



AgriFoSe2030

Agriculture for Food Security 2030
- Translating science into policy and practice



Sustainable intensification and food security

World food demand, food security and the role of smallholders

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Achieving food security is a major challenge in many parts of the world. This challenge will increase in years to come as the world population increases, natural resources become scarcer, and climate change impacts are manifested. Projections for world food demand by 2050 indicate a need to increase production in the range of 25-70% or even double the current level. As the supply of new arable land is limited, most of this additional food production will have to come from agricultural intensification.

Sustainable intensification is viewed by a wide group of actors as the most efficient way, if not the only way, to obtain the necessary increases in food production and food security while at the same time addressing environmental, social and economic challenges. In sub-Saharan Africa and South and South East Asia, smallholder farmers will be indispensable actors in sustainable intensification, as they dominate food production.

Key messages

- Intensification of agriculture is essential to reach the projected global food demand for 2050
- Sustainable intensification is viewed by a wide group of actors as the way forward to obtain the necessary production increase, while at the same time address environmental, social and economic challenges
- Sustainable intensification methods and interventions reviewed and assessed in the AgriFoSe2030 programme show that appropriate means and methods are context-specific
- In sub-Saharan Africa, South and Southeast Asia, smallholder farmers will play a major role in the intensification of agriculture, but will also need extensive support
- For implementation of sustainable intensification, it is important to identify effective indicators and metrics for monitoring and assessment, including trade-off analysis

What is sustainable intensification?

The notion of sustainable intensification was initially applied to small-scale, low-yielding farming in low-income countries. It builds on the idea that substantial increases in production are possible in traditionally managed or degraded areas, while natural resources are protected or even regenerated at the same time. Today, the concept of sustainable intensification is used in all kinds of agricultural settings and at different scales ranging from small farms to regional and global levels.

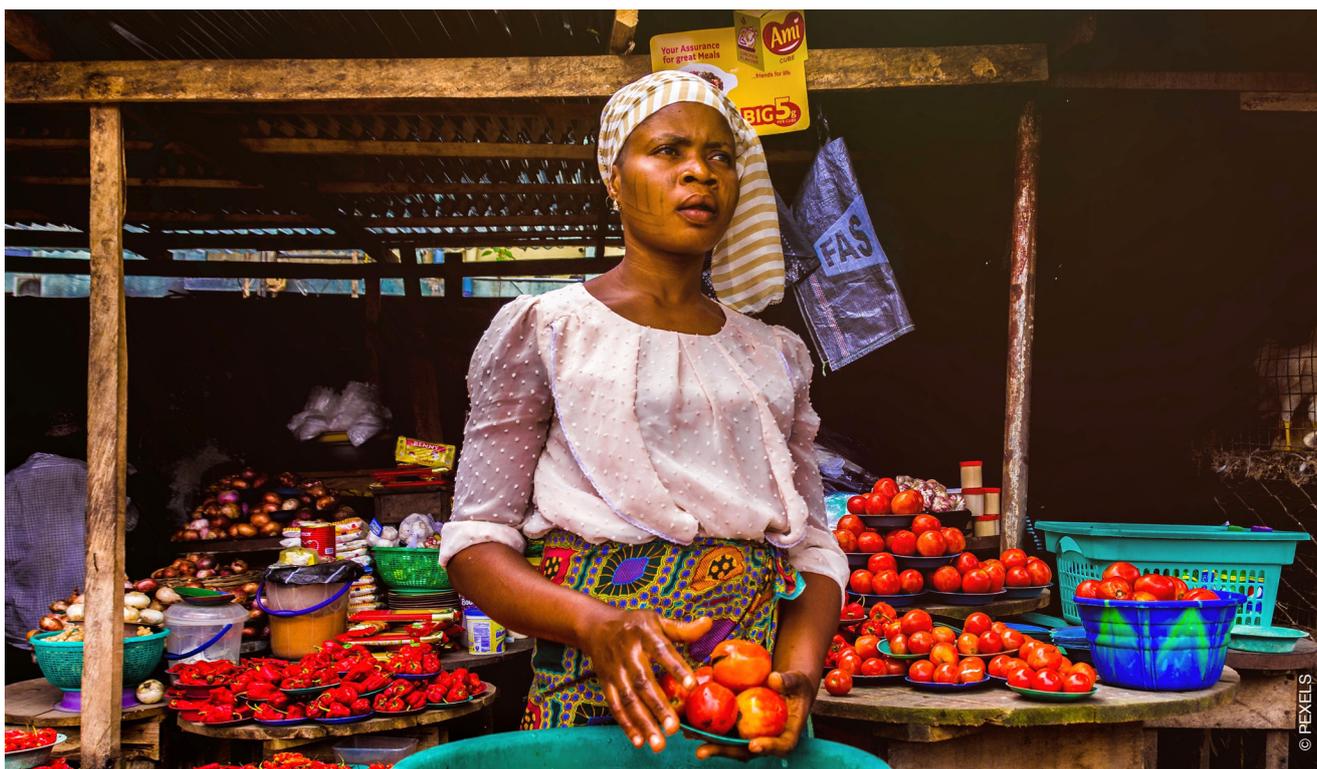
Sustainable intensification can be described as an aspiration for future food production, rather than a system stipulating certain means and methods and excluding others by demarcation of boundaries. Thus, methods and means will differ depending on circumstances.

The concept of sustainable intensification has been criticised for combining two vague concepts “sustainability” and “intensification”, making it ambiguous or even a self-contradiction oxymoron. Sustainability was initially mainly associated with ecological, environmental and natural resource aspects when used in conjunction with intensification. However, the view on sustainability has now been

widened to include social and economic aspects, particularly through the establishment of the United Nations Sustainable Development Goals. In the development discourse, sustainability comprises human wellbeing linked to different aspects of food security, nutritional aspects, poverty reduction, gender equality etc. from household to global level. Moreover, the climate issue has recently been clearly highlighted and climate-smart agriculture has become an integral part of the sustainability concept. This broad view on sustainability is also expressed in the FAO’s five visions for sustainable food and agriculture (see below).

The time aspect can create additional ambiguities, as sustainability is indefinite for some, while others point to the difficulty in grasping more than a few decades or even years, making it impossible to foresee what could be sustainable in the long-term. In addition, trade-offs can occur between sustainability goals and across scales, so that what is considered sustainable at farm or household level may not be sustainable from a broader perspective at regional or country level.

Intensification of a system needs to be specified in relation to other systems or to a baseline, as it can be time-restricted. It is usually linked to productivity, but



has several other denotations apart from increased production per unit of land, unit of livestock or per unit carbon dioxide emitted. For example, it can relate to more efficient use of resources such as land, water, nutrients, labour and capital, but also to knowledge and management skills. It is thus obvious that “sustainability” and “intensification” are both context-specific and need to be described for each case in order for the concept of “sustainable intensification” to be meaningful. Competing concepts, such as ecological intensification, take a more restricted view of sustainability and management options (see recommended reading below).

Sustainable intensification in policy and practice

In 2017, the FAO launched a vision of mainstreaming sustainable food and agriculture into national development strategies and action plans. The vision takes a broad view of sustainability and intensification, expressed in five key principles: 1) Increase productivity, employment and value addition in food systems, 2) Protect and enhance natural resources 3) Improve livelihoods and foster inclusive economic growth, 4) Enhance the resilience of people, communities and ecosystems, 5) Adapt governance to new challenges. Connected to these principles are 20 actions intended to integrate agriculture development with the overall development plan for each country, providing a basis for a resilient and sustainable society.

For practical implementation of sustainable intensified agriculture, it is necessary to demonstrate that the changes in agricultural practice, demanded in the system, result in productivity increases and that production is sustainable. Thus, there is a growing need for an improved set of indicators and metrics that can be used to better monitor and assess food and agricultural systems in regard to their productivity and sustainability. A range of indicators and combinations of indicators covering productivity, environmental, economic and social aspects, interactions, farmer participation, human health etc. have been proposed and used. However, there is a need to further develop these indicators and their associated metrics to suit individual settings and to improve the balance between different



aspects of sustainability and intensification. The indicators also need to be able to handle trade-offs and to be meaningful in practice and acceptable to farmers and other stakeholders.

Sustainable intensification in the AgriFoSe2030 programme

The focus in the AgriFoSe2030 programme is on the progression from science to policy and practice, with the aim of achieving sustainable increases in food production and food security, with the emphasis on smallholder farmers in sub-Saharan Africa and South and South East Asia. The programme applies a broad view on sustainable intensification considering production-related, environmental, social and economic dimensions in line with the FAO vision of sustainable food and agriculture.

Multiple knowledge syntheses, critical reviews of sustainable intensification management options and case studies were carried out during the first AgriFoSe2030 programme period. Some examples of how studies representing the different thematic areas of AgriFoSe2030 approached sustainable intensification are given below. These examples cover topics such as factors affecting rate of adoption, how to maintain multiple ecosystem services, efficiency in use of input resources, land use and intensification, how to improve livestock production and infectious livestock diseases.

Enhancing adoption of agroforestry as a sustainable agricultural practice in Northwest Vietnam

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Northwest Vietnam is a mountainous region where soil erosion and declining agricultural yield as a result of soil degradation and lack of land cover are common problems (Figure 1). Most people in the region rely on agriculture for their livelihood, with shifting cultivation and maize monoculture being typical agricultural practices on fragile sloping land. According to national statistics, the region had a poverty rate of 14% in 2016, compared with the national rate of 6%. To increase agricultural sustainability, the introduction of agroforestry systems, integrating trees into agriculture in combination with contour planting, was considered as one type of diversification strategy for farm households in an AgriFoSe2030 project reviewing rural transformation and livelihood diversification in Vietnam.

Efforts to enhance adoption of agroforestry in the region included promotion of market-led agroforestry practices by strengthening collaboration with the private sector. This was done through the Agroforestry for Livelihood of Smallholder Farmers in Northwest Vietnam (AFLI) initiative led by World Agroforestry (ICRAF). The AFLI project also works with local authorities to reduce other barriers to adoption of agroforestry practices. These efforts were intended to assist the Vietnamese government in upscaling sustainable agriculture in the mountainous north, which is a target in several national and sub-national policies (e.g. Vietnam's Action Plan for the 2030 Sustainable Development Agenda).



Typical sloping agricultural land in Northwest Vietnam, with sparse tree cover and serious soil erosion.



The practices promoted are simple, with proven effective conservation measures and the mixing of annual and perennial crops, such as trees for production of timber or fruit combined with crops and strips of grass for fodder or forage sales. These practices may have direct positive environmental and economic benefits such as (i) more permanent soil cover, improved soil structure and water infiltration, (ii) higher carbon storage and higher soil organic matter content, and (iii) additional and diversified sources of income.

Lesson learnt and take-home message

The adoption rate of agroforestry practices by farmers remains low, due to lack of knowledge and lack of financial back-up during the transition from current to new practices. Farmers still feel uncertain about market access for new products and have difficulties accessing credit for investment. In addition, farmers have noticed that, while crop diversification within agroforestry may increase total income, resource competition can lead to substantially lower productivity of some individual crops than when grown as the sole crop. This

requires the initial design of agroforestry systems to be improved. Therefore, promoting agroforestry as a sustainable practice should involve regular monitoring and evaluation with farmers, to continuously improve the benefits that can be derived from the system.

The government can promote adoption by e.g. providing better access to markets through improved infrastructure and information networks, better access to credit, more certainty in terms of land tenure by providing land use certificates, and better advisory services to increase knowledge and skills in plot management option.

Further reading

Mulia, R. (2019) Rural transformation and economy in Viet Nam -Progress in eradicating poverty, hunger and malnutrition. AgriFoSe2030 Report 16, 2019. <https://www.slu.se/globalassets/ew/org/andra-enh/uadm/global/agrifose/outputs/reports/agrifose-2019-16.pdf>

Adoption of sustainable intensification with improved ecosystem services in Indonesia

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The Rejoso watershed in Pasuruan District, East Java Province, Indonesia, is experiencing tremendous pressures from population growth and anthropocentric development. Associated efforts to produce more food have led to conversion of natural agroforestry systems that prevented soil erosion and supported water infiltration into pure paddy rice plantations, monocultures, horticulture and fast-growing tree plantations, which has reduced the supply of ecosystem services. The watershed provides water to neighbouring districts, but the water resource is over-utilised for rice field irrigation and domestic consumption.

To maintain ecosystem services in the watershed, new practices are being introduced in the area with the support of national agroforestry scientists. These practices include payment for ecosystem services, specific tree plantation and intermittent irrigation to reduce water consumption and simultaneously improve rice quality. This results in higher resilience to drought and water shortages, which is vital for sustainable agriculture in the long run. To ensure success of these interventions, a concept of co-investment has been introduced. It involves sharing investment and responsibility for sustainable actions among multi-stakeholders through public-private-people-partnerships. This inclusive engagement of stakeholders ensures that all on-the-ground actions and decisions are based on locally proven successful practices supported by science, an outcome that was analysed and discussed in an AgriFoSe2030 project.

Lesson learnt and take-home message

A key component in success is support to farmers for adoption and sustained use of new practices. The support to farmers should include help to develop



their business plans, and support their connection to markets and value chains. Collaboration with financing institutions (conventional government bodies, private banks and/or new innovative lending systems) is essential, as access to financial capital is a challenge for smallholders seeking to grow their subsistence agriculture into a business.

Further reading

Leimona, B., McGrath, F.L., Khasanah, N., 2020. Sharing Knowledge and Value for Nurturing Socioecological Production Landscapes: A Case of Payment for Ecosystem Services in Rejoso Watershed, Indonesia. *Sharing Ecosystem Services*. Springer, pp. 179-196.

Does labour invested in sustainable intensification practices give sufficient yield returns?

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Labour shortages during key periods, such as planting, weeding, and harvesting, are often a barrier to increased crop productivity on smallholder farms. Lack of available labour often leads to late planting and poor weed control, in turn resulting in high competition for nutrients and water and ultimately to lower yields. Labour limitations and/or low labour productivity of agricultural practices introduced to sustainably intensify agriculture can lessen the applicability of these practices.

An AgriFoSe2030 project reviewed 12 scientific papers and studied the ratio of yield change to labour demand change for three tillage systems (ridging, no-till, planting basins) that increase water availability in the soil compared with common (baseline) practice, usually flat tillage.

Ridging systems consistently increased labour productivity by increasing yields and saving labour compared with the flat tillage system. However, for take-up of the practice, draught power and machinery that allows ridging needs to be made available.

No-till systems decreased the labour requirement for land preparation but increased the labour requirement for weeding unless herbicides were used. Herbicide application brings other costs and has environmental and health effects. Nevertheless,

no-till may be attractive where labour availability or draught power is limiting at the start of the growing season, and where the crop is water-limited.

Planting basins (dug manually) led to low labour productivity as a result of increased labour demand without any yield increase, which is in contrast to other studies in drier climate. This implies that targeted planting basins could achieve higher labour productivity in the right setting.

Lesson learnt and take-home message

Sustainable intensification of crop production hinges on more efficient use of resources, including farm labour. Practices that enable mechanisation of soil management and weeding, or that include herbicide use, reduce labour inputs and in general increase yield and profitability. However, practices should be evaluated locally to satisfy the differing production goals and investment capacity of farmers. If herbicides are used, advisory support is vital to minimise negative side-effects on human health and the environment.

Further reading

Dahlin AS, Rusinamhodzi L. 2019. Yield and labor relations of sustainable intensification options for smallholder farmers in sub-Saharan Africa. A meta-analysis. *Agronomy for Sustainable Development* 39:32. doi.org/10.1007/s13593-019-0575-1



Food production gains from deforested land in Uganda, 1990-2015

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In Uganda, expansion of the area under low-input smallholder farming is a key driving factor in forest loss. Intensification of production on existing cropland could increase food production and spare natural ecosystems. National agricultural policies primarily promote input-based intensification, but other options include agro-ecological intensification or a combination of both.

For the case of Uganda, an AgriFoSe2030 project carried out a systematic literature review on national acreage of major food crops and their productivity. The aim was to calculate the potential that existed in 1990 to increase food production on available cropland, compared with production that has occurred on new land brought into cultivation since 1990. Cropland expansion was estimated from land cover changes between 1990 and 2015. The study assumed full-scale input intensification of the cropland area and calculations were based on average crop acreages and yields.

Over the period 1990-2015, cropland area in Uganda expanded by approximately 1 million ha, of

which about 80% was estimated to have resulted from conversion of forests (Figure 2). Assuming traditional farming practices and similar proportions of different crops on former forest land as in total food production, the potential increase in annual food production from the acquired area was approximately 5 Million tonnes by 2015. If the cropland area available in 1990 had been subjected to full-scale input-based intensification, it was estimated that the potential gain in annual food production would have been approximately 46.6 Million tonnes.

Lesson learnt and take-home message

More food production can be achieved through intensification of existing farming than through bringing new land into cultivation by deforestation, although the production difference depends on local conditions. While food production through intensification may not necessarily prevent land conversion, identifying intensification options is an important first step towards increased food security and minimising trade-offs between ecosystem services connected to use of arable land, forest and other natural ecosystems.

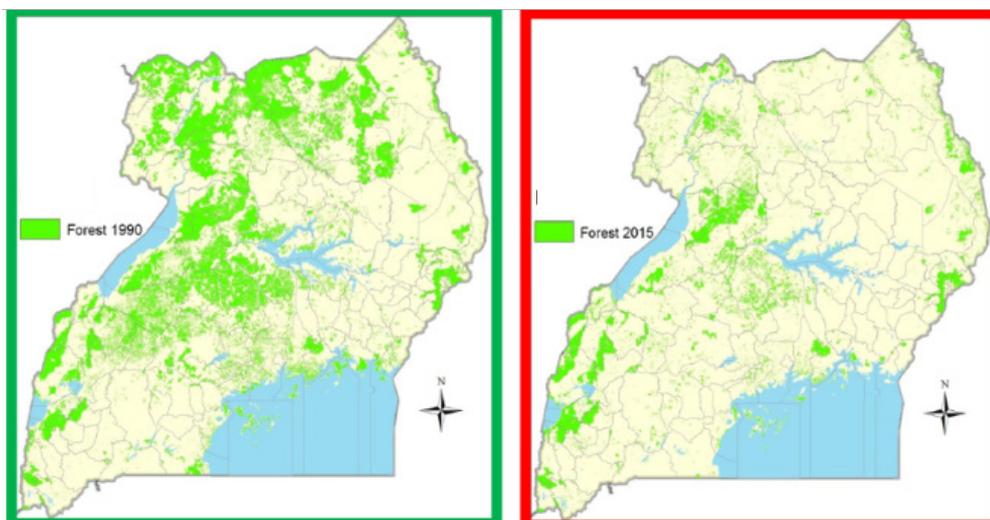


Figure 2. Change in forest cover in Uganda, 1990-2015. Images: National State of the Environment, Report 2016/17), NEMA Uganda 2017.

Further reading

Balmford, A., Green, R. E., & Scharlemann, J. P. (2005). Sparing land for nature: exploring the potential impact of changes in agricultural yield on the area needed for crop production. *Global Change Biology*, 11(10), 1594-1605.

Sustainable livestock production can be a pathway out of poverty

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Livestock is a pathway out of poverty for poor smallholders, as they can generate income from selling livestock and livestock-based products. Livestock also provides nutritious food, increases assets and resilience, provides draught power for ploughing and transport and manure as fertiliser. Livestock production has increased in many low and middle income countries, but productivity is often substantially impaired by infectious diseases, of which some are zoonotic (i.e. transmissible between animals and humans). Zoonotic diseases in particular can drive poverty and disproportionately affect the poorest populations.

Two systematic reviews within the AgriFoSe2030 programme focused on sustainable intensification in the livestock sector. One sought to identify and characterise interventions to improve livestock production and to assess their effectiveness in achieving development outcomes in a data-poor context on global level. The other sought to identify knowledge gaps that may hamper the introduction of surveillance and control programmes for infectious livestock diseases in an emerging economy, exemplified by Vietnam.

In the first systematic review a total of 15 studies of sufficient quality to produce reliable results

were identified. Among these, eight interventions to support sustainable livestock production were successful, but only four were scalable. There was good evidence that livestock support programmes, with a focus on leveraging livestock products for nutrition and helping farmers manage priority diseases, can improve human wellbeing if they are sustainably intensified.

As regards infectious livestock diseases, a large proportion of the studies included in the second systematic review dealt with zoonoses and food-borne infections, rather than infections only affecting livestock. Thus, infections that mainly affect productivity and contribute significantly to yield gaps and impacts on the livelihoods of farmers were under-represented, a bias that might be explained by funding agency priorities. It should also be noted that current disease surveillance programmes in Vietnam, as in many other countries, focus on diseases important for international trade, e.g. foot and mouth disease, avian influenza and classical swine fever.

Lesson learnt and take-home message

Results from these AgriFoSe2030 activities highlight that there are knowledge gaps in regard to supporting the smallholder livestock sector to be more sustainable and productive, with a particular need for more evaluations on long-term effects. More evidence is needed on what livestock interventions work, and why they work. We believe that under-representation in evidence-based knowledge of endemic infectious diseases affecting livestock health and productivity is common in low and middle income countries and a major factor impairing livestock productivity. This skewness may be mitigated by more research on the impact on livestock diseases, which would help policymakers prioritise livestock diseases to be included in animal health programmes.



Summary

Intensification of agriculture is essential to reach the projected world food demand for 2050, as the supply of new arable land is limited. Sustainable intensification is commonly viewed as the way forward to obtain the necessary production increase while at the same time addressing environmental, social and economic challenges. In sub-Saharan Africa and South and South East Asia, smallholder farmers will play a major role in the intensification of agriculture, but will also need massive support in achieving a sustainable intensification of their production.

Sustainable intensification is an aspiration for how food production should be changed, rather than a system stipulating certain means and methods or excluding others by demarcation of boundaries. It is context-specific and will differ depending on circumstances. For development of policies and for practical implementation

of sustainable intensification, it is important to identify effective metrics and indicators for monitoring and assessment, including trade-off analysis.

Examples of sustainable intensification methods and interventions reviewed and assessed in the AgriFoSe2030 programme show that appropriate sustainable intensification actions are indeed context-specific. The broad definition of sustainable intensification allows a variety of projects and programmes to emerge within its boundaries, resulting in wide applicability. A key aspect of the AgriFoSe2030 programme is the need to assist smallholders in the global south, a large part of them vulnerable and poor, with science and knowledge based actions and interventions in support of sustainable intensification.

Further reading

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Agriculture for Food Security (AgriFoSe2030) is a programme directly targeting Sustainable Development Goal (SDG) 2 – “... ending hunger, achieving food security, improving nutrition and promoting sustainable agriculture ...” by building capacity to synthesize and communicate the latest scientific knowledge to support the transformation of smallholder agriculture in low-income countries, particularly in sub-Saharan Africa and South and Southeast Asia. AgriFoSe2030 is implemented by a consortium of scientists from the Swedish University of Agricultural Sciences, Lund University, University of Gothenburg and the Stockholm Environment Institute. The programme is funded by the Swedish International Development Cooperation Agency (Sida).

This brief was edited by the Agrifose2030 Communication and Engagement Team.

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