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Cooperatives and community networks for enhancing ecosystem services in agri-food systems

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Cooperatives and community networks strengthen ecosystem services and promote sustainable agri-food systems. Within the TEEBAgriFood framework, they act as enabling mechanisms that mobilise social and human capital to improve the management of natural capital. Collective actions such as soil and water management, biodiversity conservation, agroforestry, crop diversification, pollinator-friendly practices, and residue recycling generate ecosystem services including nutrient cycling, water regulation, pollination, habitat provision, pest regulation, and climate regulation. Cooperatives also facilitate collective input procurement, knowledge sharing, technology access, sustainable marketing, and resource-use efficiency. Thus, integrating cooperative approaches into TEEBAgriFood assessments helps capture interactions among natural, social, human, and produced capital and their contributions to ecosystem services, livelihoods, and resilience.

Keywords: Human capital, Social capital, Sustainable technologies, TEEB framework

COOPERATIVES and community networks can play a central role in transforming individual farm-level environmental actions into collective ecosystem management. An ecosystem service is a benefit that society obtains from ecosystems, including soil fertility, pollination, water regulation, carbon sequestration, biodiversity conservation, nutrient cycling, pest regulation and climate regulation. In agriculture, many of these services cross farm boundaries; therefore, individual farmers often cannot generate them efficiently without coordination with neighbouring farmers and other stakeholders.

Cooperatives and community networks can be linked to the TEEBAgriFood capital framework by demonstrating how different forms of capital interact to support ecosystem service generation. Natural capital provides the resource base, including soil, water, biodiversity and genetic resources. Human capital, comprising farmers' knowledge, skills, labour and innovation, supports the adoption of sustainable practices. Social capital, including trust, cooperation, networks and collective institutions such as FPOs, SHGs and water-user associations, enables collective resource management and coordination. Produced capital, including machinery, irrigation infrastructure, storage and processing facilities, supports efficient resource use. Together, these capitals facilitate collective ecosystem management and generate benefits such as soil fertility, pollination, water regulation, biodiversity conservation, nutrient cycling, carbon sequestration and climate regulation.

FAO emphasises that sustainable transformation of agri-food systems requires collective action, multistakeholder partnerships, effective institutions and governance mechanisms that connect farmers, researchers, businesses, civil society and policymakers. Different types of cooperatives and community networks support farmers by facilitating collective action, improving access to resources and markets, and promoting sustainable agricultural practices and ecosystem management.

***Agricultural input and service cooperatives*:** Cooperatives facilitate the collective procurement of seeds, biofertilisers, machinery, irrigation services, and other agricultural inputs, thereby reducing input costs and improving farmers' access to quality resources. Collective procurement can promote environmentally sustainable inputs and technologies by encouraging the adoption of bio-inputs and reducing dependence on chemical fertilisers and pesticides. These practices contribute to improved soil health, nutrient cycling, and biodiversity conservation. Cooperatives can also promote efficient water and energy use through shared irrigation facilities and appropriate resource-management practices. Similarly, custom hiring centres for farm machinery reduces duplication, lowers operational costs, and minimises resource wastage. By pooling resources, knowledge, and services,

cooperatives strengthen farmers' capacity to adopt sustainable agricultural practices while simultaneously improving farm profitability, resource-use efficiency, and the delivery of ecosystem services within local agri-food systems.

***Marketing and producer cooperatives*:** Producer cooperatives enable farmers to collectively aggregate, grade, process, and market their produce, thereby strengthening bargaining power and improving access to markets, finance, technology, information, training, and storage facilities. Collective marketing can generate better price realisation and premiums for products produced through environmentally sustainable practices, creating incentives for organic and natural farming, conservation agriculture, and sustainable certification and traceability. These cooperatives also facilitate better post-harvest handling and storage, helping reduce losses and improve resource efficiency. By connecting producers with local markets and developing shorter food supply chains, they can reduce transportation-related environmental impacts while strengthening local economies and promoting sustainable and resilient agri-food systems.

***Water-user associations*:** Water-user associations and community-based organisations collectively manage irrigation tanks, canals, groundwater, and watershed resources, enabling more coordinated and sustainable use of water. Their collective management contributes to groundwater conservation by regulating extraction and promoting recharge measures, while coordinated irrigation practices improve water-use efficiency and reduce wastage. Such organisations also facilitate equitable allocation of water resources, thereby minimising conflicts among farmers and other users. Community participation in watershed restoration, including the maintenance of water-harvesting structures and catchment areas, further enhances water availability, soil moisture, and groundwater recharge. Overall, these institutions strengthen local water governance and support the sustainable management of water resources and associated ecosystem services.

***Community seed and biodiversity networks*:** Community seed and biodiversity networks enable farmers to collectively conserve, exchange, and promote traditional crop varieties, indigenous livestock breeds, and locally adapted crops. Such collective efforts help conserve genetic diversity and maintain valuable local genetic resources that are often better adapted to specific agroecological conditions. The use of diverse and locally adapted varieties can strengthen farm-level resilience to climate variability, insects, diseases, and other environmental stresses. These networks can also support pollinators and beneficial insects by maintaining diverse cropping systems and habitats. Furthermore, farmer-managed seed exchange reduces dependence on external seed systems, strengthens local seed sovereignty, preserves indigenous knowledge, and promotes sustainable and resilient agri-food systems.

***Livestock and integrated farming cooperatives*:** Livestock-based cooperatives can facilitate collective dairy, goat, poultry, and fishery enterprises while promoting the efficient recycling of crop and animal residues. By encouraging the proper collection, processing, and application of manure and other organic wastes, these cooperatives enhance nutrient recycling and improve soil fertility. Effective manure management also reduces waste accumulation and dependence on synthetic fertilisers, thereby supporting environmentally sustainable farming practices. Furthermore, integrating livestock and allied enterprises provides farmers with diversified sources of income and employment, reducing their dependence on a single farm activity. Such collective approaches strengthen resource-use efficiency, promote waste-to-resource practices, and contribute to the development of a circular bioeconomy within local agri-food systems.

***Digital and knowledge networks*:** Under human capital of the framework, digital farmer groups, mobile-based networks, WhatsApp advisory groups, and community knowledge platforms can connect farmers with scientists, extension agencies, markets, and policymakers, facilitating timely access to agricultural information and technical guidance. These networks support the rapid dissemination of climate smart and environmentally sustainable practices while enabling early warning and response to pest outbreaks. Access to real-time weather information can improve weather-based farm decision-making, particularly regarding irrigation, sowing, and crop protection. Furthermore, digital platforms provide opportunities for farmers to share local ecological knowledge, experiences, and indigenous practices, strengthening collective learning, adaptive capacity, and resilience.

Thus, collective institutions can generate environmental benefits while simultaneously improving resource-use efficiency, farmer livelihoods, resilience, and sustainability of agri-food systems.

Major advantages of the collective mechanisms in agrifood system

***Economic advantages*:** Cooperatives reduce transaction costs through collective input procurement, machinery sharing, aggregation, processing and marketing. Farmers can obtain better prices and reduce individual marketing and procurement costs. Value addition through processing can create rural employment and increase farm income. FAO identifies collective organisations as important mechanisms for improving smallholder participation in value chains and strengthening access to markets and services.

***Environmental advantages*:** Collective organisations can facilitate landscape-level conservation practices that individual farmers may be reluctant or unable to undertake alone. These include watershed restoration, agroforestry, biodiversity conservation, integrated nutrient management, residue recycling and reduction of chemical inputs.

***Social advantages*:** Cooperatives promote collective decision-making, trust, knowledge exchange and social capital. They can particularly improve participation of women, youth and marginal farmers. Collective organisations can also improve farmers' representation in local planning and policy processes,

***Climate-resilience advantages*:** Diversified farming systems, collective water management, community seed systems and ecosystem restoration can improve farmers' resilience to droughts, floods, heat stress and market shocks. Producer organisations are particularly well positioned to support climate adaptation through training, advocacy and collective services.

***Institutional advantages*:** Cooperatives can become an interface between farmers, panchayats, KVKs, agricultural universities, ICAR institutions, banks, FPOs, NGOs and private companies. This makes delivery of technology, finance, extension and government programmes more efficient.

Need of policy support

Despite their potential, cooperatives and community organisations often face weak governance, inadequate finance, limited technical capacity, poor market linkages, elite capture, low member participation and fragmented institutional support. Simply forming cooperatives without building organisational capacity may not generate sustainable outcomes. FAO emphasises that effective governance requires attention to stakeholder diversity, power imbalances, institutional capacity and coordination across sectors. Therefore, policy should move beyond simply promoting the formation of cooperatives towards fostering ecosystem service-oriented cooperatives.

***Financial incentives*:** Provide grants, concessional credit and performance-based incentives for cooperatives undertaking watershed restoration, agroforestry, biodiversity conservation, organic inputs and circular-economy activities.

***Payment for Ecosystem Services (PES)*:** Develop mechanisms through which farmers and cooperatives receive payments for measurable ecosystem services such as carbon sequestration, groundwater recharge, biodiversity conservation and watershed protection.

Table 1. Community activities supporting different capitals in TEEB framework

Collective action	Ecosystem service generated	TEEB Agrifood framework capitals
Crop diversification	Biodiversity and pest regulation	Natural Capital
Agroforestry	Carbon sequestration, soil protection and biodiversity	Natural capital + Social capital
Community watershed management	Water regulation and groundwater recharge	Natural capital + Human Capital + Social Capital
Organic/natural farming	Soil biological activity and nutrient cycling	Natural capital
Crop residue recycling	Nutrient cycling and reduced pollution	Natural capital + Produced capital
Common grazing management	Vegetation regeneration and soil conservation	Natural capital + Human capital + Social capital
Community seed banks	Genetic-resource conservation	Natural capital + Social capital
Pollinator gardens	Pollination and biodiversity	Natural capital
Collective composting	Waste recycling and soil fertility	Natural capital + Produced capital
Integrated farming	Nutrient cycling and resource efficiency	Natural capital + Produced capital

***Capacity building*:** Strengthen training in cooperative governance, accounting, digital technologies, ecosystem management, climate-smart agriculture and business development.

***Convergence of schemes*:** Integrate cooperative activities with programmes related to agriculture, rural development, watershed development, climate adaptation, natural farming, soil health, livestock and biodiversity.

***Strengthen FPO–cooperative–panchayat linkages*:** Local government institutions should work with farmer organisations to prepare village and landscape-level ecosystem management plans.

***Digital platforms and data systems*:** Develop digital systems for recording ecosystem service indicators, traceability, carbon credits, biodiversity outcomes and collective production.

***Market incentives*:** Develop premium markets, certification and public procurement mechanisms for products generated through environmentally sustainable collective practices.

***Inclusive governance*:** Policies should ensure meaningful participation of women, youth, smallholders, tenant farmers and socially disadvantaged groups. India's National Cooperation Policy 2025 also emphasises cooperative strengthening, digitalisation and inclusive participation.

SUMMARY

Cooperatives and community networks provide an important institutional mechanism for integrating economic development, social inclusion and environmental sustainability within agri-food systems. Their greatest potential lies in addressing ecosystem services that cannot be effectively managed by individual farmers alone. Collective management of soil, water, biodiversity, livestock resources, biomass, and landscapes can generate both private benefits for farmers and public environmental benefits for society. These ecosystem services, primarily derived from natural and produced capital, can in turn contribute to strengthening social and human capital through improved livelihoods, collective learning, cooperation, knowledge sharing, and community resilience.

Therefore, future agricultural policies should view cooperatives and community networks as local mechanisms for ecosystem stewardship, climate resilience, and circular agri-food-system development. Scaling these models will require evidence-based governance, capacity building, digitalization, ecosystem-service incentives, market support, and convergence of government programmes. Such an integrated approach can strengthen collective action and enable communities to effectively manage natural resources while improving livelihoods. Overall, recognising cooperatives and community networks as key institutional actors can support a coordinated, participatory, and cross-sectoral pathway towards sustainable agrifood system transformation.

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