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EVALUATION OF METHYL BROMIDE PROJECTS

Executive summary

1. The evaluation of methyl bromide (MB) projects in Africa is part of the 2012 monitoring and evaluation programme approved at the 65th meeting of the Executive Committee. It comprises two stages, a desk study and a field study, aimed at assessing the sustainability of the MB phase-out achieved in Africa to date. The desk study (document UNEP/OzL.Pro/ExCom/66/15) was submitted to the 66th meeting of the Executive Committee in March 2012. Historical consumption of MB in Africa, the main MB consuming sectors in the region, types of users, alternatives adopted and factors influencing their sustainability were considered. Key factors affecting sustainability of the phase-out and issues needing further analysis were identified, including technical feasibility of selected alternatives and their economic feasibility; market issues that may impact the sustainability of the phase-out achieved and the existing institutional capacity to sustain the phase-out; and political regulatory issues.

2. The field study included visits to seven key countries for more in-depth analyses of the issues governing sustainability of alternatives. Four key consumption sectors were covered – cut flowers, horticulture, tobacco and stored grain – allowing for sector analysis, and providing opportunity to assess specific needs and constraints as well as successful phase-out cases. Seven case studies including an individual assessment of risks of returning to MB were prepared on the basis of the information collected. Further information was gathered by attending two regional network meetings, in Djibouti and Zambia. Interviews and a presentation on the study were also held at the thirty-second meeting of the Open-ended Working Group (OEWG) in Thailand in July 2012. Reports were circulated for comments to bilateral and implementing agencies, Compliance Assistance Programme (CAP) and ozone officers of the countries visited and comments were taken into account for finalizing the report.

3. Phase-out MB in Africa has further advanced; aggregate consumption was 7.6 per cent of the baseline[1] and only seven African countries reported consumption in 2011. MB consumption has traditionally been concentrated in about ten countries in Africa, all of which have phase-out or investment projects funded by the Multilateral Fund (except South Africa, which is not eligible). All African countries are in compliance with Montreal Protocol obligations with respect to MB. However, four of the seven countries included in the field study were unable to meet the reduction and phase-out targets stipulated in their agreements with the Executive Committee when the MB phase-out projects were funded. Kenya and Zimbabwe reported small consumptions in 2011, but should have phased out in 2010. Egypt and Morocco reported consumption slightly above the agreed level for 2011. Reasons for these deviations from schedule include insufficient training of customs officers, requirement for further training in sectors where the number of growers has increased dramatically, difficulties in getting chemical alternatives registered, additional time needed to adjust infrastructure and logistics for adopting alternatives, and expansion of new productive sectors.

4. The choice of alternative technologies to replace MB is generally appropriate. Although reluctance among some MB users to change to alternatives was still apparent in some sectors, awareness about the need to phase out was also very high. Reluctance was more often associated to the fact that MB cannot usually be replaced by one single and equally effective option, which may require users to change the approach to production and process management. New technical skills may be required, and correct identification and understanding of the specific pests or diseases affecting a crop are essential. Application methods can impact the technical efficiency of alternatives. A need to improve worker protection standards to reduce safety hazards was sometimes noted.

5. An overall assessment of economic feasibility was conducted. Costs of chemical alternatives were generally similar to those of fumigating with MB; in some cases, alternatives were substantially cheaper. Economic analysis needs to go beyond the mere cost of the alternatives. There were instances

[1] This may change slightly as South Africa had not reported MB consumption at the time of preparing this report. However, reported consumption for 2010 was zero.

where initial investment was high but this was set off by increased yields and quality, early pest or disease detection, or improved cropping conditions. In selected cases alternatives were too expensive to justify their adoption, mainly owing to needing to import supplies at very high costs. Recent and substantial increases in the cost of MB were also reported, which could well place some alternatives in a different perspective.

6. Institutional capacity to support the MB phase-out was generally found appropriate and included National Ozone Units, and trade associations and training centres, which play a central role in training growers, providing technical assistance and research support. Stakeholders expressed high interest in the experiences of similar productive sectors, in other regions or countries. Cooperation efforts with international agencies and foreign governments were found in the same sectors where MB phase-out is taking place or has been completed. Although these initiatives do not relate directly to MB phase-out, they could be considered for establishing future linkages with the aim of securing continued technical support and adoption of production practices used to replace MB.

7. Regulations of varying scope were found to be in place to regulate MB imports and sometimes ban its use after the phase-out. These measures support the phase-out but need to be part of a wider approach, including registration and commercial availability of successful alternatives. Potential problems with smuggling/illegal trade were constantly mentioned, particularly in Kenya and Zimbabwe. Banning 1 lb canisters of MB as was done in Kenya is a helpful measure. Potential diversion of MB imported for quarantine and pre-shipment (QPS) into controlled uses was also indicated, together with difficulties in tracking MB use after import.

8. When analysing MB phase-out per sector, it was found that for cut flower production geared for export, replacing MB use with environmentally sustainable production methods is facilitating foreign market access. The main alternatives adopted for cut flowers are substrates and chemical alternatives. Replacement was reported to be more difficult for propagation material (nurseries), which is subjected to high health standards. Constraints were further reported with substrate recycling and/or disposal. Steaming, initially offered widely as an alternative for cut flowers, is not in widespread use, mainly due to high operational costs.

9. Horticulture crops using MB include strawberries, tomatoes, green beans, peppers, eggplants and cucurbits. Production of some of these crops has developed more recently than others; developments are in many cases geared for export but local consumption is also important, so MB users are heterogeneous. Grafting has been successfully implemented and widely adopted, particularly in the tomato and cucurbit sectors. Other successful alternatives include substrates and chemicals for the strawberry sector, and compost application.

10. In the tobacco sector, MB has been successfully replaced mostly with the floating tray system, allowing for production of high quality seedlings. Investment in new infrastructure and training is required, but excellent results are obtained. Difficulties were reported in Malawi and Zambia due to the lack of local tray suppliers and the high costs of imported trays. Growers have therefore adopted chemical options, mainly dazomet, with good results.

11. For stored cereals and other commodities (coffee, cocoa), phosphine is generally considered an efficient and well-proven alternative. Some relative disadvantages with respect to MB include longer treatment times and pest resistance, both of which can be solved. In Egypt the mixture of phosphine and 2 per cent carbon dioxide (ECO_2Fume) has been adopted successfully. Phosphine was generally reported to be substantially cheaper than MB, widely registered and available.

12. On the basis of the information gathered it is concluded that in general, the risk of returning to MB for controlled uses is presently low. However, actions to strengthen the phase-out achieved can still be taken and are suggested. Clearly, issues beyond the technical and economic feasibility of alternatives

impact their sustainability. It was also evident that sustaining the MB phase-out through the adoption of environment-friendly production practices gives market headway.

13. Incentives to reduce the price of imported inputs might be explored. Regulatory restrictions were found, mainly the slow registration of chemical alternatives, which will impact the rate of adoption of alternatives and could even prevent their use. Concerns with the continuity of programmes established through the projects were noted and should be addressed, as large efforts could be lost. Funding options may be sought through the Multilateral Fund but also externally, by creating linkages with other initiatives, promoting information exchange within productive sectors locally or at the regional level, and others.

14. Stronger tracking systems to differentiate between QPS/controlled uses are needed. Suggestions include authorizing only the 100 per cent MB formulation for QPS uses with the corresponding precautions. It was generally reported that interest in pursuing critical uses is presently low. Stocks of MB were not detected, but this information was not always available.

Background, scope and approach

15. The evaluation of MB projects in Africa is part of the 2012 monitoring and evaluation programme. At its 65th meeting, the Executive Committee decided to conduct an evaluation of MB projects undertaken in Africa, with the aim of assessing progress made in phasing out MB and the sustainability of the phase-out achieved in the face of the final phase-out deadline for Article 5 countries of 1st January 2015. The evaluation comprises two stages, a desk study and a field study, which aimed at assessing the sustainability of the MB phase-out achieved in Africa to date.

16. The desk study (document UNEP/OzL.Pro/ExCom/66/15) was submitted to the 66th meeting. It assessed constraints and hurdles to the adoption of alternatives to MB in African countries, taking into account the different stakeholders and use sectors involved. A comprehensive assessment of a total of 69 projects approved for implementation in Africa since 1997 was also conducted. These included 23 technical assistance (TAS) or training (TRA) projects, 13 demonstration projects and 33 investment projects. Given that they carry a phase-out commitment and address sustainability issues of the alternatives selected, investment projects were considered to be the most important for both the desk study analysis and subsequent follow-up during the field stage.

17. The desk study further considered historical consumption of MB in Africa and the phase-out achieved; the main MB consuming sectors in the region – tobacco seedlings, cut flowers, horticulture (particularly tomatoes, but also melons, strawberries, bananas and a variety of vegetables) and postharvest treatment of grains; the types of users (i.e. both large and small farmers, high and low tech producers); the main kinds of alternatives adopted; and factors influencing the sustainability of such alternatives.

18. Key factors affecting sustainability of the phase-out and issues needing further analysis were identified during the field stage, and used for risk analysis as follows:

(a) Technical feasibility of selected alternatives – whether the alternatives selected for implementation provide the required level of pest and disease control;

(b) Economic feasibility – whether alternatives are affordable. An alternative may be more expensive than MB but lead to higher yields and quality, offsetting the extra cost and improving commercial acceptance and market penetration of a given product;

(c) Market issues that may impact the sustainability of the phase-out achieved – consumer acceptance of alternatives, market access, availability of inputs and services;

(d) Institutional capacity to sustain the phase-out achieved – technical assistance and extension services, research and training capacity and others; and

(e) Political regulatory issues – registration of alternatives, bans on MB import use, and capacity to track MB use (QPS vs controlled uses).

19. For the purposes of the field study, visits were conducted in seven countries, covering different situations relating to phase-out (completed several years ago, recently completed, or still in process of implementation) and levels of consumption. A representative sample of countries was drawn for the field stage as follows:

(a) Cameroon also used in the past MB entirely on postharvest treatments, specifically stored cocoa and coffee beans;

(b) Egypt reporting problems with the registration of alternatives and others, with MB uses in both soils (horticulture, flowers) and postharvest (grain storage);

(c) Kenya reporting zero consumption for soil fumigation but expressing concerns that the phase-out achieved may not be sustainable. Still uses MB in cut flowers and grain storage;

(d) Malawi, reporting zero consumption since 2005 but apparently finding it difficult to sustain the phase-out (past consumption was in the tobacco sector);

(e) Morocco, where the phase-out has proceeded successfully in relevant sectors such as bananas, strawberries, cut flowers and more recently tomatoes; phase-out is ongoing for green beans and cucurbits;

(f) Zambia a low consumer with an ongoing project involving tobacco, and to a lesser extent cut flowers and horticulture; and

(g) Zimbabwe progressing very well towards phasing-out MB in the tobacco and stored grain sectors but nevertheless reporting some problems.

20. A sector-by-sector analysis was developed. Pests and diseases to be controlled in each case and sector were considered as well as production cycles, market requirements and consumer issues. This provided an opportunity to assess specific needs and constraints more closely. Cases of sectors successfully moving away from MB also provided very useful information.

21. Information collected during these field evaluations was used to prepare seven case studies and assess the risk of returning to MB use in each case. Field visits lasted between two and five working days and included discussion with National Ozone Units, Ministries of Agriculture, research institutions, extension services, farmers and their associations, fumigation companies, importers and other key stakeholders. As in the desk study, analysis on MB consumption trends in the countries visited during the field stage as well as generally in Africa, was based on statistics officially reported by the Parties in response to Article 7 of the Montreal Protocol.

22. In addition, further information was gathered by attending two regional network meetings, the Main Meeting of the English-Speaking Network of Ozone Officers, from 21 to 24 May 2012, Lusaka, Zambia and the Joint Meeting of the Ozone Officers Network of English-Speaking and French-Speaking Africa held in Djibouti, from 24 to 27 September 2012. Organizers of these two meetings kindly scheduled a session in each, for attendees to listen to a presentation on the evaluation, its goals and preliminary findings, followed by discussion time. An additional presentation was made during the thirty-second meeting of the OEWG held in Bangkok, Thailand from 23 to 27 July 2012. These events provided further opportunity to collect information and discuss issues relevant to the goals of the evaluation.

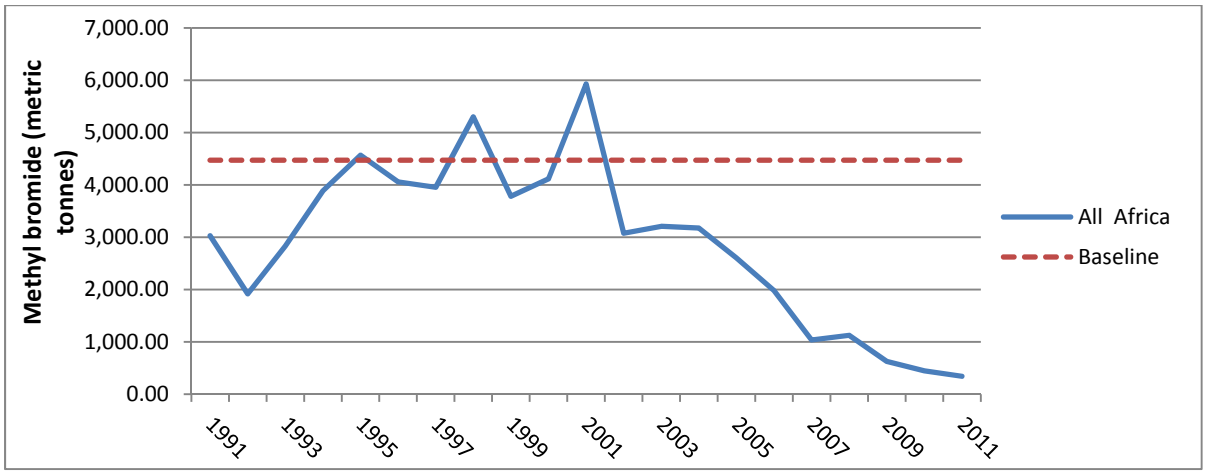
23. All draft country reports were circulated for comments to the countries and bilateral and implementing agencies concerned. The draft subsector papers and the present summary were sent to the bilateral and implementing agencies. Comments on the draft reports were received from implementing agencies, CAP and ozone officers of the countries visited and others and were taken into account for finalizing the present document.

Brief update of methyl bromide consumption in Africa

24. Since the submission of the desk study, updated consumption information has become available for Africa (Article 7). Africa's share with respect to total MB consumption for controlled uses in Article 5 Parties remains relatively unchanged from the previous year at 10.7 per cent. However, progress in phasing out MB in the region has advanced, as aggregate consumption for all African countries now

represents 7.6 per cent of the baseline[2], down from 10 per cent in 2010 and from 20 per cent in 2006. Figure I illustrates this point. It is important to note that in 2011 only seven African countries reported consumption of MB for controlled uses, and that three of those, report less that 5 ODP tonnes and Tunisia reports 6.6 ODP tonnes corresponding to high moisture dates, a use that has been temporarily exempted from controls through decision XV/12 of the Fifteenth Meeting of the Parties. South Africa had not reported 2011 consumption at the time of preparing this report, however reported zero consumption in 2010. Four additional countries had not reported (Guinea, Mali, Niger and Sao Tome and Principe), but these have either never reported consumption or reported zero for five years or more.

Figure I – Methyl bromide consumption for controlled uses in Africa, 1991-2011



Source: Ozone Secretariat Data Access Centre, October 2012

25. MB consumption has traditionally been concentrated in about ten countries in Africa. An analysis of consumption trends in these countries was included in the desk study, and it was noted that in all of them phase-out or investment projects funded by the Multilateral Fund have been implemented (except South Africa, which is not eligible), with many completed (25) and some still ongoing (9).

26. All African countries are in compliance with Montreal Protocol obligations with respect to MB. Four of the seven countries involved in the field study however have not been able to meet the reduction and phase-out targets stipulated in their agreements with the Executive Committee when the MB phase-out projects were funded (in particular for 2011) as follows:

(a) Egypt reported a consumption of 133.2 ODP tonnes when their maximum allowable consumption was 116.4 ODP tonnes;

(b) Kenya should have completed the phase-out of MB but reported 8.5 ODP tonnes for that year;

(c) Morocco was phasing out faster than agreed but reported 50.9 ODP tonnes when the maximum consumption was 46.7 ODP tonnes; and

(d) Zimbabwe should have completed MB phase-out in 2009 but had reported 10.8 ODP tonnes in 2010 and 2.4 ODP tonnes in 2011.

27. Reasons for these deviations include insufficient training of customs officers and lack of communication with the Ozone Office in Zimbabwe (imported MB was allowed into the country in 2011

[2] This may change slightly as South Africa had not reported MB consumption at the time of preparing this report. However, reported consumption for 2010 was zero.

without the required validation or permit from the Ozone Office, but situation has since been corrected), plus a requirement for further training in an industry where the number of growers has increased dramatically; in Egypt, a slow and difficult registration process for chemical alternatives (as described in the corresponding case study); in Kenya, delays in project implementation and additional time needed to make adjustments to silos so grain can be treated with phosphine; in Morocco, MB is mainly used in the production of green beans, a new and expanding sector where research on the implementation of alternatives has only been conducted very recently and for which few chemical alternatives are registered. The four countries reported that they were confident they would return to the agreed schedule and complete the phase-out as required.

Main findings of the field study – general factors impacting sustainability of the phase-out

Technical sustainability

28. In keeping with previous evaluations conducted by the Multilateral Fund, it was confirmed that the choice of alternative technologies to replace MB is generally appropriate. Technical feasibility may however be impacted by external issues for example climatic conditions which lie outside their inherent efficacy. Further, it was found that flexibility in making changes when a specific alternative or mode of application turned out to be unsuitable for the particular circumstances of the sector involved in a given country, had allowed for improved results and generating confidence among stakeholders. This was for example the case of steam originally suggested for the strawberry sector in Morocco, which turned out to be too expensive and generally unsuited for the conditions prevalent in the growing regions. The capacity and willingness to adapt technologies to local conditions is essential to the success of the alternatives.

29. Although reluctance among some MB users to change to alternatives was still apparent in some sectors, awareness about the need to phase out was also very high. Reluctance was more often associated to the fact that MB cannot usually be replaced by one single and equally effective alternative, and this often implied that growers and other users needed to change their approach to production and process management. These related mostly to combining and integrating various control options within an integrated pest management (IPM) programme but also to time management, as some alternatives required longer exposure times. Additionally, the development of new technical skills was required to make an alternative work efficiently (for example, substrate cultivation). This is further complicated by the fact that growers can return to MB relatively easily, since many alternatives do not require extensive changes in infrastructure.

30. Correct identification and a clear understanding of the specific pest and disease problems affecting a crop are essential to the selection of alternatives. Because alternatives do not generally result in broad-spectrum control of soilborne pests and diseases in the way MB does, it is extremely important to have appropriate knowledge about pest life cycles, symptoms, conducive/suppressive conditions and others. In general, this point was well addressed by technical staff.

31. Application methods or procedures can directly impact the technical efficiency of an alternative. This is particularly true with some chemical alternatives such as metham sodium, dazomet and phosphine which, if not properly applied can produce inconsistent results. Equally important is safe handling of chemicals and machinery; a need to improve worker protection standards to reduce safety hazards was noted on some occasions, particularly in relation to phosphine application.

Economic feasibility

32. Full cost analyses as suggested during the desk study were not available during the visits. The complexity involved developing such analyses and time constraints did not allow for conducting them, however an overall assessment of economic feasibility was made. Economic feasibility as considered in the course of investment project implementation was useful in this respect.

33. In many cases alternatives were reported to be economically feasible, with costs that were very similar to those of fumigating with MB; this was often the case when applying chemical soil fumigants. In some cases, alternatives were substantially cheaper (this was often the case with phosphine for stored grain fumigation). However, the economic analysis needs to consider factors that go beyond the mere cost of the chemical, such as its application and use over time.

34. There were thus instances where initial investment was high – for example, when growing on substrates or setting up the floating tray systems – but these extra costs were generally set off by increased yields and quality. In addition, cost comparisons can be quite complex. For example, when implementing an IPM programme it is often necessary to hire extra personnel to scout the cropping areas and identify pest or disease outbreaks as early as possible; although labour represents an extra cost, this can be compensated by reduced pesticide usage, which is possible through early detection. In the same manner, biofumigation or compost addition can improve the water retention capacity of soils and supply nutrients so watering and fertilization needs are reduced resulting in cost reductions.

35. In selected cases alternatives were declared to be too expensive to justify their adoption. Reasons for this included needing to import supplies (for example, seedling trays or substrates) at very high prices, absence of sufficient sales volume to justify marketing of a given input, or both. In such cases, users have been forced to look for a different alternative. Another clear example is steam, which was tested as an alternative in several projects in Africa (Kenya, Morocco, and Zimbabwe) but which turned out to be too expensive and time consuming in most cases. Recent and substantial increases in the cost of MB as reported in the course of the field stage for example in Egypt, could well place some alternatives in a different perspective.

Institutional capacity

36. In general, there is good institutional capacity in the countries visited that support the MB phase-out. Awareness about the phase-out itself was found to be high. The National Ozone Units are generally well aware and fully involved with the MB projects or activities conducted.

37. Trade associations such as the Tobacco Research Board in Zimbabwe or Agricultural Research and Extension Trust (ARET) in Malawi (which works in full cooperation with the Tobacco Research Board of that country) play a central role in training growers, providing technical assistance and research support. The Technology Transfer Centre in Agadir, Morocco, which was established through the investment projects, has been instrumental in disseminating alternatives, providing technical assistance and necessary training and solving problems encountered by growers. These services go well beyond the implementation of alternatives into pest and disease diagnosis, plant nutrition and irrigation, composting and others. In addition, bodies such as the Kenya Flower Council contribute to dissemination of information, awareness and identification of problems.

38. Awareness-raising and training activities play a major role in the commercial adoption of alternatives. In particular, stakeholders expressed high interest in learning about direct experiences in similar productive sectors, in similar regions or countries. Although information exchange has evidently been encouraged through the projects, involving for example local and regional meetings, study tours, workshops and others, these were repeatedly mentioned as most useful activities.

39. Extension services are not always widely available, however trade associations, government institutions and even private companies often play a role in providing technical assistance and updated information to growers.

40. Cooperation efforts with international agencies and foreign governments were found in the same sectors where MB phase-out is taking place or has been completed. Such is the case for example in Kenya where the Government of the Netherlands financed and supported the creation of a training centre for

small-scale agriculture, where training on alternative technologies is conducted; work funded by the European Union in Zambia previous to the onset of the MB project, on the floating tray system and which helped gain familiarity and acceptance with this technique amongst users; and food security and agricultural development initiatives conducted in Egypt under the auspices of FAO, UNIDO and other United Nations agencies. Although these initiatives do not relate directly to MB phase-out, they could well be considered for establishing future linkages where experiences could be shared and stronger cooperation ties established, with the aim of strengthening continued technical support and adoption of production practices that can be used to replace MB.

Political sustainability and regulatory issues

41. All projects funded by the Multilateral Fund include an agreement to maintain the phase-out achieved and generally, to not request any further funding for MB phase-out once completed. Projects also include agreed reduction and phase-out schedules, which should be strictly followed by the country where the project is implemented. As noted in the previous section, four of the seven countries visited during the field study showed some discrepancies between reported consumption in 2011 and the phase-out schedule. General reasons to explain this include time needed to phase in a new alternative, including training of an increased number of users; structural and logistic requirements necessary to make an alternative work; and difficulties associated to the registration of chemical alternatives

42. Additionally, the country where the project is implemented should take measures to restrict MB imports and/or use once the phase-out is achieved. This was found to be in place for example in Malawi, where all controlled uses of MB have been banned for over five years, or in Kenya where soil uses of MB were banned in 2010. Other countries have legislation referring to restrictions imposed to ODS in a broader sense; these often make reference to imports of MB and may require specific permits (from the Ministry of the Environment Ozone Unit, the Ministry of Agriculture Pesticides Division or both) and even official supervision.

43. The measures just described evidently support the MB phase-out but need to be part of a wider approach, including registration and commercial availability of successful alternatives. Some examples were found of alternatives that have become registered after successful trials were conducted through the projects (for example, 1,3-Dichloropropene registered in Morocco). There are also others where difficulties in getting the alternative chemicals registered are hampering their commercial adoption (for example, the slow and difficult registration process in Egypt with 1,3-Dichloropropene + chloropicrin (1,3-D Pic) and dimethyl disulphide (DMDS), two alternative fumigants found to be efficient).

44. Finally, the issue of illegal trade was constantly mentioned, particularly in Kenya and Zimbabwe. Banning 1 lb canisters of MB as was done in Kenya is a helpful measure as not only the small cans are easily hidden, they can also be purchased and used by growers more easily. If only larger cylinders are available, growers are discouraged from buying them as official control on purchases is easier, and application more difficult, often requiring special procedures.

45. With QPS uses of MB being exempted from controls under the Montreal Protocol, there exists a clear possibility of diverting MB imported for QPS into controlled uses. Many of the visited counterparts indicated difficulties in tracking MB use after import, although a requirement for official supervision and control of QPS treatments with MB was indicated often.

Findings of the field study – sector analysis

46. The introduction and adoption of alternatives to MB has had significant impact on different production sectors of economic importance. Alternatives can change cropping systems and production strategies, and so their implementation goes well beyond the replacement of MB.

Floriculture

47. MB was used in the past in cut flower production in five countries comprised in the field study: Egypt, Kenya, Morocco, Zambia and Zimbabwe. Consumption is now completely phased out in all of them. In all cases, production was geared for export, and the importance of abiding by international certification schemes or eco-labels (i.e. Global GAP, or the Dutch Label MPS - Sustainable) which restrict certain chemicals (including MB) and are required by flower importers, was always apparent. In consequence, phasing out MB and replacing its use with environmentally sustainable production methods is actually facilitating foreign market access.

48. Floriculture in Morocco, Zambia and Zimbabwe has diminished significantly due to factors that lie well outside the possible impacts of MB phase-out. These include climate conditions not being optimum for producing specific flower types, shipping costs and difficulties and political or economic crises. Zimbabwe in particular passed from being the second cut flower exporter in Africa (after Kenya) to exporting only nil quantities in recent years. Kenya holds the largest floriculture sector in this group by far and is a key player in the international floriculture scene. Some flower growers from these countries moved to other countries, sometimes initiating or expanding MB use. For example, countries like Ethiopia have registered significant expansion of flower production in just a few years. This could increase potential for illegal trade to MB and may interfere with both the phase-out process and the adoption of alternatives.

49. MB has been replaced in cut flower production mainly with substrates (soilless media) and chemical alternatives, generally within an IPM approach. Replacement of MB with alternatives was reported to be more difficult in nurseries producing propagation material, particularly when such material is exported to other countries and is subject to high plant health standards and certification. Constraints were further reported in Kenya with substrate recycling and/or disposal, which are being addressed in different ways, but need further development. Production in substrates (soilless media) is also technically challenging and requires thorough training; however, flower companies who were MB users usually operate within high technical standards, which are necessary to meet stringent market requirements. Initial investment for substrate production is generally high, but is offset through improved quality and yields; access to an inexpensive substrate, preferably locally available directly impacts production costs. It is a well-proven production technology in use in many developed and developing countries around the world where floriculture is important, including Colombia, Ecuador and the Netherlands.

50. Steaming, initially offered widely as an alternative for flowers, is not in widespread use, mainly due to fuel costs and the length of time the boilers need to run in order to achieve sufficient heating throughout the soil profile. Steaming was however reported as useful and feasible for cleaning recycled substrate used in cut flower production in Kenya or for nursery plants grown in raised beds or containers, with a limited amount of soil or substrate (reported in Zimbabwe).

Horticulture

51. Horticulture comprises a diverse sector including various crops such as strawberries, tomatoes, green beans, peppers, eggplants and cucurbits (melons, watermelons, cucumbers). Production of some of these crops has developed more recently than others and although developments are in many cases geared for export, local consumption is also important. In consequence, MB users are heterogeneous, including high-tech producers as well as growers using simple cropping techniques and both small-scale and large operations. MB consumption for horticulture crop production was particularly important in Egypt and Morocco, and to a lesser extent in Kenya and Zambia. Export products are normally subjected to certification schemes or eco-labels that require clean production practices including in some cases avoidance of products like MB.

52. Grafting was found to be a very successful alternative, which has been widely adopted in many countries around the world. It has particularly impacted the tomato and cucurbit sectors and is especially efficient when used in combination with other alternatives such as solarization and low doses of fumigants (1,3-D/Pic, metham sodium). Excellent examples are in place in Morocco, where presently 100 per cent of tomatoes are grafted, as well as a large proportion of melons and watermelons. This option has been so successful that at present over 20 commercial grafting companies offering grafted plants to producers are in operation. Adoption of grafting in Egypt is on the rise, although a few technical hurdles remain. Grafting requires increased hand labour and specialized infrastructure, plus extensive and specialized training which increase production costs, but reduced losses resulting from using rootstocks that are resistant to pests plus improved quality and yields arising from increased plant vigour offset the higher investment. Economic sustainability has been confirmed for this alternative system. Ample experience and research on this technology is available around the world. Consideration of such experiences plus encouraging information exchange should help solve remaining problems (for example, incompatibility between scion and rootstock which may occur in melons, or appropriate selection of rootstocks).

53. Other successful alternatives used in the horticulture sector include production in substrates (for example, for cherry tomatoes), and alternative chemicals. Constraints were reported in Egypt where alternative fumigants (mainly 1,3-D/Pic and DMDS) have shown to be successful in trials conducted through the projects but which are not commercially available to growers due to the slow registration process. Concerns were raised with respect to the short time left until the phase-out deadline for Article 5 countries, and whether it will be possible to phase in these chemicals in time. Further, concerns were expressed about restrictions on chemical fumigants taking place for example in the European Union, such as with 1,3-D. Morocco is also conducting comprehensive trials with compost at the Agriculture Training Centre with a view of transferring this technology to growers as a component of IPM programmes (compost provides beneficial and antagonistic microorganisms that contribute to the control of soilborne diseases).

54. The strawberry sector has basically adopted chemical alternatives. Previous users are mainly located in Egypt and Morocco, and in both locations satisfactory results were reported with metham sodium, which is registered and commercially available. Initially, steam was offered as an alternative in Morocco but trials showed that it was not only extremely expensive but also unsuited to conditions in northern Morocco. Some experience also exists with soilless production, especially in Egypt where trials have been conducted with rice straw substrate with good results. Strawberry nursery production was found to be important only in Egypt as strawberry runners used in Morocco are mostly imported from Spain. Although MB replacement was found to be more difficult in this crop due to very high health requirements, Egyptian companies visited reported good results with chemical alternatives + IPM and hydroponic production.

55. Relative hurdles were noted in sectors that have developed more recently for example green beans in Morocco, which need research and development to identify the main problems eventually leading to soil fumigation, as well as the most suited production practices. Chemical alternatives are not always registered for these crops and there may not be an attractive enough market for manufacturers to consider registration. These factors however go beyond the MB phase-out issue and are normal occurrence for any developing sector.

Tobacco

56. Tobacco production has been extremely important to African economy for many years, especially in southern countries, where some of the largest MB consumers were once found. Production is generally exported in the form of unmanufactured dried (cured) leaves that are purchased by large multinational cigar and cigarette companies. Although there are large-scale growers, recently a proliferation of small farmers has taken place particularly in Zimbabwe. Small growers often grow for larger companies, which

provide specific production guidelines, including good agricultural practice. As in other agricultural sectors, tobacco is subjected to certification schemes involving good agricultural practices (that require rational use of pesticide, not necessarily prohibit MB use), so moving away from MB is considered a step in the right direction.

57. MB was used in the past to sterilize soil where tobacco seedlings were grown, but is now virtually phased-out from this sector. Replacement has taken place mostly with the floating tray system, which leads to efficient production of high quality seedlings. This technology requires investment in new infrastructure (pools, plastic tunnels, irrigation systems, seedling trays, substrate, good quality water and others), technology transfer and special training; however it has been very successful in many countries around the world including Africa. Examples of successful adoption were observed particularly in Zimbabwe.

58. Difficulties with the floating tray system were reported in Malawi and Zambia, not from a technical standpoint since results were excellent, but because there are no local suppliers of seedling trays; imported trays, even from South Africa or Zimbabwe, are too expensive and make this option economically unfeasible at present. Malawi reported having access to good, inexpensive substrates that were locally available, but Zambia also identified this as an input that would impact costs. Growers nevertheless reported very good results with the floating tray system when trays had been provided by the projects, but having the technique reduced to large-scale farmers who can afford imports.

59. As a second choice, growers in Malawi and Zambia and some small-scale growers in Zimbabwe who do not have access to the floating tray system for reasons including technical challenges or costs, have adopted chemical options, mainly dazomet, to fumigate ground beds used for traditional seedling production. This option was considered successful and access to MB was never reported as essential. Rather, dazomet was often referred to as cheaper and more cost-effective than MB. Burning, which was also used as a soil sterilization technique in the past was still mentioned, but seems to have diminished greatly, very possibly as a result of the projects.

Stored grain

60. Cereals are staple food for many African countries and generally stored for varying periods of time, for use during drought or other adverse conditions. MB was traditionally used to fumigate grain stored in stacks or silos to rid it of insect pests that typically attack such commodities, in the case of Africa mainly wheat (of high importance in Egypt) and maize (very relevant in Kenya, Zambia and Zimbabwe). Other types of commodities include coffee and cocoa, which are also attacked by pests when in storage and are important export products of Cameroon.

61. In general, phosphine has been found to be an efficient alternative for stored grain, which is well proven and in has been used for many years throughout the world. Efficient pest control in stored coffee and cocoa beans was also reported. This fumigant poses some relative disadvantages when compared to MB: effective treatment takes longer and this can impact market logistics, but this can be overcome with appropriate planning; and resistance can develop in some pests if application is not done under gas-tight conditions and sub-lethal doses are used (which often leads to repeated fumigations), but this can and should be prevented and monitored, since resistance can really render phosphine useless. Of particular importance to prevent resistance are management practices that help reduce both insect populations and the number of phosphine treatments (IPM, hygiene treatments, rotating with other chemicals, cooling, CO_2). Systems to detect resistance in the laboratory and also in the field have been developed and are available[3][4].

[3] FAO, 1984. Manual of fumigation for insect control. http://www.fao.org/docrep/X5042E/X5042E00.htm.
[4] Reichmuth, C. 1991. A quick test to determine phosphine resistance in stored products research. GASGA Newsletters 15, 14-5.

62. In Egypt the mixture of phosphine and 2 per cent carbon dioxide (ECO_2Fume) has been adopted successfully and with a high level of acceptance. It is cheaper than MB and was rapidly registered so it is commercially available. The cylinder formulation is non-flammable and allows potential for lower dosages and more accurate application of phosphine than other phosphine-production methods such as aluminum phosphide (used for example in Cameroon and Zimbabwe). In Kenya, phosphine plus cooling has been selected as a convenient option.

63. Phosphine is relatively easy to handle and apply, but as with any toxic chemical, safe handling measures are important. This issue was often part of the discussions and sub-optimal practices were observed in some instances (i.e. torn tarps, fumigators not using protective gear) and corrective measures are highly recommended. Accomplishing this seems very feasible given that fumigation is usually in the hands of specialized fumigators and often even supervised by government officials. With respect to economic feasibility, phosphine was generally reported to be substantially cheaper than MB; it was also reported as widely registered and available.

64. The difference between QPS treatments and post-harvest treatments is not always sufficiently clear in reference to stored grain. In some instances, for example in Cameroon, it was found that fumigation is carried out for both pre-shipment and postharvest storage with phosphine. However there are also instances where importing countries require pre-shipment treatment with MB, even if commodities that have been stored for longer than 21 days have been previously treated with phosphine. Training for further clarification of these concepts is thus advisable.

Risk analysis

65. Sustainability of the phase-out was assessed in terms of the technical, economic, institutional and political feasibility of the alternatives implemented. Factors putting the sustainability of the MB phase-out at risk (as described in the introductory section of this report) were analysed for each relevant sector in all countries considered for the field stage of this evaluation.

66. Risks of returning/continuing MB were characterized and categorized as low, medium and high, on a qualitative basis, as per information gathered from the field visits. They were also categorized as internal (i.e. directly related to the MB substitution) or external (going beyond the phase-out process), since this directly influences their impact and possible suggested solutions or mitigation measures.

67. Mitigation measures were considered taking into consideration factors such as whether alternatives were competitive (i.e. their cost and efficacy) and whether the alternatives and the technical assistance offered was attractive to stakeholders. Reluctance to change from MB to alternatives was also addressed, and enquiries were made as to whether large stocks of MB might be available and offered at low prices. Finally, whether pressure to submit Critical Use Nominations now that the 2015 deadline is approaching was in any way present.

68. In general terms, it was concluded that awareness about MB phase-out is presently very high and key stakeholder involvement excellent. This has led to very good acceptance of alternatives and high success with their implementation in most cases. It was evident that the ability to adapt technologies and strategies to local conditions is essential in the successful adoption of alternatives.

69. For consistency, a general analysis was conducted in the same assessment terms used for the case studies, with the aim of establishing a general trend for African countries. Results of this analysis appear in Table 1.

Table 1 – General overview of sustainability of the methyl bromide phase-out achieved in Africa

Factor	Feasibility	Risks - problems	Mitigation
Technical	Very good. Technically feasible alternatives have been identified for all previous uses of MB in all the sectors considered[5].	Some alternatives technically challenging. Incorrect application practices influence performance of alternatives. Some chemical alternatives need longer validation.	Increase training on good agricultural practices, for both production and post-harvest. Intensify trials with alternatives where applicable. Encourage information exchange on new or emerging pest or disease problems and management strategies and/or related research programmes.
Economic/ Commercial	Good. Economic feasibility generally achieved. Market/consumer acceptance of alternatives high.	Initial investment to adopt alternatives can be high. Returning to MB is always a (relatively easy) option.	Cost analyses should be conducted to establish whether increased yield and improved quality, or reduced losses are offsetting the investment. Care with using resources efficiently. Adapt local (cheaper) resources (i.e. substrates). Explore options for local production of inputs (i.e. seedtrays).
Institutional	Very good, with variations. Technical assistance and training support generally of good level and available. Good institutional capacity.	Ensuring continuity (funding) of training, research and technical assistance.	Explore linkages with other projects, initiatives, and/or institutions. Encourage information exchange both at regional and local levels. Find complementary funding sources. Encourage partnerships.
Political	Good. All countries have committed to sustain the phase-out achieved.	Regulations restricting MB imports and use not always specific for MB. Difficulties in tracking actual use of MB imported for QPS use. Some concern with smuggling/illegal MB trade. Concern with increasing QPS use. Lack of registration of chemical alternatives.	Strengthen tracking systems. Intensify training of customs officials. Consider issuing regulations specifically addressing MB use. Consider de-registration of formulations different to 100 per cent MB used for QPS, particularly 1 lb canisters where these are still permitted. Explore ways of speeding up registration of alternatives. Explore incentives for local production/supply of inputs required (seedtrays, substrates, grafting companies, etc.).

[5] Except high moisture dates.

Conclusions – recommended strategy for sustaining the phase-out achieved

70. On the basis of the information gathered during the desk and field studies that comprise this evaluation, and not in line with claims from African Parties suggesting that this evaluation be conducted, it is concluded that in general, the risk of returning to MB use for controlled uses is presently low. However, actions to strengthen the phase-out achieved and ensure the continuity of the adoption of alternatives that has taken place can still be taken and are hereby suggested.

71. In the course of the field study it was clearly apparent that issues beyond the technical and economic feasibility of alternatives impact their sustainability. These include, *inter alia*, market drivers (for example, very specific market windows that require the appropriate combination of technical and business skills to access fully); consumer issues (for example, importing markets requiring specific certifications impacting production practices); infrastructure and installed capacity (for example, sufficient airfreight, cold room facilities); and large enough consumption of a given material or product to develop a market for it and ensure availability, and others.

72. It was also evident that those that are able to sustain the MB phase-out – especially through the adoption of environment-friendly production practices, make market headway. Such practices are becoming increasingly important to consumers particularly in Europe, who now demand compliance with certification schemes that guarantee products obtained by "cleaner processes" (for example, Global GAP, or the Dutch Label MPS - Sustainable, Rainforest Alliance). This often results in certain pesticides being forbidden by the certification, including MB. Since Europe is the main importing market for African products this issue impacts MB use. Many growers expressed satisfaction with being able to produce without MB and thus maintain market access.

73. Problems were encountered with sourcing some materials necessary for the implementation of some alternatives (i.e. seed trays for Malawi). Possibilities of developing local tray production were explored at the time when the MB phase-out project was conducted; however although some local companies initially expressed an interest, a large enough market was not developed to justify their investment. It is thus suggested that incentives to reduce the price of imported inputs could be explored (reducing tariffs, creating partnerships, or others).

74. Regulatory restrictions were found, mainly the slow registration of chemical alternatives (i.e. Egypt). This will clearly impact the rate of adoption of alternatives and could even completely prevent use of some of these alternatives. Parties where this situation is present may want to explore options to speed up the registration process.

75. Concerns with the continuity of programmes established through the project – particularly technical assistance and awareness was noted. This was found to be justified and should be addressed, as large efforts could be lost. Ways to continue funding may be sought, through the Multilateral Fund but also externally, by creating linkages with other initiatives, promoting information exchange within productive sectors locally or at the regional level and others. Good agricultural practices need strengthening overall (i.e. IPM, but also safe handling of materials and equipment). Equally important is monitoring performance of alternatives to ensure continuity of their performance (for example, checking for phosphine resistance, training in appropriate pesticide application/fumigation methods).

76. With respect to political issues, it was evident that stronger tracking systems to differentiate between QPS/controlled uses are needed. Suggestions include authorizing only the 100 per cent MB formulation for QPS uses (which is not suited for soil fumigation), with the corresponding precautions (pure MB is odourless and colourless, and highly toxic).

77. Finally, it was generally reported that interest in pursuing critical uses is presently low. MB use is already banned in some cases and the process of authorizing it once again seems cumbersome at the very

least. Market drivers favour non-users. And in many instances, the price of MB has increased significantly, making this option even less attractive. Stocks of MB were not detected, but this information was not always available.

Recommendation

78. The Executive Committee may wish to take note of the information provided in the final evaluation of methyl bromide projects as presented in document UNEP/OzL.Pro/ExCom/68/11.

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