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Revised FAO Action Plan on Antimicrobial Resistance 2021-2025

1. At its 130th Session, the Programme Committee “reviewed the draft Action Plan and requested its Chair to organize a Members-led, open, transparent and inclusive informal consultation with a view to reaching consensus on the draft action plan, and requested a revised version of the Action Plan to be submitted to the 166th Session of the Council for its consideration”¹.
2. Following the feedback received during the consultation, this document presents the latest version of the action plan for the consideration of the Council.

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¹ [CL 166/9](#) para 19 l)



**Food and Agriculture Organization
of the United Nations**

The FAO Action Plan on Antimicrobial Resistance 2021–2025

**Supporting innovation and resilience
in food and agriculture sectors**

Version 6

20 April 2021

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Acronyms

AMR	Antimicrobial resistance
AMU	Antimicrobial use
CAC	Codex Alimentarius Commission
FAO	Food and Agriculture Organization of the United Nations
FAO-ATLASS	FAO Assessment Tool for Laboratories and AMR Surveillance Systems
FAO-PMP-AMR	FAO Progressive Management Pathway for AMR
GAP	Global Action Plan
GDP	Gross domestic product
IACG	UN ad hoc Inter-agency Coordination Group on AMR
ICCPM	International Code of Conduct on Pesticide Management
IPPC	International Plant Protection Convention
LMIC	Low- and middle-income country
MPTF	Multi-Partner Trust Fund
NAP	National action plan on antimicrobial resistance
OIE	World Organisation for Animal Health
SDG	Sustainable Development Goal
UN	United Nations
UNEP	United Nations Environment Programme
WHO	World Health Organization

Executive summary

FAO Conferences in 2015 and 2019 underscored the importance and urgency of addressing the growing global threat of antimicrobial resistance (AMR) in all countries through a coordinated, multi-sectoral, One Health approach in the context of the 2030 Agenda for Sustainable Development. They highlighted that access to effective antimicrobials and their appropriate and prudent use has a role in productive and sustainable agriculture and aquaculture – and that their misuse contributes to the rising rates of antimicrobial resistance which negatively impacts the advances made in medicine, public health, veterinary care, food and agriculture production systems, and food safety. The conferences highlighted also that access to effective antimicrobial agents constitutes a prerequisite for productive and sustainable agriculture, particularly animal husbandry and aquaculture and safe food, on which countless livelihoods depend throughout the world, but that hard-won gains in animal and human health and development are at risk due to increasing resistance to antimicrobials.

Contributing towards the goal of **building resilience in the food and agriculture sectors by limiting the emergence and spread of AMR** depends on controlling AMR effectively as a shared responsibility among farmers, herders, growers, fishers, prescribers and policy makers in food and agriculture – as well as other sectors. Preventative action will provide an **economic benefit**, especially when compared to the considerable percent of GDP expected to be lost if AMR is permitted to develop into a **global emergency** through the widespread **failure of medicines**.

The availability and use of effective antimicrobials is essential for the health and welfare of terrestrial and aquatic animals, and in crop production. The **overuse and misuse of antimicrobials** in animal and plant production is influenced by an interplay of factors. These serve as targets for action to address challenges ranging from: i) treatment failures driving production losses and food insecurity; to ii) the impacts on human health.

Once individuals become carriers of antimicrobial-resistant organisms, they **can easily spread AMR among communities and across borders**. AMR can also reach the general population by spilling over into agriculture products and the environment, contaminating waterways, wildlife and soil. Given the global interconnected web of transmission, a **multi-sectoral and multi-disciplinary approach** is **critical to the success** of National Action Plans (NAPs) for delivering on the Global Action Plan on AMR (GAP; WHO 2015).

This FAO Action Plan on AMR 2021–2025 sets out the five objectives that guide the **programming of FAO activities. The latter will be amended as needed to reflect progress, new challenges, and available resources. The action plan principally** is intended to help guide FAO's

KEY MESSAGES

- Globally we are only as protected as our most vulnerable members because resistant microbes cross borders.
- Scientific knowledge and science-based evidence are needed to identify and manage AMR risks before they become large-scale emergencies.
- Countries will benefit from surveillance and research to design programmes to minimize and contain AMR and monitor their effectiveness.
- Stakeholders need to be enabled, empowered and incentivized to transform awareness of AMR risks into action.
- Opportunities to boost profitability through more effective agriculture practices will also help to reduce the burden of infections and emergence of AMR.
- Training stakeholders through better guidance on responsible practices such as biosecurity and biosafety will help to prevent diseases, reducing the need for antimicrobials in animals and antimicrobial pesticides in plants.
- Equal access to expert advice, prescriptions and appropriate antimicrobials, as well as AMR-relevant policies and legislation, will help tackle the challenge of antimicrobial misuse while also boosting production.
- Support is needed for research and innovations in antimicrobials, alternatives, diagnostics and production.
- The economic case for public and private investments can support resource mobilization to deliver national plans.
- Mainstreaming AMR into programmes for achieving the SDGs will help accelerate progress and boost resilience to health crises for global prosperity.

support to its Members to build capacities, and is not a policy document. The Action Plan provides for flexibility to respond to Members' requests and participation of Members in activities indicated is voluntary. The activities and support provided under the Action Plan will be guided by the latest developments in science, international guidance and standards.

The five key objectives (Figure 1) to help focus efforts and accelerate progress are:

1. Increasing stakeholder **awareness** and **engagement**
2. Strengthening **surveillance** and **research**
3. Enabling **good practices**
4. Promoting **responsible use** of antimicrobials
5. Strengthening **governance** and allocating **resources** sustainably

The Action Plan also includes a results chain (Figure 2) and a detailed list of key activities (Tables 1–5) to help guide the development and deployment of NAPs to meet FAO Members' needs.

FAO brings expertise in aquatic and terrestrial animal health and production, food and feed safety, genetic resources, crop production, natural resource management, risk communication and behavioural change. FAO also supports regulatory frameworks, standards, target-setting, norm-setting and bottom-up processes of collective action.

FAO's support to tackle AMR has gained **momentum**. This needs to be maintained and accelerated in order to coordinate the **global response for food and agriculture**.

Background

Working together to feed our growing global population and protect it from drug-resistant infections

Sustainably feeding an expanding global population depends on how well we protect our food systems from growing threats. This is especially true when it comes to managing antimicrobial resistance (AMR), which is rapidly becoming one of the greatest threats to lives, livelihoods and economies (O'Neill, 2014). AMR is a process whereby microorganisms acquire a tolerance to antibiotics, fungicides and other antimicrobials, many of which we rely on to treat diseases in people, terrestrial and aquatic animals, and plants.

One of the consequences of antimicrobial-resistant microorganisms is drug-resistant infections. Resistance is already making some diseases in humans, livestock and plants increasingly difficult or impossible to treat. It is undermining modern medicine, compromising animal production and destabilizing food security. The impact of AMR is further amplified by the slow and expensive process of discovering replacement medicines. The current efforts for the development and research of new antimicrobials and health technologies to address AMR are inadequate and in need of incentives and investment. For these reasons, AMR affects everyone and requires all of us to take urgent action. We need to keep antimicrobials working for as long as possible to buy time for new drug discovery. Together, we must combat the accelerating pace of resistance and make food systems more resilient.

This Action Plan of the Food and Agriculture Organization of the United Nations (FAO) supports the implementation of the Global Action Plan on AMR (GAP; WHO 2015). FAO's Action Plan serves as a roadmap for focusing global efforts to address AMR in food and agriculture sectors. Protecting food and health systems is a common need of our global society. FAO shares a responsibility to guard against economic losses as resistant microbes contaminate environments, cross borders and spread readily between people and animals. The time for action is now.

The benefits of acting now to strengthen and implement national plans

Action against AMR is a race against time. The world is expected to produce in the next 30 years the same amount of food as it has produced in the last 10 000 years combined (FAO, 2009; Wolcott, 2019). This heralds unprecedented pressure on our agriculture systems to deliver nutritious food safely and sustainably in the face of climate change, diminishing natural resources and global health threats, which include pandemics and drug-resistant infections.

Within the next 10 years, antimicrobial use (AMU) for livestock alone is projected to nearly double to keep pace with the demands of our growing human population (Van Boeckel *et al.*, 2015). Usage for aquaculture and plants is predicted to continue rising as well. The intensification and specialization of agriculture production is already contributing to infections increasingly difficult to treat. Human and animal waste, wastewater from hospitals and clinics, and discharge from pharmaceutical manufacturing sites that is contaminated with resistant microbes and antimicrobials can also enter the environment. These factors will speed up the emergence and spread of resistance unless we act now to improve practices to minimize and contain AMR.

Many improvements in agriculture practices to better control AMR – good nutrition, health, vaccination, hygiene, sanitation, genetics, husbandry, welfare, environmental protection and growing practices – help boost production in addition to protecting against losses from infectious disease. This can make agriculture more profitable and more sustainable.

In fact, there is a strong economic benefit for seizing this window of opportunity for implementing practical and preventive adjustments at relatively low cost now compared to the 1–5 percent or greater loss of GDP predicted for countries if AMR remains unchecked. By developing and applying One Health National Action Plans (NAPs) on AMR, countries can also prevent tens of millions more people from being forced into extreme poverty (World Bank Group, 2017).

FAO is helping countries leave no sector behind

FAO is supporting Members to strengthen their capacities and capabilities to manage AMR risks in food and agriculture sectors. In support of inclusive protection, FAO champions multi-sectoral and multi-disciplinary responses coordinated through strong governance, informed by surveillance and research and which promote good production practices and responsible AMU. The expansion of communication and behaviour change initiatives is also urgently needed to effectively target the drivers of AMR and to empower stakeholders to improve their practices.

Since the advent of antimicrobials, the occurrence of resistant microorganisms in livestock has grown exponentially, with LMICs

COMPARATIVE ADVANTAGE

FAO has an on-the-ground network in more than 150 countries.

The Organization also has wide expertise in a variety of disciplines, including aquatic and terrestrial animal health, welfare and production; food and feed safety; crop production and protection; water and land stewardship; legal affairs, communication and behaviour change; surveillance and more.

In accordance with its mandate, FAO plays an essential role in supporting governments, producers, traders and other stakeholder groups to use antimicrobials responsibly to keep antimicrobials working and to protect food and agriculture sectors from the harms of AMR.

The Organization also hosts the Secretariat of the Codex Alimentarius Commission (CAC) and the International Plant Protection Convention (IPPC), supporting the work of these standard-setting organizations by providing them with scientific advice and assisting in the implementation of standards through support to countries.

FAO works closely with the OIE and WHO in a Tripartite initiative and this collaborative approach extends to other partners, reference centres, academic institutions and regional working groups for a coordinated global response to AMR.

included (Van Boeckel *et al.*, 2019). This trend is troubling for producers and for patients as a fraction of all drug-resistant infections in humans have also been associated with foodborne or animal sources (CDC, 2013; Mughini-Gras *et al.*, 2019). This has resulted in recommendations providing guidance on responsible and prudent AMU (IACG, 2019; WHO, 2019; WHO, 2017; FAO, 2015), including the need for phasing out of AMU for growth promotion in the absence of risk analysis (OIE, 2019a).

The widespread presence of antimicrobial-resistant microorganisms in terrestrial and aquatic animals, plants and the environment is influenced by an interplay of factors across sectors (FAO 2016a; O'Neill 2015; Collignon *et al.* 2018; Caudell *et al.* 2020). These include:

- Anthropological, behavioural, sociocultural, political and economic factors;
- poor sanitation and limited access to clean water;
- limited biosecurity and production practices that lead to an overuse of antimicrobials;
- absent or inadequate oversight of AMU in agriculture with limited access to animal and plant health experts, as well as inadequate training and support for these experts;
- unregulated sales of antimicrobials without prescription; and
- increased availability of counterfeit and low-quality antimicrobials, including products with harmful combinations and sub-therapeutic concentrations.

These are interconnected targets for action to address challenges ranging from: i) treatment failures that trigger production losses and jeopardize food security; to ii) the increased transmission risk of multi-drug resistant microorganisms – commonly known as “superbugs” – through environments and food chains (O'Neill, 2014; Smith and Coast, 2013).

Timely action can help limit the spread of foodborne and zoonotic antimicrobial-resistant microorganisms, which may reach humans, animals, and crops through a multitude of transmission pathways (FAO, 2016a). These transmission pathways include both direct contact with animals and human sources, and indirect transmission through the environment and food supply chain. AMR can originate at the point of production and then be carried by animals and plants into the food chain. Resistant microorganisms can also be introduced during the handling, processing, transport, storage and preparation of food products.

Once an individual becomes a carrier of antimicrobial-resistant microorganisms, they can easily spread AMR within and between communities. AMR can also reach the general population by spilling over from human and agriculture sources into the environment and wildlife populations, whereby people can be exposed through contaminated water, soil and agriculture products. Antimicrobials or their residues in terrestrial and aquatic environments – coming from sources such as drug manufacturing plants, untreated community sewage, wastewater/run-off from animal operations and crops – are also generating selection pressure for the emergence of AMR and contributing to its spread. In parallel to managing AMU, a transition to more sustainable food production practices is essential to better controlling AMR.

The intermingled web of transmission pathways of antimicrobial-resistant microorganisms includes the potential for emergence and spread across all sectors and stages of the food supply chain. Therefore, a multi-sectoral and multi-disciplinary approach is critical to the success of NAPs. Successful NAPs are also critical for delivering on the GAP (WHO, 2015), in accordance with its Monitoring and Evaluation Framework (FAO, OIE and WHO, 2019).

FAO is providing support to Members for strengthening their own national capacities and capabilities through expertise in aquatic and terrestrial animal health and production, food and feed safety, genetic resources, crop production, natural resource management, risk communication and behaviour change, with attention to regulatory frameworks, standards, norm-setting and bottom-up processes of collective action.

Mainstreaming AMR into programmes for achieving the Sustainable Development Goals

FAO leads international efforts to achieve food security for all and recognizes that eradicating hunger – as part of the wider Agenda for Sustainable Development – can only be achieved through timely and widespread action on AMR. In May 2019, the United Nations (UN) Secretary-General António Guterres affirmed that AMR “is a global threat to health, livelihoods and the achievement of the Sustainable Development Goals.”

While there is no AMR-specific goal or indicator in the current Sustainable Development Goal (SDG) framework, AMR must be accounted for in global, regional and national plans because it is threatening the achievement of many goals (Wellcome Trust, 2018; World Bank Group, 2017), including:

- Ending poverty (SDG 1) and hunger (SDG 2);
- Promoting healthy lives and well-being (SDG 3);
- Clean water and sanitation (SDG 6);
- Responsible consumption and production (SDG 12);
- Protecting life below water and on land (SDGs 14 & 15); and
- Achieving sustained economic growth (SDG 8).

As women are less likely to be compensated – or compensated at a lower level – than men for their efforts in food production and food preparation (FAO, 2011), there is a disproportionate risk of exposure to resistant pathogens relative to financial compensation, highlighting gender equality issues as well (SDG 5). The ability to better manage AMR and prevent impacts on international relations depends too on strengthening global development partnerships (SDG 17).

Action on AMR is accelerating in line with funding

Since 2015, political commitment and international action against AMR has grown. Beginning in May 2015, the World Health Assembly resolution WHA68.7 (WHA, 2015) adopted the GAP on AMR (WHO, 2015), developed by FAO, WHO and OIE. The GAP emphasized the need for a “One Health” approach to combat AMR by involving all sectors of government and society and strengthening coordination between FAO, WHO and OIE. The main objective of the GAP is assisting Members in the development and implementation of multi-sectoral One Health NAPs. The GAP also presented key actions for addressing AMR. A political declaration at the UN General Assembly in September 2016 (UNGA, 2016) additionally requested that the UN Secretary-General submit a report to Members on the implementation of the political declaration, including recommendations emanating from an ad hoc Inter-Agency Coordination Group on AMR (IACG).

In supporting implementation of the GAP, FAO’s Thirty-ninth Conference adopted Resolution 4/2015 (FAO, 2015) on AMR in June 2015, recognizing the importance of mitigating impacts of AMR in food and agriculture sectors and the role of FAO in tackling this global threat. The FAO Action Plan on AMR 2016–2020 (FAO, 2016b) was developed

FUNDED PROJECT RESULTS & TOOLS

Funded projects were designed to boost the technical capabilities of countries and strengthen multi-stakeholder collaboration for developing and implementing NAPs in more than 40 lower-middle-income countries (UN 2019a). This includes support for countries to identify and commit resources for national plans.

FAO has facilitated access to resources and technical networks, deployed field interventions and studies promoting good practices and has developed a set of tools (FAO, 2020b) to assist countries broadening their action on AMR to more food and agriculture sectors.

The FAO Progressive Management Pathway for AMR (FAO-PMP-AMR) has been developed to support countries in identifying actions needed for step-by-step improvements in AMR control and a tool for situation analysis of AMR risks is being used by countries to prioritize actions on the basis of a risk analysis.

FAO has developed a methodology to assess national legislation relevant for AMU and AMR, including the regulatory framework of antimicrobials, legislation aimed at preventing the contamination of food and the environment and legislation to improve animal and plant health status to minimize the need for antimicrobials.

Additionally, with the aim of assisting countries in assessing their national surveillance systems and laboratory diagnostic capacity for AMR detection, FAO has developed and deployed the Assessment Tool for Laboratories and AMR Surveillance System (FAO-ATLASS) in more than 25 countries and 100 laboratories.

for implementation of this Resolution. FAO's Forty-first Conference in June 2019 adopted a second Resolution on AMR (6/2019; FAO 2019a) which acknowledged and welcomed FAO's efforts in addressing AMR as a "One Health" issue and agreed on the need for further support, through extra-budgetary resources. An AMR working group was also established in 2015, creating a mechanism for internal coordination among FAO technical divisions and regional and country offices. At the time of publication, donors for FAO AMR projects have included Canada, France, the Netherlands, Norway, the Russian Federation, Sweden, the United Kingdom, the United States of America and the European Union (FAO, 2020b; FAO, WHO and OIE, 2020).

FAO is supporting the standard setting work on AMR and working to further broaden international coordination. In 2017, the Codex Alimentarius Commission, the risk management body of the Joint FAO/WHO Food Standards Programme, established a Task Force on Antimicrobial Resistance (FAO and WHO, 2020). The Task Force is developing science-based guidance on managing foodborne AMR, taking into account the work and standards of relevant international organizations and the "One Health" approach, to ensure that Members have the guidance necessary to manage AMR across the food chain.

In May 2018, FAO, WHO and OIE (the Tripartite) signed a Memorandum of Understanding to strengthen their long-standing partnership, with a renewed focus on tackling AMR (FAO WHO OIE, 2018). This led to a two-year (2019–2020) Tripartite Work Plan, with the involvement of the United Nations Environment Programme (UNEP), which was adopted by the Twenty-fifth Tripartite Executive meeting (February 2019) and was subsequently signed by the Directors-General of FAO, WHO and OIE. (May 2019). All of the activities under the Work Plan directly contribute to the implementation of FAO's Action Plan on AMR and complement FAO's activities undertaken with regular and extra-budgetary funds.

In 2019, the Organization initiated the establishment of a technical collaborative network of FAO Reference Centres for AMR. These institutions with demonstrated key AMR capacities are supporting FAO in knowledge transfer and skills development. Up to the date of publication, these included institutions from Denmark, France, Germany, Mexico, Thailand, the United Kingdom and the United States of America (FAO, 2020a).

The IACG Report published in 2019 – to which FAO contributed through a body of technical advisors – includes 14 recommendations for progress in countries, innovation, collaboration, investment and global governance (IACG, 2019). The follow-up report to the UN Secretary-General provided highlights of progress made by Members and the Tripartite Organizations in addressing AMR on the basis of the GAP. The follow-up report also called for urgent support and investments to scale up responses at the national, regional and global levels (UN, 2019a).

In June 2019, the AMR Multi-Partner Trust Fund (AMR MPTF) was launched as a strategic, inter-sectoral, multi-stakeholder initiative to leverage the Tripartite's convening and coordinating power, as well as mandates and technical expertise to mitigate the risk of AMR. The AMR MPTF has been established for an initial five-year period (2019–2024), inviting financing to drive forward the delivery of the GAP, including the IACG recommendations. It will accelerate global, regional and national progress by catalysing the implementation of One Health NAPs (FAO WHO OIE, 2020).

Most of FAO's work on AMR to date has been implemented through extra-budgetary funds via donor funded projects. Despite information gaps on AMU and the impacts of AMR in food and agriculture – particularly in LMICs – FAO's support to tackle AMR has gained a momentum that needs to be maintained and built upon to strengthen the resilience of agriculture and food systems. Many countries have developed NAPs (WHO, FAO and OIE, 2018), but challenges remain for fully operationalizing them in all relevant sectors. Success in meeting the challenge of AMR will depend on continuing coordination of a global response for food and agriculture.

For more information on FAO AMR programming achievements, see updates to the Programme Committee (FAO, 2019a).

FAO's vision

FAO envisions a world free from poverty, hunger and malnutrition (FAO, 2019b). A core value of this work is the practical and stepwise transformation of food systems in an economically, socially and environmentally sustainable way to achieve Agenda 2030 for global health and prosperity (UN, 2019b).

FAO's goals on AMR

AMR threatens progress in meeting the SDGs as more agriculture producers may struggle to prevent and manage infections that threaten to disrupt food supply chains and thrust tens of millions more people into extreme poverty (World Bank Group, 2017). To respond to this challenge and realize the four betters: better production, better nutrition, a better environment and a better life, FAO has established two main goals for its work on AMR:

1. Reduce AMR prevalence and slow the emergence and spread of resistance across the food chain and for all food and agriculture sectors.
2. Preserve the ability to treat infections with effective and safe antimicrobials to sustain food and agriculture production.

Through the achievement of these goals, FAO will work with stakeholders to increase the capacities of the food and agriculture sectors in managing AMR risks and building resilience to AMR impacts. By working together, FAO and partners will better protect food systems, livelihoods and economies from the destabilizing forces caused by AMR.

Objectives

The five objectives of the FAO Action Plan on AMR 2021–2025 are designed to help focus initiatives at every scale towards meeting the above goal and vision. These objectives (Figure 1) account for strides already made in addressing key challenges, as well as ongoing priorities for action and are intended as a guide for the programming of FAO, its partners and food and agriculture stakeholders worldwide.

These objectives, the results chain (Figure 2) and the key activities (Tables 1–5) can be used as a roadmap for accelerating progress towards setting and meeting national, regional and global targets. Success in containing AMR, keeping antimicrobials working and boosting the resilience of food systems will depend on targeted and sustained efforts in all five areas, which are mutually reinforcing.

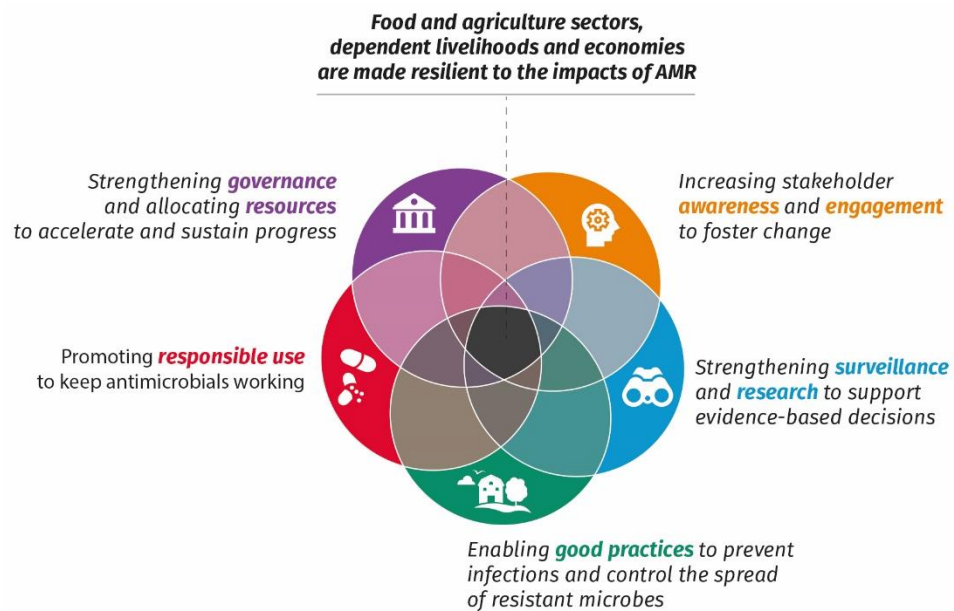


Figure 1. Effective control of AMR requires coordinated effort to meet all five objectives, in every country. Buying more time for drug discovery and keeping antimicrobials working for as long as we can, depends on multi-sectoral initiatives for responsible AMU, as well as better practices that reduce the risk of infection and the need for treatment. The success of these initiatives depends on good governance, evidence and surveillance and effective advocacy and behaviour change programmes.

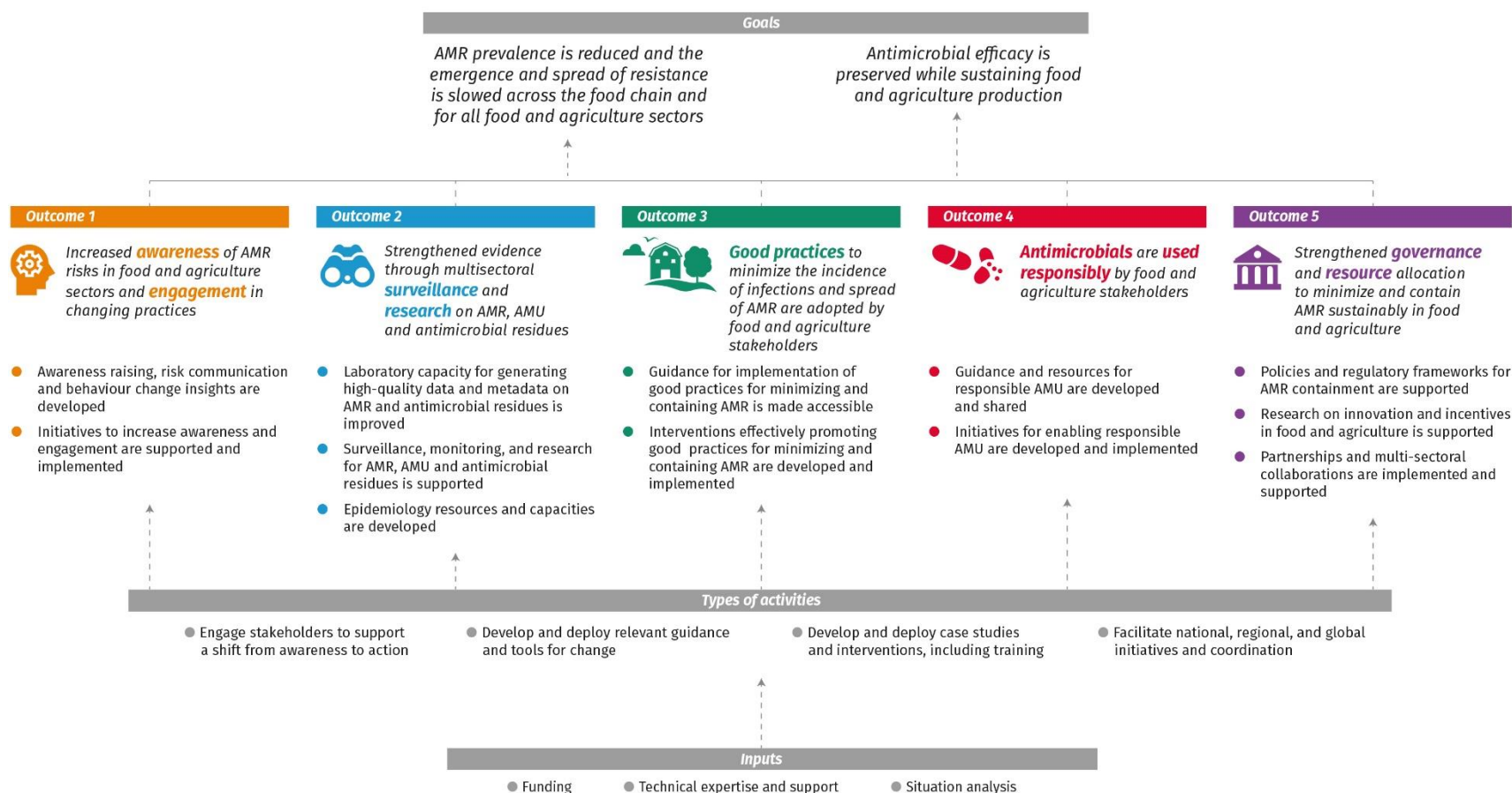


Figure 2. Results chain of inputs, activities, outputs and outcomes for limiting the emergence and spread of AMR and keeping antimicrobials working towards building resilience to AMR in food and agriculture sectors.

Objective 1: Increasing stakeholder awareness and engagement

Many factors drive food and agriculture stakeholders to overuse and misuse antimicrobials. These include persistent disease, limited access to expert advice, inadequate prescription systems and unequal access to appropriate antimicrobials. Barriers to change also exist. These range from structural, economic and environmental constraints to low awareness and risk perception, social norms that contradict good practices and the inability or unwillingness to adopt new practices that reduce AMR risks.

To address drivers of behaviour and barriers to change, FAO is continuing research on stakeholder perspectives to inform behaviour change strategies (Table 1). A key component of this programme is increasing stakeholder awareness of the individual and collective risks posed by AMR, the consequences of inaction and the benefits of choosing new practices.

Progress has been made in raising awareness among food and agriculture stakeholder groups and civil society. However, more work is required to reach every group and population. FAO plans to continue expanding its awareness efforts to promote change and reach new audiences. Now more than ever, focused efforts are urgently needed to transform awareness into action.

To achieve this, FAO will intensify efforts to engage stakeholders in collective problem solving and sustainable behaviour change through appeals to values and motivations. FAO will strengthen its ongoing programmes on risk communication and behaviour change to build knowledge, capacity and willingness for change. FAO will also analyse stakeholder decision-making contexts and pilot the application of behavioural insights to make risk-reductive behaviours easier and more appealing (Table 1). FAO will continue supporting Members to develop an enabling environment that facilitates change and ensures that stakeholders are active, committed and empowered to make that change a reality.

KEY MESSAGES

- Participatory approaches are needed to better understand stakeholder perspectives and motivations.
- Barriers to change need to be identified and collaborative solutions piloted for science-based approach to interventions.
- Stakeholders need to be enabled, empowered and incentivized to transform awareness of AMR risks into action.

Objective 2: Strengthening surveillance and research

Surveillance and research are essential to guide stakeholder decisions on how best to slow the emergence and spread of AMR for the good of food security and global health. Reliable data are needed on antimicrobial-resistant microorganisms – their distribution, AMR profiles and prevalence – in addition to data on the extent of AMU and antimicrobial residues along the food and feed chains, as well as through the various environments impacted by agriculture and aquaculture.

Strong surveillance and monitoring programmes collect risk-based epidemiological data on AMR, AMU and antimicrobial residues relevant to each agriculture sub-sector and specific value chain. This information then allows for timely assessment of hazards to feed risk assessments to develop appropriate interventions and monitor their effectiveness over time for minimizing and containing AMR.

Given competing budget priorities, surveillance is also helpful for guiding resource allocation decisions that promote efficiency and preparedness by identifying risks before they become large-scale emergencies.

While AMR / AMU surveillance in humans, livestock and food has developed faster in some countries, inclusion of some sectors such as plant health, aquaculture and the environment (e.g. contamination through animal waste) needs to be strengthened. Many countries will benefit from more support to improve laboratory capacity and develop multisectoral AMR surveillance systems. Now is the time to broaden these efforts to ensure inclusive progress.

FAO plans to continue supporting Members in building and consolidating laboratory and surveillance capacity to generate, collect and analyse high-quality data within national surveillance systems across all food and agriculture sectors as part of the complementary and joint efforts to develop the Tripartite Integrated System for Surveillance on AMR and AMU (TISSA) (Table 2). Coordinated access to existing information being gathered by the Tripartite organizations on AMR and AMU across different sectors will help countries detect emerging threats and evaluate the impact of their AMR minimization and containment initiatives.

KEY MESSAGES

- Countries will benefit from improved data collection and analysis of AMR, AMU and antimicrobial residues.
- Surveillance and research are needed to design programmes for minimizing and containing AMR and monitor their effectiveness.
- Data gathered inform efficient resource allocation decisions among competing priorities.
- Scientific knowledge and science-based evidence are needed to identify AMR risks before they become large-scale emergencies.

Objective 3: Enabling good practices

Inadequate infection prevention measures, agriculture production and aquaculture practices are major drivers of the overuse and misuse of antimicrobials. This accelerates the emergence and spread of resistance. Also contributing to the spread of resistance are agriculture production practices that unintentionally release resistant microbes into soils and water through irrigation with untreated wastewater, use of manure or untreated biosolid fertilizers (i.e. sewage sludge) and their run-off.

The solution is to support good production practices that will have the dual benefits of reducing the negative impacts of AMR while also bolstering production. Many of these improved practices can also help to protect against potentially devastating losses from infectious diseases and make agriculture production and aquaculture more sustainable. Ensuring the safe handling, processing and storing of foods is also key in controlling the spread of resistant microorganisms. Moreover, addressing barriers to behaviour change is critical to create an enabling environment that facilitates the adoption of these good practices.

FAO will continue supporting Members in improving terrestrial and aquatic animal production to reduce the incidence of infections, thereby reducing dependence on antimicrobials through better health, hygiene, sanitation and biosecurity practices (Table 3). Ensuring access to vaccines for preventable diseases is particularly important to reduce the need for antimicrobials and avoid their misuse. The development of new vaccines is also needed, starting with diseases for which critically important antimicrobials are being excessively used.

There is also ample opportunity for innovation of safe and efficacious alternatives to antimicrobials for treatment of infections and alternatives promoting good health and, where appropriate, fast growth through improved genetics, husbandry and feeding (e.g. alternative ingredients). To maintain plant health and production and to help control the spread of plant pests while reducing reliance on antimicrobial pesticides, phytosanitary measures and the promotion of more environmental-friendly plant protection practices, such as Integrated Pest Management, are crucial.

KEY MESSAGES

- Good production practices will help to reduce the burden of infections, reducing the need for antimicrobials and the emergence of AMR.
- Good practices also extend to managing the spread of AMR in the environment and transmission through the food chain.
- There are opportunities to boost profitability through more effective agriculture practices.
- There are opportunities to innovate for safe and efficacious alternatives to antimicrobials for good health and productivity in plants and animals.

Objective 4: Promoting responsible use of antimicrobials

AMU and misuse is rising with demand for animal and plant products. Given that there are few replacement drug candidates in research and development pipelines, existing antimicrobials need to be better protected from inappropriate use in order to buy more time for the development of new drugs. At the same time, equal access to appropriate antimicrobials and expert advice is needed to treat infections.

Food and agriculture sectors could be compromised due to misuse and inappropriate use of antimicrobials in food production that result in increasing emergence and spread of AMR. This in turn limits treatment options. Treatment, control and preventive use of antimicrobials can be reduced or better targeted through better diagnostics, disease prevention, and antimicrobial stewardship guidance (OIE, 2019a; WHO, 2017), contributing to reducing the use of antimicrobials in animals. There is evidence that interventions for controlling AMU in food-producing terrestrial and aquatic animals reduces the presence of antibiotic-resistant bacteria in these animals (Tang *et al.*, 2017; Wang *et al.*, 2020). Therefore, better management of AMR is possible.

Antimicrobials are also being used as pesticides to treat plant diseases caused by bacteria and fungi (Taylor & Reeder, 2020). Despite incomplete evidence, reported quantity estimates for antimicrobial pesticide usage are lower than those used for terrestrial and aquatic animals. However, the application of these products directly into the environment may have negative impacts on human, animal and environmental health (FAO and WHO, 2019). Antimicrobial pesticides in plants should be used judiciously.

In many LMICs there is the added complication of a lack of oversight and regulation for the use of antimicrobials. Therefore, it is essential to encourage all stakeholders – from drug dispensers and sellers, to users –to use antimicrobials responsibly, while ensuring fair access to medicines when they are needed. FAO will continue supporting stakeholders to use antimicrobials judiciously, providing the necessary guidance and training for treatment, control and preventive use in close collaboration with Tripartite partners and in accordance with best practices and international standards (Table 4).

KEY MESSAGES

- Improving access to expert advice, prescriptions and appropriate antimicrobials will help tackle the challenge of antimicrobial misuse.
- Training stakeholders through better guidance for antibiotic stewardship will help to reduce the inappropriate use of antimicrobials.
- Phasing out of the use of antimicrobials in animals for growth promotion in the absence of risk analysis and using antimicrobial pesticides for plants judiciously, will help accelerate action against AMR.

Objective 5: Strengthening governance and allocating resources sustainably

Effective governance guides the sustainable management of AMR. This depends on political will and a well-informed institutional framework for innovating, evaluating and strengthening policies and legislation. Studies of different policy approaches, standards, norm-setting and targets at the national, sub-national and farm levels are needed. This research will help identify sustainable options that will yield the greatest impact and return on investment. Clarifying the case for public and private investments, as well as the case for stakeholder economic incentives, will raise the profile of AMR in political agendas and support resource mobilization for delivering national plans.

Drawing from its expertise, FAO will continue assisting Members and regional organizations (e.g. Regional Economic Communities) in operationalizing, monitoring and evaluating NAPs, and facilitating the dialogue for strengthening country capacity through effective programmes, policies and legislation (Table 5). FAO has developed a methodology to assess national legislation spanning antimicrobial regulation, food safety, animal and plant health and the environment. The FAO-PMP-AMR is helping countries assess AMR capacity and make stepwise improvements in minimizing and containing AMR. FAO also provides Pesticide Registration Toolkit trainings to strengthen the capacity of national regulatory authorities in the evaluation and registration of pesticides, including antimicrobial pesticides. FAO will also continue supporting regional and international One Health initiatives and standard setting in collaboration with WHO, OIE and other international partners.

By fostering partnerships with the private sector, academia and other innovators, FAO will continue to build support for the research and development needed to combat AMR.

Stakeholders should be involved in policy development and decision making from early stages of the development and implementation processes. This way, stakeholders can develop a stronger sense of ownership and commitment. Constraints can also be better accounted for upstream of implementation for greater success and lasting results.

KEY MESSAGES

- Multi-sectoral and multi-disciplinary collaborations are needed for effective national plans and targets.
- Strengthening policies and regulatory frameworks for AMR containment – as well as incentive-based approaches – present opportunities for accelerating action on AMR.
- Support is needed for research and innovations in antimicrobials, alternatives and diagnostics.
- The economic case for incentives and public and private investments can support resource mobilization to deliver national plans.

Key Activities for 2021–2025

For achieving its vision and the outlined goals, FAO has developed a list of key activities (Tables 1–5) aligned with the five objectives (Figure 1) and corresponding outputs and outcomes in the results chain (Figure 2). These activities are intended to guide FAO programming and support to Members in capacity building for a five-year period and will be amended as needed to reflect progress, new challenges and available resources. These activities need to be implemented in close collaboration and coordination with partner organizations (OIE, WHO and UNEP) at global, regional and country levels to avoid duplication of efforts.

Activities are aimed at global, regional, national and local levels and span sectors, including terrestrial and aquatic animals, crops and the environment. Activities will also build on the technical networks and regional working groups developed since the release of the first FAO Action Plan on AMR (FAO, 2016b), including FAO Reference Centres.

Table 1. Key activities for achieving Outcome 1

Outcome 1: Increased awareness of AMR risks in food and agriculture sectors and engagement in changing practices	
OUTPUTS	ACTIVITIES
Output 1.1 Awareness raising, risk communication and behaviour change insights are developed	<ul style="list-style-type: none"> • Develop global, regional and national strategies for awareness raising, advocacy, risk communication and other behaviour change interventions (e.g. nudges). Capitalizing on inclusive and cross-sectoral participation, FAO and partners will develop these strategies to facilitate more impactful awareness and engagement initiatives. • Develop guidelines, templates, and other tools to aid partners in the development of their own targeted products for awareness raising, advocacy, risk communication and behaviour change. • Develop surveys, media monitoring strategies and behavioural assessments to understand and measure engagement levels. Measurement of engagement will drive FAO's strategic vision for how and where to advocate, train, educate and apply behavioural insights to promote calls to action and social movements around AMR risk reduction. • Implement communication and behaviour change needs assessments of FAO and partners to ensure gaps are identified for effective design of Output 1.2 training and capacity-building initiatives. • Undertake behavioural diagnostics to identify AMR behavioural drivers and barriers to change in target populations; test pilot interventions via randomized controlled experiments; and use results to inform larger-scale interventions and behaviour change strategies. FAO will use statistical evidence and participatory approaches to drive the formulation of awareness and engagement interventions for sustained improvement in political and social action (jointly with output 3.2).
Output 1.2 Initiatives to increase awareness and engagement are	<ul style="list-style-type: none"> • Develop awareness raising, advocacy and risk communication products adapted to specific stakeholder groups and tailored to cultural contexts. These may include broadcast media, social media, participatory communication products, community engagement activities (e.g. theatre), augmented or virtual reality experiences and other interactive elements to boost engagement.

supported and implemented	<ul style="list-style-type: none"> • Deliver training to FAO and partners in awareness raising, advocacy, behavioural analysis and intervention design and evaluation to enable effective communication and behaviour change activities for social impact. • Support World Antimicrobial Awareness Week (WAAW) and related global, regional, national and local awareness campaigns, channelling lessons learned from Output 1.1. • Convene meetings for AMR advocacy across sectors to facilitate information sharing and coordination of stakeholder action. • Provide academia and civil society with guidance on how to include AMR in pre-service education to ensure civil servants and private sector service providers have the knowledge and skills needed to help their communities effectively minimize and contain AMR.
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Table 2. Key activities for achieving Outcome 2

Outcome 2: Strengthened evidence through multi-sectoral surveillance and research on AMR, AMU and antimicrobial residues	
OUTPUTS	ACTIVITIES
Output 2.1 Laboratory capacity for generating high-quality data and metadata on AMR and antimicrobial residues is improved	<ul style="list-style-type: none"> • Continue the deployment of FAO-ATLASS through trained local assessors. These assessments evaluate baseline capacities and assist laboratories in improving detection and characterizations of AMR. This work also aids in the isolation and identification of bacterial species of interest for national AMR surveillance. • Develop a new tool for assessing existing laboratory capacity for antimicrobial residue testing in feed and foods of animal and plant origin, as well as for residue testing in the environment (soil and water). • Support Members with laboratory training, guidelines and protocols for antimicrobial susceptibility and residue testing. This will ensure that laboratory personnel develop satisfactory competencies and are provided with resources for harmonized procedures that generate high-quality data for the treatment of terrestrial and aquatic animal diseases and surveillance. • Develop external quality assurance guidance for AMR detection and characterization to tailor support for corrective interventions, ensuring the generation of high-quality data in laboratories participating in food and agriculture AMR surveillance systems. • Collaborate to support data-gathering and international efforts for the establishment of clinical breakpoints and epidemiological cut-off values for antibiotics used against bacterial pathogens causing bacterial diseases in terrestrial and aquatic animals. • Support Members in the use of laboratory information management systems targeting AMR laboratory data collection, analysis and interpretation in the context of national surveillance.
Output 2.2 Surveillance, monitoring and research for AMR, AMU and	<ul style="list-style-type: none"> • Continue the deployment of FAO-ATLASS for AMR surveillance systems to assist Members in identifying priority activities for building and improving their national AMR surveillance systems for the food and agricultural sectors. • Support a risk-based approach and prioritization of surveillance activities through the implementation of standards consistent with Members' needs and guidelines of international standard-setting bodies (OIE, CAC).

antimicrobial residues is supported	<ul style="list-style-type: none"> • In collaboration with partners, continue supporting the development and implementation of regional frameworks and national programmes for multi-sectoral AMR, AMU and antimicrobial residues surveillance according to national needs, resources, cost-benefit analyses and global frameworks. • Develop, expand and support the progressive implementation of available guidelines for the design of risk-based integrated AMR/AMU surveillance. This includes available OIE and Codex guidelines (FAO and WHO, 2015; OIE, 2019b), the finalization of CAC guidelines for integrated monitoring and surveillance of foodborne AMR, the strengthening or development of guidance for AMR/AMU surveillance in plant, aquaculture production and environment and assistance to Members as they progress in the implementation of their NAPs on AMR. • Develop in collaboration with OIE guidelines to support Members in collecting AMU data at the farm-level to advise antimicrobial stewardship programmes. • Provide support for the implementation of local activities to monitor the quality of antimicrobial medicines intended for livestock. • Support risk analysis of AMR/AMU data to inform science-based interventions, minimization and containment, and policy formulation. • Support the implementation of Tripartite One Health surveillance in targeted country-level capacity building activities through the dissemination and promotion of protocols and pilots such as the recently developed protocol by WHO for integrated global surveillance on ESBL-producing <i>E. coli</i> (Tricycle protocol). • Support collaborative multi-disciplinary research on how resistance develops, spreads and circulates within and across sectors and the impacts of AMR and AMU on food and agriculture.
Output 2.3 Epidemiology resources and capacities are developed	<ul style="list-style-type: none"> • In collaboration with partners, develop and pilot the FAO data platform to support Members in the collection of AMR data from animals and food, and AMU data in crops. • Collaborate with WHO and OIE for building the Tripartite TISSA platform working towards representative, statistically valid data on AMR in multiple sectors. • Develop and provide epidemiology training for AMR and AMU data management and analysis through standalone modules and integration into existing FAO programmes for epidemiology capacity-building. This supports the implementation of national integrated AMR/AMU surveillance systems and risk analysis to inform initiatives and policies.

Table 3. Key activities for achieving Outcome 3

Outcome 3: Good practices to minimize the incidence of infections and spread of AMR are adopted by food and agriculture stakeholders	
OUTPUTS	ACTIVITIES
Output 3.1 Guidance for implementation of good practices for minimizing and containing AMR is made accessible	<ul style="list-style-type: none"> • Develop a repository of tools for good practices for minimizing and containing AMR in food and agriculture including guidelines, e-learning and training materials. • Review, document and share evidence on safe and efficacious alternatives to the use of antimicrobials, innovations for good practices for minimizing and containing AMR and the use of alternative ingredients to replace antimicrobials as growth promoters. • Develop guidance for improved management of animal diseases in key food production sectors (e.g. the Progressive Management Pathway for Improving Aquaculture Biosecurity) and support recommendations for improving animal health in collaboration with key partners including OIE and food production industry groups. • Co-hosting the CAC, FAO will support the revision and update of the Codex Code of Practice to Minimize and Contain Antimicrobial Resistance (FAO and WHO, 2015) to ensure wider applicability of good practices along the food chain. • Hosting the IPPC, FAO will support the development of guidance on phytosanitary measures including integrated pest management programmes that reduce the need for antimicrobial pesticides in plant production. • In collaboration with partners, such as UNEP, develop guidance on agriculture waste management – including wastewater, manure and biosolids – and sustainable soil and land management practices to mitigate the spread of AMR in the environment. • Support the development of biosecurity practices to minimize contamination from wildlife and the off-farm environment.
Output 3.2 Interventions effectively promoting good practices for minimizing and containing AMR are developed and implemented	<ul style="list-style-type: none"> • Support the development of national programmes for the improved health of plants and terrestrial and aquatic animals through good hygiene, sanitation and biosecurity practices, integrating AMR considerations. • In collaboration with OIE, support the development of national and global vaccination programmes for terrestrial and aquatic animals integrating AMR considerations (e.g. prioritizing animal diseases responsible for the highest levels of AMU). • Support partner organizations in initiatives that are building capacity to act on the environmental dimensions of AMR in food and agriculture sectors. • Develop and deploy trainings for the education of professionals to implement quality assurance systems along the food production chain. This will support governments, professional societies and accreditation bodies for training in food safety. • Deploy trainings on the application of specific good practices for minimizing and containing AMR, including the appropriate diagnosis of diseases in terrestrial and aquatic animal health at the farm level (including small-scale producers). • Support the development and deployment of case studies as models for the effective uptake of good practices. Pilot different interventions (e.g. farmer field schools, behavioural insight applications) based on stakeholder assessments (e.g. knowledge, attitude and practice surveys, behavioural diagnostics and related methodologies) and desk research. Interventions showing the greatest positive impact on AMU and AMR will be considered targets for upscaling and further evaluation.

Table 4. Key activities for achieving Outcome 4

Outcome 4: Antimicrobials are used responsibly by food and agriculture stakeholders	
OUTPUTS	ACTIVITIES
Output 4.1 Guidance and resources for responsible AMU are developed and shared	<ul style="list-style-type: none"> • Contribute to the development, revision and update of international standards for prudent AMU in food and agriculture in collaboration with partners. These include but are not limited to the CAC “Code of Practice to Minimize and Contain Foodborne AMR”, OIE guidance for responsible use of antimicrobials in animals and the International Code of Conduct on Pesticide Management (ICCPM) for crop and plant production. (FAO and WHO, 2015; OIE, 2019b; FAO and WHO, 2014) • In collaboration with partners, develop tools and recommendations to support Members’ requests on responsible AMU in targeted sectors (i.e. livestock, aquaculture, crops) that facilitate appropriate treatment, control and preventive use and support Members requesting assistance in their efforts to phase out AMU for growth promotion. • Develop a repository of tools and guidance materials promoting responsible AMU including safe and efficacious alternatives to AMU for growth promotion.
Output 4.2 Initiatives for enabling responsible AMU are developed and implemented	<ul style="list-style-type: none"> • In collaboration with partners, build and maintain networks and platforms from global to national levels for the promotion of antimicrobial stewardship in food and agriculture initiatives among relevant stakeholders. • Deliver trainings on responsible AMU in plant production and protection through the ICCPM to better control the use of antimicrobial pesticides. • Support the deployment of workshops and trainings on tools developed for guiding Members in the practical implementation of recommendations for prudent AMU (e.g. prudent use in aquaculture (FAO 2019b), pigs and poultry (Magnusson et al. 2019)) and international guidelines (FAO and WHO, 2015; OIE, 2019b; FAO and WHO, 2014). • Support governments and professional societies in the training, education and encouragement of producers and dispensers (veterinarians, para-veterinarians and extension services) on responsible AMU. • Carry out case studies and surveys associating specific animal diseases to AMU quantities and patterns of use of antimicrobials to prioritize diseases leading to highest AMU and to analyse prudent AMU adoption levels among stakeholders. • Carry out value chain analyses of antimicrobials used for animal and plant health and stakeholder assessments to understand levels of adoption of prudent AMU from local to global levels.

Table 5. Key activities for achieving Outcome 5

Outcome 5: Strengthened governance and resource allocation to minimize and contain AMR sustainably in food and agriculture	
OUTPUTS	ACTIVITIES
Output 5.1 Policies and regulatory frameworks for AMR containment are supported	<ul style="list-style-type: none"> • Support Members and regional/subregional organizations in developing, revising and updating policies and institutional frameworks for NAP implementation. FAO will continue utilizing its expertise and will collaborate with partner organizations to support countries in operationalizing, monitoring and evaluating their NAPs. • Support Members and regional/subregional organizations to revise and update legislation relevant for AMR and AMU in the food and agriculture sectors using the FAO methodology developed for this purpose. • Support efforts of partner organizations to develop a One Health Legal Assessment Tool to help countries in the revision of their national and regional AMR-relevant legislation. FAO will support the implementation of the tool with a focus on the food and agriculture sectors. • Support Members and regional/subregional organizations, upon their requests, on phasing out the use of antimicrobials for growth promotion bringing other uses under oversight of animal health professionals by providing the necessary guidance and options with accompanying legal underpinning.
Output 5.2 Research on innovation and incentives in food and agriculture is supported	<ul style="list-style-type: none"> • Support and strengthen partnerships and collaboration for research and development on innovations (new medicines, point of care diagnosis and alternatives to antimicrobials) to ensure adequate access to those in need. FAO will foster partnerships with the private sector, FAO reference centres for AMR, academia and other innovators. • Support the development of the economic case for protecting food systems from the impacts of AMR including assessments or pilot studies on the cessation of AMU for growth promotion. • Support the development of AMR economic data for sectors under the FAO remit including knowledge-based and economic solutions (e.g. cost-benefit analyses) to better support the adoption of good practices and the generation of AMU/AMR data. In this context, FAO will support studies that reflect the possible outcomes of taking different economic policy approaches at national, sub-national and farm levels.
Output 5.3 Partnerships and multi-sectoral collaborations are implemented and supported	<ul style="list-style-type: none"> • Support AMR global governance through high-level engagement. • Strengthen multi-partner collaboration by inviting new partners to engage with AMR and AMU work to promote cross-fertilization of ideas from across sectors. • Support and mobilize resources on national, regional and global One Health cooperation initiatives in relation to AMR through enhanced partnership at all levels. • Strengthen engagement with FAO Reference Centres on AMR for research, capacity development and technical assistance to Members. • Support the development and implementation of NAPs on AMR through expanded deployment and publication of FAO tools (e.g. FAO-PMP-AMR) for NAP operationalization and prioritization of activities.

Monitoring Framework of the FAO Action Plan on Antimicrobial Resistance 2021–2025

For achieving its goals and vision, FAO has developed a results framework including a list of key activities (Tables 1 to 5 in Action Plan document) aligned with the five objectives and corresponding outputs and outcomes in the results chain (Figure 2 in Action Plan document). The results framework is intended to guide FAO programming for a five-year period and will be amended as needed to reflect progress, new challenges and available resources.

FAO will also report on AMR in relation to the SDGs, both for the indicators for which FAO is the custodian as well as the other SDGs to which FAO's AMR Programme contributes.

The following table describes the outputs to be delivered and their respective indicators under each of the five objectives of the FAO's Action Plan on AMR. These indicators are meant to monitor FAO's progress in the implementation of activities. This document also provides an initial step for further development of indicators at outcome and impact levels.

Outcome 1: Increased awareness of AMR risks in food and agriculture sectors and engagement in changing practices	
OUTPUTS	Output Indicators
Output 1.1 Awareness raising, risk communication and behaviour change insights are developed	1.1.i.1 Number of countries supported by FAO in the development of strategies for awareness raising, advocacy, risk communication and behaviour change. 1.1.i.2 Number of guidelines and capacity development tools provided by FAO to partners for the development of their own communication and behaviour change products. 1.1.i.3 Number of initiatives carried out with the support of FAO to assess stakeholder engagement, analyse barriers to change and evaluate engagement and behaviour change interventions.
Output 1.2 Initiatives to increase awareness and engagement are supported and implemented	1.2.i.1 Number of awareness raising, advocacy, risk communication and education products developed by FAO tailored to specific stakeholder groups and contexts. 1.2.i.2 Number of initiatives delivered by FAO, including trainings, campaigns and meetings, for AMR awareness raising, advocacy and behaviour change.

Outcome 2: Strengthened evidence through multi-sectoral surveillance and research on AMR, AMU and antimicrobial residues	
OUTPUTS	Output indicators
Output 2.1 Laboratory capacity for generating high-quality data and metadata on	2.1.i.1. Number of laboratories that are part of national AMR surveillance systems for food and agriculture assessed using the FAO Assessment Tool for Laboratories and AMR Surveillance Systems (FAO-ATLASS).

AMR and antimicrobial residues is improved	<p>2.1.i.2 Development of a tool to assess laboratory capacity for antimicrobial residue testing in relation to food and agriculture.</p> <p>2.1.i.3 Number of laboratory trainings and/or resources (e.g. guidelines, protocols laboratory information management systems) on antimicrobial susceptibility or residue testing supported by FAO.</p>
Output 2.2 Surveillance, monitoring and research for AMR, AMU and antimicrobial residues is supported	<p>2.2.i.1. Number of national AMR surveillance systems for food and agriculture assessed using FAO-ATLASS.</p> <p>2.2.i.2 Number of countries benefitting from FAO support in the development and the implementation of their national AMR and/or AMU surveillance systems and frameworks.</p> <p>2.2.i.3 Number of research activities related to AMR/AMU surveillance and monitoring (e.g. scientific articles, expert meetings, technical reports) to which FAO has contributed.</p>
Output 2.3 Epidemiology resources and capacities are developed	<p>2.3.i.1. Development of the FAO AMR/AMU food and agriculture data platform to support the Tripartite TISSA platform and Members' progress on AMR and AMU monitoring activities.</p> <p>2.3.i.2. Number of epidemiology trainings and resources (e.g. workshops, protocols) for AMR and AMU data management and analysis supported by FAO.</p>

Outcome 3: Good practices to minimize the incidence of infections and spread of AMR are adopted by food and agriculture stakeholders	
OUTPUTS	Output indicators
Output 3.1 Guidance for implementation of good practices for minimizing and containing AMR is made accessible	<p>3.1.i.1 Number of resources produced (e.g. repository guidance materials, e-learning courses) by FAO for the promotion of good practices for minimizing and containing AMR in food and agriculture sectors.</p> <p>3.1.i.2 Number of countries for which FAO supports capacity development to promote good practices for minimizing and containing AMR through the implementation of international guidelines (FAO and WHO, 2015; OIE, 2019b; FAO and WHO, 2014) in food and agriculture.</p>
Output 3.2 Interventions effectively promoting good practices for minimizing and containing AMR are developed and implemented	<p>3.2.i.1 Number of countries in which FAO provides support for the integration of AMR considerations in national programmes for the health of terrestrial and aquatic animals and plants.</p> <p>3.2.i.2 Number of trainings delivered with the support of FAO to professionals (e.g. veterinarians, government officials, farmers) for the promotion of good practices to reduce infections minimizing and containing AMR.</p>

	3.2.i.3 Number of studies (e.g. knowledge, attitudes and practices surveys, behavioural diagnostics) carried out with the support of FAO building knowledge on effective pilots and techniques for behaviour change and uptake of good practices.
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Outcome 4: Antimicrobials are used responsibly by food and agriculture stakeholders

OUTPUTS	Output indicators
Output 4.1 Guidance and resources for responsible AMU are developed and shared	4.1.i.1 Number of resources produced with FAO support promoting prudent AMU (e.g. repository, technical guidelines, e-learning courses). 4.1.i.2 Number of countries for which FAO supports capacity development to promote prudent AMU as determined by Members' needs and relevant international guidance (FAO and WHO, 2015; OIE, 2019b; FAO and WHO, 2014).
Output 4.2 Initiatives for enabling responsible AMU are developed and implemented	4.2.i.1 Number of initiatives (e.g. meetings, workshops) contributing to the establishment of networks or communities of practice for antimicrobial stewardship facilitated through FAO support. 4.2.i.2 Number of practical trainings in the implementation of technical guidelines and international standards for responsible AMU supported by FAO. 4.2.i.3 Number of studies conducted with FAO's support to understand levels of adoption of prudent AMU and antimicrobial value chains in animal and plant health.

Outcome 5: Strengthened governance and resource allocation to minimize and contain AMR sustainably in food and agriculture

OUTPUTS	Output indicators
Output 5.1 Policies and regulatory frameworks for AMR containment are supported	5.1.i.1 Number of i) countries; and ii) regional/sub-regional organizations to which FAO has provided support to strengthen policies and institutional frameworks for NAP implementation (e.g. government-initiated follow-up meetings on the formulation and implementing of policy recommendations, action plans, strategies and coordination activities). 5.1.i.2 Number of i) countries; and ii) regional/sub-regional organizations with legal frameworks assessed and recommendations for legal reform formulated using FAO tools, and/or taking into consideration the relevant international standards and good practices. 5.1.i.3 Number of i) countries; and ii) regional/sub-regional organizations supported to initiate a discussion on the phasing out, regulation or restriction of AMU for growth promotion.
Output 5.2 Research on innovation and incentives in food	5.2.i.1 Number of case studies or economic impact assessments of the application of good practices and optimization of AMU supported by FAO.

and agriculture is supported	<p>5.2.i.2 Number of interventions supported by FAO to generate evidence on the economic incentives.</p> <p>5.2.i.3 Partnerships established on research and development (e.g. point of care diagnostics, alternatives to antimicrobials).</p>
<p>Output 5.3 Partnerships and multi-sectoral collaborations are implemented and supported</p>	<p>5.3.i.1 Number of initiatives (e.g. networks, regional frameworks, Tripartite collaboration initiatives) supported by FAO to strengthen national, regional and global One Health collaboration in relation to AMR.</p> <p>5.3.i.2 Number of countries that have benefited from support by FAO to identify gaps and operationalize NAPs through the application of FAO tools (e.g. PMP-AMR, situation analysis of AMR risks).</p>

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- WHO. Antimicrobial Resistance. www.who.int/antimicrobial-resistance
- OIE. Antimicrobial Resistance. www.oie.int/antimicrobial-resistance

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