EC/FAO Programme on Information Systems to Improve Food Security Decision-Making in the European Neighbourhood Policy (ENP) East Area

Training on introduction of new techniques to improve crop-forecasting system in Armenia

ARMSTATEHYDROMET, Yerevan, Armenia
10–20 May 2011

- REPORT -

1. Background

A two week training workshop was jointly organized by the ARMSTATEHYDROMET (hereinafter: Hydromet) and FAO under the "*EC/FAO Programme on Information Systems to Improve Food Security Decision-Making in the European Neighborhood Policy (ENP) East Area*" from 10 to 20 May 2011. The Programme is financed by the European Commission and implemented by FAO. The Programme aims at improving food security by enhancing the national capacity to generate, analyse, communicate and mainstream more relevant and reliable information into policies and programmes. The training took place in Hydromet's meeting room.

2. Workshop objectives

The objective of the workshop was to present new techniques and tools for crop forecasting, carry out a first trial on crop forecasting (winter wheat) using the new system and provide recommendations for improving Agromet Bulletin. The training was conducted by two FAO International Consultants, Bernard Tychon (Professor, Liege University and responsible for the development of the Agrometeorological Bulletin in Belgium) and his assistant, Antoine Denis.

The first week of the training was very technical. It was dedicated to the introduction of a new modelling system and software suite (Agrometshell, Statistica, Remote sensing exercise, etc.) used for crop forecasting.

The second week was devoted to the following activities: (i) discussions of the role and objectives of the Crop Forecasting Working Group; (ii) collection of the required data on crops to be further used in crop forecasting; (iii) first trial of winter wheat yield forecast using the real data; (iv) identification of the potential users of the Bulletin; and (v) improvement of Agromet Bulletin's format and content. The training was designed and organized in order to engage all participants in discussions and reflect on appropriate recommendations for all state institutions involved in crop forecasting in Armenia.

The training agenda is provided in Annex 1.

Training was organised for the stakeholders of the Programme concerned with crop forecasting, including staff from Hydromet (Agrometeorological and Climatology Units), Ministry of Agriculture (Agricultural Planning Department, Crop Production Department), State Agrarian University and National Statistical Service (Food Security Statistics Division and Agricultural Statistics Division).

The two trainers presented the elements of the new modelling for crop forecasting and carried out a number of exercises with the trainees to apply the new techniques and tools. The Senior International Consultant also reviewed the Agromet Bulletin which is issued by Hydromet and provided recommendations for improving its content and format.

3. Participation

The training workshop was attended by 25 participants. The workshop was attended by almost all members of the Crop Forecasting Working Group. The list of participants is provided in Annex 2.

Figure 1. Training session

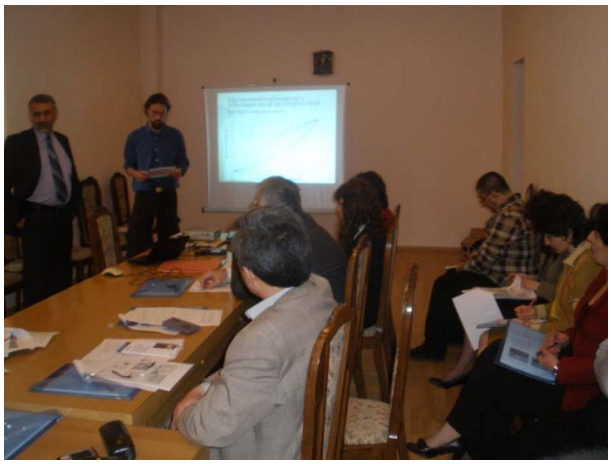

Figure 2. Group picture

4. Process

Introductory speeches

The participants were welcomed by Levon Vardanyan, Director of Armstatehydromet Service. The Director noted the importance to improve crop-forecasting system in Armenia taking into account the problems related to climate change and the importance of producing early information to provide timely support to farmers. He also emphasized the fact that the objectives of the Programme were fully in line with the priorities of their institution.

Mane Tapaltsyan, Country Coordinator, introduced the EC/FAO Programme, its objectives, areas of intervention and main activities. She thanked the Director of Armstatehydromet Service for the support provided in organizing the training.

Zara Petrossyan, Head of Armstatehydromet Operational Hydrometeorological Centre, described the developments in agrometereological forecasting in Armenia and service providing. She focused on the need for improving yield forecasting abilities through the implementation of new methods and the establishment of early warning systems of agrometeorological hazardous weather phenomena expectations.

First week

The first week was dedicated to the introduction of different pieces of software, which were applied during the second week.

During the first day, Antoine Denis gave a presentation: "General introduction to yield forecasting" describing the main problems related to food security and the importance of crop yield forecasting with reference to the European cereals balance and the European cereals market. He explained the basic relation between yield, area and production and introduced Monitoring of Agricultural Resources with Remote Sensing (MARS) and the European Crop Growth Modeling System (CGMS) models. He informed the participants of the current European method used for area assessment, the integration of very high resolution satellite images and the Land Use/Cover Area Frame Survey (LUCAS). He presented the yield assessment focusing on yield variability, factors of variability and the trend concept. Antoine Denis described the conception of crop yield forecasting models, the four main types of explanatory variables (agrometeorological, meteorological, remote sensing and other variables, for examples extreme factors and plant disease), their interactions in crop yield and production modeling. He gave two examples of operational models: the Global Monitoring for Food Security (GMFS) project and the CGMS.

The training session ended with a general introduction of Crop Yield Forecasting (CYF) model jointly presented by Antoine Denis, who focused on remote sensing, and Bernard Tychon, who introduced the agrometeorological and statistical parts.

The second day was dedicated to the description and use of the remote sensing component of the CYF model. The trainees applied the theory to practical exercises.

A general introduction to Remote Sensing theory was presented, emphasizing the Normalized Difference Vegetation Index (NDVI) concept and products, the two main types of geographical data (raster versus vector) and the SPOT VEGETATION images products.

The training mainly focused on data processing, in particular on the following topics:

- How to download SPOT VEGETATION NDVI images;
- How to use VGTEXTRACT to extract NDVI for Armenia;
- How to use the "VAST" software to compute crop phenological parameters;
- How to use the "WINDISP" software to summarize phenelogical parameter values by Province. Theory and exercises were given regarding satellite images time series, temporal evolution of NDVI signal and crop behavior according to time and space;
- Proposals for further development ("TIMESAT" software);
- Presentation of the manual "Crop Yield Forecasting – Remote sensing".

The third and fourth days were dedicated to the description and use of the Agrometeorological and the statistical component of the CYF model. The following issues were addressed:

Learning Agrometshell (AMS):

- Creation of station lists;
- Introduction of data into AMS (database management system);
- Conversion of daily data into decadal and monthly data;
- Data visualization;
- ETP calculation;
- Water balance calculation;
- AMS output extraction for the selection of explanatory variables.

Learning STATISTICA:

- Input data preparation for STATISTICA (case of potato);
  - Explanatory variables selection;
  - File format conversion;
  - Creation of additional explanatory variables with simple meteorological data, trend functions and other types of annual data linked to yield variation;
- CYF Model set up with STATISTICA;
  - Selection of relevant explanatory variables by multiple regression analysis;
  - Model validation by leave-one-out cross validation;
  - Final results, presentation and discussion of improvements.

During these two days, participants were divided into five groups. They were provided with a set of data from three weather stations and agricultural statistics figures. Trainees used these data to run the model executing systematically all the steps of the CYF process from data introduction to the model set up. Final results were presented and discussed and the work programme of the second week was fixed. Each presentation was followed by an active discussion among participants.

It has to be mentioned that the participants were very much interested in the material provided by the Consultants. They agreed that, because of the complexity and the importance of information given during the training, it would be needed more time for practical exercises.

Second week

Working group activities

The first meeting of the Working Group on Crop Yield Forecasting in Armenia (WG) took place from 19 to 20 May 2011. In addition to the group members, the meeting was attended by other interested staff from the stakeholder institutions, as well as by the International Consultants and the Country Coordinator.

The WG was created on 26 April 2011 and it consisted in 10 members, meteorologist and agronomist experts, representing Ministry of Agriculture, Ministry of Emergency Situation and Armstatyhydromet.

The main objective of the working group was to develop (calculate) crop yield forecasts for the main crops in the country and to assist in the improvement of the Agrometeorological Bulletin. During the meeting, members discussed the objectives and activities of the Working Group. They decided that the detailed activities of the WG and the definition of the role for each member would be discussed during the following meeting of the WG. The activities included selection of the main crops for crop yield forecast calculation, selection of the potential explanatory variables of yield, selection and running of the best model with actual data. WG agreed on using Agrometshell to calculate crop yields. Data used were: meteo data (all meteo daily variables and some particular data (hail, frost and heavy rains), agricultural data (soil water holding capacity, crop coefficient, disease development, field observations, etc.) and statistical data (sown area, harvested area, production and yield). Members decided to start forecasting two major crops (winter wheat and grape) at two different periods of the crop cycle (between June–August) for the all marzes (provinces) of the Armenia.

The detailed working plan and implementation activities, including the introduction of data into the model will be discussed by the WG during the further meetings.

All training materials were translated into Armenian and distributed to trainees as CDs. During the final session of the workshop, certificates of attendance were handled to most active participants.

Agrometeorological Bulletin

The improvement of the existing Agrometeorological Bulletin (produced by Armstatehydromet) was discussed during the seminar. Bernard Tychon presented different Bulletins (WMO/WAMIS, EC JRC MARS, Belgian Agrobulletin), their content and layout. WG decided to use these bulletins as examples for improving the Agrometeorological Bulletin. Members agreed that a draft new Bulletin would be developed by Hydromet and discussed during the second meeting and the updated Bulletin would be posted on the Armstatehydromet Website.

On 20 May, Bernard Tychon presented the conclusions of the training. He gave a demonstration of the first yield forecast for the winter wheat in the Aragatsotn marz using the actual available data for the period 1998–2010. WG decided to use that approach for developing two forecasts for winter wheat (June and July) and two forecasts for grape (June–August).

5. Evaluation of the training

Participants were asked to assess the relevance and effectiveness of the training at the end of the first week and at the end of the second week. The evaluation forms and the results of the surveys are presented in **Annex 3**.

6. Conclusions and follow-up actions

The workshop was successful in teaching the crop yield forecasting tools to participants. At the end of the two week training they were able to use the models and to perform crop yield forecast independently. The Crop Forecasting Working Group was created. The team of meteorologist and agronomist experts will be responsible for the implementation of the new Agromet Bulletin.

The discussions during the training demonstrated that there is strong interest from the national institutions in improving crop forecasting in Armenia. The workshop was successful in gathering both users and producers of information. It is worthwhile noting that the Ministry of Agriculture (MoA) is both producer of information (providing operational data) and user of the Agromet Bulletin for policy-making. There was excellent collaboration between the institutions involved in crop forecasting, in particular Hydromet and MoA. The workshop clearly demonstrates that this collaboration is indispensable for improving crop forecasting and will need to be institutionalized for sustainable results.

Follow up actions agreed by the participants are the following:

- WG will meet by the end of June to discuss the data provided by NSS, MoA and the meteorological data provided by Hydromet;
- WG to develop two forecasts for winter wheat (June and early July) and two forecasts for grape (July and beginning of August);
- To discuss the possibilities of getting phenological information, data on diseases and losses. Phenological data is provided by Hydromet, losses by NSS;
- Stakeholders institutions to implement the recommendations of the International Consultants to improve Agromet Bulletin and disseminate it to Marz support centres;
- The Programme to organize a follow-up mission in October to review the progress made by the WG and advise, as required, on follow-up actions to improve crop forecasting.

Annex 1. Training agenda

EC/FAO Food Security Information Systems to improve decision-making

Training on Improvement of Crop-forecasting System in Armenia

Tuesday, 10 May 2011

09:30	Registration	
09:45	Opening speech	L. Vardanyan, Director of Armstatehydromet Service
10:00	Introduction to the training	Country Coordinator
10:15	Agrometeorological forecasting and service providing in Armenia	Z. Petrossyan, Head of Armstatehydromet Operational Hydrometeorological Centre
10:30	Overall introductions to yield forecasting (including general statistics and satellite based techniques)	
13:00	Lunch	
14:00	Basics in Remote Sensing (RS)	Antoine Denis
17:00		Antoine Denis

Wednesday, 11 May 2011

10:00	Remote Sensing data processing (exercise), first part	Antoine Denis
	General overview Data format, importing and exporting	
13:00	Lunch	
14:00	Remote Sensing data processing (exercise), second part	Antoine Denis
	RS time series analysis using statistical tools Vegetation indices Images algebra Images statistics District, province and agricultural area vegetation statistics VAST and/or TIMESAT	
17:00		

Thursday, 12 May 2011

10:00	Agrometshell	Bernard Tychon
	General overview Database management: file formats, meteorological and non-meteorological data import, database configuration	
13:00	Lunch	

14:00	Agrometshell	Bernard Tychon
	Water balance calculation and risk analysis, crop coefficients estimation and crop water requirements, soil water content simulation, soil water surplus and deficit, actual evaporatransportation, soil water satisfaction index, data interpolation, start and length of the growing period, other interesting tools to work on agromet data	
17:00		

Friday, 13 May 2011

10:00	Statistical data processing	Bernard Tychon
	Simple and multiple regression theory Explanatory variable selection (statistic and agronomic approach)	
13:00	Lunch	
14:00	Non-linearity between explanatory variables and outputs Application on yield estimates: needs for a long time series Validation and cross validation techniques	
17:00		

Monday 16 and Tuesday 17 May 2011

National institutions will work separately on their own data and complete the database that will be used for the future crop-forecast. Bernard will move from place to place to see the developments.

Tuesday (afternoon), 17 May 2011

Visit to Merdzavan metereological station

Wednesday, 18 May 2011

10:00	Combination of all data	Bernard Tychon
	All data from National institutions will be combined in different databases in Hydromet	Bernard Tychon
13:00	Lunch	
14:00	All data from National institutions will be combined in different databases in Hydromet	Bernard Tychon
17:00		

Thursday, 19 May 2011

10:00	First meeting of the Crop forecasting Working Group	Bernard Tychon
	Definition of WG's role and objectives	
13:00	Lunch	
14:00	Selection of crops to be forecasted and regularity The first yield forecast will be done by the Working Group	
17:00		

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Friday, 20 May 2011

10:00	Bulletin drafting and answer to questions	Bernard Tychon
	Recommendations on improvement of Bulletin, first drafting of a new Bulletin	
13:00	Lunch	
14:00	Conclusions of the training Distribution of certificates	
17:00		

Annex 2. List of participants

Week 1

1. Heriknaz Lemberyan	- MoA, Agricultural Planning Dpt. erika5arm@yahoo.com
2. Gevorg Harutyunyan	- MoA, Crop-Production Dpt. gevorg.harutyunyan@hotmail.com
3. Arthur Petrosyan	- MoA, Agricultural planning Dpt. Artur5arm2003@yahoo.com
4. Andrias Melikyan	- Armenian State Agrarian University a_melikyan@yahoo.com
5. Zara Petrosyan	- Head of Armstatehydromet Operational Hydrometeorological Centre armstate@meteo.am, edittaron@gmail.com
6. Hamlet Melkonyan	- Deputy Director of Armstatehydromet armstate@meteo.am, hamlet_melkonyan@yahoo.com
7. Valentina Grigoryan	- Advisor to Director of Armstatehydromet armstate@meteo.am, valent_g2000@yahoo.com
8. Larisa Grigoryan	-Armstatehydromet, Head of Agrometeorological forecast department armstate@meteo.am
9. Armine Sahakayn	- Armstatehydromet, Leading specialist of Agrometeorological forecast department armstate@meteo.am
10. Rita Ghmboyan	-Armstatehydromet, Second category Specialist of Agrometeorological forecast department armstate@meteo.am
11. Nelli Arakelyan	- Armstatehydromet, First category specialist Agrometeorological forecast department armstate@meteo.am, nelliarakel@gmail.com
12. Ruzan Vardanyan	-Agricultural Statistics Unit, Chief Specialist, NSS armstat@sci.am
13. Manushak Khachatryan	-Food Security Statistics Unit, Leading Specialist, NSS mkhachmana@mail.ru
14. Nora Hakobyan	- Armstatehydromet, Metereological information supply and marketing Unit armstate@meteo.am
15. Susanna Shindyan	- Armstatehydromet, Climate survey Unit, Specialist armstate@meteo.am
16. Mariam Mkhitaryan	- Armstatehydromet, Agrometereological survey Unit, Leading Specialist armstate@meteo.am
17. Azat Safaryan	- Armstatehydromet, Climatology Unit armstate@meteo.am

18. Elena Khalatyan - Armstatehydromet, Climate survey Unit, Leading Specialist armstate@meteo.am

19. Haroutjun Gevorgyan - Armenian State Agrarian University h_gevorkyan@yahoo.com, inter@asau.am

20. Sona Hovhanissyan -RA Ministry of Emergency, Foreign Relations Dpt. hovsona@yahoo.com

21. Bernard Tychon - Agromet Consultant, Liege University bernard.tychon@ulg.ac.be

22. Antoine Denis - Agromet Consultant, Liege University Antoine.denis@ulg.ac.be

23. Mane Tapaltsyan - Country Coordinator Mane.Tapaltsyan@fao.org

Week 2

1. Heriknaz Lemberyan - MoA, Agricultural Planning Dpt. erika5arm@yahoo.com

2. Karine Yesayan - MoA, Crop-production Dpt. karineyesayan@yandex.ru

3. Gevorg Harutyunyan - MoA, Crop-Production Dpt. gevorg.harutyunyan@hotmail.com

4. Baghdasar Kghmesyan - MoA, Live-stock production Dpt. sedmoa@yahoo.com

5. Arthur Petrosyan - MoA, Agricultural planning Dpt. Artur5arm2003@yahoo.com

6. Gevorg Keshishyan - Armenian State Agrarian University keshishyan@inbox.ru

7. Zara Petrosyan -Head of Armstatehydromet Operational Hydrometeorological Centre armstate@meteo.am, edittaron@gmail.com

8. Hamlet Melkonyan - Deputy Director of Armstatehydromet armstate@meteo.am, hamlet_melkonyan@yahoo.com

9. Valentina Grigoryan - Advisor to Director of Armstatehydromet armstate@meteo.am, valent_g2000@yahoo.com

10. Armine Sahakayn - Armstatehydromet, Leading specialist of Agrometeorological forecast department armstate@meteo.am

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13. Ruzan Vardanyan - Agricultural Statistics Unit, Chief Specialist, NSS armstat@sci.am

14. Manushak Khachatryan - Food Security Statistics Unit, Leading Specialist, NSS mkhachmana@mail.ru

15. Nora Hakobyan - Armstatehydromet, Metereological information supply and marketing Unit armstate@meteo.am

16. Susanna Shindyan - Armstatehydromet, Climate survey Unit, Specialist armstate@meteo.am

17. Mariam Mkhitaryan - Armstatehydromet, Agrometereological survey Unit, Leading Specialist armstate@meteo.am

18. Azat Safaryan - Armstatehydromet, Climatology Unit armstate@meteo.am

19. Elena Khalatyan - Armstatehydromet, Climate survey Unit, Leading Specialist armstate@meteo.am

20. Haroutjun Gevorgyan - Armenian State Agrarian University h_gevorkyan@yahoo.com

21. Vladimir Yeganyan - Survey centre of Hydrometereological monitoring state service, Director armstate@meteo.am

22. Sona Hovhanissyan - RA Ministry of Emergency, Foreign Relations Dpt. hovsona@yahoo.com

23. Bernard Tychon -Agromet Consultant, Liege University bernard.tychon@ulg.ac.be

24. Antoine Denis -Agromet Consultant, Liege University Antoine.denis@ulg.ac.be

25. Mane Tapaltsyan - Country Coordinator mane.tapaltsyan@fao.org

Annex 3. Evaluation Forms

Evaluation form (first week)

FAO Training in Crop Yield Forecasting: Training Programme Survey

1. What is, according to you, the level of concordance between the training programme and the programme defined by FAO in the "Crop Yield Forecasting system improvement in Armenia" project?

□ Excellent □ very good □ good □ medium □ bad

Introduction

□ Excellent □ very good □ good □ medium □ bad

Remote sensing

□ Excellent □ very good □ good □ medium □ bad

Agrometshell

□ Excellent □ very good □ good □ medium □ bad

Statistics

□ Excellent □ very good □ good □ medium □ bad

Give your comments:

……..

……..

……..

2. Do you estimate that your training was beneficial to the activities of your Service or Institution?

□ Yes □ No

3. Estimate how this training programme will serve in your activities in your country?

…….

……..

……..

4. Evaluate the level of this training according to your own instruction level and your experience.

□ appropriate □ too difficult □ too easy

If the level did not suit you, give explanations: …….

…….

…….

5. Do you estimate that the length of your training was sufficient?

□ Yes □ No

If no, what is according to you, the length that is the more suitable?

…….

6. How was the training programme organization?

□ Excellent □ very good □ good □ mediocre □ bad

Comments: …….

……..

7. Please indicate any comments that appear important and relevant on any non-didactical aspects that were not mentioned above.

……...

……...

……...

8. Do you have some recommendation for FAO and EC for the improvement of such kind of training session?

……...

……...

……...

……...

Date: ……

Evaluation form (second week)

Working Group Activities

Note: The evaluation form was filled in not only by the members of the WG, but also by the other trainees.

1. Do you have a clear understanding of what are the Working Group's role and responsibilities?

1.1 for the Working Group as a whole:

□ absolutely □ mostly □ to some extent □ vaguely □ not at all

1.2 for you personally as a member of the Working Group:
□ absolutely □ mostly □ to some extent □ vaguely □ not at all

Comments:

……..

2. Will you be able to contribute enough of your time to Working Group of activities?

□ Yes □ No

Comments: …….

3. Do you estimate that the Working Group activities will be beneficial to the activities of your Service or Institution?

□ Yes □ No

4. Estimate how this Working Group will serve to your activities in your country?

……...

5. Please indicate any comments that appear important and relevant on any aspects of the Working Group.

……..

6. Do you have any recommendation for the improvement of the Working Group activities?

……..

Date : ……

Results of the evaluation

Week 1

Out of the 23 participants in the first week of training, 12 filled out the questionnaire. The results of the survey among the respondents were as follows.

Half of the respondents acknowledged that the training was highly relevant to the development of the Crop Yield Forecasting System in Armenia (excellent and very good) and five respondents considered that the relevance was good and one that the relevance was low (medium) (Figure 2). Figure 3 illustrates the answers provided by the respondents regarding the relevance of the specific sections of the training.

Figure 2. Relevance of the training

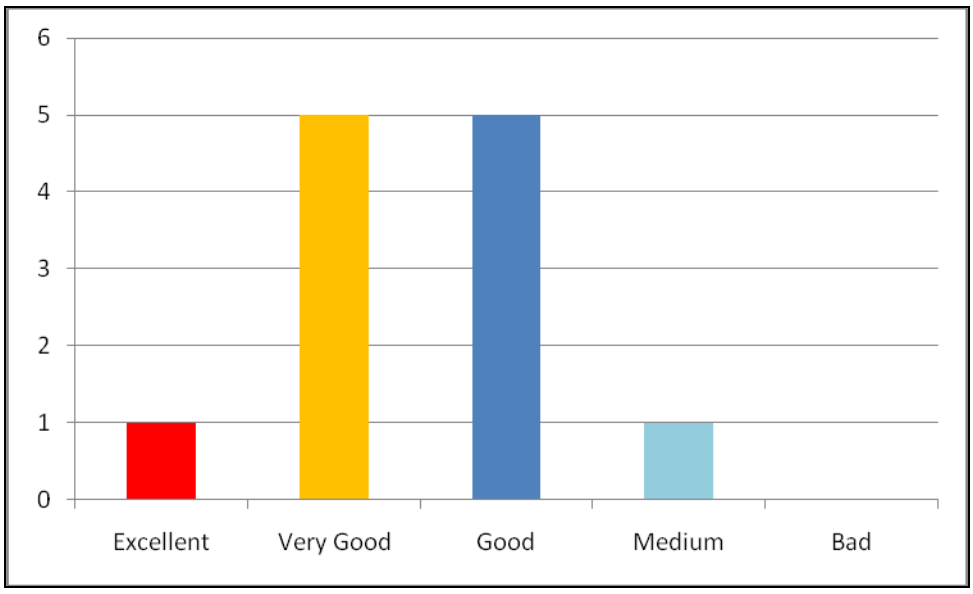
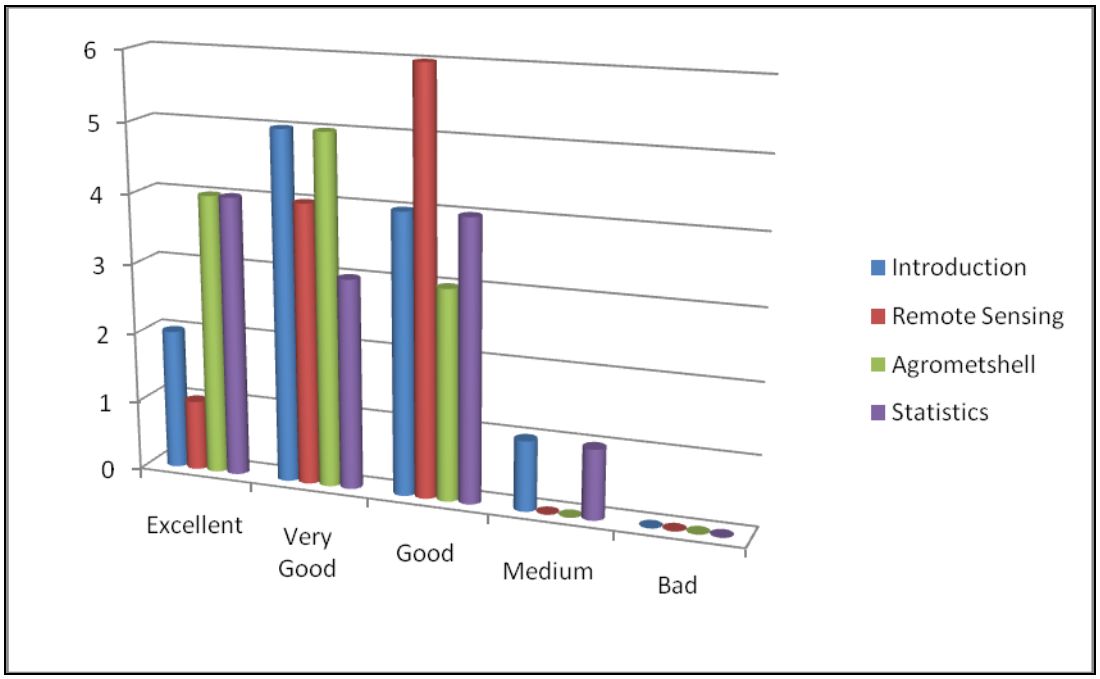


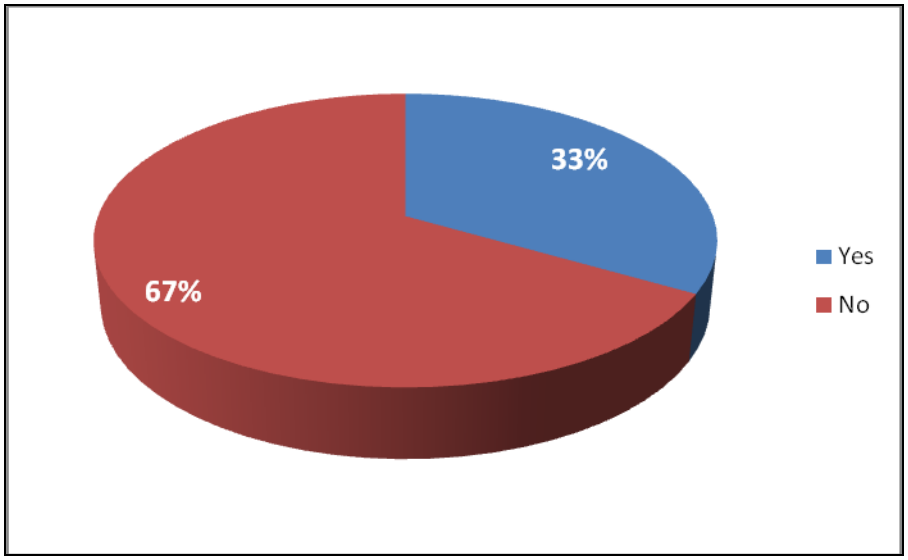
Figure 3. Relevance of specific sections of the training



All respondents considered that their service or institution will benefit from the training. Almost all respondents (11 out of 12) estimated that the level of the training was appropriate taking into account their knowledge and experience.

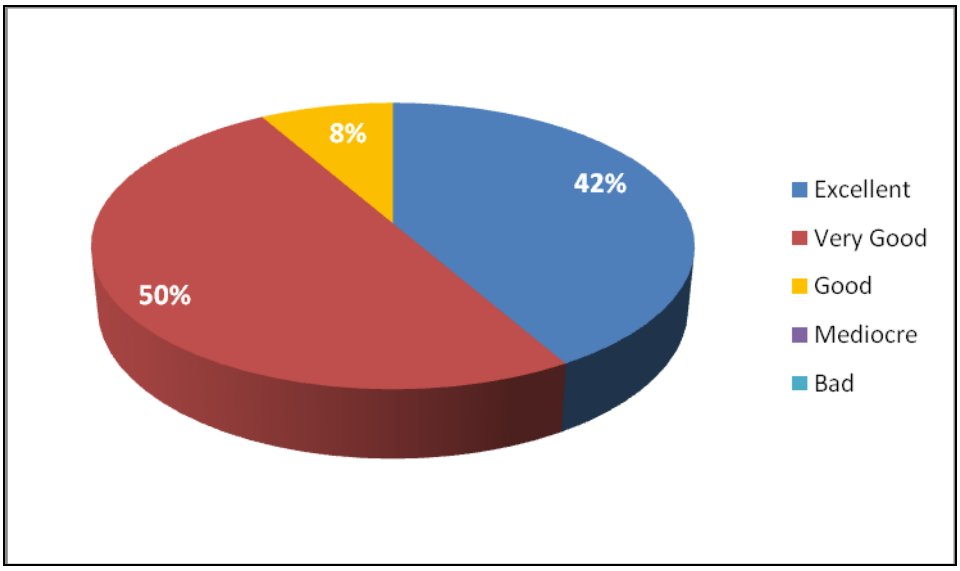
However, as illustrated in Figure 4, two-thirds of the respondents considered that the length of the training was insufficient. This issue was discussed during break-time discussions: a number of trainees estimated that more time was needed for practice as many aspects of the training were very technical.

Figure 4. Duration of the training (sufficient or not)



The organization of the training was appraised positively. As shown in Figure 5, almost all respondents found that it was very good or excellent. Some respondents however mentioned in the evaluation form that there was an insufficient number of computers. One computer was used by 3-4 participants.

Figure 5. Organization of the training



Week 2: ***Working group activities***

Ten participant (out of 25) filled out the questionnaire. The results of the survey among the respondents were as follows.

As seen in Figure 6, seven out of 10 respondents indicated that they had an clear understanding of the role and responsibilities of the working group as a whole on one side, and their own role and responsibilities personally as a member of the WG, on the other side. Two respondents pointed out that they understand only to some limited extent their role and responsibilities in the working group, as well as those of the group as a whole. The last respondent had unclear understanding of role and responsibilities.

Figure 6. Understanding of the role and responsibilities of the Working Group as a whole

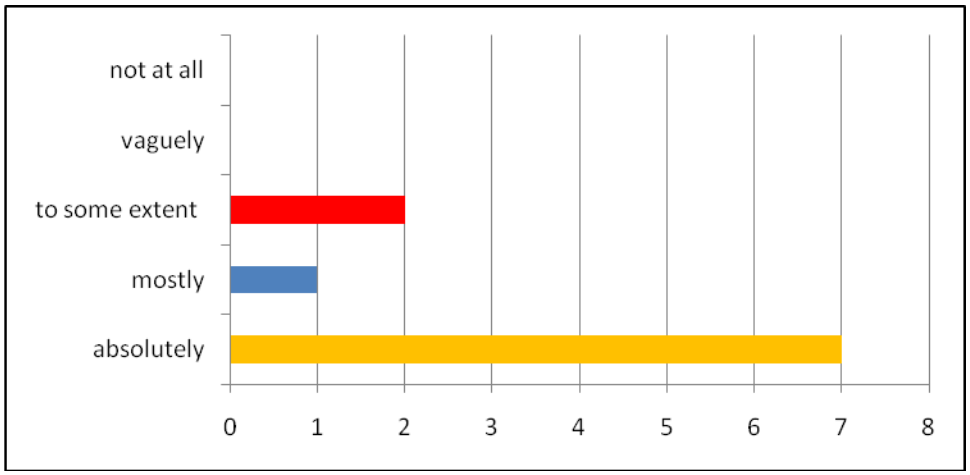
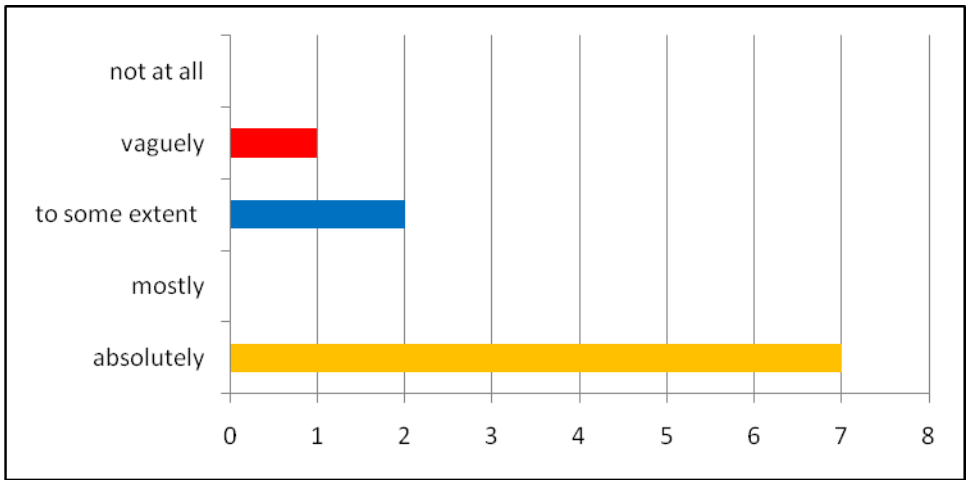
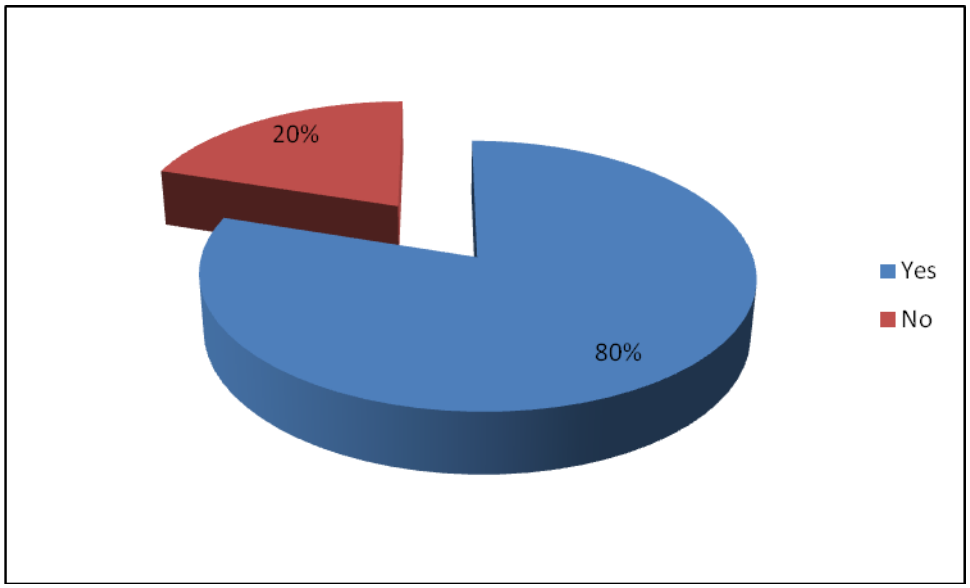


Figure 7. Understanding of own role and responsibilities as a member of the working group



Eight respondents thought that they could devote enough of their time to WG activities while two respondents were concerned about not having enough time to contribute (Figure 8).

Figure 8. Ability to devote enough time to the working group activities



All respondents believed that their service or institution would directly benefit from the WG activities.