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Boost Nature Positive Production at Sufficient Scale

- A paper on Action Track 3 -

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ACTION TRACK 3 – Boost Nature Positive Production at sufficient scale

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Abstract

Transforming traditional production systems involve five action tracks :i) access to safe and nutritious food, ii) sustainable consumption, iii) nature-positive production, iv)equitable livelihood, and v)resilience to shocks and stress .The overall goal is to reconcile the need for meeting the demands of the growing and increasingly affluent population with the necessity of restoring the environment and improving the quality of soil and other natural resources .Ten inter-connected elements of nature-positive food production systems include : diversity ,co-creating and knowledge sharing, synergies ,eco-efficiency, recycling, resilience, human/social values, culture and food traditions, prudent governance and circular economy. The strategy is to protect, manage and restore ecosystems to be able to "produce more from less" and set aside some land for nature. Thus, it is critical to avoid food wastage, encourage plant-based diet, and ensure that grain -based dairy and meat do not compete with human nutrition .In this context, landscape is the key level of intervention and action for adoption of land-positive innovations such as system-based conservation agriculture, agroforestry, bio-fertilizers etc. Landscape is where the actors and innovations come together. Such nature -positive approaches are based on bottom-up and territorial processes. Translating science into action also involves prudent governance and policy interventions which reward farmers/land managers through payments for ecosystem services.it is ,thus, important to increase and sustain investment in research and development to strengthen understanding of nature-positive production systems while increasing cooperation between public and the private sector. Furthermore, nature-positive production systems must be integrated into the curricula of schools and colleges at all levels, and also in farmers and vocational education systems.it is critical that nature-positive technologies are suited for women farmers in developing countries who must have access to the credit and essential inputs, and to rights of ownership of the land they cultivate. There must be three-way dialogue involving academic institutions, industry and the policy makers to translate scientific knowledge into viable action.

1. Introduction

This paper aims to provide some scientific basis for the concept of nature-positive production, discussing opportunities and challenges associated with sustainable, efficient smart agricultural production and suggest ways forward. Nature Positive Production refers to protection, sustainable management and restoration of productive systems. The aim is to show the complex issues in a comprehensible way, without regard to interests of any kind. The proposed actions must be solution-oriented, applicable, balancing trade-offs and optimizing synergies.

2. What do we want to achieve?

The primary objective of the Food Systems Summit 2021 (FSS 2021) is to achieve multiple SDGs by internationally coordinated integrated actions in all aspects of the food system chain (production, distribution, and consumption). More concretely, the overall goal is to provide healthy and nutritious food to all people, while creating livelihood opportunities and reducing the negative environmental, climate and health impacts associated with food systems. Five Action Tracks FSS-2021 will explore achievable ways to: 1) ensure access to safe and nutritious food; 2) shift to sustainable consumption; 3) boost nature-positive production; 4) advance equitable livelihoods; and 5) build resilience to shocks and stress. Here, as a brief paper for the Action Track 3 of the Food Systems Summit 2021, the focus is on food production systems, primarily on land.

2.1 The context

Most of the current global food production system threatens climate stability and ecosystem resilience. Scientific assessments by IPCC (2019) and IPBES (2019) conclude that many aspects of current food production systems drive degradation of land productivity and soil health, as well as biodiversity loss at multiple spatial scales, ultimately compromising the sustainability of food production systems. The IPCC Special Report on Climate Change and Land (IPCC, 2019) comprehensively highlighted that the ways in which food systems currently function undermines our ability to feed the projected 10 billion people on the planet in 2050. The report by IPBES (2019) shows that one million species are threatened with extinction, posing serious threats to human wellbeing, and that agriculture is responsible for up to 80% of biodiversity losses, and is also a key driver of deforestation and depletion of ocean resources. Similarly, the latest Living Planet Report (WWF 2020) revealed that the most important direct driver of biodiversity loss in terrestrial systems in the last several decades has been land-use change, primarily the conversion of pristine native habitats (forests, grasslands and mangroves) into agricultural systems; while much of the oceans has been overfished. Biodiversity loss as a result of food production in freshwater areas has declined by 50%. The degradation and fragmentation of natural and semi-natural ecosystems is highly correlated with the incidence of zoonosis like the SARS CoVid19 pandemic (Shaw et al., 2020) as the habitats of numerous wild animals become smaller and the contact possibilities with large livestock populations greater, both facilitating zoonotic transmissions.

Humans depend on plants, microorganisms and life support systems such as water and soil that all interact well and stay in balance. Hence, we need a radical transformation of the current food systems. The transformation includes all elements such as environment, people, inputs, processes, infrastructures, institutions and all activities that relate to the production, processing, distribution, preparation and consumption of food and their socioeconomic and environmental impacts (HLPE, 2014; Bortoletti & Lomax, 2019).

The global community of policy makers must transform the current "net-nature-negative" into "nature positive" situations at the global scale, by developing and applying effective and efficient incentives. In other words, boosting nature-positive production will be fundamental to put the global society on a pathway to a more resilient future and sustainable well-being. Food, feed and fiber production must regain their ability to support biodiversity, rebuild fertile soils, protect freshwater supplies, withdraw carbon from the atmosphere and store it in the terrestrial biosphere (i.e. soil, trees and wetlands), create employment, nourish the globe and enhance climate resilience and social stability. The experience and the evidence of the fragility and vulnerability of our current productive food systems in view of the SARS CoVid 19 pandemic underline the necessity of changing the production systems into sustainable circular ones. The current crisis is unique opportunity to change the false dilemma that economic growth is conflicted with environmental stability.

2.2 What do we mean by Nature-Positive Production?

A nature-positive production aims to build food systems that globally meet the fundamental human right to healthy food while operating within planetary boundaries that limit the natural resources available for a sustainable exploitation (Steffen et al., 2015). Doing so will require biogeochemical cycles (carbon, water, nitrogen, phosphorous) and biosphere integrity -extinction rate, loss of ecological functions- (Living Planet Report, WWF 2016). It is related to Nature-Based Solutions, which according to IUCN are "***actions to protect, sustainably manage and restore natural or modified ecosystems that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits***"

A nature-positive production is based on four pillars:

Pillar 1: Protect natural systems from new conversions for food production

Any further conversion of natural ecosystems and undisturbed habitats should be halted. Land-use change through farming and the expansion of intensive agriculture and large livestock populations are critical drivers of risks related to the exposure to emerging infectious diseases (Shaw et al., 2020) and destabilize the safe operating space of humanity (Steffen et al., 2015). It can lead to massive emissions of greenhouse gases and to losses of biodiversity including endangered species (Kiew et al., 2020; Dargie et al., 2017). The future protection of natural systems requires actions that change societies and economies in many ways. However, very importantly, it is linked to how successfully mankind can manage existing production systems in a sustainable way (see pillar 2), restore degraded farmland (see pillar 3), and return some land back to nature (pillar 4).

Pillar 2: Sustainably manage existing food production systems

Nature-positive production is characterized by a regenerative, non-depleting and non-destructive use of natural resources. It is based on biodiversity as the foundation of ecosystem services – soil, water, and climate regulation– that farmers manipulate with external inputs and with human or mechanical forces. For terrestrial food production, healthy soil is the essential means by which we produce healthy food. It will be the most critical indicator of success in producing nature-positive outcomes. The need is to work towards food systems that deliver net-positive ecosystem benefits.

Nature-positive production strives for circular processes and therefore, fosters local and regional integration of production and consumption and the use of all residues. It aims for strong innovation, but balances the different types of innovation, the social, environmental and technological ones, in an equal manner. Nature-positive production systems are both eco-efficient **and** sufficient. Sufficiency in food systems means that people avoid unnecessary food wastage and grain-based meat and dairy production does not compete with human nutrition. The system articulates all the steps of the value chain to make the best use of all the components. The nature positive production recognizes the fact that health of soil, plants, animals, people, ecosystems and the planet is one and indivisible. For the transformation of agriculture towards nature-positive production, the levels of interventions and actions are firstly the **landscape**. Here, the ethical and political framing, the financial and infrastructural incentives, the general innovation strategies and the degree of participation of stakeholders and actors are designed and decided on. The second level is the **production technology** of the entire value chain from farm to fork that must be linked to the objectives of improving and maintaining non-commodity ecosystems services in productive agriculture. In nature-positive production systems, the technologies used are consistent with the respective territorial, cultural and socio-economic context and are compatible with natural processes.

A big part of current food production fails to meet the characteristics of nature-positive production. Yet, some farming systems and technologies already perform better in that respect than others. Some of such approaches are a diversity of agroecological practices, regenerative conservation agriculture, integrated nutrient and pest management, river basin management, sustainable groundwater management, agroforestry and silvo-pastoral systems and sustainable pastoralism in the rangelands. Several specific programs for farmers target individual improvements such as introducing semi-natural habitats on the farm, applying no-till arable cropping or strictly reducing the use of pesticides and nitrogen fertilizers. The development and use of bio-inputs such as biofertilisers and bio-protectants is another environmentally-friendly approach combined with integrated crop management, intercropping and cover cropping.

If not traditional, they are all based on bottom-up and territorial processes, and innovations are grounded on the co-creation of knowledge, combining science with the traditional, practical and local knowledge of producers (FAO, 2018).

Pillar 3: Restore and rehabilitate degraded systems for sustainable food production and ecosystem services

One-third of global land area is degraded (FAO, 2015), comprising of 47% of forest and 18% of cropland (Bai et al. 2008). There are approximately 2 billion hectares of degraded and degrading lands in the world. The potential of restoration or rehabilitation is huge and it is an important land reserve helping to avoid new conversion of natural habitats and ecosystems. Specific technical measures must be taken depending on the site, socio-economic and cultural conditions. The micro- and macro-economic costs of such restorations are important. In addition, intensive cooperation with all stakeholders involved in a region or site must be ensured. The use of private funds and public

payments must be based on their effects and impacts. And research must develop new knowledge and completely new technologies to restore land and soils.

There are two types of restoration: Rewilding to natural ecosystems that restore soil health, enhance biodiversity and ecosystem services at the landscape level. Such activities often have additional benefits as they could increase resilience. The rehabilitating of agricultural productivity is equally important. Which is more appropriate is where scientific knowledge, as well as traditional knowledge, should work together towards "wise" ways to nature-positive production.

The potential is huge in helping to avoid new conversion of natural habitats and ecosystems and in reverting some agriculturally marginal land back to nature. Specific measures must be taken depending on the local bio-physical, socio-economic and cultural conditions (including pillar 1 measures). The micro- and macro-economic costs of restoration are important to determine return on investment and inform the possibility for a pre-competitive arrangement to be effected. In addition, intensive cooperation and benefit sharing with all actors and stakeholders involved in a region or site must be ensured. The development and use of adequate financial mechanisms and public policies must be based on their social, environmental and economic returns. And research must develop new knowledge and technologies to restore land and soils, in collaboration with food producers and other actors in the landscape.

PILLAR 4: Save and set aside some land back to nature.

Producing more from less and saving some land and water back to nature. Develop and adapt good practices in order to make more efficient the use of inputs and water. Nature-positive production systems are eco-efficient and they depend on sufficiently organized diets and eating behavior such as reducing unnecessary food waste and grain-based meat and dairy.

The need for a comprehensive approach in nature-positive food production is also recognized in the multilateral food policy making arena, through the development and promotion of ten *interconnected* elements (FAO 2018):

- **Diversity**
- **Co-creation and sharing of knowledge**
- **Synergies**
- **Efficiency**
- **Recycling**
- **Resilience**
- **Human and social values**
- **Responsible governance**
- **Circular and solidarity economy**

2.3. Trade-offs and challenges of nature-positive production

Prejudices and time lag of benefits
Farmers, consultants and scientists often share the same prejudice that it is not modern or scientific enough to contribute to global food security. The time delay between the implementation of system-oriented practices and the resulting benefits, such as yield increases and stability, is an additional obstacle for farmers to use such methods. Farmers are used to fast acting techniques such as fertilizers and pesticides.

Weak knowledge and advisory systems
Public and private investment in research on nature-positive production has been substantially lower in comparison to other innovative approaches, which results in significant and persistent knowledge gaps (HLPE, 2019). A systems-oriented, transdisciplinary, and long-term field research approach is clearly lacking (Aboukhalil, 2014, Edwards & Roy 2017). Therefore, there is a disconnect in the knowledge and advisory systems required to support nature-positive production and build the capacity of actors. There is also a shortage of inter- and trans-disciplinary research on agroecology that takes into account the context specificity of the approaches. Nature-positive production is not sufficiently well integrated into the curricula of universities and farmer schools.

Higher labor demand
Nature-positive production systems have a high initial demand for labor and can be more labor intense in general. This can be a serious constraint when manual labor cannot be substituted by mechanized labor. In situations where mechanization is possible, the investment required can also be a hurdle. However, provided that work conditions are decent, this can also be an opportunity for job creation.

Higher transaction costs
As nature-positive production is more diverse they tend to yield a greater number of crop or livestock products, but with a smaller volume of each product. This can limit market and processing opportunities and requires high levels of knowledge and risk taking/experimentation. Further, farmers may have to carry the financial and knowledge burden of identifying and applying alternative inputs. A number of nature-positive practices depend on collective action across a landscape scale, involving multiple farms and a range of actors. This requires higher levels of coordination and increases transaction costs.

Policy incoherence
Nature-positive production requires a different type of government support that goes beyond income-oriented subsidies or those for particular inputs or unspecific marketing actions. Current agricultural and trade policies, including subsidy schemes, still favor intensive, export oriented production of a few crops and there are still incentives for the use of fossil fuel and chemical inputs in place (Eyhorn et al. 2019). Further efforts are therefore needed to better understand which government policies can support nature-positive production and multi-functionality of agriculture more generally. Different governmental policies are contradicting and conflicting, especially agriculture, environmental, health, trade and science/education policies.
Finally, the transition towards nature positive farming is decelerated by past decisions of farmers such as the investment in large machines, skills, and retail relationships (HLPE 2019,

IPES-Food 2016). A return on those investments is more difficult when farmers shift their strategy towards nature-positive production.

Yield reductions related with nature-positive production
Replacing conventional systems or subsistence farming in marginalized conditions with diverse nature-positive production can increase the overall output of farms (Pretty et al. 2016). However, on an average, and particularly in temperate zones with highly intensive agriculture, conversion to nature-positive systems typically results in a reduction of yields that needs to be compensated by cost savings, higher product prices or other support measures in order to ensure the economic viability of the farms. The trade-off between high yields and non-commodity ecosystems services is the greatest challenge of the present.

3. Call for Actions to successfully cope with trade-offs and to scaling up nature-positive production

There are several structural lock-ins that keep the current unsustainable food production system in place. These lock-ins create a set of feedback loops that reinforce this system and include investments and policies that create path dependency (such as purchasing of expensive equipment or subsidies for chemical pesticides); export orientation; the expectation of cheap food; compartmentalized and sectoral, short-term thinking; certain discourses about feeding the world, focused solely on production volumes; measures of success (looking at single crops) and concentration of power (IPES Food 2016). Other typical lock-ins that reinforce the current system are the concentration of power in the food chain and institutional, agricultural research and technological lock-ins (WWF, 2016).

Therefore, a systematic change towards nature-positive production requires a fundamental reorientation of many societal actors and a realignment of the cooperation between them, including payments to farmers and land managers for provisioning of critical ecosystem services (e.g. carbon sequestration in soil/ trees, improving quality and renewability of water).

Strengthened multi-level, hybrid and cross-sectoral governance, as well as policies developed and adopted in an iterative, coherent, adaptive and flexible manner can maximize co-benefits and minimize trade-offs. Nature-positive approaches will be context-dependent (e.g. site- specific biophysical and socio-economic conditions). Therefore, inclusion of local actors, particularly of the most vulnerable voices, in decision-making will lead to more effective solutions.

Considering the comprehensive approach needed to foster nature positive production, any sector presented here will have to be considered in relation to other sectors. The nine calls for action can provide guidance to ensure an integrated, systemic approach.

Action 1: Sustainably governing the landscape level

The decisive level in fostering transition is the landscape, being the level where actors and innovations come together and where food producers' strategies interact with other users of the landscape and with state policies. For this reason, the landscape approach has been promoted by the Organization for Economic Co-operation and Development (OECD 2001, 2007) and the European Union (European Commission, 2006). Thus, at the landscape level, the ethical and political framing, the financial and infrastructural incentives and the general intervention strategies must be designed and decided, preferably through inclusive, participatory processes and institutions. As such, governance is critical. An important element in these interventions is therefore not just the **building and sharing of knowledge and technology** of the entire value chain from farm to fork - that must be better linked to the objectives of improving and maintaining non-commodity ecosystems services in any case - , but importantly **the governance systems** that are driving certain technologies, processes or behaviors.

The **political framing for farmers is a governance mechanism** that is common for all farmers world-wide. Therefore, it's role for the adoption of good farming practices is crucial. It is also quite common that the mechanism implies a cascade of increasing requirements leading to more sustainability. Usually, farmers violating law on environmental, public and animal health, animal welfare or land management are excluded from any support and services by the administrations. Farmers receiving income support have to respect additional environmental standards such as maintaining soil quality or protecting, groundwater, landscape and biodiversity (**cross-compliance**).The **most important incentive** for the adoption of sustainable agricultural practices and especially nature-positive production are payments for ecosystem services (Piñeiro et al., 2020). Similar cascades of a stronger political framing have to be developed on national or regional level in all regions of the world in order to boost nature-positive production. This concept can be applied for all forms of direct payments, marketing support actions, public support for applied research activities, education and training, facilitation of access to credits and insurances, legal and administrative action to secure tenure, as well as financial support for off-farm inputs and techniques much of which is dependent on the participation and agency of food producers.

Unfortunately, the transition towards nature-positive farming is decelerated by incentives for food producers to invest in large machines, skills, and retail relationships (HLPE 2019, IPES-Food 2016). Large subsidies on agricultural water promote unsustainable water usage. These lock-in make it difficult for producers to shift their strategy towards more nature-positive production.

Action 2: Soil sustainable management

Soil degradation, being exacerbated by the climate change along with land misuse and soil mismanagement, is worsening the malnutrition already affecting more than 2 billion people globally. Malnutrition, the world health crisis, is driven by soil degradation, and must be rectified by nutrition-sensitive agriculture based on healthy soils. Restoration and sustainable management of soil are also critical to enhancing and maintaining ecosystem services, identifying and implementing nature-positive agriculture, producing more from

less, and advancing Sustainable Development Goals of the United Nations(e.g., SDG#2 ,Zero Hunger, SDG #13,Climate Action, SDG #15,Life on Land). Developing resilient food production systems at local levels is specifically important during the COVID19 Pandemic that promotes food production by urban agriculture and home gardening (Lal et al., 2020; Lal 2020). Achieving the targets of land (soil) degradation neutrality, adopted by the United Nations Convention to Combat Desertification, will also improve nutritional quality of the food. Translating into action the concept "health of soil, plants, animals, people and environment is one and indivisible" by restoration of degraded soils and adoption of nutrition-sensitive agriculture will also improve human health and wellbeing and restore the environment.

Soil health and its capacity to generate ecosystem services must be enhanced through sequestration of soil organic matter content by adopting a system-based conservation agriculture, enriching the soil by planting nitrogen-fixating plants or adding N fixating microorganisms, mycorrhizae, growing cover crops, and integrating crops with trees and livestock in agrosilvopastoral systems. Adoption of nature-positive practices which enhance soil organic matter content can reduce dependence on chemicals, irrigation, tillage and other energy-intensive inputs, and would reduce losses of nutrients and water, enhance eco-efficiency, sustain productivity, and more importantly , produce more food from less resource use. Sequestration of soil organic carbon has been recommended by several international initiatives such as 4p1000 adopted by COP21 in Paris in 2015, Adapting African Agriculture by COP22 in Marrakech in 2016, and Platform on Climate Action in Agriculture by COP25 in Madrid/Santiago.

Action 3: Adapt and intensify the knowledge development of farmers, farm advisors, food technologists and academics

As immediate actions, the better understanding of nature-positive production within its complexity can be considerably improved. The scientific knowledge is tremendous but the integration with the knowledge of farmers, consumers and citizen is vastly unsatisfactory. Farmers, policy makers and scientists often share the same prejudice that nature-positive food production is not modern or scientific enough to contribute to global food security, even when it is based on continuous improvement and socio-technical innovation and has proven to be able to raise productivity. The time delay between the implementation of system-oriented practices and the resulting benefits, such as yield increases and stability, is an additional obstacle for food producers to use such methods. Farmers are often persuaded to use fast acting techniques such as fertilizers and pesticides. For farmers, co-learning activities that include a strong participation of farmers and consumers, are important. Scientists should learn to use the power of peer-to-peer learning and collaborative action-research as alternatives to providing top-down advice.
Unfortunately, public and private investment in research on nature-positive production has been substantially low in comparison to other innovative approaches, which results in significant and persistent knowledge gaps (HLPE, 2019). A systems-oriented, transdisciplinary, and long-term field research approach is clearly lacking (Aboukhalil, 2014, Edwards & Roy 2017). Therefore, there is a disconnect in the knowledge, science and advisory systems required to support nature-positive production and build on existing food

producers knowledge and strengthen the capacity of actors. There is also a shortage of inter- and transdisciplinary research on nature-positive production that takes into account the context specificity of the approaches. Finally, nature-positive production is not sufficiently well integrated into the curricula of universities and farmer schools.

Action 4: Boost knowledge and innovation for nature-positive production

Sustainability, technology and innovation are not contradictory and can be mutually reinforcing, particularly when technology is embedded in a systems approach. The wise and smart selection of technological innovations can be a very important ally for an efficient sustainable agricultural production to produce more with less. Global agriculture is undergoing major transformations through technology convergence such as new digital technologies and artificial intelligence to optimize agricultural production processes. The key for success here is to develop these technologies in participatory way to ensure which are the most suited to the specific conditions. They should be made accessible to food producers on the ground and to build on knowledge and resources that are already locally available.

Responsible consumption and sustainable production are the goal of an adequate and towards the common good oriented use of technology. To increase the optimal use of natural resources is a significant step regarding SDGs in food production. The aim is to save costs, reduce environmental impact and produce more food, with less negative impacts (WRI, 2018). Drones and advanced analysis of image data to identify pests and diseases in real time can provide a powerful toolbox for all farmers regardless of farm size. With improved biotic (pests and diseases) or physical information (meteorological, SAT early warning systems) as well as remote sensing, producers can use their mobile phones in order to strengthen their practices and make the best use of resources and inputs in order to increase productivity and income.

Parallel to digital technologies, the development of bioinputs (biofertilisers, plant protectants, growth promoting microorganisms, nitrogen fixators) is the supplement needed for nature based solutions in food production systems. Additionally, breeding programs, including gene editing can be very useful in order to select the best traits which improve productivity and/or tolerance to adverse biotic or abiotic conditions.

The strategy of integration of whole value chains and the local addition of value to the products at regional level is the best approach for the well-being of the communities. S&T can increase the portfolio of bioproducts developed from the local biodiversity, which is part of the circular economy approach.
Technological innovations must be carefully integrated depending on the local, the cultural and the respective knowledge context and always as part of a systems approach. Although a broad ecological and social innovation strategy is needed, science and technology should be integrated into nature-positive production. This fact can also be observed for small- and medium sized farms and farm families. These technologies and innovations include those in the socio-economic space, such as new ideas to govern landscape-level networks, approaches to building farmers organizations, creative use of finance to support the transition, and new ways of learning and building capacity.

Action 5: Strengthen actions and information on sustainable nutrition and food diets.

The development and scaling up of nature positive production is dependent on the transition to sustainable consumption and more plant-based diets. In many countries, market forces determine access to healthy, sustainable and nutritious food (Action Track 1). One aspect of sustainable nutrition means a higher degree of sufficiency or temperance, characterized by a reduction of food waste. As an immediate action, half of the 30 percent of total global food wastage must become saved. In addition, a considerable part of the unavoidable food wastes should become circulated by a "cradle-to-cradle" approach (McDonough and Braungart, 2002) in the feed and food circular economy. And finally, competition for the scarce resource of arable land between food and feed production must be reduced. Global food mass flow models show that the trade-offs between ecological goals and long-term sufficient nutrition of people could be minimized (Schader et al., 2015, Müller et al., 2017). In the first place, this means a better information of people and an integration of sustainable nutrition and food diets into the curriculum of schools. Further activities can include the development of personalized shopping guidance and all kind of nudging campaigns.

Action 6: Empowerment of rural areas and cross-farm co-operations

Any activities that strengthen the rural societies including through local and regional markets, Participatory Guarantee Systems (PGS) or certification systems for remote markets such as Voluntary Sustainability Standards (VSS) or organic farming can improve the farm income and livelihoods in a considerable way. There are many successful examples of how this kind of social actions and innovations help boost nature positive production. To strengthen territorial development, the value addition to products must take place at the local and regional levels and related regional networks must be strengthened.
Nature-positive production systems have a high initial demand for labor and can be more labor intensive in general, especially for women. This can be a serious constraint when manual labor entails drudgery and cannot be substituted by mechanized labor, for example because of the high cost involved. At the same time though, it offers opportunities to create employment, and revitalize rural areas, particularly when labor conditions are decent and financial incentives are re-shaped (Schuh et al., 2019). Cooperative models of farms and companies between actors need to become supported in order to mitigate work load.

Action 7: Improve access to land, water and biodiversity especially for women
Inadequate and insecure access and tenure rights for various elements of natural ecosystems (unfortunately a reality in the global North as well as the South) increase vulnerability and undermine nature positive production. Insecure access provides little incentive for food producers to invest in long-term nature positive production. Land fragmentation, soil degradation, climate change large scale water and land acquisition block the possibilities for nature positive production and increase the likelihood of environmental degradation.

Action 8: Promote marketing and processing facilities for nature-positive products

As nature-positive production is more diverse they can yield greater input and cost efficiencies while maintaining or increasing the combined productivity of a diversity of crops. Currently, adequate market and processing opportunities for smaller, diverse volumes are often lacking, which sometimes also require high levels of knowledge and experimentation as food producers identifying and apply alternative inputs. A number of nature-positive practices depend on collective action across a landscape scale, involving multiple farms and a range of actors. This requires higher levels of coordination and increases transaction costs. At the same time, in nature positive production, inputs are generally used that are accessible on-farm, which reduces the need to purchase external inputs. This lowers expenses and increases the 'added value' per unit of product, which tends to raise the income of producers (van der Ploeg et al. 2019).

Action 9: Increase policy coherence

Nature-positive production requires a different type of government support that goes beyond income-oriented subsidies or those for particular inputs or unspecific marketing actions. Current agricultural and trade policies, including subsidy schemes, still favor external input intensive monocultures, export oriented production of a few crops and there are still incentives for the use of fossil fuels, unsustainable irrigation and freshwater extraction and chemical inputs in place (Eyhorn et al. 2019). Further research is therefore needed to better understand which government policies can support nature-positive production and multi-functionality of agriculture more generally. Importantly, sectoral approaches result in contradicting and conflicting policies, especially between agriculture, environmental, health, development, trade and science/education policies.

4. Conclusions

Policy intervention and prudent governance are needed to transform food production from nature-negative to nature-positive production systems by minimizing trade-offs and optimizing synergism. The objective is to achieve climate stability and ecosystem resilience through innovative options which produce more from less, reduce waste and enhance eco-efficiency. Farmers and land managers, especially small land holders and women farmers, must be empowered through payments for ecosystem services while reconciling the urgency to adopt nature-positive systems with the necessity of producing safe and nutritious food. Examples of these technologies, which restore soil health by re-carbonization of the terrestrial biosphere (soil, forest, wetlands), include system-based conservation agriculture, agroforestry and integration of crops with trees and livestock. S&T and molecular biology methodologies are excellent tools for the development of improved organisms capable of resist or tolerate biotic and abiotic stresses, and to improve productivity facing climate change. Digitalization of agriculture is an innovation increasing every day and allows a more efficient use of resources. Nature-positive production systems must be integrated into school and college curricula and vocational educational programs. Pro-farmers and pro-nature policy interventions are needed through prudent governance which empower land managers and motivate them towards adoption of nature-positive food production systems.

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