (Figure 6).

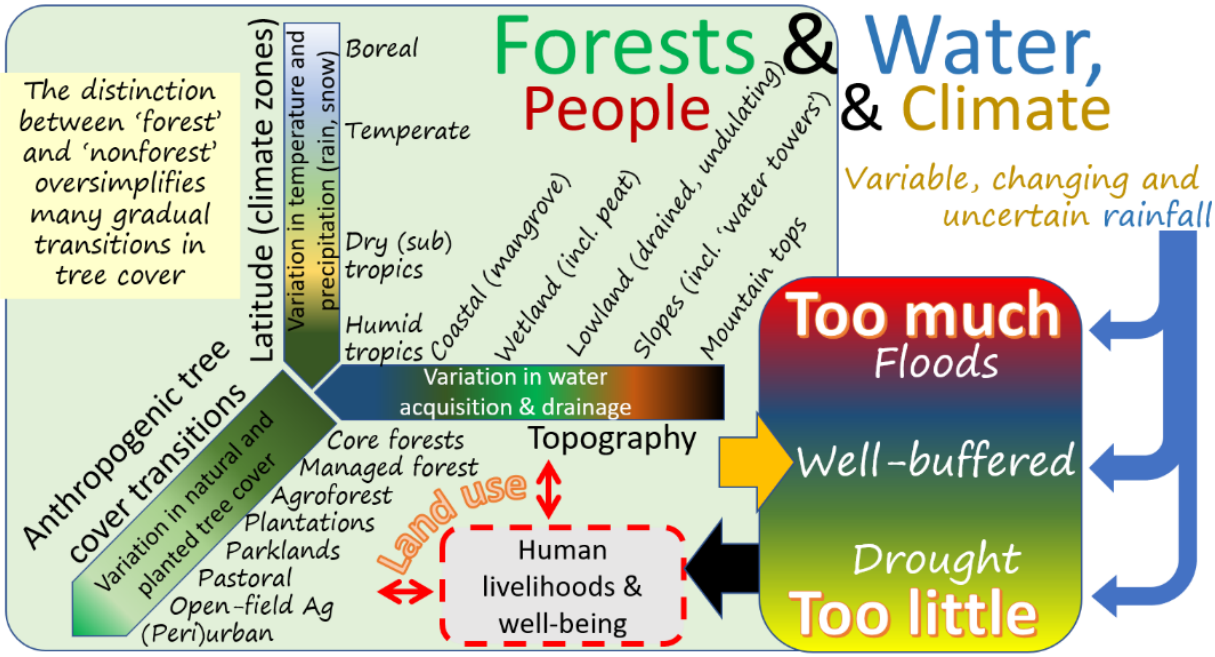

Figure 5. Three main axes of variation that influence biophysical tree-water relations: latitude (climate zone), topography and anthropogenic tree cover transitions, combining to the degree to which variable rainfall is buffered from a human perspective avoiding both situations of 'too much' and 'too little' [28]

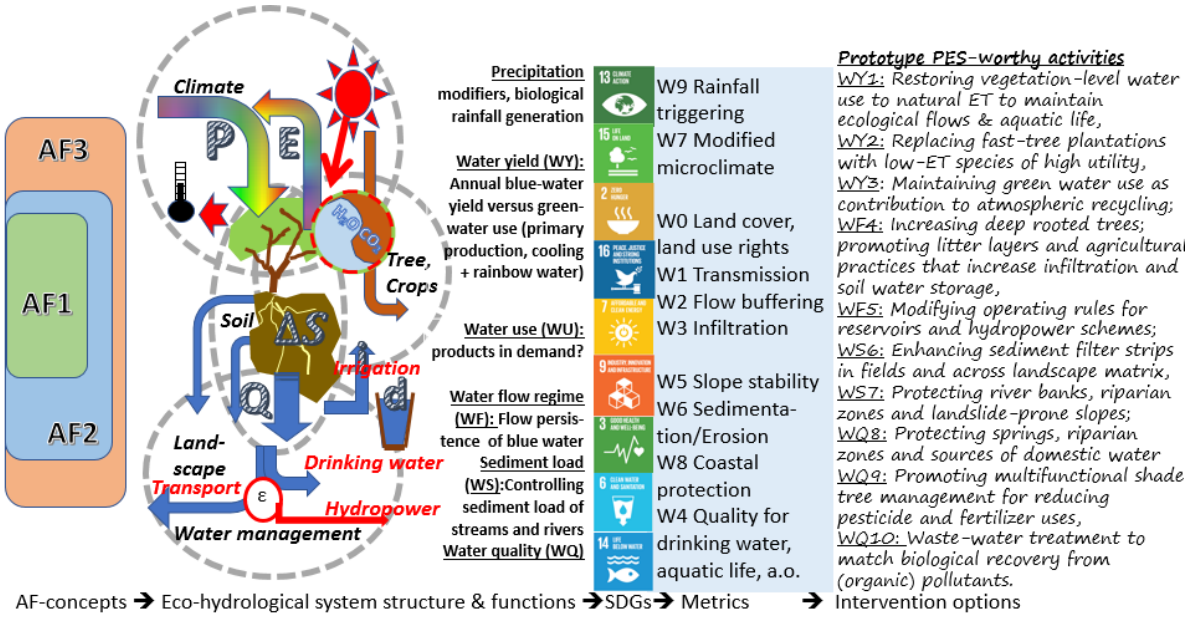

Figure 6. Water, influenced by trees, agroforestry (with its plot/farm, landscape and policy-level interpretations in AF1, AF2 and AF3, respectively) and forests in dynamic landscapes as connector of SDGs, with prototypes of coinvestment in ecosystem services that start to get track records of experience in 'learning landscapes' [29]

5. Linking knowledge and action in AF research, education and capacity development

By interpreting 'agroforestry' as more than a set of plot-level technologies (AF1), and landscape-level search for multifunctionality (AF2), the 'new' agenda [AF3] of contributing to a more integrated policy framework for natural resource management and land use that includes agriculture, forestry and

everything in-between, is challenging. It cannot be achieved by emphasizing how 'unique' and 'important' the plot-level integration of trees, crops and livestock is – although that still has a role to play [13]. Active participation in newly emerging forms of local governance that links bottomup and topdown concerns for biodiversity conservation [30] can build on the understanding of 'agroforests' that has emerged over decades of research-engagement in Indonesia. By focussing on the specific types of synergy between SDGs that has been identified [31], the role of trees and agroforestry can be brought into the wider debate in a search for coherence. Mixing all the colours of the 17 SDGs in the commonly used visual interpretation leads to a grey blur. It is important that all the ink or paint dries first to represent its own SDG before joining in a position in the overall rainbow. From that perspective, agroforestry should keep its identity while seeking a role in the nexus of SDGs.

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