RESEARCH PROGRAM ON Policies, Institutions, and Markets
CGIAR
Led by IFPRI

Bioversity International

Workshop Report: Integrating Biodiversity and Ecosystem Services into Foresight Models

May 7 and May 8, 2015, Bioversity International, Rome

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Contents

1 Introduction

Ecosystem Services (ESS) and biodiversity depend on the interaction of multiple ecosystem types at different temporal and spatial scales, which are characterized by dynamic and non-linear relationships (Birkhofer et al. 2015; Bennett, Peterson, and Gordon 2009). There are few analytical models which can integrate or link across these different scales, capture complex behavior of (agricultural) ecosystems, and evaluate agricultural systems at different scales, from farm level to global level (Balbi et al. 2015). Even simulation models, which take a more systems oriented approach, have often focused on isolated processes and rarely examined effects of agricultural practices in multiple ecosystems (Balbi et al. 2015; Barraquand and Martinet 2011).

In order to inform decision-making regarding resource allocation and planning, it is important that analytic tools and methodologies integrate ESS in the analytic process. Analysis and information presented to policy makers for consideration of appropriate policies to promote sustainable practices should be based on approaches that allow the integration or linkage of evaluation across different scales. Such approaches can consist of methodologies that can combine different modeling techniques (Balbi et al. 2015). This includes the use of different types of data, including spatially explicit quantitative and semi quantitative data and expert opinion (Balbi et al. 2015).

Against this background, under the CGIAR Research Program on Policies, Institutions, and Markets (PIM), Bioversity International convened the workshop *Integrating Biodiversity and Ecosystem Services into Foresight Models"* to identify opportunities to enhance existing agricultural modeling capabilities to incorporate key ecosystem services, which affect sustainable agricultural productivity growth, and to support these modeling capabilities with relevant geospatial data from Bioversity and other sources. ESS considered are associated risks of pest/disease incidence, pollination, water quality and use efficiency, and soil health, which in turn are affected by agricultural crop diversity and other factors.

The workshop held at Bioversity International in Rome, Italy, from 7 – 8 May 2015 brought together a group of researchers and members of CGIAR centers, and other institutions who are interested in modelling biodiversity and ESS using geospatial data (see Annex 1 for a list of participants). The workshop focused on modeling at different scales: household/farm level, the agricultural sector level and the economy-wide level, in order to explore trade-offs and complementariness between productivity, nutrition and ESS.

2 Workshop Methodology

The workshop opened with a welcome address by Ann Tutwiler, Director General of Bioversity International, and Anita Regmi, Head of Development Impact Unit at Bioversity, followed by an introduction of participants. The workshop was organized into four main sections: i) presentation of availability and use of geospatial data ii) presentation of different economic models: household/landscape, partial

equilibrium and general equilibrium models; iii) working groups on data/economic model followed by presentation of outcomes from these group discussions; and iv) final discussion (see Annex 2 for the full workshop agenda).

3 Workshop Sessions

Workshop sessions were divided in two types: presentations and group discussions. Presentations were aimed at familiarizing all participants with the different approaches of agricultural economic models and spatial data. After each presentation, participants had a chance to raise questions. Discussion groups contributed to developing a better perspective for the different agricultural economic models and data. Thus, participants were provided with a number of questions to guide the discussions.

3.1 Presentations

The first session had the objective to set the stage. Keith Wiebe (IFPRI) provided an update on the Global Futures and Strategic Foresight program, a CGIAR initiative led by IFPRI. Steve Prager (CIAT) discussed the current capabilities and needs for integrating biodiversity and ESS into foresight models.

Session 2 consisted of three presentations related to the generation, availability and use of geospatial data. Alberto Zezza (World Bank) presented Geo-referencing in the Living Standard Measurement Study-Integrated Surveys on Agriculture (LSMS-ISA). LSMS is an open access household survey program focused on generating high quality data, improving survey methods and building capacity. This program has the aim of facilitating the use of household survey data for policy making. LSMS-ISA is focused on agriculture in Sub-Saharan Africa. Devra Jarvis (Bioversity International) briefly introduced Bioversity data compiled over 18 years of work (1996-2015) on measuring annual and perennial crop (fruit trees in Central Asia) diversity, in relation to their resilience to pests and diseases, on farms in many countries around the world. Celine Termote (Bioversity International) presented the agriculture biodiversity 4-cell assessment methodology used in all three CGIAR Systems CRPs and the related data collected by Bioversity using this methodology. Melanie Bacou (IFPRI) presented HarvestChoice, which is an open access platform that provides data on farming, cultural and socio-economic conditions with a particularly good coverage for Africa. Datasets are organized into a matrix of 10km x 10km grid cells. In addition, Harvest Choice offers interactive tools which are used for creating scenarios by manipulating and overlaying over 700 agricultural indicators (Harvest Choice 2015)

Session 3 had two presentations related to the use of remote sensing to scale GIS analysis to larger geography. Chandra Biradar (ICARDA) and Michael Marshall (ICRAF) pointed out that remote sensing is a useful tool for assessing land cover change, as well as for scaling from farm level to landscape-level through the use of different spatial resolution images. It was mentioned that one of the biggest data gaps is the lack of socio-economic data in remote sensing.

Session 4 focused on Partial Equilibrium Bio-Economic Modeling. The first presentation was on IMPACT model by Keith Wiebe (IFPRI). He introduced the IMPACT model, which is a global food policy model developed and maintained by IFPRI and widely applied to global projections on agricultural supply, demand and trade. IMPACT is used for ex-ante assessments of the long run impacts of changes in drivers of agricultural production and consumption such as socio-economic, technological and climate change. IMPACT currently includes 58 agricultural commodities and 320 food global production units, defined by the intersection of 159159 countries and 154 water basins. Scenarios are based on alternative assumptions about economic growth, population growth, technological change, climate change and other factors. IMPACT works at country or regional level and offers indicators of food security at national, regional and global levels. Regarding ESS and biodiversity, IMPACT currently is working only with land use and water management but the model is quite flexible, thus results can be linked with external models, such as soil and water assessment tools. IMPACT could also be linked with models of different scales. Future work envisaged with the model includes developing a nutrition model component and quality of diet indicators, as well as differentiating impacts at household group levels (such as rural/urban and poor/ non poor households).

The second presentation made by Ulrich Kleinwechter (IIASA) introduced GLOBIOM, which is a partial equilibrium model of the world agricultural, forest and bioenergy sectors developed by IIASA. GLOBIOM covers 18 crops which represent 70% of cropland in 30 economic regions and up to 200,000 simulation units. In GLOBIOM, consumer and producer surplus are maximized following a spatial equilibrium modeling approach. GLOBIOM captures environmental aspects such as water, carbon sequestration, and land use, but not explicitly biodiversity. It is possible to incorporate ESS and biodiversity by using external data within the 200,000 simulation units. GLOBIOM can be linked with models of other scales. GLOBIOM worked with MIRAGE (CGE model) for biofuel studies, and EPIC (bio-physical model). Currently, the GLOBIOM team is working with IFAD to explicitly represent smallholder households in the model. For this purpose socio-demographic characteristics are taken into account.

Session 5, presented the Integrated Valuation of Ecosystem Services and Tradeoffs (InVEST) Model. Justin Johnson (University of Minnesota) gave a virtual presentation on this free and open source software suite developed with the aim of informing and improving natural resource management and investment decisions. InVEST consist of 18 different models for analyzing ESS: carbon, biodiversity, crop pollination, water, timber production, and others which have different data requirements. InVEST works at a household, landscape, watershed and national level. It has been used by academic institutions, international organizations (e.g. WWF, Nature Conservancy), private business and governments. The model is applied around the world, with a focus on North and South America, Africa and Asia. InVEST can provide different outputs (e.g. carbon sequestration) at different levels (e.g. household, farm), which could become inputs for bio-economic models, making it very useful for policy makers. With a view to the future, it is possible to develop and analyze future scenarios and associated impacts on ESS.

Session 7 focused on Household/Landscape models. Walter Rossing (University of Wageningen) presented the Farm and Landscape IMAGES Model. IMAGES is a spatially explicit, GIS based land use optimization model, which employs the Differential Evolution optimization strategy and concepts of Pareto optimality. Similar to linear programming approaches, decision variables and objectives can be programmed for the single units. The model covers a wide range of crops and livestock. It has been applied in Europe, Latin America, Asia and Africa. ESS and biodiversity are incorporated through the landscape quality, as well as dietary diversity. Tradeoffs between nutrition, environment and productivity are analyzed with a farm level model, considering gross margin vs. nature value. It is possible to incorporate ESS/biodiversity (nature value), as well as other objectives. The output of these models can be used in PE and CGE models.

Felix Bianchi (University of Wageningen) presented a discussion on Pest/Disease Modeling. The model generates maps of the potential for natural pest suppression by natural enemies of agricultural pests. The model is based on a landscape scale study in which parasitism rates have been assessed in cabbage crops in the Netherlands. Being a statistical model, its main shortcoming is that the ecological mechanisms underlying the analyzed phenomena are not captured. It was mentioned that the value of biocontrol through species interaction can reach 400 million USD/year.

The household DAHBSIM model was presented by Guillermo Flichman (CIHEAM-IAAM). DAHBSIM is a household model with a dynamic recursive optimization approach and non-separability between production and consumption. The annual results are used as inputs for the following year (e.g. soil conditions). Production, consumption and labor allocation choices are made simultaneously. The model covers a wide range of annual crops, livestock and some perennial crops. The model is still a work in progress, but there is an empirical application in Malawi. DAHBSIM considers joint production functions, which means that a farm produces two or more products, such as a crop and externalities (e.g. carbon sequestration, erosion, N-leaching). Water, (type of) nitrogen and nutrition could be added as a constraint in the model. The presenter mentioned that it is possible to convert the analysis to a normative approach, thus allowing for the analysis of tradeoffs between nutrition, environment and productivity. ESS and biodiversity could be incorporated in the model through the effects of land use change and the multi-product production function. DAHSIM outputs can be used in PE and CGE models.

Session 8 focused on General Equilibrium Modeling. David Laborde (IFPRI) gave a presentation about MIRAGE. MIRAGE is a global CGE model that has been developed to study trade policy scenarios, covering 140 regions. MIRAGE has been applied for studies of climate change and biofuels, and nutrition is added through external modules. There is some scope for incorporating ESS and biodiversity in MIRAGE. The model is calibrated under market-clearing assumption and exogenous factors can be changed to run scenarios: policy variables, technological shifters, and supply of factors of production. Tradeoffs between nutrition, environment and productivity can be analyzed at the sectoral aggregation level. It is relatively easy to incorporate ESS and biodiversity through external modules. MIRAGE could be linked to

household models. The principal shortcoming of MIRAGE for the analysis of ESS and biodiversity is that the analysis is conducted at a high level of aggregation.

Sherman Robinson (IFPRI) presented GLOBE, which is a "standard" global CGE model that has been calibrated using data derived from the GTAP database. The model is calibrated under a market-clearing assumption and exogenous factors can be changed to run scenarios. The presentation pointed out that partial equilibrium (PE) models are more appropriate for integrating greater details of biodiversity and ESS into the analysis. But the option to link CGE and PE models allow discussing the cross-sectoral national and global level policy implications of PE-level analyses.

3.2 Group Discussions

For the group discussions, workshop participants were split into four groups dealing with the four different topics. Group discussions during the first day dealt with Data (two groups) and Partial Equilibrium (PE) Models (two groups). On the second day of the workshop, the topics for group discussion sessions were Household/Landscape Models and Computable General Equilibrium (CGE) models, each discussed by two groups. Participants were provided with a number of questions to guide the discussions:

1. What should be the objective of collaborative work in this area?
2. What are 3 concrete work streams which would accomplish this goal?
3. What geographic area or areas may be recommended for focus?

Session 6:

<u>Topic 1: Data</u>

Question 1: What should be the objective of collaborative work in this area?

- Identify data availability and gaps, e.g. meta-analysis/inventory for the CGIAR system.
- Develop a common open access platform where data is shared among the members of the community.
- Coordinate research agendas across centers and address CGIAR SLOs.

Question 2: What are 3 concrete work streams which would accomplish this goal?

- Consolidate what exists in terms of data and identify data gaps.
- Focus on methods for data integration. Working with national stakeholders could contribute to avoid data duplication.
- Bring together CGIAR case studies.

Question 3: What geographic area or areas may be recommended for focus?

- Group 1 mentioned CGIAR priority countries, hotspots and major carbon emitters.
- Group 2 mentioned that it is important to assure that data collection has spatial and temporal overlap, with few places having deep data and a global coverage with wide data.

<u>Topic 2: Partial Equilibrium (PE) Models</u>

Question 1: What should be the objective of collaborative work in this area?

- The main challenge is to link model outputs from PE scales to local/HH, or to link impacts of agricultural systems on ESS/biodiversity and to link the necessary data across scales. Options for addressing this challenge have to be identified.
- An option would be collaboration across model scales, for example using outputs from PE models in landscape models or household/farm level models.
- Another option would be the use of statistical approaches, e.g. from ecological modeling, to link PE model output to biodiversity and ESS.

Question 2: What are 3 concrete work streams which would accomplish this goal?

- Identify PE model outputs that can be used to inform about ESS and biodiversity indicators and include a feedback mechanism between biodiversity and production.
- Establish a link between PE models and modeling approaches of other scales, e.g. landscape models, household models, or statistical ecological modeling.

Question 3: What geographic area or areas may be recommended for focus?

PE models are global models, but could focus on a particular region based on consideration of data availability, priorities for CGIAR research (biodiversity hotspots) or on ESS of interest

Session 10:

<u>Topic 3: Household/Landscape Models</u>

Question 1: What should be the objective of collaborative work in this area?

- Model farmer decision making processes which affect ecosystems and the provision of ESS and biodiversity.
- Incorporate shocks into the system (ecological and economical), non-market values and genetic diversity into models.

Question 2: What are 3 concrete work streams which would accomplish this goal?

- Work on ecological production functions, linking agrobiodiversity with ESS.
- Develop or look into current household/landscape dynamic models.
- Other suggestions were: integrate resilience concepts and parameters into the models, identify and integrate multiple resolutions of diversity and link ancillary population models for affected species groups (e.g. pests, predators, etc) to develop rules of thumb.

Question 3: What geographic area or areas may be recommended for focus?

- Representative landscapes (under-studied ones).
- Across range of landscape structures (conversion) and management styles.
- Sentinel landscapes where Bioversity works (but some areas with no interventions to be able to assess impact of interventions).

<u>Topic 4: Computable General Equilibrium (CGE) Models</u>

Question 1: What should be the objective of collaborative work in this area?

- Enhance the use of CGEs (and other models) to provide decision makers with relevant information on ESS, biodiversity and related socio-economic impacts.
- Look into complementarities between biophysical and CGE/PE models.
- CGE/PE models could be used to explore policy space to assess implications on farm level (top-down approach), as well as to feed changes in profitability or productivity from household/farm level models into CGE/PE models.

Question 2: What are 3 concrete work streams which would accomplish this goal?

- CGEs require going beyond rural/farming households to include all the households, spill-over effects and capture externalities (positive or negative).
- Quantify and value (whenever possible) selected ESS. This work can be country specific with an effort to increase the coverage. This implies taking stock of existing work done, setting (adjusting) standards, elaborating a sound methodology for measurement and valuation, building a dataset, and disseminating as a public good.

Question 3: What geographic area or areas may be recommended for focus?

- Start with one region (pilot).

4 Workshop Outputs

The workshop had aimed for the following outputs:

- Identify the next steps to link relevant data from Bioversity and other sources with ongoing modeling work.
- Narrow down and prioritize components from model enhancement consideration, together with relevant geographical area of consideration for all 3 scales of modeling efforts.
- Identify the next steps for developing concrete future program of work for integrating Bioversity and ESS into foresight models (see section 5).

1. Link Relevant Data from Bioversity and Other Sources with Ongoing Modeling Work

Sessions 2 and 3 focused on the generation, availability and use of geospatial data from Bioversity International, the Living Standard Measurement Study-Integrated Surveys on Agriculture (World Bank), HarvestChoice (IFPRI) as well as the options to scale from farm level to landscape through the use of different spatial resolution images. Open access satellite images and associated databases permit for remote sensing analysis of ESS where few data are available. During Session 6, two groups discussed about data. It was a consensus that an open access meta-database of available data should be developed, in a format that could be useful for the different types of models. For this purpose a consolidation of existing data is necessary, as well as the identification of data gaps and constraints.

2. Prioritize Components for Model Enhancement Consideration and Relevant Geographical Area

Participants agreed that the main challenges are to link model outputs from CGE/PE scales to local/HH or vice versa, to link impacts of agricultural systems on ESS/biodiversity and to link data across scales. It was suggested that CGE/PE models could be used to explore the policy space to assess implications at the farm level (top-down approach), and feed changes in profitability or productivity from HH/farm level models into CGE/PE models. Another recommendation was to look into complementarities between biophysical and HH/farm, landscape and PE/CGE models. Work on ecological production functions for linking agrobiodiversity with ESS, was another suggestion.

Regarding the identification of relevant geographical areas, participants had different opinions. Group 1 in the Data session mentioned CGIAR priority countries, hotspots and major carbon emitters. Group 2 in the Data session mentioned that it is important to assure that data collection has spatial and temporal overlap, with few places having deep data along with a wider global coverage. The PE models groups considered that research could focus on a particular region based on considerations of data availability, priorities for CGIAR

research (biodiversity hotspots) or on ESS of interest. The HH/Landscape model group considered to choose representative landscapes. Finally, the CGE groups mentioned the need to start with one region (pilot).

5 Next Steps

There was general agreement among the participants that the workshop was very successful in bringing together different economic model approaches. As a principal result from the workshop, a consensus emerged that the following issues have to be addressed:

- The environmental services (ESS) of interest have to be clearly identified and key concepts of biodiversity and related variables have to be defined in order to develop a common language among the participants.
- Develop a methodology to identify the scale of ESS and time frame. For this issue, it was suggested to develop a typology of questions related to biodiversity and socio-economic impacts, which may help guide future work.
- Develop a meta-database of available data in a format that could be useful for the different types of models.

Other Comments

At the end of the workshop representatives from CGIAR's Standing Panel on Impact Assessment (SPIA) and FAO provided their reactions to the workshop discussions. The central messages of these participants were in line with the consensus emerging among most participants.

Tim Kelley (SPIA)

- It is necessary to make clear and show in foresight work that agrobiodiversity has a value and fulfils a purpose, and therefore has to be valued by society.
- It is important to understand where biodiversity brings benefits and under which conditions its value is maximized.
- Biophysical aspects of biodiversity and its outputs (value) are not understood.
- Lack of data and models to assess value of biodiversity is a limitation.
- Questions to answer:
    - What are the key biodiversity indicators?
    - Who's going to collect them?
    - What is the method for evaluating them?

Answering these questions will help us to get on a pathway toward performing impact assessment related to biodiversity.

Lorenzo Bellu (FAO)

- It is necessary to complement quantitative model analyses with other, qualitative, types of validation (stakeholder consultations) because models tend to "flatten" scenarios, and they do not capture full richness of scenarios.
- During the workshop, distinction between biodiversity and ESS was often not clear. Precise concepts and definitions are needed.
- Payments for environmental services (PES) may need to be considered to examine to which extent they could be an additional source of income to contribute to food security. This, along with other instruments of providing incentives for preserving crucial ESS for the future, is an important new dimension.

Andrea Cattaneo (FAO)

- Benefit of this process is that a first step has been taken to fill the gap between biodiversity/ESS indicators and economic analysis.
- Developing a formal protocol/shared vision regarding the objects and objectives of analyses for consideration will be helpful.

References

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Annexes

Annex 1: List of participants

Name	Institution
Felix Bianchi	WUR
Walter Rossing	WUR
Alberto Zezza	World Bank
Francesco Caracciolo	University of Naples
Justin Andrew Johnson **(virtual)**	University of Minnesota
Jonas Luckmann	University of Hohenheim
Luca Salvatici	Roma Tre University
Rebecca Pietrelli	Roma Tre University
Pierluigi Montalbano	Roma Tre University
Giorgia Sforna	Roma Tre University
Aditya Sood **(virtual)**	IWMI
Paolo Colangelo	Istituto per lo Studio degli Ecosistemi
James Stevenson	ISPC/SPIA
Tim Kelley	ISPC/SPIA
Medha Devare **(virtual)**	CGIAR
Catherine Pfeifer **(virtual)**	ILRI
Petr Havlik	IIASA
Ulrich Kleinwechter	IIASA
David Laborde	IFPRI
Keith Wiebe	IFPRI
Melanie Bacou	IFPRI
Siwa Msangi	IFPRI
Sherman Robinson **(virtual)**	IFPRI
Michael Marshall **(virtual)**	IFPRI

Chandrashekhar Biradar	ICARDA
Lorenzo Bellu	FAO
Andrea Cattaneo	FAO
Alessandra Garbero	IFAD
Teresa Rojas Lara	Consultant
Guillermo Flichman	CIHEAM/IAMM
Daniel Suryadarma **(virtual)**	CIFOR
Himlal Baral	CIFOR
Steven Prager	CIAT
Anita Regmi	Bioversity
Devra Jarvis	Bioversity
Elisabetta Gotor	Bioversity
Hannes Gaisberger	Bioversity
Nadia Bergamini	Bioversity
Sonia Dias	Bioversity
Celine Termote	Bioversity
Vanessa Bryant	Bioversity
Nicole Demers	Bioversity
Natalia Estrada Carmona	Bioversity
Gaia Gullota	Bioversity
Sylvia Wood	Bioversity
Enoch Kikulwe **(virtual)**	Bioversity

Annex 2: Agenda

Thursday 7 May

09:00 – 09:15	Welcome, *Ann Tutwiler (Bioversity's DG)*
09:15 - 09:45	Welcome, *Anita Regmi*, Bioversity Logistics/Program details, *Facilitator* Get to know each other, *Facilitator* **Session 1: Setting the stage** • Global Futures and Foresight context setting, *Keith Wiebe,* IFPRI *(10' plenary talk)* • Current capabilities and needs for integrating biodiversity and ESS into foresight models, *Steve Prager*, CIAT *(10' plenary talk)*
09:45 - 10:45	**Session 2:** Generation**, availability and use of geospatial data** Moderator: *Steve Prager*, CIAT : Rapporteur: *Hannes Gaisberger*, Bioversity
	Presentation 1: Geo-referencing in the Living Standard Measurement Study-Integrated Surveys on Agriculture (LSMS-ISA), *Alberto Zezza*, World Bank Presentation 2*:* Diversity & biotic/abiotic resilience data, *Devra Jarvis* & *Celine Termote*, Bioversity Presentation 3: Platforms for sharing, analysis: *Melanie Bacou*, IFPRI
10:45 - 11:00	**Coffee**
11:00 - 11:45	**Session 3: Using** remote **sensing to scale GIS analysis to larger geography** Moderator: *Siwa Msangi*, IFPRI : Rapporteur: *Nadia Bergamini*, Bioversity
	Presentation 4: Remote sensing to scale analysis: *Chandra Biradar*, ICARDA Presentation 5: Virtual presentation Remote sensing to scale analysis: *Michael Marshall*, ICRAF
11:45 - 12:45	**Session 4: Partial equilibrium** bio-**economic modelling** Moderator: *Elisabetta Gotor*, Bioversity : Rapporteur: *Francesco Caracciolo*, University of Naples
	Presentation 6: IMPACT, *Keith Wiebe,* IFPRI Presentation 7: GLOBIOM, *Ulrich Kleinwechter*, IIASA
12:45 - 13:45	**Lunch**
13:45 - 14:15	**Session 5:** InVEST **model** Presentation 8: Virtual presentation, *Justin Johnson*, University of

	Minnesota Moderator: *Facilitator* : Rapporteur: *Himlal Baral*, CIFOR
14:15 - 14:30	**Instructions on group discussion,** *Facilitator*
14:30 – 15:30	**Session 6a: Group discussion on data and PE modelling,** *Facilitator* 2 groups for each topic, *one Facilitator per group*
15:30 - 15:45	**Coffee**
15:45 - 17:15	**Session 6b: Report back from group discussion**, *Facilitator* *Facilitator and group's rapporteurs*
17:15 - 17:30	**Recap of day and take home messages,** *Anita Regmi*
19:30	**Group dinner Ristorante Spirito DiVino**

Friday 8 May

09:00 – 09:30	Economic models and biodiversity, *Anita Regmi* Ecosystem Services and Resilience, *Natalia Estrada Carmona*
09:30 - 11:30	**Session 7: Household/landscape model** Moderator: *James Stevenson*, ISPC/SPIA : Rapporteur: *Jonas Luckmann,* University of Hohenheim
	Presentation 7: *Felix Bianchi*, WUR, pest/disease modelling Presentation 8: *Walter Rossing*, WUR, Farm and Landscape IMAGES model
10:45 - 11:00	**Coffee**
11:00 – 11.30	Presentation 9: *Guillermo Flichman*, CIHEAM-IAMM, including consumer preferences in the model
11:30 - 12:30	**Session 8: General equilibrium modelling** Moderator: *Tim Kelley*, ISPC/SPIA : Rapporteur: *Luca Salvatici,* Roma Tre University
	Presentation 10: MIRAGE, *David Laborde,* IFPRI Presentation 11: Virtual presentation GLOBE, *Sherman Robinson,* IFPRI
12:30 - 13:30	**Lunch**
13:30 - 14:30	**Session 10a: Group work,** *Facilitator* 4 groups previously divided will discuss a set of defined questions, one Facilitator per group
14:30 - 15:30	**Session 10b: Report back from group discussion,** *Facilitator* Groups reporting back to plenary, *Facilitator and groups' rapporteurs*
15:30 - 15:45	**Coffee**
15:45 – 16:45	**Session 11: Next steps,** *Anita Regmi assisted by facilitators*
16:45 – 17:30	**Session 12: Comments from external panel members** *Andrea Cattaneo* (FAO), Tim Kelley (SPIA), *Lorenzo Bellu* (FAO)
17:30 - 17:45	**Closure,** *Anita Regmi assisted by facilitators*

Annex 3: Presentations

Please check the separate links online.