The expected benefits at farm level after a 10-year period will be mainly from reduced cost caused by minimizing land preparation cost (energy, labor) and consequently increased farmers' revenues by:

- USD 760/ha/year for cereals/legumes.

- USD 490/ha/first year, then USD 620/ha starting 2nd year for rainfed trees.

- USD 250/ha/first year then USD 310/ha starting 2nd year as reduced cost from no-till for irrigated fruit trees.

Figure 55 illustrates different NPV according to crop type in Conservation agriculture. Benefits at farmer's level with or without the deployment of CA are shown for olive tree in Table 64. Olive tree was taken as an example for analysis since its values as considered in the mid-range as shown in Fig. 56.

In conclusion, adopting and diffusing conservation agriculture for cereals, olive and fruit trees on up to 16,000ha in 10 years will enable: i) achieving a total Net Present Value over a 10 year period estimated at USD 36.9 million (Annex VI), ii) improving soil and water conservation through minimal soil disturbance and maintaining a green cover or agriculture residues on the soil surface, iii) reducing CO_2 emissions through minimal soil disturbance and iv) preserving food security, since yields are stable (availability of food), with lower inter-annual variation.

The mobilized resources to realize these benefits are less than USD 3.5 million. Therefore, and since the benefits exceed by far the cost of the technology, the transfer and diffusion of CA is a favorable and encouraged practice in Lebanon.

Table 64 – Cost Benefit Analysis (in USD): an example for olive production at farmer's scale (1ha).

	Revenues under conventional agricultural practices	Revenues under CA	Additional revenue under CA	Additional costs from applying CA	Net benefits from applying CA	Discounted net adaptation benefits (6%)
	A	B	C=B-A	D	E=C-D	$F=E/(1+0.06)^{yr}$
Year	USD/ha	USD/ha	USD/ha	USD/ha	USD/ha	USD/ha
1	380	1,000	620	0	620	585
2	340	800	460	0	460	409
3	380	1,000	620	0	620	521
4	340	1,000	660	0	660	523
5	380	1,000	620	0	620	463
6	340	1,000	660	0	660	465
7	380	1,000	620	0	620	412
8	340	1,000	660	0	660	414
9	380	1,000	620	0	620	367
10	340	1,000	660	0	660	369
NPV						4,528

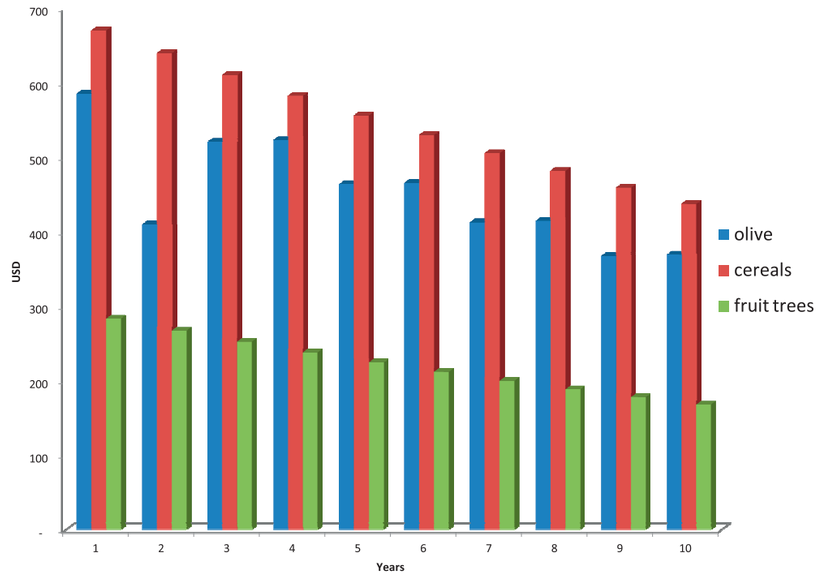

Fig. 55 - Comparison of annual NPV per ha over a 10-year period for 3 types of crops under CA at farmer's level

Source: Author's own design

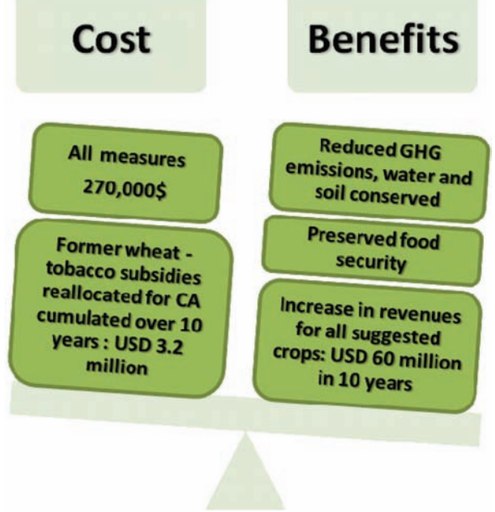

Fig. 56 - Costs and benefits of Conservation Agriculture over a 10-year period

Source: Author's own design

6.4.5 Technology Action Plan for Conservation Agriculture

Target for technology transfer and diffusion

The target for the action plan proposed is a large scale and long term project between 2015 and 2025 aiming at shifting more than 4,000ha of fruit trees and 15,000ha of cereals and legumes to Conservation Agriculture. The required budget is 3.47 million USD.

The Technology Action plan for the deployment and diffusion of conservation agriculture is presented in Table 65.

Table 65 - Technology Action plan for Conservation Agriculture

Measures	Priority	Objective	Responsible parties	Beneficiaries	Time scale	Monitoring and Evaluation indicators	Estimated cost (USD)	Donors
Conducting training sessions and filed work	1	To increase the experience of technicians in CA	National and international experts (ICARDA, ACSAD, LARI, GIZ, etc.)	MoA, NGOs	Short term	Number of training sessions, Percent active technicians in disseminating CA	5, 000 For 50 technicians	World Bank Adaptation Fund GEF IFAD FAO Islamic Bank EU USAID Kuwaiti Fund Italian, Spanish Cooperation
Conducting experimental studies in fields of research institutes and on farm level	1	To better understand the effect of CA on different crops under different agro-climatic conditions	LAR, Academic institutions	MoA, NGOs, farmers	Medium term	Publications of research results Number of experiment plots % of budget dedicated to R&D	240,000 for experiments in 6 LARI stations and 20 on-farm plot covering 10 crops	
Conducting field days and visits to demonstration plots, seminars and TV programme	1	To change farmers behavior concerning no-till and show the comparative advantages of CA	MoA, LARI, NGOs	farmers	Medium term	Number of farmers converted to CA, surface producing in CA	9,000 for 450 farmers participating in seminars and field days; 6,000 for TV program	
Lobbying to get ministerial proposal to shift from crop-oriented to practice-oriented	2	To avoid additional public debt, and promote CA	National consultant-MOET, MoF, MoA, Parliament	farmers	Long term	Parliament and government decisions and law amendment	10,000 For National consultant study	
Allocating the necessary budget for subsidies	2	To give incentives to farmers to keep their crop residues in field and enhance R&D	MoF, MoET, MoA	farmers	Long term	Amount of subsidies per annum given to cereal-legume growers	3,200,000 for subsidies as estimated in assumptions	

6.5 Analysis of Technology: Selection of Adapted Varieties and Rootstocks (SAVR)

6.5.1 General description of SAVR

This technology embeds the replacement of actual seeds and seedlings produced locally or imported, by appropriate adapted varieties and rootstocks to future climate.

SAVR is a consumer good involving public and private sectors as well as different actors within the market chain, mainly seed and seedling importers, which are usually agriculture companies. Most of the import is demand driven, where farmers make their requests. Imported plant material is in many cases patented, and royalties legitimate to plant breeders as Intellectual Property Right (IPR), are added to the price which makes the SAVR of a higher cost. In the case of many horticultural crops, seeds are germinated and grafted locally then sold to farmers such as fruit tree and grapevine seedlings, however in most cases, the plant material origin, property right and quality are not guaranteed since plants are not inspected or certified by a third party.

Regulations for seed and seedlings import are minimal. A prior permit of import is currently being required, however registration of varieties is not yet done. Certificates of origin and phytosanitary certificate are required by both MoA and Custom Service, yet plant material authenticity, traceability and property right are not guaranteed. Lebanon which is not a member of the International Union for the Protection of New Varieties of Plants (UPOV) is trying to overcome this obstacle through bilateral agreements with foreign nurseries in order to import and pay the necessary royalties, hence enable SAVR multiplication locally. Standards and norms of multiplied plant material are limited to the seedlings delivered by “Machatel Loubnan” nurseries association which authenticity and sanitary inspection are guaranteed through a certification programme conducted by LARI-MoA. Yet a limited number of seedlings of varieties of pome stone and citrus fruits are produced.

The Ministry of Agriculture is trying to develop a seed/seedling policy to monitor and control this market. In collaboration with LARI, it has initiated the multiplication and certification of some non-patented varieties in accredited nurseries. However sanitation, conservation and multiplication of local SAVR are still far from being reached in the short term. Further diffusion of plants by local nurseries without paying the mentioned royalties will not be a solution on the long run; exports of products resulting from patented varieties to countries under UPOV is restricted. Making the necessary institutional arrangements for IPR will not only stimulate foreign trade, but also create the necessary enabling environment for the development of biotechnologies and SAVR in Lebanon.

Table 66 presents the legislation related to seed and seedlings varieties.