MORE ABOUT PARALLEL SESSION:

ADDRESSING TRADE-OFFS AND SYYNERGIES BETWEEN SDGS AT DIFFERENT LEVELS

Organizer
Wageningen University and Research
Chair: Katrien Descheemaeker

Background
The aspirational SDGs defined at global level must be translated to national levels and create impact at local level. Reaching SDG2 at national level (e.g. sufficient food produced to feed each member of the national population) does not yet guarantee that SDG2 is achieved at local level (everybody has access to sufficient food). Reaching SDG2 may be at the cost of other SDGs such as SDG13 (climate change) because increase in production leads to increase in GHG emissions or SDG 15 (life on land) when production leads to conversion of areas with high biodiversity into crop land. At each level and between levels synergies and trade-offs can be expected within SDG2 or between SDG2 and other SDGs.

Objective
In this session we would like to introduce this topic by five short presentations focusing on reaching SDG2 at different levels (global-regional-national-local) and identifying the SDGs that need to be considered as well. Furthermore some sessions propose methods to deal with the problem of trade-offs between SDGs and between levels The introductions will be followed by a plenary discussion about how to deal with different levels when looking at synergies and trade-offs between SDG2 and other SDGs. The aspiration SDGs must be translated to national levels and create impact at local level.

Draft program
This parallel session is organized around a number of individual papers submitted on this subject. Each paper has a 7 minute pitch and 3 minutes for answering questions. After the presentations a plenary discussion will be held with the audience. Presenters in bold.

Authors	*Title*	*Levels and SDGs*
Linda Velthuizen, Ken Giller, Maja Slingerland (PPS) Peter Oosterveer (ENP), Inge Brouwer (HNE), Sander Janssen (ESG) Imke de Boer, Hannah van Zanten (DPS), all WUR	The Missing Middle in SDG 2: The dual disconnect between global goals and local contexts, and between food production and consumption	Global-Local Synergies and trade-offs within SDG2
Marieke Sassen, Arnout van Soesbergen (UNEP-WCMC, PPS-WUR)	Balancing trade-offs among SDGs under future uncertainty: scenarios and mapping for East Africa.	Global-Regional (EastAfrica)-national (Kenya /Tanzania) SDG 2 (zero hunger), SDG15 (life on land), SDG 6 (clean water and sanitation), SDG 13 (climate action)
Juliana D. B. Gil (PPS-WUR)	Reconciling global sustainability targets and regional action for food security and climate change mitigation.	Global, regional (Western Europe) and national (The Netherlands) SDG-2 (zero hunger) and SDG-13 (climate action)
Lindsay Shutes, H. D. Cui, **T. Achterbosch**, G. Philippidis, P. Havlik, T. Heckelei, A. Leip & H. Valin (WER-WUR)	To what extent will the evolution of the European food system to 2030 contribute to the Sustainable Development Goals?	Global-Europe SDG2 (Zero hunger), SDG9 (Industry, Innovation and Infrastructure), SDG13 (Climate action), SDG15 (Life on land), SDG17 (Partnerships)
Wytze Marinus, Esther Ronner, **Gerrie W. J. van de Ven** (PPS), Fred Kanampiu (IITA-Kenya), Samuel Adjei-Nsiah (IITA-Ghana) and Ken E. Giller (PPS)	The devil is in the detail! Sustainability assessment of African smallholder farming.	Global-local (farm level) SDG2 (zero hunger) operationalised and translated to different local situations

The discussion will focus around the following three points:

- Which other sustainability objectives (SDGs) are mostly at risk or enabled when pursuing SDG-2?
- Which methods are promising to understand trade-offs and synergies, and assess them across different levels?
- How can the identified trade-offs be tackled and synergies be harnessed, and which actors are needed in this process?

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The Missing Middle: Connecting global goals to local contexts and agricultural production to food consumption to achieve Sustainable Development Goal 2

Linda JL Veldhuizen, Imke JM de Boer, Inge D Brouwer, Ken E Giller, Sander Janssen, Peter Oosterveer, Hannah HE van Zanten, Maja A Slingerland

The world faces substantial challenges in sustainably nourishing its population. Agriculture contributes to 10-12% of man-made greenhouse gas emissions (Smith et al. 2014) and to 70% of freshwater withdrawals (Foley et al. 2011), while a third of all food produced is wasted along the value chain (Alexander et al. 2017, Gustavsson et al. 2011). At the same time, 815 million people are undernourished, 2 billion are suffering from micronutrient deficiencies (Development Initiatives 2017, HLPE 2017). SDG 2 and other SDGs of Agenda 2030 demand the world to tackle these and related challenges by 2030.

Increased integration of the global economy has given rise to more globalized, specialized and complex food systems. The opening up of borders, combined with technologies that enabled e.g. cooled transport and reduced transport costs, resulted in increased global trade in food products (Palpacuer and Tozanli 2008). Hence, the consumption of food in such globalized food systems has become more and more distanced from the production of food. Consequently, consumer decisions are commonly made in disconnect from the environmental and social impacts that occur elsewhere from producing these products (Boström et al. 2015, Swisher et al. 2018), which results in various externalities.

In globalized food systems, a single food item passes many hands and many borders as a result of the various specialized processes involved. The larger number of companies, governments and other stakeholders involved in such food systems means that the responsibility and the ability to address externalities become more dispersed. Moreover, globalized food systems have not only distanced consumers from producers, but also managers in multinationals from food producers such as smallholder farmers and global policy-makers from citizens, which makes it even more difficult to properly address externalities on the ground.

Hence, globalized food systems have given rise to a distancing between production and consumption that results in externalities which are difficult to address due to the myriad of stakeholders involved and horizontal and vertical distancing between these stakeholders. We refer to this challenge as the Missing Middle and pose that addressing this Missing Middle is an essential step to achieve the SDGs. Figure 1 shows a simplified representation of the two intersecting axes of the Missing Middle in SDG 2, i.e. the global–local axis and the food production–consumption axis. These two axes relate to the distancing between global and local levels, and between producers and consumers of food.

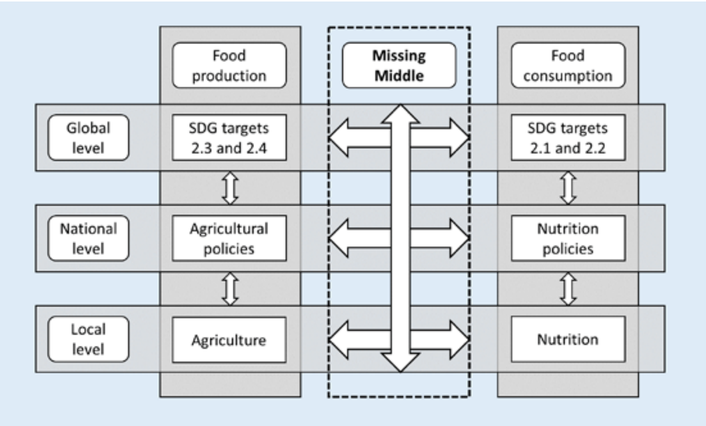

Figure 1: Representation of the Missing Middle in SDG 2

Various examples of the Missing Middle can be observed in government, the private sector, consumers and research (Figure 2). In government, for example, policies on agriculture are prepared by the ministry of agriculture, whereas policies on nutrition are prepared by the ministry of health. In addition, countries commonly have multiple levels of government, e.g. national, subnational and local governments. In the private sector, a focus on single value chains means that linkages between value chains in the wider food system are overlooked. Moreover, increased distancing in large companies between a company's management and employees also contributes to the Missing Middle. The choices that consumers make impact international public goods such as land use and greenhouse gases in the atmosphere. Consumers, however, often make many consumptive decisions per day without considering the consequences of these decisions on resources and actors involved in the food system (producers and value chain actors) from the global to the local level, nor the consequences of their choices on their own health. Scientists increasingly rely on interdisciplinary research to study complex and multidimensional research questions. One main challenge in this is to bridge differences in research questions, units of analysis, methodology etc. to bridge the gap between research on agriculture in relation to nutrition and research on health in relation to nutrition, and between global- and on local-level studies.

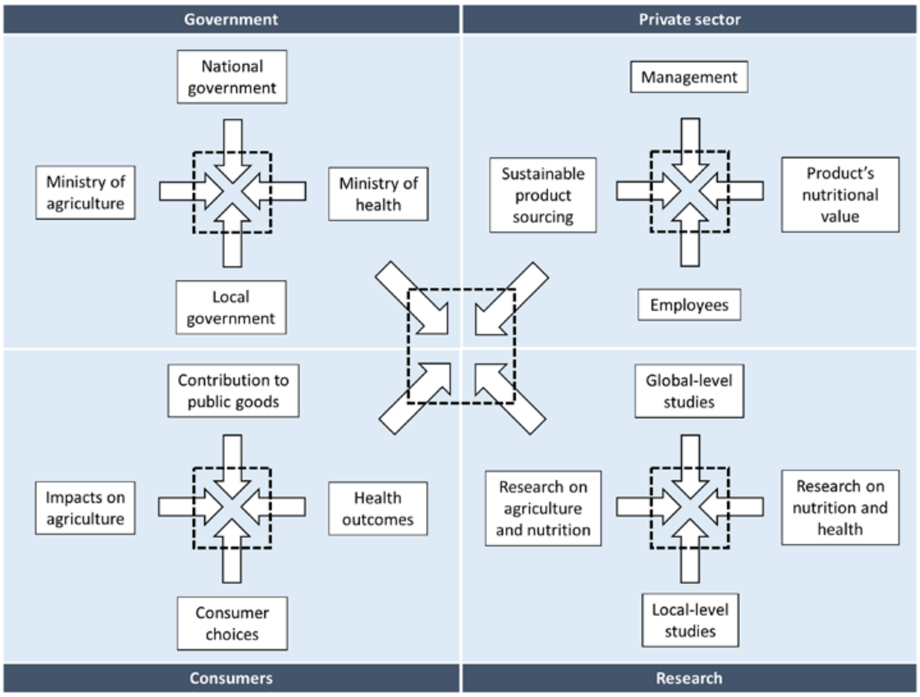

Figure 2: Examples of the Missing Middle within and between government, the private sector, consumers and research. The arrows indicate that uncoordinated action on the production-consumption and global-local axis of the Missing Middle (indicated by the black dotted square) influence SDG 2 outcomes in a non-harmonized way

Several approaches can contribute to bridging the Missing Middle, e.g. systems thinking, working in partnership, transdisciplinary approaches, continuous exchange and dialogue, and explicitly addressing trade-offs. In this context, the food systems perspective (HLPE 2017) offers a useful framework by integrating all stakeholders and processes from food production up to food consumption, as well as system drivers and outcomes. However, rather than aiming to include all stakeholders involved in food systems, we suggest to identify key challenges to be approached from an integrated perspective. In this way stakeholders address a more specific issue at the local level, which increases the chances of successful collaboration to bridge the missing middle between production and consumption for more effective SDG implementation.

Balancing trade-offs among SDGs under future uncertainty: scenarios for East Africa

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Introduction

Land use and land management decisions as well as the highly uncertain future context within which land use related policy operates have major impacts on biodiversity and ecosystems and the goods and services they provide to people. Decision makers need to balance trade-offs and capitalise on potential synergies among different SDGs and their targets whilst also accounting for potential future change. Some drivers of change, such as for example population growth, urbanization and climate change are relatively certain: there are models and projections and quantified confidence statements. Other factors are much harder to predict, such as globalization, commodity markets, governance regimes etc., though they may also influence the future and affect trade-offs and potential synergies. Together with these drivers, trade-offs and synergies among SDGs will vary through time and in space. Combining spatially explicit information on plausible future land use change and biodiversity and ecosystem services provision can help to identify potential impacts, possible spatial trade-offs and to prioritise areas for further investigation or action.

This study uses a modelling framework that considers the implications of four plausible socio-economic scenarios for East Africa in 2030 and 2050 for national-level demand, yields and production for food and other agricultural commodities in Kenya and Tanzania (SDG 2) and the ensuing potential land use changes. The modelling suite then assesses the implications of these land use changes for biodiversity and ecosystem services in a spatially explicit manner (SDG 15). Potential implications for linked goals such as SDG 6, and SDG 13 are also discussed.

Methods

Scenarios and modelling

The socio-economic scenarios were specifically developed for the East Africa region by the Climate Change, Agriculture and Food Security (CCAFS) programme of the CGIAR in 2010 and 2011 (Vervoort *et al.*, 2013) and quantified using the International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT) partial equilibrium model (Robinson *et al.*, 2015). Spatially explicit land use and land cover for both countries was then simulated using the LandSHIFT model (Schaldach *et al.*, 2011) which allocates land use to grid cells based on a weighted multi-criteria analysis.

To assess spatial trade-offs between different conservation policies and agricultural production, the LandSHIFT model was driven with different assumptions with regard to protected areas (PAs) using data from the World Database on Protected Areas (WDPA) (UNEP-WCMC and IUCN, 2014) and key biodiversity areas (KBAs) (BirdLife International, 2013).

SDG analysis

We used the outputs from IMPACT to assess demands, yields and production for food and other agricultural commodities (SDG 2). LandSHIFT's outputs for agriculture (pasture and cropland) allowed us to assess the most likely spatial arrangement of these elements of this SDG.

For SDG 15, we calculated the change in the biodiversity importance metric (a metric of relative biodiversity which is based on the distribution of suitable habitat for species in the region) due to land use change for all species (target 15.1), as well as specifically for threatened species (target 15.5). In addition we implemented the LandSHIFT land use model outputs in the Co$tingNature V3 model (Mulligan, 2015) to assess changes in ecosystem services provided (target 15.1). For SDG 6, we implemented the LandSHIFT model outputs in the WaterWorld hydrological model (Mulligan, 2013) to calculate potential change in clean water provided to people downstream. We used the Co$tingNature modelled ecosystem service on hazard mitigation as a proxy to assess changes in SDG 13 (goal 13.1).

In order to assess the trade-offs and synergies between the SDGs, we calculated relative changes for each SDG by country, combining the different variables for SDG 15 and present results by country for each scenario for 2030 and 2050.

Results and discussion

We found that production of staple crops, cash crops and meat increases under all scenarios in order to meet the demands of the growing population. Production increases for crops are achieved through expected yield increases and area expansion, for meat mainly through strong expansion of pasturelands. Variations among scenarios reflect different governance, trade and agricultural (investment) policy contexts. The results show that increases in agricultural outputs trade-off directly and in space with biodiversity and also in space with regulating ecosystem services. The latter trade-off is strongly associated with forest loss due to agricultural expansion. Analysis of the impact of different biodiversity conservation policy options shows that expanding protection in one area may lead to loss of unprotected critical habitat elsewhere, and highlights the importance of using a spatially explicit approach when considering potential trade-offs and linkages among SDG targets and goals.

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Oral presentation "Reconciling global sustainability targets and regional action for food security and climate change mitigation"

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The 17 Sustainable Development Goals (SDGs) launched in 2015 by the United Nations aim at "ending poverty, protecting the planet and ensuring prosperity for all"[1]. The SDGs imply country-led implementation, through which local diversity and context-specificities should be accounted for. At the same time, sustainability actions taken locally must, on aggregate, be consistent with planetary boundaries[2].

Ensuring the simultaneous and integrated achievement of SDG targets at the national, regional and global levels is not a trivial task in any sector, including agriculture. Achieving consistency between the internationally agreed 1.5ºC and 2ºC climate mitigation targets and regional agricultural policies involve potential trade-offs and the complexities of burden-sharing across countries.

Seeking to contribute to the operationalization of SDGs 2 and 13 at different scales, this study examines how the GHG emission intensity of agriculture (EIA) should evolve globally, regionally (Western Europe) and nationally (The Netherlands) under different socioeconomic pathways, so that both food security and climate change mitigation are met. The indicator EIA, herewith measured as GHG emissions from agriculture divided by total agricultural produce (EIA_{DM}) or farmland (EIA_{HA}), aids the identification of regions where mitigation efforts are most needed[3]. It also offers a straightforward indication of different regions' comparative advantage for food production and how the geographic allocation of food production may hinder or boost climate change over time.

The study is divided in three main parts. In *Part I*, we use an integrated assessment model (IMAGE[4]) to estimate the EIA of 26 world regions, so that climate mitigation and food security are both met until 2050. We check whether and how EIA is projected to change across these world regions based on the lowest cost approach to mitigate climate change. We also explore the sensitivity of regional EIAs to different socioeconomic pathways (i.e. SSPs) consistent with 1.5ºC (RCP 1.9) and 2ºC (RCP2.6) climate targets by 2100[5,6]. These scenarios are henceforth called SSP1-1.5C, SSP2-1.5C, SSP1-2C and SSP2-2C. In *Part II,* we use the EIA curves obtained for the "Western Europe" region (WEU) under all four scenarios to derive a set of EIA curves for the Netherlands. The downscaling is done according to three different methods: (i) the share of WEU's production and GHG emissions represented by the Netherlands remains the same as in 2015 throughout the study's timeframe; (ii) the trends since 2005 of the shares of GHG emissions and agricultural production in the WEU represented by the Netherlands are extrapolated until 2050; and (iii) Dutch agricultural emissions reduce in line with EU policies on effort sharing, with the share of agricultural production levels remaining constant. In *Part III*, we examine past and current emission trends from the three main sources of GHG emissions in Dutch agriculture (i.e. enteric fermentation, manure management, and soil management). We also analyse whether they are likely to persist and whether other strategies could contribute to EIA reduction as calculated in Part II, ultimately discussing the need for greater emission cuts via technical efficiency and behavioural change.

Results show that, by 2050, relative to 2010 values, EIA should decrease at all levels – regardless of whether it is measured on a land or on a product basis. Concerning the Dutch agricultural sector, the comparison of current and projected methane and nitrous oxide emissions from enteric fermentation, manure management and agricultural soils reveals the need for significantly more ambitious policy targets and systemic changes. Over 2010-30 our model indicates that Dutch agricultural GHG emissions must decrease by 26% while maintaining or even increasing production. The extrapolation of current trends is uncertain and will not ensure more than a 5% reduction. Besides, non-technical barriers may hamper the adoption of low-carbon technologies by farmers and their contribution to climate mitigation.

This indicates that, besides technological fixes and incremental changes, transformative agricultural pathways involving behavioural change towards more sustainable consumption patterns are paramount. It is necessary to go beyond efficiency measures and to consider absolute changes, such as the reduction of the Dutch herd size. IMAGE projections that most of the mitigation should be achieved through the reduction of methane emissions largely reflects the fact that the potential for mitigation in arable farming in the Netherlands is comparatively small. Moreover, herd reduction is relevant to all three processes analysed; it helps reduce methane emissions from enteric fermentation and manure management while reducing nitrous oxide emissions indirectly through less fertilizer use in feed production. Finally, almost 100% of concentrates used in dairy, pig and poultry feed in the Netherlands are imported from countries with relatively higher emissions.

Given the interdependence amongst different world regions and countries, changes in the Dutch agricultural sector may affect production levels elsewhere. Unless accompanied by changes in dietary patterns, the reduction of the Dutch herd – or other absolute changes – might lead to the mere replacement of production to another, less carbon-efficient world region; in other words, if the demand for meat and dairy remains the same, a reduction in the Dutch production would have to be compensated by an increase in the supply of these products elsewhere. It should be noted that, since in SSP1 global meat consumption is already 30% lower than default projections, changes in Dutch dietary patterns would have to be additional to that. Within that context, the reduction of livestock production in peatlands should be prioritized since these are the regions with the highest GHG emissions[7].

The future development of agriculture and its associated greenhouse gas (GHG) emissions are hugely important for climate security, food security and economic prosperity of rich and poor regions alike. Besides shedding light on the interaction between climate and agricultural strategies, our analysis illustrates the application of cross-scale thinking in the operationalization of the SDG agenda and underscores the need for concerted action amongst countries.

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To what extent will the evolution of the European food system to 2030 contribute to the Sustainable Development Goals?

Lindsay Shutes, H. D. Cui, T. Achterbosch, G. Philippidis, P. Havlik, T. Heckelei, A. Leip & H. Valin (WER-WUR)

The Sustainable Development Goals, agreed by 193 countries of the United Nations in September 2015, galvanize policy action from all global players through responsible production and consumption. In this study, we explore the extent to which the evolution of the EU food system to 2030 is likely to contribute to the Sustainable Development Goals. We consider three possible paths of development for the EU food system based on Shared Socio-Economic Pathways, with a focus on the implications for synergies and trade-offs between SDG2 *Zero hunger*, SDG9 *Industry, Innovation and Infrastructure* , SDG13 *Climate action*, SDG15 *Life on land* and SDG17 *Partnerships*.

The three pathways for the EU food system to 2030 are based on SSP1 – a low challenge pathway with a focus on sustainability, SSP2 – a middle of the road pathway with intermediate challenges and SSP3 – a high challenge pathway. We consider which pathways are most consistent with progress towards the Goals, how the EU fares relative to other regions and whether particular pathways call for policy action in Europe to assist with global progress.

We conduct the analysis using three models: the Modular Applied GeNeral Equilibrium Tool (MAGNET), GLOBIOM and CAPRI. MAGNET is a global economic simulation model that has been extended with the newly developed MAGNET SDGs Insights Module which includes a suite of official and supporting indicators, covering 12 of the 17 SDGs. GLOBIOM is a global model to assess competition for land use between agriculture, bioenergy, and forestry and supplies key SDG indicators. CAPRI is a partial-equilibrium model of agriculture in the EU that provides a wide range of economic and environmental indicators. Together, these models form a toolbox for the assessment of the evolution of the EU food system using a suite of European indicators developed within the Sustainable Food and Security (SUSFANS) project, complemented with SDG indicators for the rest of the world.

The approach allows synergies and trade-offs among economic, social and environmental objectives to be assessed in scenarios where several market instruments are operating simultaneously. The results of the scenarios highlight synergies and trade-offs both across SDGs and across scales: showing where the impact for the EU differs from the rest of the world, particularly developing regions, with a view to maximising gains for all.

The synergies across SDGs are embodied by certain SDG goals being reinforced by related SDGs. SDG17, which aims to revitalize the global partnership by promoting an open global trading system, will help enhance global food availabilities and achieve food security, which are the goals of SDG2. SDG13, which calls for urgent action to combat climate change, is consistent with SDG9 that encourages building resilient infrastructure to increase the ability to adapt to climate change and greater adoption of clean technologies and industrial processes to reduce greenhouse gas emissions. SDG15 will also help realize SDG2 and SDG13 by promoting sustainable use of terrestrial ecosystems and restoring degraded land as this will increase land productivity and strengthen ecosystem's capacity for adaptation to climate change.

The trade-offs across SDGs are reflected in certain SDG goals being counteracted by other SDGs. SDG2, with a goal for ending hunger and achieving food security, may require increases in food production and this implies that more land needs to be used for producing food and thus less land will be available for maintaining resilient ecosystems to combat climate change. Also, increases in food production require increases in energy consumption and this would lead to more greenhouse gas emissions. In a sense, realization of SDG2 may create difficulties in pursuing SDG13 and SDG15.