General optimization model of wood procurement

$$Min\ MTC = [\sum_{a=1}^{A}\sum_{b=1}^{B}\sum_{d=1}^{D}(c1x1_{abd}X1_{abd} \times (1+i^{-13})^{d})$$
$$+\sum_{a=1}^{A}\sum_{b=1}^{B}\sum_{d=1}^{D}((c1x1_{abd}+c2x2_{abd})X2_{abd} \times (1+i^{-13})^{d})$$
$$+\sum_{a=1}^{A}\sum_{b=1}^{B}\sum_{c=1}^{C}\sum_{d=1}^{D}((c1x3_{abcd}+c2x3_{abcd})X3_{abcd} \times (1+i^{-13})^{d})$$
$$+\sum_{a=1}^{A}\sum_{b=1}^{B}\sum_{d=1}^{D}((c1x4_{abd}+c2x4_{abd})X4_{abd} \times (1+i^{-13})^{d})$$
$$+\sum_{a=1}^{A}\sum_{b=1}^{B}\sum_{c=1}^{C}\sum_{d=1}^{D}((c1x5_{abcd}+c2x5_{abcd})X5 \times (1+i^{-13})^{d})$$
$$+\sum_{a=1}^{A}\sum_{c=1}^{C}\sum_{d=1}^{D}(cx6_{acd}X6_{acd} \times (1+i^{-13})^{d})$$
$$+\sum_{a=1}^{A}\sum_{b=1}^{B}\sum_{d=1}^{D}(cx7_{abd}X7_{abd} \times (1+i^{-13})^{d}) + \sum_{a=1}^{A}\sum_{c=1}^{C}\sum_{d=1}^{D}(cx8_{acd}X8_{acd} \times (1$$
$$+i^{-13})^{d}) + \sum_{a=1}^{A}\sum_{b=1}^{B}\sum_{d=1}^{D}(cx9_{abd}X9_{abd} \times (1+i^{-13})^{d})\ ]$$

Subject to

$$X1_{abd} + X2_{abd} \geq X1max_{abd}$$
$$X1_{abd} \leq X1max_{abd}$$
$$X7_{abd-1} + X4_{abd} - X3_{abcd} - X5_{abcd} = X7_{abd}$$
$$X7_{abd=12} \leq X7E_{ab}$$
$$X7_{abd=0} = X7B_{ab}$$
$$X8_{acd-1} + X3_{abcd} + X5_{abcd} - D_{acd} = X8_{acd}$$
$$X8_{acd-1} + X3_{abcd} + X5_{abcd} \geq X10_{acd}$$
$$X8_{acd} \geq X8min_{acd}$$
$$X8_{acd} \leq X8max_{acd}$$
$$X8_{acd=12} \leq X8E_{ac}$$
$$X8_{acd=0} = X8B_{c}$$
$$X9_{abd-1} + X1_{abd} + X2_{abd} - X4_{abd} = X9_{abd}$$

$$X9_{abd=12} \leq X9E_{ab}$$

$$X9_{abd=0} = X9B_{ab}$$

$$X1_{abd};\ X2_{abd};\ X3_{abcd};\ X4_{abd};\ X5_{abcd};\ X6_{acd};\ X7_{abd};\ X8_{acd};\ X9_{abd} \geq 0$$

Where:

MTC = minimum total wood procurement costs (€),

Activities:
$X1_{abd}$ = Cubic meters of environmentally sustainable timber a purchased in region b for month d,
$X2_{abd}$ = Cubic meters of environmentally non-sustainable timber a purchased in region b for month d,
$X3_{abcd}$ = Cubic meters of timber a transported from region b to plant c for month d,
$X4_{abd}$ = Cubic meters of timber a harvested in region b for month d,
$X5_{abcd}$ = Cubic meters of timber a chipped in region b to plant n at month d,
$X6_{acd}$ = Cubic meters of timber a chipped at plant c at month d,
$X7_{abd}$ = Cubic meters of timber a in roadside storage in region b at month d,
$X8_{acd}$ = Cubic meters of timber a in plant storage c at month d,
$X9_{abd}$ = Cubic meters of timber a in stand storage in region b at month d,
$X10_{acd}$ = Cubic meters of timber a required at plant c at month d,

Operation costs:
$c1x1_{abd}$ = purchasing cost (€m^{-3}) of environmentally sustainable timber a from region m at month d,
c1x3abcd = transportation costs (€m^{-3}) of timber a from region b to plant c at month d,
c1x4abd = harvesting cost (€m^{-3}) for timber a from region b at month d,
$c1x5_{abcd}$ = chipping and transport cost (€m^{-3}) of timber a from region b to plant c at month d,
$cx6_{acd}$ = chipping cost (€m^{-3}) of timber a at plant c at month d,
$cx7_{acd}$ = storage cost (€m^{-3}) of timber a at roadside in region b at month d,
$cx8_{acd}$ = storage cost (€m^{-3}) of timber a at plant n at month d,
$cx9_{acd}$ = storage cost (€m^{-3}) of timber a in stand storage in region b at month d,

CO_2 emission allowance costs:
$c2x2_{abd}$ = CO_2 cost (€m^{-3}) of environmentally non-sustainable timber a from region b at month d,
$c2x3_{abcd}$ = CO_2 cost (€m^{-3}) of fossil fuel for transport timber a from region c to plant c at month d,
$c2x4_{abd}$ = CO_2 cost (€m^{-3}) of fossil fuel for harvesting timber a from region b at month d,
$c2x5_{abcd}$ = CO_2 cost (€m^{-3}) of fossil fuel for chipping and transport timber a from region b to plant c at month d,

Constraints:
$X1max_{abd}$ = maximum cubic meters of sustainable harvesting of timber a in region b at month d,
$X3max_{ab}$ = maximum cubic meters of timber a transported from region b,
$X3min_{ab}$ = minimum cubic meters of timber a transported from region b,
$X4max_{abd}$ = maximum cubic meters of timber a harvested from region b at month d,
$X4min_{abd}$ = minimum cubic meters of timber a harvested from region b at month d,
$X7B_{ab}$ = Cubic meters of timber a by roadside in region b at the beginning of year,
$X7E_{ab}$ = Cubic meters of timber a by roadside in region b at the end of year,
$X8B_{ac}$ = Cubic meters of timber a in storage at plant c at the beginning of year,
$X8E_{ac}$ = Cubic meters of timber a in storage at plant c at the end of year,
$X8max_{acd}$ = maximum cubic meters of timber a in storage at plant c at month d,

$X8min_{acd}$ = minimum cubic meters of timber a in storage at plant c at month d,
$X9BI_{ab}$ = Cubic meters (m^3) of timber a in stand storage at region b at the beginning of year,
$X9E_{ab}$ = Cubic meters (m^3) of timber a in stand storage at region b at the end of year,
$X9max_{abd}$ = maximum cubic meters of timber a in stand storage at region b at month d,
$X9min_{abd}$ = minimum cubic meters of timber a in stand storage at region b at month d,
$X10max_{acd}$ = maximum cubic meters of timber a required at plant c at month d,
$X10min_{acd}$ = minimum cubic meters of timber a required at plant c at month d,
i = annual interest (6%),
A = timber assortments (1, …, a, …, 12),
B= regions (1, …, b, …, 48),
C = plants (1, …, c, …, 21),
D = months (1, …, d, …, 12).