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CONFÉRENCE DES PARTIES À LA CONVENTION SUR LA DIVERSITÉ BIOLOGIQUE SIÉGEANT EN TANT QUE RÉUNION DES PARTIES AU PROTOCOLE DE CARTAGENA POUR LA PRÉVENTION DES RISQUES BIOTECHNOLOGIQUES
Cinquième réunion
Nagoya (Japon), 11-15 octobre 2010
Point 13 de l'ordre du jour provisoire*

ÉVALUATION DES RISQUES ET GESTION DES RISQUES (ARTICLES 15 ET 16)

Note du Secrétaire exécutif

I. INTRODUCTION

1. Le Protocole de Cartagena pour la prévention des risques biotechnologiques contient des dispositions sur l'évaluation des risques (Article 15 et annexe III) afin de déterminer et d'évaluer les effets défavorables potentiels des organismes vivants modifiés sur la conservation et l'utilisation durable de la diversité biologique, compte tenu également des risques pour la santé humaine et de la gestion des risques (Article 16) et de permettre aux Parties de mettre en place et d'appliquer des mécanismes, des mesures et des stratégies appropriés pour réglementer, gérer et maîtriser les risques définis par les dispositions du Protocole relatives à l'évaluation des risques.

2. À sa première réunion, la Conférence des Parties siégeant en tant que réunion des Parties au Protocole a décidé d'étudier à sa cinquième réunion une modalité pouvant permettre d'identifier les organismes vivants modifiés qui ne sont pas susceptibles d'avoir des effets défavorables sur la conservation et l'utilisation durable de la diversité biologique, en tenant compte également des risques pour la santé humaine et ce, en vue d'arriver à une décision conformément au paragraphe 4 de l'article 7[1].

3. À leur quatrième réunion, compte tenu de la nécessité d'avoir des orientations supplémentaires sur certains aspects de l'évaluation des risques et de la gestion des risques, les Parties ont créé, par le biais du Centre d'échange pour la prévention des risques biotechnologiques, un forum en ligne à composition non limitée sur les aspects spécifiques de l'évaluation des risques et un groupe spécial d'experts techniques sur l'évaluation des risques et la gestion des risques, conformément au mandat

* UNEP/CBD/BS/COP-MOP/5/1.

[1] Paragraphe 7 a) i) de l'annexe à la décision BS-I/12

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annexé à la décision. En outre, les Parties au Protocole ont prié le Secrétaire exécutif de convoquer : i) des groupes de discussion et au moins une conférence en ligne en temps réel par région avant chacune des réunions du groupe spécial d'experts techniques afin d'identifier les questions centrales relatives aux aspects spécifiques de l'évaluation des risques et de la gestion des risques mentionnés dans l'annexe à la décision; et ii) deux réunions du groupe spécial d'experts techniques sur l'évaluation des risques et la gestion des risques avant la cinquième réunion de la Conférence des Parties siégeant en tant que réunion des Parties au Protocole[2].

4. Dans leur examen du renforcement des capacités en matière d'évaluation des risques, les Parties ont, à leur quatrième réunion, également prié le Secrétaire exécutif : i) de coordonner et de faciliter, en collaboration avec les organes compétents des Nations Unies et autres organisations internationales, le développement de la formation à l'évaluation des risques et à la gestion des risques liés aux organismes vivants modifiés; ii) d'organiser, avant la cinquième réunion de la Conférence des Parties, des stages de formation régionaux et sous-régionaux afin de permettre au pays d'acquérir une expérience pratique de l'élaboration et de l'évaluation des rapports d'évaluation des risques conformément au Protocole; et iii) convoquer un atelier sur le renforcement des capacités et l'échange d'expériences en matière d'évaluation des risques et de gestion des risques liés aux organismes vivants modifiés dans la sous-région du Pacifique[3].

5. Outre l'examen de la nécessité d'élaborer des orientations supplémentaires sur certains aspects de l'évaluation des risques comme il en est fait mention dans le paragraphe 3 et conformément à son mandat tel qu'il a été arrêté par les Parties, le groupe spécial d'experts techniques a également été prié d'étudier les modalités possibles de coopération pour l'identification des organismes vivants modifiés qui sont susceptibles d'avoir des effets défavorables sur la conservation et l'utilisation durable de la diversité biologique, en tenant compte également des risques pour la santé humaine. Pour aider le groupe spécial d'experts techniques sur l'évaluation des risques et la gestion des risques dans ses délibérations, la Conférence des Parties siégeant en tant que réunion des Parties au Protocole a prié les Parties et invité les autres gouvernements et les organisations compétentes à présenter des informations scientifiquement fondées disponibles sur l'identification des organismes vivants modifiés ou des caractères particuliers de ces organismes qui pourraient avoir des effets défavorables sur la conservation et l'utilisation durable de la diversité biologique, en tenant compte également des risques pour la santé humaine. Les Parties ont également prié le Secrétaire exécutif de compiler les informations communiquées et d'élaborer un rapport de synthèse pour examen par le groupe spécial d'experts techniques et les Parties[4].

6. En conséquence, la présente note a été établie par le Secrétaire exécutif pour aider les Parties au Protocole dans leur examen du point de l'ordre du jour sur l'évaluation des risques et la gestion des risques. La section II contient une analyse des principaux résultats de la procédure d'élaboration d'orientations supplémentaires sur certains aspects de l'évaluation des risques. La section III contient une vue d'ensemble des activités de renforcement des capacités effectuées en réponse aux demandes de la réunion des Parties. La section IV contient une vue d'ensemble des communications et recommandations concernant la coopération pour identifier les organismes vivants modifiés ou les caractères d'organismes vivants modifiés *qui peuvent avoir des effets défavorables* sur la conservation et l'utilisation durable de la diversité biologique, en tenant compte également des risques pour la santé humaine[5]. La section V fournit quelques éléments qui peuvent aider les Parties à étudier des modalités pour identifier les organismes vivants modifiés qui *ne sont pas susceptibles d'avoir des effets*

[2] Paragraphes 3, 4 et 6 de la décision BS-IV/11

[3] Paragraphes 12 et 13 de la décision BS-IV/11

[4] Paragraphes 3, 4 et 6 de la décision BS-IV/11

[5] Voir le paragraphe 4 b) iii) de l'annexe à la décision BS-I/12

défavorables sur la conservation et l'utilisation durable de la diversité biologique, en tenant compte également des risques pour la santé humaine[6]. La section VI tire quelques conclusions et propose des éléments d'un projet de décision pour examen par les Parties.

II. ORIENTATIONS SUPPLÉMENTAIRES SUR CERTAINS ASPECTS DE L'ÉVALUATION DES RISQUES

7. Désireux d'appliquer les différents éléments de la décision BS-IV/11 concernant l'élaboration d'orientations supplémentaires sur l'évaluation des risques, le Secrétariat, en consultation avec le Bureau de la Conférence des Parties siégeant en tant que réunion des Parties au Protocole, a mis en place un mécanisme continu qui comprend trois types d'activités : i) groupes spéciaux de discussion en ligne; ii) conférences régionales en ligne et en temps réel; et iii) réunions face à face du groupe spécial d'experts techniques.

8. La procédure a débuté avec l'ouverture du groupe d'experts techniques en ligne à composition non limitée sur l'évaluation des risques et la gestion des risques (Forum en ligne) par l'intermédiaire du Centre d'échange pour la prévention des risques biotechnologiques[7].

9. Dans une notification, le Secrétaire exécutif a invité les Parties, les autres gouvernements et les organisations concernées à désigner des experts de l'évaluation des risques au Forum en ligne en utilisant pour ce faire le format commun de désignation d'experts en prévention des risques biotechnologiques. Le Secrétariat a vérifié si les formulaires de candidature étaient complets conformément aux critères et conditions minimales à remplir par ces experts (voir la Décision BS-IV/4).

10. Au total, 229 experts ont été inscrits au Forum en ligne à composition non limitée dont 153 ont été désignés par un total de 48 Parties et 11 par un total de cinq non-Parties, 65 experts étant inscrits en qualité d'observateurs[8].

11. Dans le cadre de la préparation des travaux du groupe spécial d'experts techniques, huit groupes spéciaux de discussion en ligne et quatre conférences régionales en ligne et en temps réel (Europe, Amérique latine, Afrique et Asie) ont eu lieu entre novembre 2008 et février 2009 dans le cadre du Forum en ligne[9].

12. Les participants au groupe spécial d'experts techniques ont été choisis sur la base de leur participation active aux activités du Forum en ligne et ce, conformément au *modus operandi* consolidé de l'Organe subsidiaire chargé de fournir des avis scientifiques, techniques et technologiques de la Convention sur la diversité biologique[10], comme demandé dans la décision BS-IV/11 et en consultation avec le Bureau de la Conférence des Parties siégeant en tant que réunion des Parties au Protocole. La liste des participants figure à l'annexe I du présent document.

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[6] Voir le paragraphe 7 a) i) de l'annexe à la décision BS-I/12

[7] Disponibles à l'adresse suivante : http://bch.cbd.int/onlineconferences/forum_RA.shtml

[8] La liste des participants est disponible à l'adresse suivante : http://bch.cbd.int/onlineconferences/participants_ra.shtml

[9] Les transcriptions complètes des travaux des groupes de discussion sont disponibles à l'adresse suivante : http://bch.cbd.int/onlineconferences/archived_discussions_ra.shtml. Les documents et transcriptions complètes des conférences électroniques en temps réel sont disponibles à l'adresse suivante : http://bch.cbd.int/onlineconferences/realtime_ra.shtml.

[10] Paragraphe 18 de l'annexe III de la décision VIII/10 de la Conférence des Parties.

13. La première réunion du groupe spécial d'experts techniques sur l'évaluation des risques et la gestion des risques s'est tenue du 20 au 24 avril 2009 à Montréal. Dix-huit personnes de dix-sept Parties ainsi que huit observateurs de trois non-Parties et de cinq organisations y ont pris part en qualité de membres du groupe.

14. Entre les deux réunions du groupe spécial d'experts techniques, plusieurs activités ont été réalisées en vue de faire avancer le projet des orientations sur chacune des questions spécifiques identifiées à la première réunion du groupe et de mettre à l'essai la feuille de route comme en avaient fait la demande les Parties. Ces activités ont été les suivantes :

a) *Dans le cadre du Forum en ligne à composition non limitée :* dix groupes de discussion spéciaux et quatre conférences en ligne et en temps réel (Afrique, Asie et Pacifique, Groupe régional occidental et pays d'Europe centrale et orientale, et GRULAC)[11]; et

b) *Dans le cadre du* groupe spécial d'experts techniques *:* cinq cycles de groupes de discussion en ligne, deux téléconférences du Bureau de ce groupe et réunions face à face du sous-groupe de travail sur la feuille de route et de ce Bureau[12].

15. Les activités énumérées au paragraphe 14 ci-dessus ont alterné entre le Forum d'experts en ligne à composition non limitée et le groupe spécial d'experts techniques afin de créer une boucle de retour d'informations pour chaque nouveau projet de version des documents d'orientation établis par les sous-groupes de travail du groupe spécial et de permettre la participation d'un grand nombre d'experts d'un bout à l'autre du processus.

16. La deuxième réunion du groupe spécial d'experts techniques a eu lieu du 20 au 24 avril 2010 à Ljubljana en Slovénie. Y ont pris part quatorze membres du groupe spécial d'experts techniques de Parties ainsi que deux membres de non-Parties et quatre d'organisations.

17. On trouvera à l'annexe II du présent document une liste complète des activités réalisées dans le cadre du Forum en ligne et du groupe spécial d'experts techniques.

A. Résultats du forum d'experts en ligne à composition non limitée sur l'évaluation des risques et la gestion des risques

18. Les recommandations du Forum en ligne au groupe spécial d'experts techniques avant sa première réunion ont porté sur les questions suivantes :

a) élaboration d'orientations sur les aspects spécifiques ci-après de l'évaluation des risques et de la gestion des risques : i) poissons, arbres, microorganisme et pharmaplantes vivants modifiés; ii) organismes vivants modifiés avec empilage de gènes ou de caractères; iii) environnements récepteurs spécifiques; et iv) surveillance à posteriori et effets à long terme d'organismes vivants modifiés libérés dans l'environnement; et

b) plan d'action pour l'élaboration de matériels d'orientation sur des aspects spécifiques priorisés ainsi que la feuille de route.

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[11] Les transcriptions complètes des travaux des groupes de discussion sont disponibles à l'adresse suivante : http://bch.cbd.int/onlineconferences/archived_discussions_ra.shtml . Les documents et transcriptions complètes des conférences immédiates en ligne sont disponibles à l'adresse suivante : http://bch.cbd.int/onlineconferences/realtime_ra.shtml.

[12] Les réunions du sous-groupe de travail sur la feuille de route et du Bureau du groupe spécial d'experts techniques ont eu lieu du 12 au 14 octobre 2009 à La Haye.

19. Après la première réunion du groupe spécial d'experts techniques, les délibérations qui se sont tenues dans le cadre du Forum d'experts en ligne à composition non limitée ont contribué à l'état d'avancement du projet et de la mise à l'essai de la feuille de route ainsi qu'à l'élaboration des orientations sur des aspects spécifiques de l'évaluation des risques qui ont été considérés par le groupe spécial d'experts techniques comme des priorités (c'est-à-dire les moustiques vivants modifiés, les cultures vivantes modifiées qui sont tolérantes à l'agression abiotique et les organismes vivants modifiés avec empilage de gènes).

20. Durant plusieurs cycles de délibérations, les experts du Forum en ligne ont apporté au groupe spécial d'experts techniques des contributions significatives au contenu de la feuille de route comme aux aspects spécifiques de l'évaluation des risques. S'agissant de la feuille de route, ils ont pour la plupart émis des opinions positives sur son utilité et son bien-fondé, faisant plusieurs recommandations sur la manière d'en améliorer la convivialité.

21. Durant le dernier cycle des groupes de discussion spéciaux, les membres du Forum en ligne ont été invités à faire à la réunion des Parties des recommandations pour leur examen à la cinquième réunion sur la marche à suivre des procédures d'évaluation des risques et de gestion des risques. Les participants au Forum sont intervenus sur l'utilité de la feuille de route et les orientations sur certains aspects de l'évaluation des risques, notant que ces documents devraient être révisés et actualisés à intervalles réguliers afin d'en assurer la pertinence et de prendre en compte les faits nouveaux.

22. Les participants au Forum en ligne ont également noté la nécessité d'élaborer des orientations supplémentaires sur certains aspects de l'évaluation des risques dont les thèmes énumérés dans les documents d'information UNEP/CBD/BS/COP-MOP/5/INF/12 et UNEP/CBD/BS/COP-MOP/5/INF/13 ont été considérés par le Forum comme un point de départ pour l'élaboration d'orientations supplémentaires[13]. En outre, les participants ont recommandé que les thèmes ci-après soient pris en compte : i) établissement de scénarios de risques; ii) stratégies de gestion des risques, y compris la surveillance à posteriori des impacts des organismes vivants modifiés libérés dans l'environnement; iii) analyse des incertitudes et de la variabilité; iv) une "liste de contrôle" des éléments essentiels de la procédure d'évaluation des risques; et v) comment mieux relier la procédure d'évaluation des risques en vertu du Protocole aux dispositions et décisions qui relèvent de la Convention sur la diversité biologique.

23. Il a par ailleurs été recommandé pendant les discussions du Forum en ligne que, dans l'élaboration du Forum en ligne, les Parties devraient continuer de se consulter et que les orientations existantes élaborées par d'autres organisations internationales (comme par exemple l'OCDE et le GIEC) devraient être prises en considération.

24. En ce qui concerne un mécanisme d'élaboration d'orientations supplémentaires, un grand nombre d'experts ont recommandé la création d'un groupe spécial d'experts techniques, des discussions en ligne et un échange d'informations par le biais du Centre d'échanges pour la prévention des risques biotechnologiques, ou un ensemble de ces options. D'autres exemples de mécanismes d'élaboration d'orientations comprenaient des consultations entre experts et un groupe d'experts chargé d'impartir une formation de suivi, une fois élaborées les orientations.

[13] Disponibles à l'adresse suivante : http://bch.cbd.int/protocol/meetings/documents.shtml?eventid=3018

25. Les observations et recommandations faites dans le cadre du Forum d'experts en ligne à composition non limitée sont synthétisées et mises à disposition sous la forme de documents d'information pour examen par les Parties (UNEP/CBD/BS/COP-MOP/5/INF/12 et 14)[14].

B. Résultats du groupe spécial d'experts techniques sur l'évaluation des risques et la gestion des risques

26. Les principaux résultats de la première réunion du groupe spécial d'experts techniques ont été les suivants : i) un projet de feuille de route; ii) l'identification et la hiérarchisation de trois autres questions spécifiques d'évaluation des risques (c'est-à-dire les moustiques vivants modifiés, les cultures vivantes modifiées qui sont tolérantes à l'agression abiotique et les organismes vivants modifiés avec empilage de gènes) pour l'élaboration d'orientations; iii) la mise en place de quatre sous-groupes de travail chargés de cibler chacune des questions identifiées; et iv) l'établissement d'un plan d'action consistant en un résumé des clauses et procédures d'élaboration d'orientations avant la deuxième réunion du groupe spécial d'experts techniques.

27. Pendant la période intersessions, en consultation avec le groupe d'experts en ligne à composition non limitée, des sous-groupes de travail du groupe spécial d'experts techniques ont élaboré plus en détail les projets de documents d'orientation sur les quatre questions spécifiques d'évaluation des risques et expérimenté le projet de feuille de route pour l'évaluation des risques associés aux organismes vivants modifiés.

28. À sa deuxième réunion, le groupe spécial d'experts techniques a obtenu les principaux résultats suivants :

a) mise au point du document intitulé "Orientations sur l'évaluation des risques associés aux organismes vivants modifiés" et divisé en deux sections intitulées "Partie I : Feuille de route pour l'évaluation des risques associés aux organismes vivants modifiés" et "Partie II : Types spécifiques des organismes et caractères vivants modifiés" (c'est-à-dire les moustiques vivants modifiés, les cultures vivantes modifiées qui sont tolérantes à l'agression abiotique et les organismes vivants modifiés avec empilage de gènes ou de caractères). Ce document figure à l'annexe III et il sera également mis à disposition par le biais du Centre d'échange pour la prévention des risques biotechnologiques[15];

b) recommandations au Secrétariat sur la manière d'intégrer et d'actualiser le document des orientations établi par le groupe spécial d'experts techniques et les outils de récupération des matériels de base disponibles au Centre des ressources d'information pour la prévention des risques biotechnologiques du Centre d'échange; et

c) une évaluation du plan d'action établi à sa première réunion.

29. Le groupe spécial d'experts techniques a également fait des recommandations aux Parties à leur cinquième réunion en vue de l'élaboration plus détaillée d'orientations sur des thèmes additionnels d'évaluation des risques, en particulier sur les questions spécifiques d'évaluation des risques qui ont été identifiées et priorisées pendant la Forum en ligne à composition non limitée et la première réunion du groupe.

[14] Les documents d'information UNEP/CBD/BS/COP-MOP/5/INF/12 et UNEP/CBD/BS/COP-MOP/5/INF/14 sont disponibles à l'adresse suivante : http://bch.cbd.int/protocol/meetings/documents.shtml?eventid=3018

[15] Disponibles à l'adresse suivante : http://bch.cbd.int/onlineconferences/forum_RA.shtml

30. Le rapport de la première réunion et le rapport final du groupe spécial d'experts techniques sont disponibles sous la forme de documents d'information pour examen par les Parties[16].

31. On trouvera à l'annexe IV du présent document la série complète des recommandations adressées par ce groupe à la cinquième réunion des Parties.

III. RENFORCEMENT DES CAPACITÉS EN MATIÈRE D'ÉVALUATION DES RISQUES

32. En réponse à la demande des Parties sur le renforcement des capacités en matière d'évaluation des risques, le Secrétariat a coordonné un processus multipartite d'élaboration de cours de formation et ce, en collaboration avec des organisations du système des Nations Unies (Convention d'Aarhus de la Commission économique des Nations Unies pour l'Europe, Convention internationale pour la protection des végétaux de l'Organisation des Nations Unies pour l'alimentation et l'agriculture (FAO) et Programme des Nations Unies pour l'environnement (PNUE)), d'autres organisations internationales (Global Industry Coalition et Third World Network) et le secteur universitaire (University of Canterbury et University of Minnesota).

33. L'élaboration de ces cours a eu lieu pas à pas. Le Secrétariat a dans un premier temps préparé un schéma de la formation et invité les collaborateurs à y contribuer et à faire des observations. Ensuite, sur la base des retours d'information, il a préparé un projet de manuel de formation et invité les collaborateurs à l'examiner. Il a ensuite révisé ce projet de manuel sur la base des retours d'information et des observations faites pendant la procédure d'examen collégial.

34. Tout en utilisant les dispositions du Protocole de Cartagena sur la prévention des risques biotechnologiques, en particulier son annexe III comme base de la rédaction et de la révision du manuel de formation naissant, le Secrétariat a également essayé d'incorporer d'une manière globale les leçons de l'expérience et la pratique courante de plusieurs cadres réglementaires nationaux et d'organisations internationales.

35. Le résultat de ce processus est un projet de manuel de formation intitulé "Evaluation des risques associés aux organismes vivants modifiés" qui comprend quatre modules : i) Aperçu de la prévention des risques biotechnologiques et Protocole de Cartagena sur la prévention des risques biotechnologiques; ii) Travaux préparatoires – Compréhension du contexte dans lequel une évaluation des risques est faite; iii) Réalisation de l'évaluation des risques; et iv) Établissement d'un rapport sur l'évaluation des risques.

36. Le manuel de formation est disponible sous la forme d'un document d'information et par le biais du Centre d'échange pour la prévention des risques biotechnologiques pour examen par les Parties[17].

37. En réponse également à la demande des Parties d'organiser des activités de renforcement des activités afin de permettre aux pays d'échanger les leçons de leur expérience et d'apprendre directement à établir comme à analyser des rapports sur l'évaluation des risques en conformité avec le Protocole, le manuel de formation décrit ci-dessus a été utilisé dans le cadre des activités suivantes :

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[16] Les documents d'information UNEP/CBD/BS/COP-MOP/5/INF/13 et UNEP/CBD/BS/COP-MOP/5/INF/15 sont disponibles à l'adresse suivante : http://bch.cbd.int/protocol/meetings/documents.shtml?eventid=3018

[17] Le manuel de formation est disponible sous la forme d'un document d'information qui porte la cote UNEP/CBD/BS/COP-MOP/5/INF/22 à l'adresse suivante : http://bch.cbd.int/protocol/meetings/documents.shtml?eventid=3018 et par le biais du Centre d'échange pour la prévention des risques biotechnologiques à l'adresse suivante : http://bch.cbd.int/protocol/cpb_art15/training .

a) l'atelier sous-régional pour les pays du Pacifique sur le renforcement des capacités et l'échange d'expériences en matière d'évaluation des risques, du 4 au 7 juillet 2010 à Nadi (Fidji); et

b) le cours de formation sous-régional pour les pays asiatiques sur l'évaluation des risques associés aux organismes vivant modifiés, du 12 au 16 juillet 2010 à Siam Reap (Cambodge).

38. Douze représentants de six Parties au Protocole (Fidji, îles Salomon, Kiribati, Nioué, Samoa et Tonga), deux pays non-Parties (îles Cook et Vanuatu) et une organisation (University of Canterbury, Nouvelle-Zélande) ont pris part à l'atelier sous-régional pour les pays du Pacifique. Vingt-trois représentants de quinze Parties au Protocole (Bhoutan, Cambodge, Inde, Indonésie, Malaisie, Mongolie, Myanmar, Pakistan, République arabe syrienne République démocratique populaire lao, République islamique d'Iran, Thaïlande, Turkménistan, Viet Nam et Yémen), une organisation non gouvernementale (Third World Network) et le Programme des Nations Unies pour l'environnement ont pris part au cours de formation pour les pays asiatiques. Un expert des Pays-Bas y a également pris part.

39. Les participants ont été invités à remplir un questionnaire pour évaluer l'atelier organisé à l'intention des pays du Pacifique et le cours de formation à l'intention des pays asiatiques. Les résultats ont montré que, en général, ces activités : i) dispensaient une formation concrète à l'établissement et à l'analyse de rapports sur l'évaluation des risques conformément aux articles et à l'annexe III du Protocole; ii) aidaient à mettre en valeur les compétences nécessaires pour comprendre comment utiliser et interpréter les informations existantes ainsi qu'à identifier et combler les lacunes en matière d'information; et iii) aidaient à comprendre comment établir les informations de référence nécessaires pour faire une évaluation des risques.

40. Les résultats du questionnaire ont également révélé que la plupart des participants convenaient que le manuel de formation établi par le Secrétariat en collaboration avec d'autres organismes des Nations Unies et organisations concernées : i) est un outil de formation utile à l'évaluation des risques; ii) est facile à comprendre par étape; iii) donne une vue d'ensemble adéquate de la procédure d'évaluation des risques; et iv) est utile pour un large éventail d'utilisateurs.

41. Dans leur retour d'informations additionnelles, les participants ont estimé que le manuel d'information est un excellent outil de travail qui fait une introduction bien structurée et approfondie de la procédure d'évaluation des risques ainsi qu'un instrument utile pour les Parties comme pour d'autres pays et organisations concernées. Ils ont indiqué que pour en améliorer l'utilité, ce manuel devrait :

a) être davantage amélioré en, notamment, y ajoutant un glossaire de termes, une liste de sigles, des graphiques, des diagrammes, des exemples d'autres organismes vivants modifiés qui ne sont pas des cultures;

b) incorporer des éléments du document intitulé "Guidance on Risk Assessment of Living Modified Organisms" élaboré par le groupe spécial d'experts techniques, à savoir de la feuille de route (graphique par exemple) et des orientations sur les types spécifiques d'organismes et caractères vivants modifiés (c'est-à-dire l'évaluation des risques associés aux moustiques vivants modifiés, aux cultures vivantes modifiées qui sont tolérantes à l'agression abiotique et aux organismes vivants modifiés avec empilage de gènes ou de caractères); et

c) être présenté sous la forme d'un outil d'apprentissage plus convivial (comme par exemple un logiciel interactif); et

d) être publié dans toutes les langues des Nations Unies.

42. Les participants à l'atelier pour les pays du Pacifique et au cours de formation pour les pays asiatiques sont convenus que les Parties pourraient à leur cinquième réunion envisager les éléments/activités suivants :

Renforcement des capacités sur l'évaluation des risques

a) Cours de formation additionnels sur l'évaluation des risques au niveau national ou pour de plus petites zones géographiques (de 5 à 7 pays environ par exemple) où l'environnement récepteur est similaire pour permettre la participation d'un équipe centrale d'experts par pays;

b) Formation de suivi préalable à l'évaluation des risques portant par exemple sur différents types d'utilisations escomptées (c'est-à-dire l'introduction dans l'environnement et les organismes vivants modifiés destinés à être utilisés directement pour l'alimentation humaine et animale, ou destinés à être transformés) et différents types d' organismes vivants modifiés;

c) Cours de formation spécialisés sur les sujets suivants : i) établissement de rapports et de recommandations sur l'évaluation des risques; ii) extraction de données pertinentes de notifications; iii) évaluation de la qualité des données soumises; et iv) collecte de données de référence détaillées;

d) Formation de formateurs qui peuvent poursuivre les activités de formation à l'échelle nationale;

Orientations sur l'évaluation des risques

e) Publication et distribution de la brochure du groupe spécial d'experts techniques intitulée "Guidance on Risk Assessment of Living Modified Organisms", y compris une version en ligne dans toutes les langues des Nations Unies sur le site Internet du Centre d'échange pour la prévention des risques biotechnologiques;

f) Élaboration d'orientations supplémentaires sur l'évaluation des risques comme l'a recommandé le groupe spécial d'experts techniques;

Renforcement général des capacités en matière de prévention des risques biotechnologiques

g) Formation régionale additionnelle à l'identification des organismes vivants modifiés; et

h) Formation de décideurs à l'interprétation des recommandations de l'évaluation des risques et à la mise en oeuvre des stratégies de gestion des risques.

43. Les rapports de ces activités de renforcement des capacités sont disponibles sous la forme de documents d'information pour examen des Parties (UNEP/CBD/BS/COP-MOP/5/INF/16 et 17)[18].

[18] Les documents d'information UNEP/CBD/BS/COP-MOP/5/INF/16 et UNEP/CBD/BS/COP-MOP/5/INF/17 sont disponibles à l'adresse suivante : http://bch.cbd.int/protocol/meetings/documents.shtml?eventid=3018

IV. COLLABORATION EN MATIÈRE D'IDENTIFICATION DES ORGANISMES VIVANTS MODIFIÉS OU DES CARACTÈRES SPÉCIFIQUES *QUI PEUVENT AVOIR DES EFFETS DÉFAVORABLES* SUR LA CONSERVATION ET L'UTILISATION DURABLE DE LA DIVERSITÉ BIOLOGIQUE, COMPTE TENU ÉGALEMENT DES RISQUES POUR LA SANTÉ

44. Dans une notification, le Secrétaire exécutif a invité les Parties, les autres gouvernements et les organisations concernées à soumettre des informations scientifiquement solides sur l'identification des les organismes vivants modifiés ou des caractères d'organismes vivants modifiés qui peuvent avoir des effets défavorables sur la conservation et l'utilisation durable de la diversité biologique, en tenant compte également des risques pour la santé humaine[19].

45. Dans quelques-unes des communications reçues par le Secrétariat, des références ont été faites aux organismes vivants modifiés ou caractères d'organismes vivants modifiés qui peuvent avoir des effets défavorables tels que le coton, les poissons, le maïs, les arbres, les virus et les organismes vivants modifiés destinés à la production de composés pharmaceutiques, avec empilage de gènes ou de caractères, la résistance des insectes, la tolérance à l'agression abiotique et aux pesticides, l'ingestion de nutriments modifiés ou l'hébergement de gènes marqueurs de résistance aux antibiotiques. Quelques communications par contre ont noté qu'il n'y a pas de preuves scientifiques faisant état d'effets défavorables potentiels d'organismes vivants modifiés qui ont été commercialisés à ce jour.

46. Sur la base des communications susmentionnées, le Secrétariat a préparé pour examen par le groupe spécial d'experts techniques un document intitulé "Compilation of submissions on the identification of living modified organisms or specific traits that may have adverse effects on the conservation and sustainable use of biological diversity, taking also into account risks to human health"[20].

47. Après avoir délibéré sur cette question, le groupe spécial d'experts techniques a identifié les modalités de coopération suivantes : i) échange d'informations par le biais du Centre d'échange pour la prévention des risques biotechnologiques; ii) ateliers; iii) un groupe spécial d'experts techniques; et iv) coopération dans le domaine de l'analyse des organismes vivants modifiés.

48. Plusieurs membres du groupe spécial d'experts techniques sont également convenus qu'une procédure par étape pourrait être établie à cette fin dans le cadre de laquelle une première phase de collecte d'informations serait suivie d'une deuxième phase portant sur l'analyse de ces informations.

49. Le groupe spécial d'experts techniques a fait des recommandations concrètes sur cette question (voir les paragraphes f) et g) iv) de l'annexe IV ci-dessous).

[19] Notification SCBD/BS/MPDM/jh/67587 (2009-056) disponible à l'adresse suivante : http://bch.cbd.int/protocol/notifications/

[20] Disponible sous la forme d'un document d'information qui porte la cote UNEP/CBD/BS/COP-MOP/5/INF/11 à l'adresse suivante : http://bch.cbd.int/protocol/meetings/documents.shtml?eventid=3018.

V. IDENTIFICATION DES ORGANISMES VIVANTS MODIFIÉS *PEU SUSCEPTIBLES D'AVOIR DES EFFETS DÉFAVORABLES* SUR LA CONSERVATION ET L'UTILISATION DURABLE DE LA DIVERSITÉ BIOLOGIQUE, COMPTE TENU ÉGALEMENT DES RISQUES POUR LA SANTÉ

50. Le paragraphe 4 de l'article 7 du Protocole dispose que "la procédure d'accord préalable en connaissance de cause ne s'applique pas aux mouvements transfrontières intentionnels des organismes vivants modifiés qui, dans une décision de la Conférence des Parties siégeant en tant que Réunion des Parties au Protocole, sont définis comme peu susceptibles d'avoir des effets défavorables sur la conservation et l'utilisation durable de la diversité biologique, compte tenu également des risques pour la santé".

51. Dans ses délibérations sur les modalités susceptibles de permettre l'identification des organismes vivants modifiés qui n'auront probablement pas d'effets défavorables sur la conservation et l'utilisation durable de la diversité biologique, en tenant compte également des risques pour la santé humaine, les Parties peuvent, à leur cinquième réunion, prendre en considération, notamment les communications suivantes qu'ont faites les Parties par le biais du Centre d'échange pour la prévention des risques biotechnologiques dans le cadre de la procédure simplifiée (Article 13) en vertu de laquelle les importations d'organismes vivants modifiés ont été exemptées de la procédure d'accord préalable en connaissance de cause[21].

52. Au 10 juin 2010, les organismes vivants modifiés suivants avaient été soumis au Centre d'échange pour la prévention des risques biotechnologiques dans le cadre de la procédure simplifiée :

OVM pour lequel la procédure simplifiée a été appliquée	Pays	BCH Fichier
Coton Bollgard™	Colombie	8151
Coton Roundup Ready™	Colombie	8155
Coton Bollgard II™ (MON-15985-7)	Afrique du Sud	5666
Coton Bollgard™ (MON-00531-6)	Afrique du Sud	5679
Maïs YieldGard™ (MON-00810-6)	Afrique du Sud	5712
Maïs YieldGard™ (SYN-BT011-1)	Afrique du Sud	5715
Maïs Roundup Ready™ (MON-00603-6)	Afrique du Sud	8164
Soja Roundup Ready™ (MON-04032-6)	Afrique du Sud	8167
Coton Roundup Ready™ (MON-01445-2)	Afrique du Sud	8170
Maïs Roundup Ready™ YieldGard™ (MON-00603-6 x MON-00810-6)	Afrique du Sud	40513
Coton Roundup Ready™ Flex™ (MON-88913-8)	Afrique du Sud	40514
Coton Roundup Ready™ Bollgard™ (MON-00531-6 x MON-01445-2)	Afrique du Sud	40516

VI. CONCLUSIONS ET ÉLÉMENTS D'UN PROJET DE DÉCISION

A. Orientations supplémentaires sur certains aspects de l'évaluation des risques

[21] Paragraphe 1 b) de l'article 13

53. Les tâches confiées par les Parties au Forum en ligne et au groupe spécial d'experts techniques en vue de l'élaboration d'orientations supplémentaires sur l'évaluation des risques ont été remplies avec succès au moyen d'une procédure comprenant des délibérations en ligne et des délibérations face à face.

54. Un vaste groupe d'experts ont délibéré en ligne par le biais de groupes de discussion ad hoc et de conférences en temps réel pour ensuite faire des recommandations à un plus petit groupe, le groupe spécial d'experts techniques, dont les membres se sont réunis face à face. Cette procédure a permis à un grand nombre d'experts de diverses disciplines scientifiques et techniques touchant à l'évaluation des risques de contribuer à l'élaboration du matériel d'orientation à moindre coût et dans les limites des ressources financières disponibles.

55. Un des résultats de cet processus est un document intitulé "Guidance on Risk Assessment of Living Modified Organisms". Le groupe spécial d'experts techniques et le Forum en ligne ont recommandé que ce document soit : i) publié et distribué, y compris une version en ligne dans le cadre du Centre d'échange pour la prévention des risques biotechnologiques, dans toutes les langues des Nations Unies; ii) mis davantage à l'essai durant par exemple des ateliers régionaux, y compris le cas échéant en coopération avec des initiatives existantes en matière de renforcement des capacités et de formation; et iii) revisité dans un délai de deux ans, la nécessité d'actualiser la liste des matériels de base devant être déterminée dans un délai d'un an.

56. Bien que des progrès significatifs aient été faits pour tenir compte de la nécessité d'élaborer des orientations sur l'évaluation des risques avec l'établissement du document susmentionné, de nombreux membres du groupe spécial d'experts techniques et du Forum en ligne ont estimé que l'élaboration plus poussée d'orientations est encore nécessaire et ils ont par conséquent recommandé que soit maintenue la procédure consistant à conjuguer un Forum en ligne et un groupe spécial d'experts techniques.

57. Sur la base de ces informations et compte tenu notamment des recommandations du Forum en ligne et du groupe spécial d'experts techniques, la Conférence des Parties siégeant en tant que réunion des Parties au Protocole souhaitera peut-être :

a) appuyer et avaliser la poursuite des travaux du Forum d'experts en ligne à composition non limitée et du groupe spécial d'experts techniques sur l'évaluation des risques et la gestion des risques pour i) élaborer des orientations supplémentaires sur des types spécifiques d'organismes vivants modifiés et de caractères associés, compte tenu notamment des thèmes énumérés à l'annexe V ci-dessous; et ii) réviser le texte de la brochure intitulée "Guidance on Risk Assessment of Living Modified Organisms" sur la base par exemple de la mise à l'essai des orientations durant les activités de renforcement des capacités et actualiser ses listes de matériels de base;

b) prier le Secrétaire exécutif : i) de publier et de distribuer dans toutes les langues des Nations Unies le document intitulé "Guidance on Risk Assessment of Living Modified Organisms", y compris une version en ligne sur le Centre d'échange pour la prévention des risques biotechnologiques; ii) de mettre à l'essai durant les ateliers régionaux le document sur les orientations, y compris le cas échéant en coopération avec les initiatives existantes de renforcement des capacités et de formation; iii) de réviser le format commun de soumission de fichiers au Centre des ressources d'information sur la prévention des risques biotechnologiques du Centre d'échange afin de lier ces fichiers sur l'évaluation des risques à des sections spécifiques dudit document;

c) poursuivre les délibérations dans le cadre du Forum d'experts en ligne à composition non limitée sur l'évaluation des risques et la gestion des risques et prier le Secrétaire exécutif d'inviter des experts additionnels;

d) créer un groupe spécial d'experts techniques sur l'évaluation des risques et la gestion des risques et prier le Secrétaire exécutif d'appliquer le même *modus operandi* dans le choix des experts que celui appliqué lors de la procédure précédente.

B. Renforcement des capacités en matière d'évaluation des risques

58. S'agissant du renforcement des capacités, un manuel de formation a été élaboré en collaboration avec des organisations du système des Nations Unies et des organisations internationales. Ce manuel a servi d'assise aux activités de renforcement des capacités qui ont eu lieu pour les sous-régions de l'Asie et du Pacifique. Les participants à l'atelier et au cours de formation ont fait plusieurs recommandations sur l'amélioration de l'utilité et la convivialité du manuel. De surcroît, ils ont recommandé que la manuel soit transformé en un matériel de formation interactif (comme par exemple un CD-ROM), traduit et distribué dans toutes les langues des Nations Unies.

59. Sur la base de toutes ces informations et compte tenu notamment des recommandations des participants aux activités de renforcement des capacités, la Conférence des Parties siégeant en tant que réunion des Parties au Protocole souhaitera peut-être :

a) prier le Secrétaire exécutif d'organiser, à la date la plus rapprochée possible et sous réserve des fonds disponibles, d'autres cours de formation régionaux ou sous-régionaux afin de permettre aux pays d'acquérir une expérience concrète dans le domaine de l'établissement et de l'analyse de rapports sur l'évaluation des risques et ce, conformément aux articles et à l'annexe III du Protocole;

b) prier en outre le Secrétaire exécutif, en coopération avec l'Organisation des Nations Unies et d'autres organisations, d'améliorer l'utilité du manuel de formation intitulé "Risk Assessment of Living Modified Organisms" : i) en le révisant à intervalles réguliers sur la base des recommandations émanant des activités régionales et sous-régionales de renforcement des capacités; ii) en le transformant en un outil d'apprentissage interactif comme un CD-ROM et en le mettant à disposition par le biais du Centre d'échange pour la prévention des risques biotechnologiques; et iii) en publiant et distribuant le manuel aux Parties, aux autres gouvernements et aux organisations concernées.

C. Identification des organismes vivants modifiés ou caractères spécifiques d'organismes vivants modifiés qui i) **peuvent avoir** *ou ii)* **n'auront probablement pas** *des effets défavorables sur la conservation et l'utilisation durable de la diversité biologique, en tenant compte également des risques pour la santé humaine*

60. Les Parties, les autres gouvernements et les organisations concernées ont exprimé des vues divergentes au sujet de l'identification des organismes vivants modifiés ou caractères spécifiques d'organismes vivants modifiés qui peuvent avoir des effets défavorables sur la conservation et l'utilisation durable de la diversité biologique, en tenant compte également des risques pour la santé humaine. Le groupe spécial d'experts techniques a identifié les modalités suivantes pour résoudre la question : i) échange d'informations additionnelles par le biais du Centre d'échange pour la prévention des risques biotechnologiques; ii) ateliers; iii) un groupe spécial d'experts techniques; et iv) coopération dans le domaine de l'analyse des effets défavorables potentiels des organismes vivants modifiés. Cette procédure pourrait commencer par étapes, la première consistant à collecter des informations pour ensuite faire une analyse de ces informations.

61. En ce qui concerne l'identification des organismes vivants modifiés qui n'auront probablement pas d'effets défavorables sur la conservation et l'utilisation durable de la diversité biologique, en tenant compte également des risques pour la santé humaine, les Parties souhaiteront peut-être prendre note

notamment des décisions prises en application de la procédure simplifiée sur les importations d'organismes vivants modifiés exemptés de la procédure d'accord préalable en connaissance de cause.

62. Sur la base de ces informations et compte tenu notamment des vues exprimées par les Parties, les autres gouvernements et les organisations concernées ainsi que des recommandations du Forum en ligne à composition non limitée et du groupe spécial d'experts techniques, la Conférence des Parties siégeant en tant que réunion des Parties au Protocole souhaitera peut-être créer un ou plusieurs mécanismes dont par exemple un échange d'informations, des ateliers et/ou un groupe d'experts afin de donner aux Parties la possibilité de prendre des décisions sur l'identification des organismes vivants modifiés ou caractères spécifiques d'organismes vivants modifiés qui i) *peuvent avoir* ou ii) *n'auront probablement pas* des effets défavorables sur la conservation et l'utilisation durable de la diversité biologique, en tenant compte également des risques pour la santé humaine.

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Annex II

ACTIVITIES CARRIED OUT UNDER THE OPEN-ENDED ONLINE EXPERT GROUP ON RISK ASSESSMENT AND RISK MANAGEMENT AND BY THE AD HOC TECHNICAL EXPERT GROUP ON RISK ASSESSMENT AND RISK MANAGEMENT

Activity	Date / Location
Opening of the Online Forum and announcement of the topics and calendar of the discussion groups	6 November 2008, online
Ad hoc discussion groups under the Open-ended Online Forum on risk assessment and risk management of: (i) living modified (LM) fish; (ii) LM trees; (iii) LM microorganisms and viruses; (iv) LM pharmaplants; (v) living modified organisms (LMOs) with stacked genes or traits; (vi) post-release monitoring and long-term effects of LMOs released into the environment; and (vi) specific receiving environments; as well as on a Flowchart ("Roadmap") for risk assessment: the necessary steps to conduct risk assessment according to Annex III of the Protocol	10 November – 19 December 2008, online
First Series of Regional Real-time Online Conferences (for Europe, Latin America, Africa and Asia)	28 January – 17 February 2009, online
First Meeting of the Ad Hoc Technical Expert Group (AHTEG) on Risk Assessment and Risk Management	20 – 24 April 2009, Montreal, Canada
Meeting of the AHTEG Bureau.	24 April 2009, Montreal, Canada
Ad hoc discussion groups within the AHTEG Sub-working Groups for further drafting of the guidance documents	May – June 2009, online
Ad hoc discussion groups under the Open-ended Online Forum for input to the work of the AHTEG Sub-working Groups	22 June – 12 July 2009, online
Teleconference of the AHTEG Bureau	24 July 2009
Ad hoc discussion groups within the AHTEG Sub-working Groups for further drafting of the guidance documents and testing of the Roadmap	August – October 2009, online
Progress reports on the work of the AHTEG Sub-working Groups	October 2009
Meetings of the AHTEG Sub-working Group on the Roadmap and AHTEG Bureau	12 – 14 October 2009, The Hague, Netherlands
Ad hoc discussion groups within the AHTEG Sub-working Groups for further drafting of the guidance documents and testing of the Roadmap	November 2009, online
Ad hoc discussion groups under the Open-ended Online Forum for further input to the work of the AHTEG Sub-working Groups	23 November – 14 December 2009, online

Activity	Date / Location
Ad hoc discussion group under the Open-ended Online Forum on "The way forward for the development of further guidance on risk assessment and risk management of LMOs"	7 – 14 December 2009
Ad hoc discussion groups within the AHTEG sub-working groups for further drafting of the guidance documents	January 2010, online
Second series of Regional Real-time Online Conferences (for Africa, Asia and the Pacific, WEOG and CEE, and Latin America and the Caribbean)	2 – 11 February 2010, online
Ad hoc discussion group under the AHTEG for final drafting of the guidance documents in preparation for the second AHTEG meeting	March 2010, online
Teleconference of the AHTEG Bureau	7 April 2010
Preparatory meetings of the AHTEG Sub-working Groups	19 April 2010, Ljubljana
Second meeting of the Ad Hoc Technical Expert Group	20-23 April 2010, Ljubljana

Annex III

GUIDANCE ON RISK ASSESSMENT OF LIVING MODIFIED ORGANISMS

This document was developed by the Ad Hoc Technical Expert Group (AHTEG) on Risk Assessment and Risk Management under the Cartagena Protocol on Biosafety.[22]

This is intended to be a **"**living document**"** that will be improved with time as new experience becomes available and new developments in the field of applications of living modified organisms (LMOs) occur, as and when mandated by the Parties to the Cartagena Protocol on Biosafety.

PART I:

ROADMAP FOR RISK ASSESSMENT OF LIVING MODIFIED ORGANISMS

This "Roadmap" provides an overview of the process of environmental risk assessment for a living modified organism (LMO) in accordance with Annex III[23] to the Cartagena Protocol on Biosafety (hereinafter "the Protocol") and all other articles related to risk assessment. This Roadmap was developed in response to decision BS-IV/11[24] of the Conference of the Parties serving as the meeting of the Parties to the Protocol (COP-MOP). Annex III is the basis of the Roadmap. Accordingly, this Roadmap is a guidance document and does not replace Annex III. The overall aim of the Roadmap is facilitating and enhancing the effective use of Annex III by elaborating the technical and scientific process of how to apply the steps and points to consider in the process of risk assessment.

The purpose of this Roadmap is to provide further guidance on using Annex III with additional background material and links to useful references relevant to risk assessment. The Roadmap may be useful as a reference for risk assessors when conducting or reviewing risk assessments and in capacity-building activities.

The Roadmap applies to all types of LMOs[25] and their intended uses within the scope and objective of the Protocol, and in accordance with Annex III. However, it has been developed based largely on living modified crop plants because of the extensive experience to date with environmental risk assessments for these organisms. It is intended to be a "living document" that will be modified and improved on over time as and when mandated by COP-MOP, and in the light of new experience, information and developments in the field of applications of LMOs, e.g. when other types of LMOs have been evaluated more extensively in environmental risk assessments.

[22] The AHTEG on Risk Assessment and Risk Management was established by the Conference of the Parties serving as the meeting of the Parties to the Cartagena Protocol on Biosafety (COP-MOP) in its decision BS-IV/11. The terms of reference for the AHTEG as set out by the Parties may be found in the annex to decision BS-IV/11 (http://bch.cbd.int/protocol/decisions/decision.shtml?decisionID=11690).

[23] http://www.cbd.int/biosafety/articles.shtml?a=cpb-43 .

[24] http://www.cbd.int/biosafety/cop-mop/results/?id=11690 .

[25] Including products thereof, as described in paragraph 5 of Annex III to the Protocol.

INTRODUCTION

General introduction

Background

In accordance with the precautionary approach[26] the objective of the Protocol is "to contribute to ensuring an adequate level of protection in the field of the safe transfer, handling and use of LMOs resulting from modern biotechnology that may have adverse effects on the conservation and sustainable use of biological diversity, taking also into account risks to human health, specifically focusing on transboundary movements".[27]

For this purpose, Parties shall ensure that risk assessments are carried out when making informed decisions regarding LMOs.

An LMO and its use may have several effects, which may be intended or unintended, taking into account that some unintended effects may be predictable. The objective of risk assessment is to *identify* and *evaluate* the potential adverse effects of LMOs on the conservation and sustainable use of biological diversity in the likely potential receiving environment, taking also into account risks to human health.[28] The risk assessment is performed on a case-by-case basis. What is considered an adverse effect depends on protection goals and assessment end-points taken into consideration when scoping the risk assessment. The choice of protection goals by the Party could be informed by Articles 7(a), 7(b) and 8(g) and Annex 1 of the Convention on Biological Diversity.

According to the general principles of Annex III of the Protocol, risk assessments shall be based, at a minimum, on information provided in accordance with Article 8 and other available scientific evidence in order to identify and evaluate the possible adverse effects of LMOs on the conservation and sustainable use of biological diversity, taking also into account risks to human health.[29]

Annex III states that "risk assessment should be carried out in a scientifically sound and transparent manner, and can take into account expert advice of, and guidelines developed by, relevant international organizations. Lack of scientific knowledge or scientific consensus should not necessarily be interpreted as indicating a particular level of risk, an absence of risk, or an acceptable risk. (…) Risk assessment should be carried out on a case-by-case basis. The required information may vary in nature and level of detail from case to case, depending on the LMO concerned, its intended use and the likely potential receiving environment".[30]

The risk assessment process

Risk assessment is a structured process. Paragraph 8 of Annex III provides a description of the key steps of the risk assessment process to identify and evaluate the potential adverse effects and manage risks.

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[26] "In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation" (Principle 15 of the Rio Declaration on Environment and Development) at: (http://www.unep.org/Documents.Multilingual/Default.asp?DocumentID=78&ArticleID=1163), and in line with Articles 10.6 and 11.8 of the Protocol.

[27] http://www.cbd.int/biosafety/articles.shtml?a=cpb-01 .

[28] Annex III, paragraph 1.

[29] Article 15, paragraph 1.

[30] Annex III, paragraphs 3, 4 and 6.

Paragraph 9 describes, depending on the case, points to consider in this process. The steps describe an integrated process whereby the results of one step may be relevant to other steps. Also, risk assessment may need to be conducted in an iterative manner, where certain steps may be repeated or re-examined to increase or re-evaluate the confidence in the conclusions of the risk assessment. When new information arises that could change its conclusions, the risk assessment may need to be re-examined accordingly. Similarly, the issues mentioned in the 'overarching issues' section below can be taken into consideration again at the end of the risk assessment process to determine whether the objectives and criteria that were set out at the beginning of the risk assessment have been met.

Risk assessment is done in a comparative manner, meaning that risks associated with living modified organisms should be considered in the context of the risks posed by the non-modified recipient organism in the likely potential receiving environment.[31] Additionally, experience with the same, or, as appropriate, similar, genotypic or phenotypic characteristics may be taken into consideration along with the non-modified recipient organism in the risk assessment of an LMO. For instance, the comparison with the (near-)isogenic or closely related non-modified recipient is used in step 1 of the risk assessment (see below) where the novel genotypic or phenotypic characteristics associated with the LMO are identified. But when the potential consequences of adverse effects are evaluated, broader experience, such as mentioned in step 3 (a), may be taken into account, when establishing a baseline. Results from experimental field trials or other environmental information and experience with the same LMO may be taken into account as information elements in a new risk assessment for that LMO. In all cases where information, including baseline data, is derived from other sources, it is important to establish the validity and relevance of the information for the risk assessment. For instance, it should be taken into account that the behavior of a transgene,[32] as that of any other gene, may vary because it depends on the genetic and physiological background of the recipient as well as on the ecological characteristics of the environment that the LMO is introduced into.

The concluding recommendations derived from the risk assessment in step 5 are required to be taken into account in the decision-making process on an LMO. In the decision-making process, other Articles of the Protocol or other relevant issues may also be taken into account and are addressed in the last paragraph of this Roadmap: 'Related Issues'.

A flowchart illustrating the risk assessment process according to this Roadmap is annexed hereto.

(*See references relevant to "General Introduction"*).

Overarching issues in the risk assessment process

There are some overarching issues to consider in the design/planning phase of the risk assessment process to ensure the quality and relevance of the information used. These entail, among others:

- Setting criteria for relevancy in the context of a risk assessment – e.g. data may be considered relevant if they can affect the outcome of the risk assessment.

- Establishment of scientifically robust criteria for the inclusion of scientific information.

    - Data should be of an acceptable scientific quality. Data quality should be consistent with the accepted practices of scientific evidence-gathering and reporting and may include

[31] Annex III, paragraph 5.

[32] For the purpose of this document, a transgene is a nucleic acid sequence in an LMO that results from the application of modern biotechnology as described in Article 3 (i) (a) of the Protocol.

independent review of the methods and designs of studies. Data may be derived from a variety of sources, e.g. new experimental data as well as data from relevant peer reviewed scientific literature.

- Sound science is based on transparency, verifiability, and reproducibility (e.g. reporting of methods and data in sufficient detail, so that the resulting data and information could be confirmed independently), and on the accessibility of data (e.g. the availability of relevant, required data or information or, if requested and as appropriate, of sample material), taking into account the provisions of Article 21 of the Protocol on the confidentiality of information. The provisions of sound science serve to ensure and verify that the risk assessment is carried out in a scientifically sound and transparent manner.

- Identification and consideration of uncertainty.

According to the Protocol, "where there is uncertainty regarding the level of risk, it may be addressed by requesting further information on the specific issues of concern or by implementing appropriate risk management strategies and/or monitoring the living modified organism in the receiving environment".[33]

Uncertainty is inherent in the concept of risk. To date, "there is no internationally agreed definition of 'scientific uncertainty', nor are there internationally agreed general rules or guidelines to determine its occurrence. Those matters are thus dealt with – sometimes differently – in each international instrument incorporating precautionary measures".[34, 35]

It should be kept in mind that uncertainty cannot always be reduced by providing additional information. For example, new uncertainties may arise as a result of the provision of additional information.

Considerations of uncertainty strengthen the confidence and scientific soundness of a risk assessment. In communicating the results of a risk assessment, it is important to consider and analyze in a systematic way the various forms of uncertainty that can arise at each step and in combination at step 4 of the Roadmap. An analysis of uncertainty includes considerations of its source and nature.

The *source(s)* of uncertainty may stem from the data/information itself and/or the choice of study design including the methods used, and the analysis of the information.

The *nature* of uncertainty may be described for each identified source of uncertainty arising from: (i) imperfect knowledge or lack of available information, which may be reduced with more research/information, and (ii) inherent variability.

[33] Annex III, paragraph 8 (f).

[34] *An Explanatory Guide to the Cartagena Protocol on Biosafety*, paragraph 57 (http://data.iucn.org/dbtw-wpd/edocs/EPLP-046.pdf).

[35] Article 10, paragraph 6, of the Protocol: "Lack of scientific certainty due to insufficient relevant scientific information and knowledge regarding the extent of the potential adverse effects of a living modified organism on the conservation and sustainable use of biological diversity in the Party of import, taking also into account risks to human health, shall not prevent that Party from taking a decision, as appropriate, with regard to the import of that living modified organism intended for direct use as food or feed, or for processing, in order to avoid or minimize such potential adverse effects."

(*See references relevant to "Identification and consideration of uncertainty"*).

Context and scoping of the risk assessment

In setting the context and scope for a risk assessment, a number of aspects should be taken into consideration, as appropriate, that are specific to the Party involved and to the specific case of risk assessment. These aspects include:

- Existing policies and strategies based on, for instance, regulations and the international obligations of the Party involved; (ii) Guidelines or regulatory frameworks that the Party has adopted; and (iii) Protection goals, assessment end-points, risk thresholds and management strategies. Setting the context and scope for a risk assessment that are consistent with these policies, strategies and protection goals may involve a process that includes risk assessors, decision-makers and various stakeholders prior to conducting the actual risk assessment;

- (i) Framing the risk assessment process; (ii) Taking into account the expected (potential) conditions of handling and use of the LMO; (iii) Taking into account customary practices and habits that could affect the protection goals or end-points; identification of relevant questions to be asked for that purpose;

- Identification of methodological and analytical requirements, including any reviewing mechanisms, that is required to achieve the objective of the risk assessment as laid down, for instance, in guidelines published or adopted by the Party that is responsible for conducting the risk assessment (i.e. typically the Party of import according to the Protocol);

- The nature and level of detail of the information required may depend on the intended use of the LMO and the likely potential receiving environment. For small scale field releases, especially at early experimental stages, less information may be available compared to the information available for large scale environmental release, and for commercial scale planting;

- Experience and history of use of the non-modified recipient, taking into account its ecological function;[36] and

- Establishing criteria for describing the level of the (potential) environmental adverse effects of LMOs, as well as criteria for the terms that are used to describe the levels of likelihood (step 2), the magnitude of consequences (step 3) and risks (step 4) and the manageability of risks (step 5; see risk assessment steps below).

(*See references relevant to "Context and scoping of the risk assessment"*).

THE RISK ASSESSMENT

To fulfill its objective under Annex III, as well as other relevant Articles of the Protocol, risk assessment is performed in five steps, as appropriate. These five steps are indicated in Paragraph 8 (a)-(e) of Annex III and also detailed below. Their titles have been taken directly from the paragraphs 8 (a)-(e) of Annex III.

[36] The term "ecological function" (or: "ecological services") provided by an organism refers to the role of the organism in ecological processes. Which ecological functions or services are taken into account here will be dependent on the protection goals set for the risk assessment. For example, organisms may be part of the decomposer network playing an important role in nutrient cycling in soils or be important as a pollen source for pollinators and pollen feeders.

For each step a rationale and points to consider are provided. Some points to consider are taken from paragraph 9 of Annex III, whereas others have been added based on generally accepted methodology of LMO risk assessment and risk management. The relevance of each point to consider will depend on the case being analyzed.

(*See references relevant to "Risk Assessment in general"*).

Step 1: "An identification of any novel genotypic and phenotypic characteristics associated with the living modified organism that may have adverse effects on biological diversity in the likely potential receiving environment, taking also into account risks to human health." [37]

Rationale:

The purpose of this step is to identify biological changes resulting from the genetic modification(s), including any deletions, compared to the non-modified organism, and identify what, if any, changes could cause adverse effects on the conservation and sustainable use of biological diversity, taking also into account risks to human health. This step is similar to the 'hazard identification step' in other risk assessment guidance. The comparison of the LMO is performed with the non-modified recipient, or a (near-)isogenic line or, as appropriate, with a non-modified organism of the same species, taking into consideration the new trait(s) of the LMO.

In this step, scientifically plausible scenarios are identified in which novel characteristics of the LMO could give rise to adverse effects in an interaction with the likely potential receiving environment. The novel characteristics of the LMO to be considered can be genotypic or phenotypic, biological. They may be intended or unintended, predicted or unpredicted. The points to consider below provide information elements on which hazard identification can be built.

The type and level of detail of the information required in this step may vary from case to case depending on the nature of the modification of the LMO and on the scale of the intended use of the LMO. For small scale field releases, especially at early experimental stages, less information may be available and some of the resulting uncertainty may typically be addressed by risk management measures (see step 5).

Points to consider regarding the characterization of the LMO:

(a) Relevant characteristics of the non-modified recipient (e.g. (i) its biological characteristics, in particular those that, if changed, or interacting with the new gene products or traits of the LMO, could cause changes in the behavior of the non-modified recipient in the environment in a way that may cause adverse effects; (ii) its taxonomic relationships, (iii) its origin, centers of origin and centers of genetic diversity); (iv) ecological function, and (v) as a component of biological diversity that is important for the conservation and sustainable use of the biological diversity in the context of Article 7(a) and Annex I of the Convention;

(b) Relevant characteristics of the genes and of other functional sequences, such as promoters, that have been inserted into the LMO (e.g. functions of the gene and its gene product in the donor organism with particular attention to characteristics that could cause adverse effects in the recipient);

(c) Molecular characteristics of the LMO related to the modification (e.g. (a) characteristics of the insert(s) which may include (i) gene products (intended and unintended), (ii) levels of expression, (iii) functions, (iv) insertion site in the genome of the recipient and any effects of

[37] The bold printed headings of each step are direct quotes from Annex III of the Protocol.

insertion, (v) stability or integrity within the genome of the recipient; (b) (i) the transformation method, (ii) the characteristics of the vector if and, as far as it is present in the LMO, including its identity, source or origin and host range) with particular attention paid to any characteristics that are related to potential adverse effects. The availability and relevance of this information may vary according to the type of application. Characteristics related to adverse effects may also result from changed expression levels of endogenous genes due to effects of a transgene or from combinatorial effects;[38]

(d) Consideration of genotypic (see point to consider (c) above) and phenotypic, biological changes in the LMO, either intended or unintended, in comparison with the non-modified recipient, considering those changes that could cause adverse effects. These may include changes at the transcriptional and translational level and may be due to the insert itself or to genomic changes due to the transformation or recombination processes.

Point to consider regarding the receiving environment:

(e) Characteristics of the likely potential receiving environment, in particular its attributes that are relevant to potential interactions of the LMO that could lead to adverse effects (see also paragraph (g) below),[39] taking into account the characteristics that are components of biological diversity;

(f) The intended scale and duration of the environmental release.

Points to consider regarding the potential adverse effects resulting from the interaction between the LMO and the receiving environment:

(g) Characteristics of the LMO in relation to the receiving environment (e.g. information on phenotypic traits that are relevant for its survival in, or its potential adverse effects on the likely receiving environment – see also paragraph (e) above);

(h) Considerations for unmanaged and managed ecosystems (such as agricultural, forest and aquaculture systems) that are relevant for the likely potential receiving environment. These include the potential for dispersal of the LMO through, for instance, seed dispersal or outcrossing within or between species, or through transfer into habitats where the LMO may persist or proliferate;

(i) Potential consequences of outcrossing and flow of transgenes from an LMO to other sexually compatible species, which could lead to introgression of the transgene(s) into the population of sexually compatible species;

(j) Effects on non-target organisms;

[38] For the purpose of this document, the term "combinatorial effects" refers to effects that may arise from the interactions between two (or more) genes. The effects may occur at the level of gene expression, or through interactions between RNA, or among gene products. The effects may be qualitative or quantitative; quantitative effects are often referred to as resulting in antagonistic, additive or synergistic effects.

[39] Examples of relevant attributes of the receiving environment include, among others: (i) ecosystem type (e.g., agroecosystem, horticultural or forest ecosystems, soil or aquatic ecosystems, urban or rural environments); (ii) extension of dimension (small, medium, large or mixed scale); (iii) previous use/history (intensive or extensive use for agronomic purposes, natural ecosystem, or no prior managed use in the ecosystem); (iv) the geographical zone(s) in which the release is intended, including climatic and geographic conditions and the properties of soil, water and/or sediment; (v) specific characteristics of the prevailing faunal, floral and microbial communities including information on sexually compatible wild or cultivated species; and (vi) biodiversity status, including the status as centre of origin and diversity of the recipient organism and the occurrence of rare, endangered, protected species and/or species of cultural value.

(k) Cumulative effects;[40]

(l) Effects of the incidental exposure of humans to (parts of) the LMO (e.g. exposure to pollen), and the toxic or allergenic effects that may ensue;

(m) Potential adverse effects as a consequence of horizontal gene transfer (HGT) of transgenic sequences from the LMO to any other organism in the likely receiving environment. With regard to HGT to micro-organisms (including viruses), particular attention may be given to cases where the LMO is also a micro-organism; and

(n) A consideration of uncertainty arising in step 1 that may significantly impact the identification of hazards in this step (see "Identification and consideration of uncertainty" under Context and scoping of the risk assessment above).

(*See references relevant to "Step 1"*).

Step 2: "An evaluation of the likelihood of adverse effects being realized, taking into account the level and kind of exposure of the likely potential receiving environment to the living modified organism."

Rationale:

The potential adverse effects identified in step 1 may result in risks, but this depends on the likelihood and the consequence of the effects. In order to determine and characterize the overall risk (in step 4), the likelihood of each adverse effect being realized has to be assessed and evaluated beforehand.

One aspect to be considered is whether the receiving environment will be exposed to the LMO in such a way that the identified adverse effects may actually occur, e.g. taking into consideration the intended use of the LMO, and the expression level, dose and environmental fate of transgene products as well as plausible pathways leading to adverse effects.

Other aspects to be considered here are (i) the potential of the LMO (or its derivatives resulting from outcrossing) to spread and establish beyond the receiving environment (in particular into protected areas), and whether that could result in adverse effects; and (ii) the possibility of occurrence of adverse (e.g. toxic) effects on organisms (or on organisms other than the 'target organism' for some types of LMOs).

The levels of likelihood may be expressed, for example, by the terms 'highly likely', 'likely', 'unlikely', 'highly unlikely'. Parties may consider describing these terms and their uses in risk assessment guidelines published and/or adopted by them.

Points to consider:

(a) Information relating to the type and intended use of the LMO, including the scale and duration of the release, bearing in mind, as appropriate, user habits, patterns and agronomic practices;

(b) The relevant characteristics of the likely potential receiving environment that may experience or may be a factor in the occurrence of the potential adverse effects (see also step 1 (e), (f) and (g)), taking into account the variability of the environmental conditions and any long-term adverse effects. Levels of expression in the LMO and persistence and accumulation in the

[40] For the purpose of this document, the term "cumulative effects" refers to effects that occur due to the presence of multiple LMOs in the receiving environment.

environment (e.g. in the food chain) of substances with potentially adverse effects newly produced by the LMO, such as insecticidal proteins, toxins and allergens;

(c) Available information on the location of the release and the receiving environment (such as geographic and biogeographic information, including, as appropriate, coordinates, information on the sexually compatible species and whether they are co-localized with the LMO and whether flowering occurs at the same time, or in general, interbreeding can occur);

(d) For the case of outcrossing and outbreeding from an LMO to sexually compatible species, the considerations would include: (i) the biology of the sexually compatible species; (ii) the potential environment where the sexually compatible species may be located; (iii) the chance of introgression of the transgene into the sexually compatible species;

(e) Expected exposure to the environment where the LMO is released and means by which incidental exposure could occur at that location or elsewhere (e.g. gene flow or incidental exposure due to losses during transport and handling);

(f) A consideration of uncertainty arising in step 2 (see "Identification and consideration of uncertainty" under "Context and scoping of the risk assessment" above).

(*See references relevant to "Step 2"*).

Step 3: "An evaluation of the consequences should these adverse effects be realized."

Rationale:

This step describes an evaluation of the magnitude of the consequences in the likely potential receiving environment, taking into account, among others, results of tests done under different conditions such as laboratory experiments or experimental field releases. The evaluation is comparative and should be considered in the context of the adverse effects caused by the non-modified recipient or, if more appropriate, by a near-isogenic or other non-modified organism of the same species. The evaluation may also be considered in the context of the adverse effects that occur in the environment and which are associated with existing practices such as various agronomic practices, for example, for pest or weed management if such information is available and relevant. The evaluation of the consequence of adverse effects may be expressed as, for instance, 'major', 'intermediate', 'minor' or 'marginal'. Parties may consider describing these terms and their uses in risk assessment guidelines published and/or adopted by them.

Points to consider:

(a) Relevant experience with the consequences of existing practices with the non-modified recipient or, if more appropriate, with a non-modified organism of the same species in the likely potential receiving environment, may be useful in order to establish baselines to evaluate, for example, the consequences of (i) agricultural practices, such as the level of inter- and intra-species gene flow, dissemination of the recipient, abundance of volunteer plants in crop rotation; occurrence of pests and/or beneficial organisms such as pollinators and pest predators; or (ii) pest management, including effects on non-target organisms in pesticide applications while following accepted agronomic practices;

(b) Adverse effects which may be direct and indirect, immediate and delayed. Some of these adverse effects may result from combinatorial and cumulative effects;

(c) Results from laboratory experiments examining, *inter alia*, dose-response relationships (e.g., EC 50s, LD 50s) and from field trials evaluating, for instance, potential invasiveness;

(d) For the case of outcrossing to sexually compatible species, the possible adverse effects that may occur, after introgression, due to the expression of the transgenes in the sexually compatible species; and

(e) A consideration of uncertainty arising in step 3 that may significantly impact the evaluation of consequences should the adverse effects be realized (see "Identification and consideration of uncertainty" under Context and scoping of the risk assessment above).

(*See references relevant to "Step 3"*).

Step 4: "An estimation of the overall risk posed by the living modified organism based on the evaluation of the likelihood and consequences of the identified adverse effects being realized."

Rationale:

The purpose of this step is to determine and characterize the level of the overall risk based on the identified individual risks posed by the LMO on the conservation and sustainable use of biological diversity, taking also into account human health. The individual risks are determined on the basis of an analysis of the potential adverse effects identified in step 1, their likelihood (step 2) and consequences (step 3), and also taking into consideration any relevant uncertainty that emerged in the preceding steps.

It should then be determined whether the assessed risks meet the criteria set out in the protection goals, assessment endpoints and thresholds, as established in relevant legislation of the Party or in its practice. Where there is uncertainty regarding the level of risk, it may be addressed by requesting further information on the specific issues of concern or by implementing appropriate risk management strategies and/or monitoring the LMO in the receiving environment (see also step 5). Description of the risk characterization may be expressed as, for instance, 'high', 'medium', 'low', 'negligible' or 'indeterminate due to uncertainty or lack of knowledge'. Parties may consider describing these terms and their uses in risk assessment guidelines published and/or adopted by them.

To date, there is no universally accepted method to estimate the overall risk but rather a number of methods are available for this purpose. The outcome of this step may be, for example, a description explaining how the estimation of the overall risk was performed.

Points to consider:

(a) The identified potential adverse effects (step 1);

(b) The assessments of likelihood (step 2);

(c) The evaluation of the consequences (step 3);

(d) Any interaction between the identified individual risks;

(e) Any cumulative effect due to the presence of multiple LMOs in the receiving environment; and

(f) A consideration of uncertainty arising in this and the previous steps (see "Identification and consideration of uncertainty" under Context and scoping of the risk assessment above).

(*See references relevant to "Step 4"*).

Step 5: "A recommendation as to whether or not the risks are acceptable or manageable, including, where necessary, identification of strategies to manage these risks"

Rationale:

In this way, step 5 provides an interface between the process of risk assessment and the process of determining whether risk management measures are necessary and, if so, which measures could be implemented to manage the risks associated with the LMO.

The evaluation of the overall risk on the basis of the identified individual risks conducted in the previous step may lead to the conclusion that the identified risks are not acceptable in relation to the established protection goals, assessment end-points and risk thresholds, also when taking into account risks posed by the non-modified recipient and its use. Then the question arises whether risk management options can be identified that have the potential to remove the identified risks or reduce their magnitude. In the process of the formulation of risk management options, the effect of the proposed options on the identified risks should be explained. The appropriate steps of the risk assessment should then be reiterated by taking into account the implementation of the risk management options to estimate the new levels of likelihood, consequence and risk and to assess if the risk management measures are appropriate and sufficient.

The issues mentioned in the 'overarching issues' section can be taken into consideration again at the end of the risk assessment process to evaluate whether the objectives and criteria that were set out at the beginning of the risk assessment have been met.

The recommendation of acceptability of risk(s) should acknowledge the previously identified uncertainties. Some uncertainties may be reduced by monitoring (e.g. checking the validity of assumptions about the ecological effects of the LMO), requests for more information, or implementing the appropriate risk management options.

The recommendation(s) as to whether or not the risks are acceptable or manageable and recommendations for risk management options are submitted for consideration in the decision-making process.

Points to consider related to the acceptability of risks:

(a) The criteria for the establishment of acceptable/unacceptable levels of risk, including those set out in national legislation or guidelines, as well as the protection goals of the Party, as identified when setting the context and scope for a risk assessment;

(b) In establishing a baseline for the comparison of the LMO, any relevant experience with the use of the non-modified recipient, and practices associated with its use in the potential receiving environment; and

(c) The feasibility of the adoption of risk management or monitoring strategies.

Points to consider related to the risk management strategies:

(d) Existing management practices, if applicable, that are in use for the non-modified recipient organism or for other organisms that require comparable risk management and that might be appropriate for the LMO being assessed, e.g. isolation distances to reduce outcrossing potential of the LMO, modifications in herbicide or pesticide management, crop rotation, soil tillage, etc.;

(e) Methods to detect and identify the LMO and their specificity, sensitivity and reliability in the context of environmental monitoring (e.g. monitoring for short- and long-term, immediate and delayed effects; specific monitoring on the basis of scientific hypotheses and supposed cause/effect relationship as well as general monitoring) including plans for appropriate contingency measures to be applied in case the results from monitoring call for them;

(f) Management options in the context of the intended use (e.g. mitigating the effect of an LMO producing insecticidal proteins by the use of refuge areas to minimize the development of resistance against these proteins).

(*See references relevant to "Step 5"*).

RELATED ISSUES

Some members of the AHTEG considered some issues to be related to risk assessment and decision-making process but outside the scope of this Roadmap. These issues were, *inter alia*:

- Risk management (Article 16);
- Capacity-building (Article 22);
- Public awareness and participation (Article 23);
- Socio-economic considerations (Article 26);
- Liability and redress (Article 27);
- Co-existence;
- Ethical issues.

Annex

FLOWCHART FOR RISK ASSESSMENT

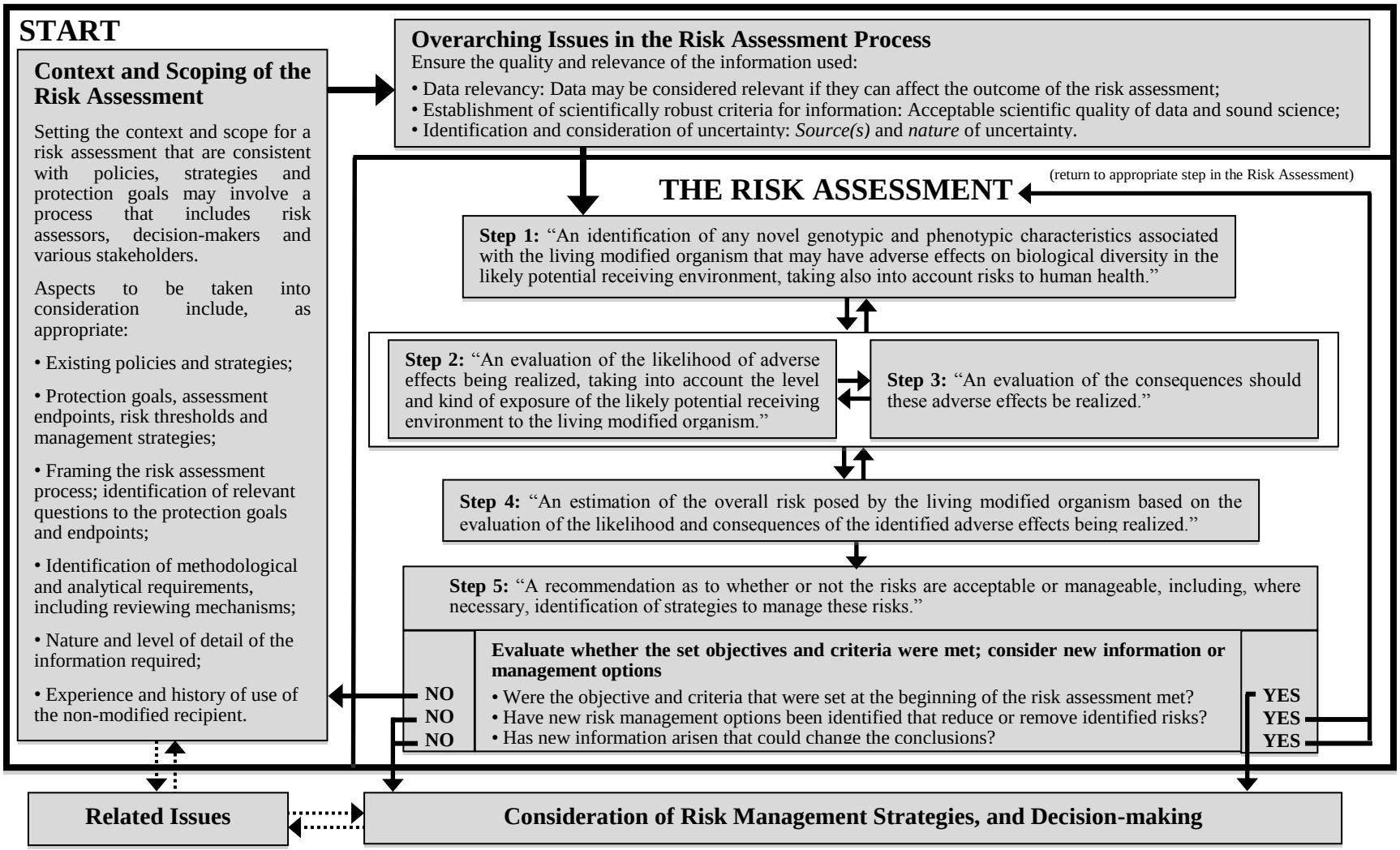

Figure 1. The Roadmap for Risk Assessment. The flowchart represents the steps to *identify* and *evaluate* the potential adverse effects of LMOs on the conservation and sustainable use of biological diversity in the likely potential receiving environment, taking also into account risks to human health. The box around steps 2 and 3 shows that these steps may sometimes be considered simultaneously or in reverse order.

PART II

SPECIFIC TYPES OF LMOs AND TRAITS

A. RISK ASSESSMENT OF LIVING MODIFIED ORGANISMS WITH STACKED GENES OR TRAITS

INTRODUCTION

Worldwide, a growing number of LMOs with stacked transgenic traits, particularly LM crops, are being developed for commercial uses. As a result, the number of stacked genes in a single LMO and the number of LMOs with two or more transgenic traits is growing.

Stacked transgenic traits can be produced through different approaches. In addition to the cross-hybridising of two LMOs, multiple trait characters can be achieved by transformation with a multigene cassette, retransformation of an LMO or simultaneous transformation with different transgene cassettes (i.e., cotransformation).

This guidance document focuses on stacked transgenic traits that have been produced through cross-breeding of two or more LMOs.

LMOs with multiple transgenic traits resulting from re-transformation, co-transformation or transformation with a multigene cassette should be assessed according to the Roadmap.

This guidance document complements the Roadmap for Risk Assessment developed by the AHTEG on Risk Assessment and Risk Management, and focuses on issues that are of particular relevance to the risk assessment of LMOs with stacked events generated through cross breeding of single or multiple event LMO.

This is intended to be a "living document" that will be shaped and improved with time as new information and/or experience becomes available and new developments in the field of applications of LMOs occur, as and when mandated by the Parties to the Protocol.

OBJECTIVE

The objective of this document is to give additional guidance on the risk assessment (RA) of LMOs with stacked events generated through conventional crossing of single or multiple event LMOs. Accordingly, it is meant to complement the Roadmap for Risk Assessment[41] and address special aspects of LMOs with stacked transgenes/traits resulting from the conventional crossing. For the time being it will be restricted to plant LMOs.[42]

[41] In accordance with a mandate from the Parties to the Cartagena Protocol on Biosafety (the Protocol), the AHTEG has developed 'a "roadmap", such as a flowchart, on the necessary steps to conduct a risk assessment in accordance with Annex III to the Protocol and, for each of these steps,' has provided 'examples of relevant guidance documents'. The Roadmap is presented, together with the present document, to the Parties of the Protocol on the occasion of the fifth meeeting of the Conference of the Parties serving as the meeting of the Parties.

[42] It is also restricted to those LMO generated through the methods of Modern Biotechnology as defined in Art. 3 (i) (a) of the Protocol. LMOs derived from fusion of cells are not covered in this document.

USE OF TERMS

Transformation event (TraEv)

For the purpose of this document, a transformation event (TraEv) is an LM plant which results from the use of modern biotechnology applying *in vitro* nucleic acid techniques[43] that may involve, but is not limited to, single or multiple gene transformation cassettes. In either case, the result will be one transformation event.

Stacked event (StaEv)

For the purpose of this document, a stacked event (StaEv) is an LM plant generated through conventional cross breeding of two or more single parental transformation events (TraEvs) or two already stacked events. Accordingly the transgene[44] cassettes may be physically unlinked (i.e. located separately in the genome) and may segregate independently.

Unintentional stacked event

Unintentional stacked events are the result of outcrossing of stacked events into other LMOs or compatible relatives in the receiving environment. Depending on the segregation pattern of the stacked genes this may result in new and/or different combinations of TraEvs.

SCOPE

This guidance document focuses on stacked events (StaEv) resulting from conventional crossings between two or more single transformation events (TraEv) as parental lines so that the resulting LMO contains two or more transgenic traits. It is understood that the individual TraEvs making up the StaEv have been assessed previously in accordance with Annex III of the Cartagena Protocol on Biosafety and as described in the Roadmap.

ISSUES TO BE CONSIDERED IN THE RISK ASSESSMENT

Assessment of sequence characteristics at the insertion sites and genotypic stability *(see step 1, Point to consider (c) of the Roadmap for Risk Assessment)*

Rationale:

Although recombination, mutation and rearrangements are not limited to LMOs, the combination of transgenic traits via cross breeding may further change the molecular characteristics of the inserted genes/gene fragments at the insertion site and/or influence the regulation of the expression of the transgenes. In addition, changes to the molecular characteristics may influence the ability to detect the LMO, which may be needed in the context of risk management measures (see step 5 of the Roadmap. The reappraisal of the molecular sequence at the insertion sites, and the intactness of the transgenes may be confirmative to the molecular characteristics of the parental LMOs, but may also be a basis for assessing any intended or unintended possibly adverse effects on the conservation and sustainable use of biological diversity in the likely potential receiving environment and of potential adverse effects on human health. The extent of the reexamination may vary case by case and take into account the results of the parental LMO risk assessment.

[43] See Article 3 (i) (a) of the Protocol.

[44] For the purpose of this document, a transgene is a nucleic acid sequence that results from the application of modern biotechnology as described in Article 3 (i) (a) of the Protocol.

Assessment of potential interactions between combined events and the resulting phenotypic effects *(see step 1, point to consider (d) of the Roadmap for Risk Assessment)*

Rationale:

The combination of two or more TraEvs resulting in a StaEv may influence the expression level of each of the transgenes and there may be interaction between the genes and the expressed products of the different transgenes. In addition, the stacked transgenes may alter the expression of endogenous genes.

Therefore, in addition to information about the characteristics of the parental single-TraEv LMOs, specific information on potential for interactions between the altered or inserted genes, stacked proteins or modified traits and endogenous genes and their products in the StaEv LMO should be considered and assessed. For example, it should be assessed whether the different transgenes affect the same biochemical pathways or physiological processes, or are expected to or may have any combinatorial effects that may result in potential for new or increased adverse effects relative to the parent LMOs.

Assessment of combinatorial and cumulative effects of stacked event LMOs on the conservation and sustainable use of biological diversity in the likely potential receiving environment, taking also into account potential adverse effects to human health *(see step 1, point to consider (c), step 2, point to consider (c) and step 3, point to consider (b) of the Roadmap for Risk Assessment)*

Rationale:

Assessment of combinatorial and cumulative effects[45] is based on the environmental risk assessment data for the StaEv LMO in comparison to the closely related non-modified recipient species and the parent LMOs in the likely receiving environment, taking into consideration the results of the genotypic and phenotypic assessments outlined above.

If potential new or increased adverse effects on the conservation and sustainable use of biological diversity or on human health are identified in relation to the StaEv through the above analysis of possible interactions, additional supporting data on StaEv may be required, such as:

(a) Phenotypic characteristics, including the levels of expression of any introduced gene products or modified traits, compared to the parent LMOs and to relevant non-modified recipient organisms (plants);

(b) Compositional analysis (e.g. levels of expression in the LMO and persistence and accumulation in the environment, such as in the food chain) of substances with potentially harmful effects newly produced by the StaEv, (e.g. insecticidal proteins, allergens, anti-nutritional factors, etc.) in amounts that differ from those produced by the parental LMOs or non-modified recipient organisms;

(c) Additional information depending on the nature of the combined traits. For example, further toxicological analysis of the StaEv may be required to address any combinatorial effects arising from the stacking of two or more insecticidal traits that result in a broadened target range or increased toxicity.

Also, indirect effects due to changed agricultural management procedures, combined with the use of the transgenic stacked event LMO, should be taken into consideration.

[45] See definition of combinatorial and cumulative effects in the Roadmap (footnotes 38 and 40, respectively).

Intentional and unintentional StaEvs may have altered environmental impacts as a result of cumulative and combinatorial effects of the stacked traits prevalent in different LMOs of the same species in the receiving environment. Unintentional StaEvs may arise from outcrossing with other LMOs of the same species or cross-compatible relatives (see "Use of terms"). If a number of different StaEvs are cultivated in the same environment a number of varying unintentional StaEvs may occur. Changed impacts on non-target organisms or a change in the range of non-target organisms in the likely receiving environment should be taken into account.

Development of specific methods for distinguishing the combined transgenes in a stacked event from the parental LMOs *(see step 5, point to consider (d) of the Roadmap for Risk Assessment)*

Rationale:

Some of the risk management strategies for StaEvs may involve methods for the detection and identification of these LMOs in the context of environmental monitoring. Currently, many detection methods for LMOs rely on DNA-based techniques, such as polymerase chain reaction (PCR) or protein based ELISA tests targeted to single transformation events. The methods used to detect the transgene in the parental lines may not be sensitive or specific enough to differentiate between single parental transformation events and the same event being part of a stacked event. A special problem may arise particularly in the cases where the StaEv contains multiple transgenes with similar DNA sequences. Therefore, the detection of each and all individual transgenes in a StaEv may become a challenge and need special consideration.

BIBLIOGRAPHIC REFERENCES

See references relevant to the "*Guidance Document on Risk Assessment of LMOs with Stacked Genes or Traits*".

B. RISK ASSESSMENT OF LIVING MODIFIED CROPS WITH TOLERANCE TO ABIOTIC STRESS

INTRODUCTION

The aim of this document is to provide further guidance for the risk assessment of living modified (LM) crops with improved tolerance to abiotic stress.

This guidance document should be considered in the context of the Cartagena Protocol on Biosafety. The elements of Articles 15 Annex III of the Protocol also apply to LM crops with tolerance to abiotic stress. Accordingly, the methodology and points to consider[46] contained in Annex III are also applicable to this type of LMO.

The potential environmental adverse effects of an LM crop with abiotic stress tolerance depends on (i) the receiving environment; (ii) the modified crop, (iii) phenotypic changes resulting from the genotypic changes made to the plant and (iv) its intended use. A risk assessment would be performed on a case-by-case basis in accordance with Annex III of the Protocol.

This guidance document complements the Roadmap for Risk Assessment developed by the AHTEG on Risk Assessment and Risk Management, and focuses on issues that are of particular relevance to the risk assessment of LM crops tolerant to abiotic stress.

USE OF TERMS

"Abiotic stresses" are environmental conditions caused by non-living factors that are detrimental or suboptimal to the growth, development and/or reproduction of a living organism. Types of abiotic stresses include, for example, drought, salinity, cold, heat, soil pollution and air pollution (e.g., nitrous oxides, ozone).

RISK ASSESSMENT

While the same general principles used in the risk assessments of other types of LMOs also apply to LM crops with increased tolerance to abiotic stress, there are a number of specific issues that may be of particular importance when assessing the risks of LM crops tolerant to abiotic stresses.

Questions that may be relevant to the risk assessment of LM crops with tolerance to abiotic stress in connection with the intended use and receiving environment include:

- Would the tolerance trait have the potential to increase the invasiveness, persistence or weediness of the LM crop that causes adverse effects to other organisms?
- Would a LM plant expressing tolerance to a particular abiotic stress have other advantages in the targeted receiving environment that cause adverse effects?
- Would any LMO arising from outcrossing with the abiotic stress tolerant LM crop, have the potential to colonize an ecosystem beyond the targeted receiving environment?
- Would the abiotic stress tolerance trait, for example, via pleitropic effects, have the potential to affect, *inter alia*, pest and disease resistance mechanisms of the LM crop?

[46] Paragraphs 8 and 9 of Annex III, respectively.

Some of the potential adverse effects to be evaluated in the risk assessment, from the introduction of crops tolerant to abiotic stress into the environment include, for example: a) increased selective advantage(s) other than the intended tolerance trait; b) increased persistence in agricultural areas and increased invasiveness in natural habitats; c) adverse effects on organisms exposed to the crop; and d) consequences of potential gene flow to wild or conventional relatives. While these adverse effects may exist regardless of whether the tolerant crop is a product of modern biotechnology or conventional breeding, some specific issues may be more relevant in the case of abiotic stress tolerant LM crops.

Characterization of the LM crop with tolerance to abiotic stress in comparison with its non-modified crop *(see step 1 of the Roadmap for Risk Assessment)*

Rationale:

The first step in the risk assessment process involves the characterization of genotypic or phenotypic, biological, intended and unintended changes associated with the abiotic stress tolerant LM crop that may have adverse effects on biodiversity in the likely receiving environment, taking into account risks to human health. This step is the 'hazard identification step' in other risk assessment guidance.

The identification of genotypic and phenotypic changes in the abiotic stress tolerant LM crop, either intended or unintended, is typically done in comparison with the non-modified recipient organism (see step 1 of the Roadmap). The non-modified comparator provides the baseline information for comparison of trials when it is grown at the same time and location as the LM crop. Comparisons with the observed range of changes in the non-modified crop in different environments, also provides baseline information.

Challenges with respect to experimental design: Abiotic stress crops may present unique challenges in experimental design for risk assessment. In some cases, for instance, an approach uses different reference plant lines, which typically include a range of genotypes representative of the natural variation in the crop species. In such conditions, choosing appropriate comparators could be a challenge and there are several proposals on whether and how the comparative approach can be used to characterize LM crops tolerant to abiotic stress in these likely receiving environments. Another important consideration is whether the experimental design properly controlled for the effect of the abiotic stress trait. In the extreme case, when the non-modified crop has never been grown in the range of conditions of the receiving environment because the abiotic stress conditions prevent or severely affect the growth of the non-modified crop, a comparative approach between the LM crop and the non-modified crop will need to be adjusted.

The use of non-isogenic reference lines can make it more difficult to identify statistically meaningful differences. In some situations when a comparator may not be available to carry out a meaningful comparison, a characterization of the abiotic stress tolerant LM crop as a novel genotype in the receiving environment may be conducted. In the future, information available from "omics" technologies, for example, "transcriptomics" and "metabolomics", if available, may help to detect phenotypes (e.g., the production of a novel allergen or anti-nutrient) that cannot be detected using a comparison between field grown plants at a suboptimal condition.

Points to consider:

(a) Characteristics of the LM crop under the abiotic stress and non-stress conditions and under different stresses, if applicable;

(b) Likelihood of gene flow to wild or domestic relatives; and

(c) Whether one or more suitable comparators are available and the possibility of their use in the appropriate experimental design.

Unintended characteristics *(see step 1 of the Roadmap for Risk Assessment)*

Rationale:

Both intended and unintended changes to the LM crop which are directly or indirectly associated with the abiotic stress tolerance that may have adverse effects should be identified. These include changes to the biology of the crop plant (e.g. if the genes alter multiple characteristics of the plant) or to its distribution range in relation to the potential receiving environment (e.g. if the plant can grow where it has not grown before), that may cause adverse effects.

The abiotic-stress-tolerant LM crop may have unintended characteristics such as tolerances to other types of biotic and abiotic stresses, which could lead to a selective advantage of these crop plants under conditions other than that related to the modified trait. For instance, crops modified to become tolerant to drought or salinity may be able to compete better than their counterparts at lower and higher growing temperatures.

It is also possible the LM crops with enhanced tolerance to an abiotic stress could have changes in seed dormancy, viability, and/or germination rates under other types of stresses. Particularly if genes involved in abiotic stress are also involved in crucial steps in physiology, modifications involving these genes may, therefore, have pleiotropic effects. Such LM crops may also transfer genes for stress tolerance at higher frequencies than observed in non-modified crops.

A potential mechanism for interactions between abiotic and biotic stresses may exist in plants. For example, drought or salinity-tolerant LM crops may acquire a changed tolerance to biotic stresses, which could result in changed interactions with their predators, parasitoids and pathogens, and, therefore, have both direct and indirect effects on organisms that interact with them.

Points to consider:

(a) Any intended or unintended change that may lead to selective advantage or disadvantage acquired by the LM crop under other abiotic or biotic stress conditions that could cause adverse effects;

(b) Any change in the resistance to biotic stresses and how these could affect the population of organisms interacting with the LM crop; and

(c) A change in the substances (e.g., toxin, allergen, or nutrient profile) of the LM crop that could cause adverse effects.

Increased persistency in agricultural areas and invasiveness of natural habitats *(see steps 1, 3 and 5 of the Roadmap for Risk Assessment)*

Rationale:

Climate change, water depletion or elevated salt content are examples of factors that limit the growth, productivity, spread or persistence of a crop. Expression of the genes for abiotic stress tolerance could result in increased persistence of the modified crop in agricultural areas. Expression of these genes may also alter the capacity of LM crops to spread to and establish in climatic and geographic zones beyond those initially considered as the likely or potential receiving environments.

The gene(s) inserted for tolerance to, for instance, drought and salinity might also affect molecular response mechanisms to other forms of abiotic stress, such as cold temperatures. For example, when the genetic modification affects genes that also regulate key processes in seeds, such as abscisic acid (ABA) metabolism, physiological characteristics such as dormancy and accumulation of storage lipids may also be changed. In such cases, the seeds of a tolerant crop, modified for drought or salinity tolerance, may acquire in addition tolerance to cold resulting in an increased winter survivability of the seeds. Therefore, an abiotic stress-tolerant crop may acquire the potential to persist better than its conventional counterpart under different abiotic-stress conditions.

Points to consider:

(a) Consequences of the increased potential for persistency of the modified crop in agricultural habitats and consequences of increased potential for invasiveness in natural habitats;

(b) Need for control measures if the abiotic stress-tolerant crop shows a higher potential for persistency in agricultural or natural habitats, that could cause adverse effects;

(c) Characteristics that are generally associated with weediness such as prolonged seed dormancy, long persistence of seeds in the soil, germination under a broad range of environmental conditions, rapid vegetative growth, short lifecycle, very high seed output, high seed dispersal and long-distance seed dispersal; and

(d) Effects of climate change on agriculture and biodiversity and how this could change the habitat range of the LM crop in comparison to the non modified crop.

(e) If the LM crop expressing tolerance, would have a change in its agriculture practices.

BIBLIOGRAPHIC REFERENCES

See references relevant to the "Guidance Document on Risk Assessment of LM Crops with Tolerance to Abiotic Stress".

C. RISK ASSESSMENT OF LIVING MODIFIED MOSQUITOES

INTRODUCTION

Living modified (LM) mosquitoes are being developed through modern biotechnology to reduce transmission of vector borne human pathogens, particularly those that cause malaria, dengue and chikungunya. Control, including eradication of such diseases, is a recognized public health goal. Some of the strategies being developed are to control mosquito vectors by suppressing their population or reducing their competence. These strategies can be subcategorized according to the technology involved and the method used. Some are intended to develop LM mosquitoes that are genetically modified to be sterile or self-limiting (i.e., unable to pass the modified trait on indefinitely through subsequent generations). Modern biotechnology techniques for developing sterile LM mosquitoes are different from those based on the use of irradiation to induce male sterility.

Other modern biotechnology strategies are also being used for developing LM mosquito populations that are self-sustaining or self-propagating (i.e., heritable modifications intended to spread through the target population). The strategy used is an important factor to be considered in the risk assessment and risk management process since there might be different points to be considered, depending on the specific strategy used.

The biology and ecology of mosquitoes on the one hand, and their impact on public health as vectors of human and animal diseases on the other hand, pose new considerations and challenges during the risk assessment process, which have mainly dealt with LM crop plants thus far.

This guidance document provides information for the risk assessment of environmental releases of LM mosquitoes and aims at helping to conduct risk assessments for environmental releases of LM mosquitoes. Although the focus of this guidance is on LM mosquitoes, in principle, it may also be useful for the risk assessment of similar non-LM mosquito strategies.

The main emphasis of this guidance document is the assessment of potential risks to biodiversity. Nevertheless, the potential adverse effects to human health arising from environmental releases of LM mosquitoes should also be considered.

This guidance document complements the Roadmap for Risk Assessment developed by the AHTEG on Risk Assessment and Risk Management and focuses on specific issues that may need special consideration on the risk assessment for environmental releases of LM mosquitoes.

OBJECTIVE

The objective of this document is to give additional guidance on the risk assessment (RA) of LM mosquitoes in accordance with Annex III to the Cartagena Protocol on Biosafety.[47] Accordingly, it aims at complementing the Roadmap for Risk Assessment on specific issues that may need special consideration for the environmental release of LM mosquitoes.

[47] The Parties to the Cartagena Protocol on Biosafety have mandated the AHTEG to 'develop a "roadmap", such as a flowchart, on the necessary steps to conduct a risk assessment in accordance with Annex III to the Protocol and, for each of these steps, provide examples of relevant guidance documents'. The Roadmap is meant to provide reasoned guidance on how, in practice, to apply the necessary steps for environmental risk assessment as set out in Annex III of the Protocol. The Roadmap also demonstrates how these steps are interlinked.

SCOPE

This document focuses on the specifics aspects of risk assessment of LM mosquitoes developed to be used in the control of human and zoonotic diseases such as malaria, dengue, chikungunya, yellow fever and West Nile.

ISSUES TO BE CONSIDERED IN THE RISK ASSESSMENT

(See step 1 of the Roadmap for Risk Assessment of LMOs)

Specific and comprehensive considerations should be undertaken with respect to the potential adverse effects of a particular LM mosquito, taking into account the species of the mosquito, the LM trait, the intended receiving environment, and the objective and scale of the intended release. These considerations should focus on, for instance: (a) description of the genetic modification; (b) the kinds of possible adverse effects for which there are scientifically plausible scenarios; (c) the species and ecological processes that could be affected by the introduction of the LM mosquitoes; (d) the protection goals of the country where the LM mosquitoes will be introduced; and (e) a conceptual link between the identified protection goals and the introduction of the LM mosquito into the environment.

The biology and, to some extent, the ecology of the mosquito species that transmit malaria and dengue are well known in many regions of the world. However, in certain regions and in the environment where the LM mosquito is likely be released, more information may be needed depending on the nature and scale of the LM strategy to be deployed. In many of these environments few studies have been conducted to examine gene flow among vectors, their mating behaviour, the interactions between vectors sharing one habitat, how pathogens respond to the introduction of new vectors, etc. Such information may be needed to establish a baseline in order to successfully assess the risks of LM mosquitoes. Additionally, methods for the identification of specific ecological or environmental hazards are also needed.

Effects on biological diversity (species, habitats, ecosystems, and ecosystem services)

(*See step 2 of the Roadmap for Risk Assessment of LMOs*)

Rationale:

The release of LM mosquitoes may have a negative impact on the target vector and pathogen[48] and other species, such as:

New or more vigorous pests, especially those that have adverse effects on human health: (i) the released LM mosquitoes may not function as expected, for example gene silencing or production failures could result in the release of non-sterile or competent mosquitoes and thus increase the vector population or disease transmission; (ii) the released LM mosquitoes could transmit another disease more efficiently than indigenous non-LM mosquitoes, such diseases might include yellow fever, chikungunya, etc.; (iii) suppression of the target mosquito might result in the population of another vector species to increase and result in higher levels of the target disease or the development of a new disease in humans and/or animals. These other vector species may include other mosquito vectors of other diseases; (iv) the released LM mosquitoes might become pests; (v) the released LM mosquitoes might cause other pests to become more serious, including agricultural pests and other pests that affect human activities.

[48] For the purpose of this guidance, the term "target vector" refers to the mosquito that transmits the disease and "target pathogen" is the disease causing agent transmitted by the target mosquito.

Harm to or loss of other species: The released LM mosquitoes might cause other species (for instance fish that rely seasonally on mosquitoes for food) to become less abundant. These include species of ecological, economic, cultural and/or social importance such as wild food, endangered, keystone, iconic and other relevant wildlife species. Ecological effects might result from competitive release if the target mosquito population is reduced or from trophic consequences of species that rely on mosquitoes for food at specific times of the year. Effects may also occur if (i) the target mosquitoes transmit a disease to animal species, (ii) the released LM mosquitoes transmit a disease to animal species more efficiently, (iii) another vector of an animal disease was released from control when the target mosquito population was reduced, or (iv) the population of a target pathogen is reduced or lost and this may affect other organisms that interact with it.

Although mosquitoes, like other insects, typically have strong reproductive isolating mechanisms that will not allow interspecific gene flow, if sterile interspecific mating between released LM mosquitoes and other mosquito species should occur, it could disrupt the population dynamics of these other species, leading to harm or loss of valued ecological species. Moreover, cessation of transmission of pathogens to other animals (e.g., West Nile virus to birds, Rift Valley fever virus to African mammals) might alter the population dynamics of those species, favouring increases in their numbers.

Disruption of ecological communities and ecosystem processes: The ecological communities in the ephemeral, small aquatic habitats occupied by the non-LM mosquitoes are unlikely to be disrupted beyond the possibilities already addressed above under "harm to or loss of other species." However, if the released LM mosquitoes were to inhabit natural habitats (e.g. tree-holes), disruption of the associated community is a possibility. The released LM mosquitoes might degrade some valued ecosystem process. This might include processes such as pollination or support of normal ecosystem functioning. These processes are often referred to as "ecosystem services". However, the valued ecosystem processes may also be culturally or socially specific. Under some circumstances, mosquito species are significant pollinators. In those cases, mosquito control of any kind might reduce the rate of pollination of some plant species or cause a shift to different kinds of pollinators. Habitats in which mosquitoes are the dominant insect fauna (e.g., high Arctic tundra, tree holes) would be changed if mosquitoes were eliminated; however, the common target vector species are usually associated with human activity and therefore not as closely tied to ecosystem services.

Points to consider:

(a) Impacts on the target mosquitoes and pathogens resulting from the use of the strategy under consideration;

(b) Whether the LM mosquitoes have the potential of causing adverse effects on other species which will result in the other species becoming agricultural, aquacultural, public health or environmental pests, or nuisance or health hazards;

(c) Whether the target mosquito species is native or invasive to a given area;

(d) The habitat range of the target mosquito species and whether the habitat range is likely to be affected by climate change;

(e) Any other species (e.g. animal hosts, larval pathogens or predators of mosquitoes) in addition to the pathogen, that typically interact with the LM mosquito in the likely receiving environment;

(f) Whether the release of LM mosquitoes is likely to affect other mosquito species that are pollinators or otherwise known to be beneficial to ecosystem processes;

(g) Whether the LM mosquitoes are likely to have an adverse effect on other interacting organisms, e.g. predators of mosquitoes;

(h) Whether species replacement by other disease vector species may occur, and if so, whether it can result in an increased incidence of the target disease or new diseases in humans or animals.

Gene Flow

(*See steps 2 and 3 of the Roadmap for Risk Assessment of LMOs*)

Rationale:

With regard to the biosafety of LM mosquitoes, gene flow refers to the transfer of transgenes[49] or genetic elements from the LM mosquitoes to non-LM mosquitoes. It can occur via cross-fertilisation or other movement of the transgenes or genetic elements. Various factors may influence gene flow and any associated adverse effects, such as, the strategy, the transgenes, the gene drive system [50] and the stability of the trait(s) carried by the mosquito over generations, as well as the receiving environment, etc.

Gene flow through cross-fertilization: Some LM mosquitoes are being developed to spread the introduced trait rapidly through the target mosquito population. For instance, when introduced into *Anopheles gambiae*, the trait may be expected to spread throughout the *A. gambiae* species complex. Other LM mosquito technologies are designed to be self-limiting and, in such cases, spread of the transgenes or genetic elements in the target mosquito population is not intended or expected. For the self-limiting technologies, the potential for an unexpected spread of the introduced trait should be considered by focusing on the assumption that any management strategy to limit the spread could fail. Gene flow between different species should be considered for all of the LM mosquito technologies in spite of the fact that mosquitoes, like other insects, typically have strong reproductive isolating mechanisms that will not allow interspecific gene flow. Identifying the key reproductive isolating mechanisms and possible conditions that could lead to the breakdown of such mechanisms is of particular importance in the risk assessment of LM mosquitoes with this trait. In addition, the fitness conferred by the introduced trait and the population size and frequency of the introduction of the LM mosquito into the environment will also determine the likelihood and rate of spread of the transgenes or genetic elements.

Horizontal gene flow: For the purpose of this document, "horizontal gene flow", is the movement of genetic information from one organism to another through means other than sexual transmission. Gene drive systems for moving genes into wild populations may be the initial focus of the risk assessment. The risk of horizontal gene flow in LM mosquitoes that do not contain a gene drive system is likely to be smaller but should nevertheless be assessed on a case-by-case basis.

Persistence of the transgene in the environment. Some of the transgenes in LM mosquitoes are designed not to persist whereas others are expected to spread rapidly and/or persist through wild populations. In cases where the LM mosquitoes have been found through the risk assessment process to have the potential to cause adverse effects to the biological diversity, taking also into account human health, methods to reduce the persistence of the transgene in the environment needs to be considered

[49] For the purpose of this document, a transgene is a nucleic acid sequence in an LMO that results from the application of modern biotechnology as described in Article 3 (i) a of the Protocol.

[50] Gene drive systems are methods of effectively introducing the desired gene into a mosquito population (Selfish DNA versus Vector-Borne Disease, Environmental Health Perspectives (2008) 116 - http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2235231/pdf/ehp0116-a00066.pdf).

Points to consider:

(a) Whether LM mosquitoes have the potential to transfer the modified traits to wild mosquito populations (when it is not an intended strategy) and/or to non-related organisms, and if so, the occurrence of any potential undesirable consequences;

(b) Whether the LM mosquitoes have the potential to induce undesirable characteristics, functions, or behaviour within the target mosquito species, other wild related species or non-related organisms;

(c) Any undesirable consequence should the transgene persist in the environment.

Evolutionary responses (especially in target mosquito vectors or pathogens of humans and animals)

(*See step 1 of the Roadmap for Risk Assessment of LMOs*)

Rationale:

Any strong ecological effect also exerts an evolutionary selection pressure on the human and animal pathogens and the mosquito vectors. The main evolutionary effects are those that could result in a breakdown in the effectiveness of the technology and the resumption of previous disease levels. Some LM mosquito strategies aim at modifying the mosquito vector's ability to transmit diseases through changes in its physiological mechanisms. An evolutionary effect resulting in the development of resistance to physiological mechanisms in the targeted pathogen might occur when modifying mosquito vector competence. This might harm the effectiveness of the strategy used and result in a population of pathogens that may be transmitted more easily by all types of vectors.

Other evolutionary effects could be hypothesized, including effects resulting from climate change, but they would first require the occurrence of some adverse effect on a species, community or ecosystem effect. Therefore, consideration of secondary evolutionary effects can be postponed until such effects are identified and found to be significant.

Points to consider:

(a) Whether the target mosquito vector has the potential to evolve and avoid population suppression, regain vector competence or acquire new or enhanced competence to another disease agent, and if so, the occurrence of any possible undesirable consequences;

(b) Whether the trait has the potential to evolve and thus lose its effectiveness, or the pathogen to evolve and overcome the limitation posed by the genetic modification, and if so, the occurrence of any possible undesirable consequences.

RISK-MANAGEMENT STRATEGIES

(*See step 5 of the Roadmap for Risk Assessment of LMOs*)

Risk assessors may want to consider risk-management strategies such as the quality control of the released LM mosquitoes and monitoring them and the environment for potential unintended adverse effects. There should also be strategies in place for halting the release and application of mitigation methods if an unanticipated effect occurs. Careful implementation of the technology including the availability of mitigations measures (such as an alternative set of control measures should a problem occur) and the integration of other population control methods should be considered. In some

circumstances methods to reduce the persistence of the transgene in the environment or to mitigate adverse effects resulting from the expression of the transgene might be needed. Monitoring during and after the environmental release of the LM mosquitoes so as to address prompt detection of unexpected adverse effects may also be considered.

Points to consider:

(a) Availability of monitoring methods to:

(i) Measure the efficacy and effectiveness of LM mosquito technology;

(ii) Assess the potential evolutionary breakdown of the LM mosquito technology (monitoring for transgene stability and proper function over time);

(iii) Determine the level to which the identified adverse effects may be realized, including detection of unexpected and undesirable spread of the transgenic trait (monitor for undesirable functions or behaviours within target species and other wild related species).

(b) Availability of mechanisms to recall the LM mosquitoes and transgenes in case they spread unexpectedly (e.g. mass release of wild-type mosquitoes above a certain threshold, alternative control methods including genetic control).

(c) Availability of methods for managing the dispersal of the LM mosquitoes and ensuring that they do not establish themselves beyond the intended receiving environment (eg. vegetation-free zones, traps, high threshold gene drive systems).

(d) Availability of methods to manage potential development of resistance, e.g. in the target vector or pathogen.

OTHER ISSUES

There are other factors that may be taken into consideration in the decision for environmental releases of LM mosquitoes which are not covered by Annex III of the Protocol. They encompass, *inter alia*, social, economic, cultural and health issues associated with the application and acceptance of the technology.

BIBLIOGRAPHIC REFERENCES

See references relevant to the "*Guidance Document on Risk Assessment of LM Mosquitoes*".

Annex IV

RECOMMENDATIONS TO THE CONFERENCE OF THE PARTIES SERVING AS THE MEETING OF THE PARTIES TO THE CARTAGENA PROTOCOL ON BIOSAFETY AT ITS FIFTH MEETING

1. The Ad Hoc Technical Expert Group (AHTEG) on Risk Assessment and Risk Management took note of the deliberations under the Open-ended Online Expert Forum on Risk Assessment and Risk Management in particular about the need for further guidance on specific aspects of risk assessment and considered the existing guidance materials on risk assessment of living modified organisms.

2. The AHTEG recognized the importance of involving experts in the various scientific and technical fields relevant to risk assessment in any future activity taking into account the limited financial and human resources.

3. The following recommendations were made by the AHTEG:

(a) The document "Guidance on Risk Assessment of Living Modified Organisms" should be published and distributed, including an online version under the Biosafety Clearing-House (BCH), in all UN languages;

(b) The "Guidance on Risk Assessment of Living Modified Organisms" should be further tested for example during regional workshops including cooperation with existing initiatives for capacity-building and training, as appropriate;

(c) The "Guidance on Risk Assessment of Living Modified Organisms" should be revisited within two years and the need for an update of the list of background materials should be assessed within a year;

(d) Further development of guidance on risk assessment of living modified organisms should be considered. The topics identified and prioritized during the first meeting of the AHTEG as well as those mentioned at the second meeting could be the starting point for the further development of guidance on risk assessment (see list annexed hereto as annex V);

(e) A process should be established for the incorporation of background materials, available in the Biosafety Information Resources Centre of the Biosafety Clearing-House, that are relevant in the different sections of the "Guidance on Risk Assessment of Living Modified Organisms". In order to assist this process, the Secretariat should be requested to revise the common format for submission of records to the Biosafety Information Resources Centre (BIRC) of the BCH with the view to identifying and including a mechanism to link BIRC records on risk assessment to specific sections of the guidance document;

(f) Recognizing that the exchange of information is a central element for identifying living modified organisms or specific traits that have been assessed as having the potential to cause adverse effects on the conservation and sustainable use of biological diversity taking also into account risks to human health, a process should be established by:

(i) Urging Parties and inviting non-Parties to submit relevant information to the BCH on experiences in conducting risk assessment with regard to this topic;

(ii) Requesting the Secretariat to undertake a regular analysis of the information contained in the BCH within the context of this process and reporting to the COP-MOP for that purpose;

(iii) Organizing workshops where the information submitted would be analyzed through a guided-process.

(g) The goals of the above recommendations (a) to (f) could be achieved by a combination of an extended Open-ended Online Expert Forum on Risk Assessment and Risk Management and an AHTEG on Risk Assessment and Risk Management, as well as a combination of online conferences, ad hoc discussion groups and face-to-face meetings with a view to:

(i) Developing additional guidance documents on the basis of the "Guidance on Risk Assessment of Living Modified Organisms" on specific types of living modified organisms and traits;

(ii) Reviewing the text of the "Guidance on Risk Assessment of Living Modified Organisms" and updating the lists of background materials;

(iii) Incorporating background materials, available in the Biosafety Information Resources Centre of the Biosafety Clearing-House, that are relevant to the different sections of the "Guidance on Risk Assessment of Living Modified Organisms";

(iv) Analysing the results of the workshops on living modified organisms or specific traits that have been assessed as having the potential to cause adverse effects.

(h) Human and financial resource implications should be considered for the process set up to achieve the above goals.

Annex V

TOPICS FOR THE DEVELOPMENT OF GUIDANCE MATERIALS ON RISK ASSESSMENT

Further topics indentified in the first meeting of the AHTEG as priorities for the development of guidance:[51]

- Post-release monitoring and long-term effects of LMOs released into the environment;
- Risk assessment and risk management in specific receiving environments;
- Risk assessment of living modified microorganisms and viruses;
- Risk assessment of living modified pharmaplants;
- Risk assessment of living modified crops;
- Risk assessment of living modified trees;
- Risk assessment of living modified fish;
- Risk assessment living modified organisms for production of pharmaceutical and industrial products;
- "Co-existence" between LMOs and non-LMOs in the context of small scale farming;
- Risk assessment of living modified plants for biofuels;
- Risk assessment of living modified organisms produced through synthetic biology.

Further topics identified in the second meeting of the AHTEG as possible priorities for the development of guidance:

- Uncertainty analysis;
- Establishment of criteria for transparency and reproducibility of information;
- Interface between risk assessment and risk management;
- Environmental risk assessment and monitoring taking into account human health;
- Unintentional transboundary movements;
- Risk assessment and management of LMOs intended for introduction into unmanaged environments.

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[51] From annex II of the report of the first meeting of the Ad Hoc Technical Expert Group on Risk Assessment and Risk Management (UNEP/CBD/BS/COP-MOP/5/INF/13).