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Central Asia research evidence for policy

(Left) A dryland afforestation project in the Negev desert, Israel, thrives with only 250 mm of annual precipitation. Photo: Henri Rueff (Right) A farmer in Tajikistan planting a fruit tree seedling after having prepared his land on a slope. Photo: Hanspeter Liniger

NCCR north south

Carbon finance and dryland afforestation

Case studies featured here were conducted in: Israel, Pakistan, and Tajikistan

Policy message

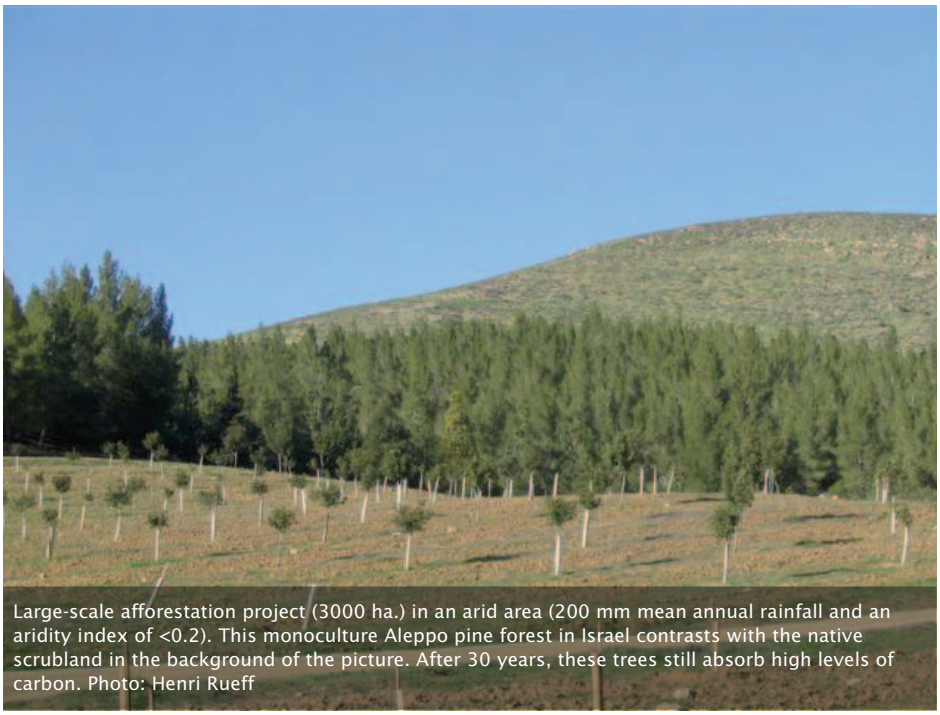
- Shifting afforestation in drylands from large-scale projects (government and aid agencies' initiatives) to small-scale projects (farmers' initiatives) would cause ***less harm to the environment*** while storing carbon and rehabilitating degraded land.
- Farmers need additional incentives to plant trees on their land, as ***carbon payment*** is insufficient on small-scale plantations.
- Trees planted for the mitigation of climate change, for which farmers would receive carbon payment, may also have other purposes such as providing fruits, fodder, shading and reducing soil erosion.
- A combination of ***interventions*** could help to increase incentives for farmers; these interventions may be financial, by way of extension services, or organisational.

Planting trees in drylands has a number of benefits – reducing erosion, providing fodder, storing carbon, preventing floods – and should be encouraged, but only under certain conditions. For one, small-scale forests are more beneficial to the environment than large-scale fast-growing forests, which affect native ecosystems. While afforestation can in theory be financed by carbon payment, prices are still not high enough for farmers to consider this. Intermediaries can assist farmers in obtaining higher carbon rewards by granting them financial credit, ensuring annual payment, providing extension services, and organising farmers into larger units to decrease certification costs.

Planting trees, but at what scale?

For more than a century, trees have been planted in the drylands of the Mediterranean Basin, the Middle East, sub-Saharan Africa, South Asia, and the Americas. However, rain-fed dryland afforestation is becoming subject to a growing controversy. Most dryland countries have large-scale afforestation schemes initiated by their government or international aid agencies. Reasons put forward for supporting these projects include land control, combating desertification, increasing the value of land, and providing jobs and recreational sites. By contrast, opponents of large-scale afforestation claim that these projects have caused the eviction of communities using the land before the trees were planted. There is also evidence that large-scale afforestation in the drylands – usually monoculture plantations consisting of fast-growing exotic species – significantly reduces aquifer recharge, as the trees consume most of the precipitation water. In addition, the new forests can negatively affect the diversity of native flora and fauna because of the ecosystem changes they impose.

A more sustainable solution for dryland areas would be to plant small-scale forests, which provide the same benefits as large-scale plantations but without the drawbacks. Given current levels of CO_2 emissions and with scientific evidence showing trees to



Large-scale afforestation project (3000 ha.) in an arid area (200 mm mean annual rainfall and an aridity index of <0.2). This monoculture Aleppo pine forest in Israel contrasts with the native scrubland in the background of the picture. After 30 years, these trees still absorb high levels of carbon. Photo: Henri Rueff

Featured Case Studies

Introducing rather than excluding pastoralists: cost-efficiency of grazing in dryland forests

A case study in the Negev desert, Israel, has shown the benefits for forest agencies and Bedouin herders of having small ruminants graze the understory vegetation in a dryland forest. For the forest agency, the grazing was a cheap and efficient means of fire control while the herders benefited from an extended source of annuals during times of drought (Rueff et al. 2004).

Fodder tree plantation and climate mitigation in Pakistan

A case study in Pakistan has shown that understanding where certain communities live and what fodder they use for livestock can help in planning the plantation of appropriate trees in key areas. Conflicts have occurred, for example, where nomadic herders have made use of fodder trees belonging to sedentary landowners. Planting trees financed by carbon money could ease tensions (Rahim et al. 2010).

Planting fruit trees and fodder to rehabilitate degraded slopes in Tajikistan

The intervention consisted of building terraces and ditches along the contour lines of a steep slope on which fruit trees where planted and fodder was grown. This case study demonstrates the benefits of complementary uses of land in the drylands. Carbon payment could have contributed to reducing the high costs due to intensive labour at the implementation stage (WOCAT 2007).

be more drought-resistant in an atmosphere richer in CO_2, it makes sense to promote this. Carbon payment could be used to finance incentives for farmers to plant trees on a small scale, allowing them to plant fodder trees or other tree species, depending on their needs. While the carbon market may incite foresters to plant fast-growing exotic species to maximise the income generated by carbon, small-scale farmers may be interested in having multiple services from planting local trees without necessarily focusing on carbon money. The downside of relying only on the carbon market is that carbon payment is currently not high enough to provide sufficient incentive for farmers to start planting trees in a previously barren area.

How insufficient is carbon payment?

A recent study estimated the minimum price of carbon at which a dryland farmer would consider replacing his conventional use of land (rearing livestock on pastures or growing wheat) with tree-planting. Examining many scenarios with different precipitation regimes, researchers calculated the price of carbon necessary for a tree plantation to have a rate of return comparable to that of a conventional (i.e. pastures or wheat) use of land. This model was applied at several land productivity and aridity levels in accordance with the regulations of the Clean Development Mechanism (CDM – see definition box).

Results show that the price of carbon would have to be at least 30 times higher for a farmer to start planting trees in the drylands. In the wetter areas of the drylands, the price of carbon would have to be even higher: while trees sequester more carbon in wetter conditions, conventional land use is still more profitable. For the farmer, the high costs of verifying the carbon stored in trees and soil organic matter make it a costly investment.

Further research needed

Though the above study considered a wide range of possibilities, more research is needed. An estimate using the regulations set by the Voluntary Market (see definition box) instead of the CDM market could reveal a different minimum payment for carbon.

The Voluntary Market has different certification and regulation procedures from those of the CDM. Further research is also needed to estimate possible combinations of tree-planting/cropping/pasture use for farmers to receive multiple services on the same unit of land. This analysis could help to find the optimal combinations depending on environmental conditions and the farmers' needs. Complementary uses of land have proven to be an efficient way of sustainably managing land in the drylands (see featured case studies box).

Intervention

In principle, the carbon market was designed to give developing countries an incentive to participate in global mitigation efforts. However, under current conditions, the carbon market fails to integrate and reward marginalised and underprivileged communities in developing countries. Although carbon payment is currently insufficient to make tree-planting profitable for small-scale farmers, there are a number of interventions which could help farmers to financially benefit.

There is also a case for suggesting that some of these interventions could be financed by public money, as society as a whole would benefit from the environmental services provided by these farmers' plantations. The interventions could occur through intermediaries such as governmental agencies, NGOs, local community-based organisations, or other institutions. The interventions may be finan-

cial, by way of extension services or organisational.

- *Financial intervention:* Farmers are unlikely to invest in tree-planting if they are only paid after several years, as is currently the case under the CDM. Intermediaries could secure annual payments instead, regardless of real payment regime and crediting periods agreed with the buyer. The intermediaries could also provide farmers with microcredit services to reduce the financial burden of investing in tree plantations.

- *Extension support:* Farmers must apply a number of techniques for rain-fed dryland afforestation to work. These include preparing the land with microcatchments (see definition box), pit-digging, earth mounds, and finding the optimal location where trees should be planted to receive most of the runoff water. Once land is prepared, substantial extension services are required to assist in the selection of tree species and combinations of species, as well as the establishment of nurseries to grow and provide seedlings.

  Adequate tree density per unit of land must also be understood ahead of planting, in order to ensure successful tree growth. Pruning, thinning, and fire control measures must be undertaken regularly during the lifespan of an afforestation project. Finally, extension support could help farmers to predict the amount of carbon sequestered in order to prepare themselves for such long-term investments (up to 30 years). Extension support is also needed to monitor and ensure payment for carbon build-up in soils as a result of planting trees. This should not be neglected, as carbon in soils makes up a substantial amount of the mitigation effect.

- *Organisational intervention:* Priority should be given to informing farmers in drylands about the existence of a carbon market. Since transaction (implementation, certification, and verification) costs are very high, external intermediaries could reduce farmers' costs by organising them in larger units. The intermediaries would then represent the group of farmers, sell their carbon credits, receive payment, and redistribute it to the farmers annually. The intermediary organisation could also represent farmers' interests and, in their stead, keep abreast of the complex certification and verification procedures.

Definitions

Afforestation: refers to the plantation of forests on barren land widely practiced in drylands. Afforestation in drylands usually aims at restoring degraded land, since a tree canopy impedes runoff generation and thus water erosion. In addition, afforestation provides shaded areas, leisure areas, and jobs. However, large-scale monocultures with drought-resistant species in deserts consume and transpire all the water, and alter native ecosystems.

Rain-fed dryland afforestation: the type of dryland afforestation project covered in this policy brief is rain-fed and thus receives only seasonal precipitation. This requires that tree species selected for this type of planting be able to cope with long dry and hot periods as well as successive years of drought. The drylands considered here range from arid (100 mm of annual precipitation) to dry sub-humid (800 mm of annual precipitation).

Reforestation: refers to the plantation of forests on barren areas that were previously forested.

Clean Development Mechanism (CDM): a mechanism under the Kyoto Protocol through which developed countries may finance greenhouse gas emission reduction or removal projects in developing countries, and receive credits for doing so which they may apply towards meeting mandatory limits on their own emissions. (source: Glossary of climate change acronyms, UNFCCC. http://unfccc.int/essential_background/glossary/items/3666.php)

Microcatchments: a number of land preparation techniques in pits to "harvest" runoff water and enable its infiltration in the soil at the root zone of trees.

Voluntary Market: a carbon offsetting scheme that functions outside of the compliance market set by the Kyoto Protocol and is regulated by different standards.

A small-scale tree plantation in Israel, in a lower watershed catchment where runoff water is harvested for trees. Tree fodder, grass, and fuel-wood add to the benefits of carbon sequestration. The concentration of runoff water from large watersheds allows trees to be planted in dryer areas (in this case in an area with only 100 mm mean annual precipitation). Photo: Keren-Kayemet Leisrael

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Policy implications of NCCR North-South research

Environmental harm

While it may be tempting to continue to invest in large-scale afforestation, large-scale fast-growing exotic monocultures harm the environment by consuming all the water and altering the native ecosystem. Alternatively, small-scale afforestation can also provide services of carbon sequestration, flood control, and soil conservation while being less harmful to the environment.

Carbon payment

Carbon payment is currently too low for small-scale farmers to consider planting trees solely for the mitigation of climate change. However, farmers may also seek multiple uses of trees such as fodder, fuel-wood, or shading for livestock, which may compensate for their lower carbon revenues. Policies and interventions in the form of financial, extension, and organisational support could increase the reward to farmers.

Intervention

Intermediaries such as governmental and aid agencies, community-based organisations, and NGOs can intervene in various ways to support farmers in planting small-scale forests in drylands. One way is to provide financial support in the form of credits, along with ensuring yearly carbon payment. Further interventions should be at the extension service level, to implement nurseries and assist farmers with the plantation and in maintenance techniques. Intervention should also be undertaken at the organisational level: as transaction costs are very high and often cancel out benefits from carbon payment, intermediaries can organise farmers into larger "mitigation" entities in order to decrease transaction costs. Interventions could in part be financed by public money, as not only the farmers, but society as a whole, would benefit from the ecosystem services such tree plantations provide.

Further reading

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